From collaborative to institutional reflexivity: calibrating responsibility in the funding process

Abstract

Science-policy organisations are expected to be reflexive of their political influence on research and society. In this long-standing discourse on institutional reflexivity, formal organisations have largely been considered as a whole, and from a structural, or systemic perspective, whereas much less is known about everyday organisational practices; how individual organisational members reflect on and act upon their own as well as their organisation's limits of knowledge and pre-commitments, if at all. We address this gap through an analysis of qualitative interviews with one national funding institution's staff overseeing funding for research into information and communication technologies (ICT). We develop a bridging concept between individual and institutional reflexivity, which we call 'collaborative reflexivity'. Through collaborative reflexive processes, individual employees contribute to the entire organisation's institutional reflexivity. Our findings help to better understand 'responsible' behaviour in funding processes, as part of the growing international movement of Responsible Research and Innovation (RRI).

1. Introduction

This paper is concerned with tensions at the interfaces between science and policy; science and society; and policy and society. More specifically, we focus on how formal organisations deal with such tensions, that is, their **institutional reflexivity**. The concept of institutional reflexivity is relatively flexible and has encompassed both broad concepts of institution, per Wynne (1993), who used it to refer to the entirety of science, as loose and unbounded as that might be, and narrow ones that apply the term to specific organisations such as universities and funders (e.g. Valdivia & Guston 2015; Macnaghten & Chilvers 2014), which have more defined boundaries.

Funding institutions in this narrow sense face opportunities and challenges in trying to take appropriate decisions around the allocation of money and other resources. While the concept of institutional reflexivity has a rich historical path and has been applied to many different types of organisations and contexts, there has been very little research concerned with reconstructing and analysing institutional reflexivity from a practice-oriented perspective.

There is insufficient understanding of **whether** and if so, **how** employees within funding institutions think about and act upon their own and their entire organisation's political influence on research, which often appears hidden in established knowledge and analytical pre-commitments.

It has been shown that reflexivity, including the institutional reflexivity of formal organisations, comes in different forms and guises (e.g. Babcock 1980; Lynch 2000; cf. Raffel & Sandywell 2016; Stilgoe et al. 2013). We build on this existing scholarship by defining and providing examples for collaborative reflexivity as an interactional achievement; a constantly reinforced and reinforcing mechanism that embeds itself into a culture of employees within an organisation, but also as its explicit policy aims and strategic goals. Thus, we are putting forward a practice-oriented concept of reflexivity that is inspired by ethnomethodology (Lynch 2000; Psathas 1980; Hughes et al. 2005), a micro-analytical approach to knowledge and social order that takes institutions not as given, but constantly (re-)created through seemingly trivial everyday activities. We consider concrete physical and cognitive activities such as, travelling around, chatting to people on the phone and developing doubts, and how such practices, in conjunction, contribute to an organisation's overall reflexivity.

We have developed this bottom-up approach to an organisation's reflexivity through a detailed analysis of qualitative interviews with staff employed with a national funding institution. In focusing on the ways in which interviewees reported on their daily work, we came to reconsider the relationship between an individual's reflexivity, on the one hand, and an entire organisation's reflexivity on the other. The two types of reflexivity are not strictly separated but rather, two poles of a spectrum encompassing all sorts of collaborative activities (thinking and doing) that involve both the individual and the organisation. In other words, there is an empirical space 'in-between', the space of collaborative activities, that existing literature has not as yet analysed. More specifically, we have not found any

approach to institutional or organisational reflexivity considering this phenomenon from an ethnomethodological perspective.[1]

The development of the concept of collaborative reflexivity is the outcome of a longer research process we started in 2011. We detail this process, and our methodological approach more generally, in the following section 2. We then discuss the literature that is relevant for our empirical study, focusing on the discourse around institutional reflexivity (section 3). Subsequently, in section 4 we provide the empirical analysis that informs our conceptual contribution. This is explained in the final section, where we also discuss limitations of our study, and draw out our main lessons on reflexivity at the science-policy interface. Our analysis contributes to better understanding and shaping 'responsible' behaviour in funding processes, a major theme in the growing field of 'Responsible Research and Innovation', or 'RRI' (e.g. Owen, Macnaghten, & Stilgoe 2012; Von Schomberg 2011).

2. Methodological approach

Our conceptual contribution to understanding reflexivity at the science-policy interface has evolved from empirical research that we started in 2011. At the time, we became interested in understanding better researchers' and other stakeholders' attitudes and behaviour through the lens of Responsible Research and Innovation (RRI). In 2011, RRI was a small, nascent initiative, while today it is a broad international movement concerned with ensuring that science, technology development and science policy are conducted in a 'responsible' way (Owen et al. 2012). The proliferating RRI discourse covers many topics and guiding principles, including the principle of reflexivity, but also many other concepts such as anticipation or public engagement (Stilgoe et al. 2013; Burget, Bardone, & Pedaste 2017). These and other RRI concepts are not well differentiated from one another, rather they overlap in various ways. For instance, principles and practices of public engagement are often considered hand in hand with reflexivity (e.g., Bellamy 2016; Blue & Dale 2016).

While the exact nature of the relationship between reflexivity and RRI may not always be clear, it is worth pointing out that reflexivity is generally accepted to be a constituent aspect of RRI. In their seminal paper on RRI, Stilgoe et al (2013: 1568) refer to 'four integrated dimensions of responsible innovation: anticipation, reflexivity, inclusion and responsiveness.' This understanding of the crucial role that reflexivity plays is also visible in the Anticipate-Reflect-Engage-Act (AREA) framework (Owen, 2014), the conceptualisation of RRI that was adopted by the UK Engineering and Physical Sciences Research Council (now part of UK Research and Innovation). Another frequently cited seminal

---

[1] There is qualitative research into organisational learning at the science-policy interface, including funding agencies (Pallett/Chilvers 2013; 2015) which is important to contextualise our study. Pallett and Chilvers (2013: 1163) coin the term 'transformative learning' and define this as 'a change in a person's frame of reference, leading to a greater awareness of the influences on one's actions'. While such cognitive 'transformations' in a given individual are part of our concept of reflexivity, we emphasise the interactional dimension of reflexivity. Reflexivity, or 'transformative learning', is strongly tied to a myriad of mundane everyday encounters and exchanges between two or more individuals. A more detailed discussion of this interactionist approach is provided in section 5.1.

source of the RRI discourse (von Schomberg 2013) sees ethical reflexivity in research practices as part of the implementation of RRI. The Nuffield Council on Bioethics (Nuffield Council on Bioethics 2013: 118) describes 'continuous reflexive evaluation' of neurotechnologies as a feature of RRI. Salles et al (2018: 201) make a similar point when they state that RRI requires 'the nurturing of a certain type of reflexivity among a variety of stakeholders, from scientists to funders.' Even authors who are critical of the concept and implementation of RRI such as Maasen (Maasen 2018) see reflexivity as constitutive of RRI.

While it is thus unproblematic to describe reflexivity as a core to RRI, it is not necessarily clear what this means in practice. This is where our own empirical research steps in.

In 2011, literature on RRI was still largely theoretical and conceptual, and empirical research was scarce. Given our own backgrounds in computer science and social science research into Information and Communication Technologies (ICT), we designed a broad inquiry into one country's research and funding processes concerned with ICT and related technologies. From 2011 to 2013 we conducted semi-structured interviews with 11 members of staff of the funding organisation who were responsible, at different levels of seniority, for managing the allocation and oversight of funding in a range of ICT research areas, , for example computer vision, robotics, and artificial intelligence. Interviewees were selected based upon their direct involvement in the ICT research funding process serving the academic community.

The goal of the interviews was to find out how social and ethical challenges are identified, discussed and resolved within research projects that the funders were responsible for. From this we constructed a picture of how the interviewees engage in critical reflection regarding the potential impacts of ICT. Specifically, we wanted to understand the processes and procedures that motivate discussions of ethical and social challenges amongst themselves and with the research community.

Later, in late 2015 to early 2016, we had the opportunity to interview again one of the earlier interviewees and two further funding administrators in the same funding organisation. By this date, RRI was more widely embedded in the funding organisation.

All interviews ran between 60 to 90 minutes, were audio recorded, and either fully or selectively transcribed. The transcripts were then subject to thematic analysis (Ryan & Bernard 2003). The focus was on the identification of recurring themes associated with concepts and activities that appear in interview transcripts in the form of opinions, reflections, conceptualisations and experiences that convey the ways in which staff identify, debate and resolve social and ethical challenges related to research funding practice. For the rest of the paper we shall refer to these interviewees simply as managers, staff, or employees of a specific national funding institution.

Considering all interviews together, we found that we could 'talk back' to the long-standing discourse on institutional reflexivity (Wynne, 1993), which most recently saw a revival in a number of contributions to RRI (Owen & Pansera 2019; Radatz et al. 2019; Stilgoe 2018). Our original interviewing schedules in 2011, as well as those in 2015, included a variety of questions such as, what a manager would understand by 'responsible' behaviour; what his or her attitude was vis-à-vis public

engagement; and how interviewees dealt with the potential social impacts of ICT, if at all. Through analysing the broader lines of reasoning and narratives that interviewees constructed around the answers to those questions we came to identify a multi-faceted pattern that does not have a name yet in existing literature, thus we refer to it as 'collaborative reflexivity'.

This new concept is meant to capture reflexivity as embedded in the day-to-day activities of managing funding processes. It is a form of reflexivity that consists of ordinary organising practices such as: discussing aspects of work with researchers over the phone or in person; and combining this with policy documents which filtrate into discussions with their team colleagues who draft and revise plans for future funding. Our key argument is that through many such seemingly trivial work tasks individuals **collaboratively create reflexivity** and **move towards institutional reflexivity**.

While the history of institutional reflexivity is varied and rich, dating back to Wynne (1993), if not earlier, we focus on the term as part of RRI, as explained previously. . To be more precise, we focus on conceptualisations of institutional reflexivity identified from a review of a sample of existing RRI literature, or 91 publications, discovered by searches using Google Scholar and 'snowball' sampling. We chose Google Scholar as a database because it is broad in scope – it identifies different types of publications – including peer-reviewed journal articles as well as 'grey' literature such as books, working papers and conference proceedings. Two phrases were searched: 'responsible research and innovation' and 'institutional reflexivity'. We conducted a second search with a combination of 'responsible innovation' and 'institutional reflexivity'. Excluding duplicates and hits in languages other than English, this dual search yielded 76 results. We submitted all these publications to a first round of broad thematic analysis (Ryan & Bernard 2003) by reading a given publication's abstract (if existing), introduction and conclusions, thus excluding all publications that mention 'institutional reflexivity' only in passing. The remaining 37 publications which made a point or a longer statement with or about institutional reflexivity, were then submitted to a more detailed reading. Next, snowballing (following up citations, references and specific arguments) was used selectively to deepen the analysis of a particular point, or where authors had relied upon a prior paper. This led to including 15 additional papers in the review.

Against this background, the following section provides a discussion of those 28 publications[2] that concern our empirical field, that is, funding institutions and processes, and touch on a specific aspect of our empirical analysis, notably how staff relate to public engagement. Engaging with the public(s) is a recurrent theme in the literature on institutional reflexivity.

3. Institutional and individual reflexivity

---

[2] The appendix provides a list of all 91 publications systematically searched and reviewed for this paper, highlighting those 28 publications we quote in section 3. Apart form section 3 we also included some more publications from the sample in other sections, for instance, Radatz et al. (2019) in discussing our methodological approach (section 2).

In this section we review the concept of reflexivity, demonstrating that the current discourse on institutional reflexivity implies a distinction between individual and systemic, or structural reflexivity, but leaves a gap of intersubjective and interaction-based reflexivity. In other words, our main finding is that an actor- and practice-oriented perspective has largely been missing to date, with some exceptions (e.g., Bellamy et al. 2013; Demers-Payette, Lehoux, & Daudelin 2016). There is hardly any account of institutional reflexivity being (re)produced and changed through detailed organisational practices (e.g., Orlikowski & Yates 2002; Hughes et al. 2005). Recently, Pallett & Chilvers (2015) have discussed a practice approach to organisations operating at the science-policy interface, but they do not provide any empirical analysis. This is different in their earlier publication (Pallett & Chilvers 2013), which however lacks the interactionist approach we put forward, and explain further in section 5.

Another important finding from the literature review relates to how authors connect three themes to one another, namely institutional reflexivity, political influence (or power) and public engagement. Various publications in our sample interpret institutional reflexivity as a specific political activity, in the sense that reflexive actors would challenge established systems or structures of power. In other words, authors conceptualise reflexivity as pushing for disruption and conflict. And this disruptive power is often attributed to public engagement processes, where members of the public interfere with ruling knowledge and decision-making processes, including knowledge and decision-making in funding processes. Focusing on such arguments around political power and public engagement, we shall now take a closer look at how institutional reflexivity has been conceived to date.

In discussing institutional reflexivity, many RRI scholars (e.g. Correljé et al. 2013; Stilgoe, Lock, & Wilsdon 2014; Van Oudheusden 2014b) use the seminal paper from Wynne (1993) as their starting point. Wynne argued that science, as constituted by the entirety of the research establishment, lacked 'institutional reflexivity'.[3] He described institutional reflexivity as comprising:

'the process of identifying, and critically examining (and thus rendering open to change), the basic, preanalytic assumptions that frame knowledge-commitments. […] [I]t is to ask how public institutions like science act (or do not act) as systems for reflexive learning in the sense of understanding their own precommitments, so that these can be negotiated, rather than blindly imposed on society at large or different publics within it' (Wynne 1993: 324).

The scientific establishment was called to account for its failures to engage publics in science and its lack of self-examination and self-knowledge. Wynne was highly critical of the 'public deficit' model of non-specialist scientific understanding, drawing attention to the extremely nuanced, context-specific and efficient models of public understanding of science that his research showed.

Over a period of time many authors adopted and adapted the notion of institutional reflexivity and applied it to different types of organisations and empirical contexts. In many cases Wynne's original

---

[3] More specifically, Wynne maintains that the mentioned organisations would struggle with the 'entrenched institutional culture of scientism'. For Wynne (1993: 324-325) scientism is the belief that science as such is the most sophisticated, highest form of reflexivity and hence, by definition, exempted from any questioning by outsiders of science. Importantly, not only scientists but also other actors would share this belief, thus collectively producing and reproducing the mentioned 'culture' of non-reflexivity, meaning absence of institutional reflexivity.

AUTHORS' VERSION as accepted after peer review; 03-05-2020

criticism was adopted too (e.g., Macnaghten & Chilvers 2014). Other authors differed and found that depending on the context and organisation considered, institutional reflexivity did exist in specific forms or to a certain degree (e,g., Braun & Kropp 2010). Wynne himself changed his view over time, stating around 20 years later that a range of organisations, namely 'research councils in the UK and internationally', would have become more responsive to public concerns, but still face an 'uphill struggle' against a much wider 'culture' of non-reflexivity (Wynne 2014). Owen (2014) supports this, discussing how responsible innovation is attempting to answer some of these concerns. Stilgoe (2018) explores institutional reflexivity in an even broader context, describing processes of social learning as a form of governance in which institutions and systems improve over time, while Pansera & Owen's (2018) large-scale study of responsible innovation practice in the UK describes a slowly shifting pattern of greater engagement, though not necessarily in the form Wynne may have envisaged.

Although Wynne was discussing the entire scientific establishment, the term 'institutions' will be used here to mean structured organisations (e.g., Guagnin et al. 2012) that operate as discrete bodies within the scientific establishment, such as public research funders. Considering whether these bodies operate in a 'reflexive' manner incorporates, inevitably in the opinion of scholars such as van Oudheusden (2014a) and Pellé (2016), a political dimension. As the institutions in question are often public bodies, there is additional context to be considered in the interface between science and policy. Funders must make choices, and so questions around matters such as the way in which public money is spent, and assessments of research quality, have political dimensions. Political considerations pervade decisions about what research is taken forward (Wynne 2014: 65) and how that research is carried out.

Conversely, research also feeds (back) into policy decisions. Scientific understandings are frequently used as a basis or justification for policy, and this has clear repercussions for policy making, a point discussed by Pereira & Saltelli (2017) in their analysis of the EC's Joint Research Centre. They recommend that the JRC and bodies like it adopt both an engrained culture and a specific set of policy objectives in order to provide qualitatively better groundwork for policy. In particular, the involvement of publics and non-specialists is recommended as a means of operationalising this reflexivity.

This engagement with publics and the political dimension is also more robustly addressed by van Oudheusden (2014a) who argues that democratic technology assessment frameworks, which aim to provide more inclusive and grassroots-informed science, carry with them implicit political dimensions. These dimensions include issues as various as 'How do actors "co-create" outcomes? How do they deliberate? On whose terms is participation … established, and why?' (van Oudheusden, 2014a: 73). Van Oudheusden (2014a) argues that unless these questions are recognised and understood, then the legitimacy of a – supposedly – democratic process that involves stakeholders cannot be taken for granted. Stilgoe et al. (2014) point to the problems inherent in this particular manifestation of reflexivity, suggesting that public engagement can be seen as simply a 'rubber stamp' for an approach already decided upon. Blue & Dale (2016) also draw attention to the power-dynamics in the way deliberative exercises are framed.

AUTHORS' VERSION as accepted after peer review; 03-05-2020

Institutional reflexivity has also repeatedly been discussed as institutional responsiveness (Fisher & Maricle 2015; Forsberg et al. 2015; Pellizzoni 2004); again, some understand institutional responsiveness being directly connected to political power, and how to shape it through public engagement processes. Forsberg et al. (2015) review at length ways in which institutions either do or should incorporate responsibility frameworks within their operations. One of their key insights is the power of institutions to provide an assessment framework. They make a distinction between an assessment **of** responsibility (encompassing the mechanisms whereby institutions gauge how well responsibility actions have been carried out) and assessing **with** responsibility (utilising responsibility frameworks in their own embodied values and operations). Forsberg et al. (2015) also draw from the corpus of work on organisations, drawing attention to Scott (1987) on organisations as 'open' systems that respond to 'shifting environmental expectations' (Forsberg et al. 2015: 25), including the expectations of non-expert members of the public.

The difficulty of carrying out collaborative engagement with non-expert members of the public is highlighted in a number of publications. For example, Davies & Selin (2012) discuss 'responsibility' in terms of anticipatory governance and describe the problems they encountered when carrying out upstream engagement exercises. Pidgeon et al. (2017) offer four challenges in the methodologies of working with publics, including framing issues, the question of who is involved (reflecting again the political nature of collaborative stakeholder work), the values that are brought to bear, and the amount of time these exercises need. Obar (2015) argues that it cannot be assumed that private citizens are able to maintain even a passing familiarity with the number of relevant scientific debates and developments that are in progress at any one time.

For some, such reservations over public engagement processes are history repeating itself. Wynne deplored the concept of the 'public deficit' model in 1993, and took aim again at this model thirteen years later by reiterating his demand that the scientific establishment examine its preconceptions, and question whether, in fact, it was scientific understanding of publics that was the issue, rather than public understanding of science (Wynne 2006). Stilgoe et al. (2014) also point out the persistence of the attitude that it is the public that is the problem – the 'deficit model' refuses to go away. Recent analysis on these relationships in a Spanish context from Llorente et al. (2019) finds that there remain significant misunderstandings as to the nature of public comprehension of science topics.

To conclude, we find that the current discourse on institutional reflexivity tends to consider science-policy organisations as deficient, namely that they lack, or are insufficiently realising, proper public engagement. Moreover, the discourse is mostly preoccupied with organisations as a whole, thus missing out on detailed organisational activities that one by one, and in combination, contribute to overall institutional reflexivity. We believe that these existing tendencies in theoretical discourse represent important conceptual shortcomings. Reflexivity does not only happen on an individual level or, largely independent of this, on the institutional level. Moreover, a given organisation such as a funder does not necessarily have a reflexive deficit when 'failing' to engage with publics. We believe

there is another form of reflexivity that links the two poles - individual and institutional reflexivity - as we discovered from the empirical research that we now describe.

4. Collaborative reflexive organising in funding processes

In this section we describe our empirical findings of how reflexivity is enacted within funding bodies. This section builds on the theoretical discussion described in the previous section. We suggest that what we observed is neither exclusively individual reflexivity, nor institutional reflexivity 'in deficit' of public engagement. Instead, the reflexive processes that we describe cover a space in-between the two.

We begin by linking back the reflexive processes we observed to the discourse on public engagement, as reviewed in section 3. We do find that institutional actors are reluctant to participate in public engagement activities, and we elaborate on this point in the following section 4.1. However, we then proceed to demonstrate that there are **other** ways in which institutional actors do display reflexivity.

For ease of reading we switch to present tense. It should be kept in mind that the quotes we present and interpret here capture interviewees' views and reported activities from 2011-2013, as well as 2015-2016 when we conducted three more interviews. All interviewees will be quoted anonymously (interviewee 1 to 11 for the earlier interviews, interviewee 12 to 14 for the more recent data). Moreover, we apply male-female gender distinctions freely, broadly reflecting the fact that the group of interviewees was mixed in that regard.

4.1 A sceptical attitude towards the public, and public engagement activities

At times interviewees are wary of taking assertive action often associated with 'responsible' conduct, for instance, to make space for discussions not only of positive, but also potential negative consequences of research. While undesirable consequences could, at least in part, be apprehended through public engagement activities (e.g., the Sciencewise public consultation on autonomous vehicles: Ashley et al., 2019), most interviewees hold a strong opinion against allowing members of the general public to participate in decision-making around funding priorities.

For example, interviewee 2 says that the public should not get too involved, and if anything, a 'weighted public opinion' would be needed, administered through experts. In a similar vein, when asked whether it would be worthwhile to conduct public engagement exercises such as those undertaken in nanotechnology (e.g., Murphy 2013), interviewee 4 emphasises that it would be 'so complicated', 'bloody complicated', to 'ask people who didn't know about the research useful sensible questions, it really would'. For nanotechnology the questions would be rather 'defined', whereas the research area under his purview would be 'so diffuse and horrible that it's very difficult to explain the overall picture'. At a later point in the interview, this manager says that 'a lot of the duty to consult with the public is discharged at the point where they put their cross in the ballot box and elect a [Member of Parliament]

who forms a government and has a set of policies'. And government policies would ultimately trickle down into funding decisions.

The interviewees' lack of interest in radically opening up the funding process to public scrutiny is part of a basic understanding of staff acting only as 'facilitators' (interviewees 1 and 7), 'moderators' (interviewee 7) or 'mediators' (interviewee 8). Managers would only be required to 'encourage' or 'nudge' (interviewee 6) **researchers** to integrate public engagement measures into their envisaged projects. As interviewee 2 put it: 'it's about what you [as a researcher] are actually going to do in your project'. The interviewees feel they have only a minor or secondary role to play in public engagement and none whatsoever in the assessment of potential harm. They justify this attitude by describing the complexity of the research areas they manage, and that only experts – scientific experts – can give the appropriate consultative advice.

This view also surfaces in our more recent interviews with managers in the same funding institution. Again, staff members rely largely on the expertise of funded researchers to make sure that harm to society is avoided:

'I think they [researchers] have an obligation to think about the impacts of what they might produce. If they produce something that is going to be used by the military, then that may kill someone. They have an obligation to think about that. That doesn't mean they have to make, stop, but they need to have thought about that' (interviewee 12). In a similar vein, interviewee 13 discusses a specific example, laser technology, and how it can be used in a beneficial but also detrimental way such as, for deliberately blinding people. He says that this is an issue that could have very well been raised by researchers in early phases of development.

Such views expressed by the interviewees suggest, at first, that staff employed with the funding institution shift responsibility for potential harm from research to researchers themselves. Nevertheless, at other times during the interviews, managers do show a sense of what could be called their co-responsibility, namely, their own responsibility for preparing the ground for other actors' responsible behaviour. This is indicated, for instance, by interviewee 12 saying: 'I suppose as a funder, […] [it is on us to make] sure that other people understand […] the implications of their research, and what they're using the money on and what they're producing and what that could be used for. So we have an obligation to ensure that they're thinking about it' (interviewee 12).

To conclude, other authors have criticised institutional actors for their reluctance to consider any possible detrimental impact of research, and to engage with members of the public (Bellamy 2014; Valdivia & Guston 2015). However, in our empirical data we found that interviewees' seeming reluctance is actually connected to managers being sceptical of their own knowledge and abilities. They find that their own knowledge is too limited, and that only researchers, as experts in their field, could reasonably estimate potential harmful consequences of their research, and conduct public engagement activities tailored to their specific projects. We shall now exemplify and discuss this 'knowledge problem' that funding managers have, an issue that effectively is the starting point of their collaborative reflexivity.

4.2 Acknowledging the limits of one's knowledge

Various interviewees show an awareness of their own knowledge being limited, and they appear to use it with caution. For example, asking interviewee 8 about research topics that should not be pursued from a societal perspective, she emphasizes twice 'that's too big! … It's not what I can answer', and adds:

'You would have to ask the experts who know the area, what should or shouldn't be funded. You have to have the expertise to know, a community decision. […] I don't know whether this is an arrogance or not but my initial response is it (?) would the general public, as a whole, be able to appreciate the issues on the table and appreciate the consequences of their decisions. […] It's not a project only decision, we'd be cutting off a line of research that could potentially transform society in a good way! […] It's not easy!' (interviewee 8).

The manager shows a sense of responsibility by warning that major changes in funding directions through public consultation could 'cut off' beneficial research agendas. It is also noteworthy that she wonders whether her scepticism towards involving the public is 'an arrogance', and she repeats this during the interview. Thus, she is aware that her scepticism may not be fully appropriate, and through expressing her (self-)doubt she takes a (small) step back from her own opinion. In a similar vein, when asked whether the funding institution should encourage more public dialogue, interviewee 2 says the discussion would need to be 'informed', adding: 'even for us, a lot of the time to actually understand the technical challenges, the research and the benefits of it, [we need to be] really quite involved'. Public dialogue exercises could be appropriate for higher-level strategy building, but not at the level of more specific funding decisions.

Such reservations from staff might be justified similar to the view put forward by Douglas (2003) that scientists' moral responsibility arises precisely from their specialist knowledge. Non-experts would be unable to understand and judge the consequential decisions of scientists in 'the fine tuning of methodologies, the characterization of data, or the interpretation of data' (Douglas 2003: 64).

This view resonates with one manager (interviewee 7) saying that her role implies taking a broad view as compared to a researcher's narrower specialist focus. In a way, interviewee 8 implicitly follows up on this point by explaining: 'academics will actually say "oh yes but this particular SQL [Structured Query Language] query, blah blah blah", and they'll know why it's a problem and why sharing information is an issue as opposed to just having a general unease about it' (interviewee 8). In a similar vein, interviewee 4 elaborates on the desirable openness of many funding calls. These should not include specific questions and criteria related to potential ethical issues and social consequences. They would rather be designed in order to elicit the broadest possible variety of research proposals. Such a broad call would be necessary since 'you don't know everything that might be going on in future, so we have to allow people to suggest stuff'.

The fact that staff members have only a limited knowledge of the research areas they manage appears to be coupled to a specific organisational policy. We found that research areas are frequently allocated to managers 'against the grain', namely, non-aligned with their own research background. For example, a given manager may have a research background and even a PhD in some natural science

area, but not in computer science or in another ICT-related field. Nevertheless, it is precisely these *un*familiar research areas that the managers in the funding institution are charged to oversee.

This deliberate mismatch between a given manager's background and his or her managed research area is an important base condition for collaborative reflexivity. It appears that collaborative reflexivity is enabled, but also, in a way, hindered by the existing policy. Managers cannot simply lean back on their existing knowledge and preanalytic assumptions about a given research area, but instead, they need to make a substantial effort and familiarise themselves with the new field. For instance, interviewee 6 says that she 'obviously' knows more 'about certain areas' in the field she had studied herself, and this could mislead her to 'naturally favour' certain lines of enquiry 'over something you don't understand'. Having to manage different, unfamiliar research areas would, over time, help each manager's 'development', given that 'each research community is slightly different'. However, the interviewee also says that it is very important to 'have some knowledge of your community', and adds that perhaps, and much to her liking, a change in the existing organisational policy is under way. Indeed, as another interview suggests, managers would also benefit from pre-existing familiarity with the research they oversee. Interviewee 3 spent many minutes of the interview explaining the laborious work of building up a reasonably good understanding of the research areas assigned to him. We will take a closer look at this practical knowledge work, which involves a variety of consultation activities, in the following section.

What can be seen from the last quotes and interpretations is a specific dilemma associated with reflexivity. We find that this epistemic dilemma has not been sufficiently acknowledged in the existing theoretical discourse. On the one hand, influential authors (e,g., Wynne 1993; Stilgoe et al. 2013) have argued that reflexivity means to stay open-minded and reconsider one's existing knowledge and background assumptions frequently. On the other hand, we find that a given actor – such as a member of staff of a funding institution – **also** needs a (temporarily) safe knowledge ground, and sufficiently stable assumptions, to understand and manage a given research area in the first place.

4.3 Consulting with colleagues and other stakeholders

Perhaps as a consequence of acknowledging the limits of their own knowledge, the managers we interviewed are active in consulting different stakeholders. For instance, interviewee 8 mentions that upper management would expect her and her colleagues 'to engage with both industry and academics'. Referred to as 'chatting' to as many people as possible – not only during formal meetings such as workshops, but also informally (and more frequently) via telephone and email as well as during visits (interviewee 7). As interviewee 2 explains, a manager's knowledge of a given research area would depend 'a lot' on 'travelling around and meeting researchers', thus 'trying to build up a picture'.

The managers explain the complexity of consultation activities from workshops, to more intense, experimental sessions. In workshops, the funder selects up to 40 academics to explore the different ways that researchers can contribute to the priorities identified by the funder. During these half or full day events, with the academic community's help, they identify high-level challenges within each

priority. These then form the basis of a funding call. An experimental session on the other hand, is much smaller (about 10 academics), and is a much more intense process, usually a five-day event. The events are focused on a very specific goal and most often funding is attached to the outcomes of those sessions. The funder will bring people together who may not have thought of working together where they are led through a series of exercises to identify a research project that they could collaborate on together. At the end of the event, participants may have a proposal ready that is then funded (interviewee 6).

In addition, the managers rely on consultation processes developing within research communities. It is up to the academic reviewers of proposals to identify potential ethical issues and, based upon the results of the peer review process, the funders will follow the recommendations of the academics. The funder relies upon the peer review, after which they defer to the university ethics board (interviewee 4). As interviewee 2 notes, 'we rely on that system to back up the process'. In other words, there are a series of checks and balances in operation around notions of professional and research responsibility that operates in a devolved rather than in a centralised manner.

According to our interviews, the project managers consult mostly with the academic research community. Another relevant source of knowledge development is frequent exchange of ideas and expertise with colleagues (interviewee 3, 6, 8). However, staff do receive input from additional stakeholders regarding skills development, commercial innovation and long-term strategic goals with industry. There are expert panels made up of 50% academics and 50% industry. At the time of the interviews there was no representation from NGOs, learned societies nor representatives of public more generally (interviewee 5). This indicates that academic and commercial research perspectives are favoured over other societal stakeholders. More diverse consultation activities would probably require more resources committed by the funders in terms of time and personnel.

4.4 Adjusting subsequent actions in funding processes

Previously we have exemplified the ways in which staff of the funding organisation engage in consultation activities with various stakeholders, including both external stakeholders (e.g. researchers, members of industry) and internal stakeholders (colleagues). Many of these activities appear to feed into rethinking and redoing funding procedures and decisions, as the following examples indicate.

One manager provided an overview of the different organisational units and activities involved in the institution's funding processes. She starts off by explaining that the leaders of her organisational unit ('they') would engage in a range of consultation processes which would inform the institution's broader strategic planning:

'They talk to researchers, to business, to industry and to learned societies. They'll pick up things that are happening in [government] […], look at what's happening internationally, and their job is to ask questions and then listen what comes back. They synthesise that into a set of papers that goes to [a specific group] […] who are academics and industrialists drawn from the community. [They] then propose future plans on the ICT budget and that then goes forward to [a higher decision-making body in

the funding institution] […] And before it gets [there], it gets to [another group] […] [who] are responsible for synthesising an integrated set of plans.' (interviewee 5)

The quote indicates that the managers' consultation processes with different stakeholders feed into a multi-step procedure of the funding institution's overall strategy building. To provide a related example, interviewee 2 explains that he and his colleagues from upper management would regularly 'assess' and make 'judgements' about 'the value' of those lines of enquiry, funded at a given point in time. The managers' value judgements would be influenced by many factors, including 'collecting' researchers' perspectives and 'trying to assimilate' these multiple views in 'the context of a much wider landscape'. The interviewee continues, saying that he would always 'keep an eye on how things are developing' under his purview, and staff would 'discuss internally whether [ethical] issues are dealt with'. He added that 'if I found that there was a need to raise awareness to do something specific in a particular area, I could have a discussion [with upper management] and see if it was a priority or not'.

The last quote raises the question of whether staff have any significant hand in developing the funding institution's priorities. Note that the interviewee says he would (only) 'see' whether something is a priority or not. Indeed, from various interviewees (1, 2, 5) we learn that the funding institution's room for manoeuvre is limited by the government, for instance, through the government providing the institution's budget; the government appointing the institution's highest management level; or certain governmental targets. On the one hand, the funding institution has a legal status independent of the government and is thus in the position to identify for itself the most promising research. On the other hand, the organisation receives its budget and basic directions from government, and thus needs to foster suggestions for funding routes that sufficiently meet governmental expectations.

Given this structural quandary, we find that managers do make an effort to shape future funding routes in response to what they learn from different stakeholders. For instance, when asked how decisions about future lines of research to be funded are being taken, interviewee 6 first explains that most funding calls are only loosely pre-configured through governmental expectations, whereas a few calls are indeed designated and designed to respond more directly to specific governmental requirements. However, even the more specific calls get shaped through managers' consultation processes with researchers:

'We are going to be working with the [research] community using workshops to develop what the scope of that call should be. And the purpose of that is to really kick start those [governmental] priorities. […] We do all types of workshops, the particular ones for [call 1] and [call 2] are to explore the different ways that researchers can contribute to those priorities. So, for [call 1], what we want to do is get a range of researchers from across the ICT landscape together and work out what some of the high-level challenges are underneath that priority. […] For [call 2], which I don't look after, my understanding is that the workshop will look more at what would encourage researchers to work more closely together, what we mean by working together, and what's inhibiting that at the moment, so that can help inform what we ask for in the call' (interviewee 6).

In a similar vein, interviewee 4 says that 'we develop our strategy as it is just by speaking to people who seem to know what they are talking about', and calls this 'a sort of grass roots type strategy'. While this indicates, again, the importance of consultation processes for the shaping of future funding strategies, the interviewee also makes clear that in his view, there is only little room for manoeuvre for the parties involved due to the power of the government: 'he who plays the piper calls the tune' (interviewee 4). He adds that 'if the government is giving the money out, then it's what they say they want the money to achieve is right'.

To conclude, the interview data suggests that despite the government, or 'piper', largely 'calling the tune' of what ends up being funded, managers do shape governmental priorities through collaborations (e.g. workshops) with researchers. As already pointed out in the previous section, researchers do stand out as the stakeholders that are most relevant to the managers. These appear to engage less often, or in a less intense way, with other external stakeholders (e.g. representatives of industry, NGOs, learned societies). Thus, it appears that reflexivity as realised by the employees of the funding institution has a bias towards a specific stakeholder group, academic researchers. However, we find that this is an understandable tendency given the complexity and temporal dynamics of the various research fields and associated funding processes that any one manager needs to oversee.

5. Discussion and conclusions

The empirical work described in the previous section demonstrates that the literature on reflexivity as discussed in section 3 does not do justice to organisational reality. Based on our observations we therefore introduce the concept of collaborative reflexivity, which we believe is an important concept that helps plug the gap between individual and institutional reflexivity, and thereby make sense of organisational reality.

5.1 Collaborative reflexivity covering the space 'in-between'

Our interviews with funding staff show that these actors are not keen on engaging with the public, and this could be understood, at first sight, as the rulers' refusal to give away power, and lack of institutional reflexivity. Our research, thus, appears to confirm part of the existing theoretical discourse (see section 3). However, our empirical analysis also shows that the managers of funding processes are keen on encouraging **researchers** to engage with publics wherever possible. In other words, institutional reflexivity is not simply lacking but enacted, in a way, indirectly. As for fundamental disruption, a feature often associated with institutional reflexivity (see section 3), we do find staff changing their views and shaping calls in response to new information from different stakeholders, but these revisions tend to be incremental, undramatic changes, rather than a major form of fundamental disruption. We find reconsiderations and redirections, but not revolution, or any such spirit. Again, this does not mean that institutional reflexivity is lacking, and we explain now in which sense it does exist.

In a way, our own empirical findings do not make the public deficit model go away as discussed by various authors. Our interviewees were also wary of public engagement. However, we find that they nevertheless **do** display reflexivity, namely 'collaborative reflexivity'. The notion of collaborative reflexivity provides a conceptual bridge between individual reflexivity and institutional reflexivity.

An important starting point for our conceptualisation of this 'in-between' position is Lynch's systematic analysis of different notions of reflexivity (Lynch 2000). Lynch maintains that every social action is, by definition, reflexive; hence his argument that reflexivity is not an 'academic virtue' but ubiquitous (cf. Babcock 1980). Given this ubiquity, the analyst's attention should shift to analysing different **kinds** of reflexivity, the meanings of which would vary **in relation to** a given community of practice and would be tied to a specific context of usage.

Lynch's relational perspective to reflexivity, and ethnomethodology's more general emphasis on social order being 'accomplished' in social interactions (e.g. Psathas 1980), form the bedrock of our own practice-oriented approach to reflexivity. At first sight, we may seem to be introducing a paradoxical perspective since many authors, as we demonstrated previously, consider institutional reflexivity a systemic, or structural property, which applies to an entire field such as, 'science' (Wynne 1993), or entire organisations (e.g. Guagnin et al. 2012; Stilgoe et al. 2013). However, considering various scholars' findings that organisations are continuously enacted, or 'structured' by individuals (Orlikowski & Yates 2002: 685; cf. Weick et al. 2005), we maintain that institutional reflexivity is not only a property or quality of entire systems, but also of individuals, or more precisely, of their interacting with other individuals, and their sense-making throughout such interactions. We found that the staff of the funding institution we interviewed engage with their colleagues as well as external stakeholders (researchers, representatives of industry or learning societies) in sense-making activities which represent a specific form of reflexivity that sits midway between an individual's agency and organisational, or systemic structures.

Our concept of collaborative reflexivity, and how it mediates between individual and institutional reflexivity, can be elucidated by drawing on ethnographic research conducted by Hughes et al. (2005), who observed portfolio managers' everyday work in a multi-national bank. What interests us here, is how the authors conceive of meaning; rule-following; and the distinction between formal and informal organisation. First, the meaning of something – for instance, the meaning of 'science for society' – is not a given but rather is 'an intersubjective achievement'. In other words, meaning is generated through individuals' orienting towards, and interacting with each other. Second, rules are often not external to the action they govern, but 'intimately involved' in action itself (Hughes et al 2005: 101). The two sides can be distinguished analytically, and often, individuals experience rules (institutions) as external forces. However, in practice, rules (institutions) are also continuously created, recreated or changed, and this happens through individuals relating to one another in joint sense-making activities. Third, Hughes et al. (2005: 101) maintain that the distinction between 'formal' and 'informal' organisation is not useful for understanding organised action, since the real-time flow of everyday work would often consist of a multifaceted mix of activities which would be hard to categorise as either one

or the other. If anything, organisational members themselves should be consulted to see how they apply the two terms (if at all).

Returning to the case at hand, we are interested in interactive sense-making practices that are on display within funding processes. Here we find a form of reflexivity that consists of ordinary organising practices such as, telephone conversations with colleagues and other stakeholders; meeting up with researchers; reading up on latest governmental policies in policy documents; and from all these different sources, drafting and revising plans for future funding. We argue that through many of such seemingly trivial work tasks, individuals collaboratively create reflexivity. Since particular individuals, namely researchers, are encouraged to engage with publics, the overall reflexivity thus produced is not necessarily 'deficient'. Figuratively speaking, funding staff move from the left end of the spectrum (individual reflexivity) to the right end (institutional reflexivity).

Thus, the concept of collaborative reflexivity does not contradict but rather feeds into institutional reflexivity as understood by Wynne (1993) and others (e.g., Forsberg et al. 2015; Stilgoe et al. 2013). However, these authors have not paid attention to the level of individual attitudes and interactions. We found that an individual employee accomplishes collaborative reflexivity through interactions with their colleagues and other stakeholders, a process consisting of three basic steps, analytically:

(1) acknowledging that one reaches the limits of one's existing knowledge (explicit and implicit);

(2) responding to such irritations through consulting with colleagues and other stakeholders;

(3) making efforts to change existing approaches accordingly: adjusting one's own and the organisation's subsequent actions, e.g. shape future funding schemes, and make funding decisions.

Note that this definition of collaborative reflexivity does take into account Wynne's (1993: 324) original definition of institutional reflexivity as a 'process of identifying, and critically examining (and thus rendering open to change), the basic, preanalytic assumptions that frame knowledge-commitments'. However, we relocate such reflexive processes at the microanalytical level of inter-subjective interactions.

5.2 Limitations and contribution

Our work relies on the empirical findings from a relatively small number of interviews which were conducted in one funding organisation. We can therefore not claim to have insights into processes of reflexivity across organisations, in different locations or in different contexts. We furthermore focused on processes related to RRI, which means that there are likely to be other structures of reflexivity that we did not observe. We have been selective, we did not enter neighbouring theoretical discourses such as on reflexive governance (e.g., Voß et al. 2006). For instance, our empirical findings fall partly under 'governance on the outside', and partly under 'governance on the inside', as distinguished by Smith and Stirling (2007: 352). In addition, our concept of collaborative reflexivity does include what Stirling

(2006) has singled out (and criticised) as reflection only. It would therefore be a useful extension of our work to consider a broader range of publications on reflexivity and governance; to broaden the set of respondents; to investigate other types of organisations; and to extend interview schedules beyond questions of 'responsible' behaviour.

A further limitation lies in our chosen method, qualitative interviews. These are not ideal for the practice perspective on organisations that we wish to strengthen. Ethnographic fieldwork would be a more appropriate methodological choice, but given the potentially delicate empirical setting and task - social scientists' entering science policy spaces where there is a preference to act with discretion - truly ethnographic research may be hard to realise.

Having said this, we believe that the conceptual contribution of our work is significant. We have demonstrated that there is an important practice-based space between individual and institutional reflexivity that existing literature has overlooked. Many of the phenomena that can be observed in 'responsible' funding practice can be described with recourse to collaborative reflexivity. Organisational policies and overall institutional discourses drive the agenda. However, the implementation of these policies often does not take place uniformly and consistently. Processes of reflexivity inform how staff of funding bodies interpret and implement policies. But these processes of reflexivity are neither exclusively individual, which would render them somewhat idiosyncratic, nor comprehensive, but they happen through rather agile communication and collaboration. Such crucial activities cannot be imposed but only cultivated.

The recognition that there are organising practices of collaborative reflexivity can also be used to explicitly link individual and institutional reflexivity. For funding organisations, for example, this means that there are relatively simple and straightforward mechanisms that could be employed to foster reflexivity, using well-established means of collaboration such as workshops, focus groups etc, but also more unusual 'mechanisms' such as, allowing for time and space to acknowledge one's own and others limits of knowledge (epistemic 'errors') which can be a starting point for consultation activities with other stakeholders, as we demonstrated. An organisation aiming to strengthen its reflexive capabilities can thus make use of the insights we present here.

Therefore, this paper and its introduction of the concept of collaborative reflexivity not only fills a gap in the academic literature, and provides empirical evidence to demonstrate the validity of the concept. The insights presented here are also of practical relevance for organisations seeking to maximise their reflexive capabilities.

Acknowledgements

Appendix: Publications included in the literature review

Andersen, H. (2017). *Conceptions of Responsible Research and Innovation in Funding Processes*. A case study of Convergence Environments at the University of Oslo: Life Science. Master thesis. http://urn.nb.no/URN:NBN:no-62234

Arnaldi, S., Quaglio, G. L., Ladikas, M., O'Kane, H., Karapiperis, T., Srinivas, K. R., & Zhao, Y. (2015). Responsible governance in science and technology policy: Reflections from Europe, China and India. *Technology in Society, 42*, 81–92. https://doi.org/10.1016/j.techsoc.2015.03.006

Beck, S. (2019). Coproducing knowledge and politics of the anthropocene: the case of the future earth program. In F. Biermann & E. Lovbrand (Eds.), *Anthropocene Encounters: New Directions in Green Political Thinking* (p. 243). Cambridge University Press.

Beck, S., & Forsyth, T. (2015). Co-production and democratizing global environmental expertise: The IPCC and adaptation to climate change. In S. Hilgartner, C. A. Miller, & R. Hagendijk (Eds.), *Science and Democracy: Making Knowledge and Making Power in the Biosciences and Beyond*. Routledge.

Beck, S., & Mahony, M. (2018). The IPCC and the new map of science and politics. *Wiley Interdisciplinary Reviews: Climate Change*, *9*(6), 1–16. https://doi.org/10.1002/wcc.547

Bellamy, R. (2016). A Sociotechnical Framework for Governing Climate Engineering. *Technology, & Human Values*, *41*(2), 135–162. https://doi.org/10.1177/0162243915591855

Bellamy, R. (2014). Beyond Climate Control: 'Opening up' Propositions for Geoengineering Governance. *Climate Geoengineering Governance Project Working Paper*, *11*(May).

Bellamy, R., Chilvers, J., Vaughan, N. E., & Lenton, T. M. (2013). "Opening up" geoengineering appraisal: Multi-Criteria Mapping of options for tackling climate change. *Global Environmental Change*, *23*(5), 926–937. https://doi.org/10.1016/j.gloenvcha.2013.07.011

Bergen, J. P. (2017). Responsible Innovation in light of Levinas: rethinking the relation between responsibility and innovation. *Journal of Responsible Innovation*, *4*(3), 354–370. https://doi.org/10.1080/23299460.2017.1387510

Blue, G., & Dale, J. (2016). Framing and power in public deliberation with climate change: critical reflections on the role of deliberative practitioners. *Journal of Public Deliberation*, *12*(1), Article 2.

Bolz, K., & de Bruin, A. (2019). Responsible innovation and social innovation: toward an integrative research framework. *International Journal of Social Economics*, *46*(6), 742–755. https://doi.org/10.1108/IJSE-10-2018-0517

Bowman, D., Rip, A., & Stokes, E. (2017). Introduction. In *Embedding New Technologies into Society: A Regulatory, Ethical and Societal Perspective*. Pan Stanford Publishing Pte Ltd.

Braun, K., & Kropp, C. (2010). Beyond Speaking Truth? Institutional Responses to Uncertainty in Scientific Governance. *Science, Technology, & Human Values*, 35(6), 771–782. https://doi.org/10.1177/0162243909357916

Burget, M., Bardone, E., & Pedaste, M. (2017). Definitions and Conceptual Dimensions of Responsible Research and Innovation: A Literature Review. In *Science and Engineering Ethics* (Vol. 23, Issue 1, pp. 1–19). https://doi.org/10.1007/s11948-016-9782-1

Burri, R. V. (2018). Models of Public Engagement: Nanoscientists' Understandings of Science–Society Interactions. *NanoEthics*, *12*(2), 81–98. https://doi.org/10.1007/s11569-018-0316-y

Conley, S. N., Foley, R. W., Gorman, M. E., Denham, J., & Coleman, K. (2017). Acquisition of T-shaped expertise: an exploratory study. *Social Epistemology*, *31*(2), 165–183. https://doi.org/10.1080/02691728.2016.1249435

Correljé, A., Cuppen, E., Dignum, M., Pesch, U., & Taebi, B. (2013). The acceptability of shale gas? Values in the design of technologies, institutions and stakeholder interactions. *Proceedings of the 16th Conference of the European Roundtable on Sustainable Consumption and Production (ERSCP) & 7th Conference of the Environmental Management for Sustainable Universities (EMSU), 4–9 June 2013, Istanbul, Turkey*, 1–20.

Correljé, A., Cuppen, E., Dignum, M., Pesch, U., & Taebi, B. (2015). Responsible Innovation in Energy Projects: Values in the Design of Technologies, Institutions and Stakeholder Interactions. In *Responsible Innovation 2: Concepts, Approaches, and Applications* (pp. 183–200). https://doi.org/10.1007/978-3-319-17308-5

Davies, S. R., & Selin, C. (2012). Energy futures: Five dilemmas of the practice of anticipatory governance. *Environmental Communication*, *6*(1), 119–136. https://doi.org/10.1080/17524032.2011.644632

Delgado, A. (2016). *Technoscience and citizenship: ethics and governance in the digital society*. Springer International Publishing.

Delgado, A., & Åm, H. (2018). *Experiments in interdisciplinarity: Responsible research and innovation and the public good*. https://doi.org/10.1371/journal.pbio.2003921

Demers-Payette, O., Lehoux, P., & Daudelin, G. (2016). Responsible research and innovation: a productive model for the future of medical innovation. *Journal of Responsible Innovation*, *3*(3), 188–208. https://doi.org/10.1080/23299460.2016.1256659

Deplazes-Zemp, A., Gregorowius, D., & Biller-Andorno, N. (2015). Different Understandings of Life as an Opportunity to Enrich the Debate About Synthetic Biology. *NanoEthics*, *9*(2), 179–188. https://doi.org/10.1007/s11569-015-0226-1

Einsiedel, E. F. (2014). Publics and their participation in science and technology: changing roles, blurring boundaries. In M. Bucchi & B. Trench (Eds.), *Routledge Handbook of Public Communication of Science and Technology* (2nd ed.). Routledge. https://doi.org/https://doi.org/10.4324/9780203483794

Fastman, B., Metzger, M., & Harthorn, B. H. (2016). Forging New Connections Between Nanoscience and Society in the UCSB Center for Nanotechnology in Society Science and Engineering Fellows Program. In K. Winkelmann & B. Bhushan (Eds.), *Global Perspectives of Nanoscience and Engineering Education* (pp. 375–393). Springer International Publishing. https://doi.org/10.1007/978-3-319-31833-2_14

Fisher, E., & Maricle, G. (2015). Higher-level responsiveness? Socio-technical integration within US and UK nanotechnology research priority setting. *Science and Public Policy*, *42*(1), 72–85.

Foley, R., & Wiek, A. (2017). Bridgework ahead! Innovation ecosystems vis-à-vis responsible innovation. *Journal of Nanoparticle Research*, *19*(2). https://doi.org/10.1007/s11051-017-3770-5

Forsberg, E. M., Quaglio, G. L., O'Kane, H., Karapiperis, T., Van Woensel, L., & Arnaldi, S. (2015). Assessment of science and technologies: Advising for and with responsibility. *Technology in Society*, *42*, 21–27. https://doi.org/10.1016/j.techsoc.2014.12.004

Frow, E., & Calvert, J. (2013). Opening up the future(s) of synthetic biology. *Futures*, *48*, 32–43. https://doi.org/10.1016/j.futures.2013.03.001

Funtowicz, S. O., & Ravetz, J. R. (1993). Science for the post-normal age. *Futures, 25*(7), 739–755. https://doi.org/10.1016/0016-3287(93)90022-L

Genus, A., & Stirling, A. (2018). Collingridge and the dilemma of control: Towards responsible and accountable innovation. *Research Policy*. https://doi.org/10.1016/j.respol.2017.09.012

Gianni, R., & Goujon, P. (2019). What are the conditions for the ethical implementation of RRI? In R. Gianni, J. Pearson, & B. Reber (Eds.), *Responsible Research and Innovation: From Concepts to Practices*. Routledge.

Grimpe, B., Hartswood, M., & Jirotka, M. (n.d.). *Towards a Closer Dialogue between Policy and Practice: Responsible Design in HCI*. https://doi.org/10.1145/2556288.2557364

Grinbaum, A., & Groves, C. (2013). What Is "Responsible" about Responsible Innovation? Understanding the Ethical Issues. In *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society* (pp. 119–142). https://doi.org/10.1002/9781118551424.ch7

Groves, C. (2017). Care and techno-science: Re-embedding the futures of innovation. *Embedding New Technologies into Society: A Regulatory, Ethical and Societal Perspective*, 89–113. https://doi.org/10.1201/9781315379593

Guagnin, D., Hempel, L., & Ilten, C. (2012). Bridging the Gap: We Need to Get Together. In D. Guagnin, L. Hempel, C. Ilten, I. Kroener, D. Neyland, & H. Postigo (Eds.), *Managing Privacy through Accountability* (pp. 102–124). Palgrave Macmillan UK. https://doi.org/10.1057/9781137032225_6

Gwizdała, J. P., & Śledzik, K. (2017). Responsible Research and Innovation in the Context of University Technology Transfer. *Acta Universitatis Lodziensis. Folia Oeconomica*, *2*(328), 55–73. https://doi.org/10.18778/0208-6018.328.04

Irwin, A. I., Bucchi, M., Felt, U., Smallman, M., & Yearley, S. (2018). *Re-framing Environmental Communication: engagement, understanding and action*.

Klaasen, P., Rijnen, M. C. J. A., Vermeulen, S., Kupper, F., & Broerse, J. E. W. (2018). Technocracy versus experimental learning in RRI. In *Responsible Research and Innovation: From Concepts to Practices* (pp. 77–98). Routledge.

Kokotovich, A. E. (2014). *Contesting risk: science, governance and the future of plant genetic engineering*. University of Minnesota.

Krabbenborg, L., & Mulder, H. A. J. (2015). Upstream Public Engagement in Nanotechnology: Constraints and Opportunities. *Science Communication*, *37*(4), 452–484. https://doi.org/10.1177/1075547015588601

Kuzma, J. (2017). Society and Policy Maker's Responsibilities. In G. Emilien, R. Weitkunat, & F. Lüdicke (Eds.), *Consumer Perception of Product Risks and Benefits* (pp. 547–566). Springer International Publishing. https://doi.org/10.1007/978-3-319-50530-5_29

Li, F., Owen, R., & Simakova, E. (2015). *Framing responsible innovation in synthetic biology: the need for a critical discourse analysis approach*. *2*(1), 104–108. https://doi.org/10.1080/23299460.2014.1002059

Llorente, C., Revuelta, G., Carrio, M., & Porta, M. (2019). Scientists' opinions and attitudes towards citizens' understanding of science and their role in public engagement activities. *PLoS ONE*, 14(11), 1–20.

Maasen, S. (2016). The Quest for Reproducibility Viewed in the Context of Innovation Societies. In *Reproducibility* (pp. 541–562). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118865064.ch26

Macnaghten, P., & Chilvers, J. (2012). Governing risky technologies. *Vision Research*, *9*(March).

Macnaghten, P., & Chilvers, J. (2014). The future of science governance: Publics, policies, practices. *Environment and Planning C: Government and Policy*, *32*(3), 530–548. https://doi.org/10.1068/c1245j

Malagrida, R., & Martinez-Samper, P. (2016). Responsible research and innovation. In J. Llovet (Ed.), *Handbook of translational medicine*. University of Barcelona.

Mei, L., & Chen, J. (2019). Responsible innovation: Origin, attribution and theoretical framework. In Routledge (Ed.), *The Routledge Companion to Innovation Management*.

Mubarok, M. H. (2017). *Capacities and Accountabilities of Stakeholders in Indonesia's Rural Electrification Program A View from Responsible Innovation and Learning Approaches* [TU Eindhoven]. https://doi.org/10.13140/RG.2.2.25058.02248

Murphy, B. Y. P. (2013). Dialogic Science and Democracy : the Case of Nanotechnology. In *Politics, Participation and Power - Civil Society and Public Policy in Ireland* (pp. 1–14). Glasnevin Press.

Murphy, P. (2010). Nanotechnology: Public Engagement with Health, Environmental and Social Issues. STRIVE Report (2007-FS-EH-1-M5). In *STRIVE Report Series No.61*. www.epa.ie

Nathan, G. (2019). Design-thinking approach to ethical (responsible) technological innovation. In R. Gianni, J. Pearson, & B. Reber (Eds.), *Responsible Research and Innovation: From Concepts to Practices*. Routledge.

Nielsen, M. V. (2016). The concept of responsiveness in the governance of research and innovation. *Science and Public Policy*, scv078. https://doi.org/10.1093/scipol/scv078

Nyadzi, E., Nyamekye, A. B., Werners, S. E., Biesbroek, R. G., Dewulf, A., Slobbe, E. Van, Long, H. P., Termeer, C. J. A. M., & Ludwig, F. (2018). Diagnosing the potential of hydro-climatic information services to support rice farming in northern Ghana. *NJAS - Wageningen Journal of Life Sciences*. https://doi.org/10.1016/j.njas.2018.07.002

Obar, J. A. (2015). Big Data and The Phantom Public : Walter Lippmann and the fallacy of data privacy self-management. *Big Data & Society*, 2(2), 1-19. https://doi.org/10.1177/2053951715608876

Owen, R. (2014). The UK Engineering and Physical Sciences Research Council's commitment to a framework for responsible innovation. *Journal of Responsible Innovation*, 1(1), 113–117. https://doi.org/10.1080/23299460.2014.882065

Owen, R., & Pansera. (2019). Responsible Innovation and Responsible Research and Innovation. In D. Simon, S. Kuhlmann, & J. Stamm (Eds.), *Handbook on Science and Public Policy* (1st ed., pp. 26–48). Edward Elgar. https://doi.org/10.4337/9781784715946.00010

Owen, R., Stilgoe, J., Macnaghten, P., Gorman, M., Fisher, E., & Guston, D. (2013). A Framework for Responsible Innovation. In *Responsible Innovation* (pp. 27–50). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118551424.ch2

Pallett, H., & Chilvers, J. (2015). Organizations in the making: Learning and intervening at the science-policy interface Organisations in this highly active and contested sphere have become interesting to. *Progress in Human Geography*, *39*(2), 146–166.

Pallett, H., & Chilvers, J. (2013). A decade of learning about publics, participation, and climate change: institutionalising reflexivity? *Environment and Planning A, 45,* 1162-1183.

Pansera, M., & Owen, R. (2018). *Report from national case study: United Kingdom*. Retrieved from https://www.rri-practice.eu/wp-content/uploads/2019/06/RRI-Practice_National_Case_Study_Report_UNITED-KINGDOM.pdf

Paredes-Frigolett, H. (2016). Modeling the effect of responsible research and innovation in quadruple helix innovation systems. *Technological Forecasting and Social Change*. https://doi.org/10.1016/j.techfore.2015.11.001

Pellé, S. (2016). Process, outcomes, virtues: the normative strategies of responsible research and innovation and the challenge of moral pluralism. *Journal of Responsible Innovation*, *3*(3), 233–254. https://doi.org/10.1080/23299460.2016.1258945

Pellizzoni, L. (2004). Responsibility and Environmental Governance. *Environmental Politics*, *13*(3), 541–565.

Pereira, A. G., & Saltelli, A. (2014). *Of Styles and Methods*. https://doi.org/10.2788/14832

Pereira, Â. G., & Saltelli, A. (2017). Post-normal institutional identities: Quality assurance, reflexivity and ethos of care. *Futures*, *91*, 53–61. https://doi.org/10.1016/j.futures.2016.11.009

Pidgeon, N., Harthorn, B. H., Satterfield, T., & Demski, C. (2017). Cross-national comparative communication and deliberation about the risks of nanotechnologies. In *The Oxford Handbook of the Science of Science Communication* (pp. 147–155). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780190497620.013.16

Pfotenhauer, S. M., Juhl, J., & Aarden, E. (2019). Challenging the "deficit model" of innovation: Framing policy issues under the innovation imperative. *Research Policy*, *48*(4), 895–904. https://doi.org/10.1016/j.respol.2018.10.015

Radatz, A., Reinsborough, M., Fisher, E., Corley, E., & Guston, D. (2019). An assessment of engaged social science research in nanoscale science and engineering communities. *Science and Public Policy*, *0*(0), 1–13. https://doi.org/10.1093/scipol/scz034

Reber, B. (2018). RRI as the inheritor of deliberative democracy and the precautionary principle. *Journal of Responsible Innovation*, *5*(1), 38–64. https://doi.org/10.1080/23299460.2017.1331097

Schippers, M. C., West, M. A., & Dawson, J. F. (2015). Team Reflexivity and Innovation: The Moderating Role of Team Context. *Journal of Management,* *41*(3), 769-788.

Ribeiro, B. E., Robert, Smith, D. J., & Millar, K. (1948). A Mobilising Concept? Unpacking Academic Representations of Responsible Research and Innovation. *Science and Engineering Ethics*, *23*, 81–103. https://doi.org/10.1007/s11948-016-9761-6

Schwarz-Plaschg, C. (2018). The Power of Analogies for Imagining and Governing Emerging Technologies. *NanoEthics*, *12*(2), 139–153. https://doi.org/10.1007/s11569-018-0315-z

Scott, W. (1987). *Organizations: Rational, natural, and open systems* (2nd ed.). Upper Sadle River, NJ: Prentice Hall.

Stilgoe, J. (2015). *Experiment Earth: responsible innovation in geoengineering*. Routledge. Abingdon, UK

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. *Research Policy*, *42*(9), 1568–1580. https://doi.org/http://dx.doi.org/10.1016/j.respol.2013.05.008

Stilgoe, J. (2018). Machine learning, social learning and the governance of self-driving cars. *Social Studies of Science*, *48*(1), 25–56. https://doi.org/10.1177/0306312717741687

Stilgoe, J., Lock, S. J., & Wilsdon, J. (2014). Why should we promote public engagement with science? *Public Understanding of Science*, *23*(1), 4–15. https://doi.org/10.1177/0963662513518154

Stirling, A. (2016). Knowing Governance. In *Knowing doing governing; realising heterodyne democracies* (Issue January). https://doi.org/10.1057/9781137514509

Smallman, M. (2019). 'Nothing to do with the science': How an elite sociotechnical imaginary cements policy resistance to public perspectives on science and technology through the machinery of government. *Social Studies of Science*. https://doi.org/10.1177/0306312719879768

Suddaby, R., & Laasch, O. (2020). Responsible Management as Re-enchantment and Retrovation. In O. Laasch, R. Suddaby, D. Jamali, & E. Freeman (Eds.), *The research handbook of responsible management*. Edward Elgar. https://www.researchgate.net/publication/335727449

Tanimura, B. E., Of, A. N. O. V., & Esearch, G. E. R. (2014). *Geoengineering Research Governance : Foundation , Form , and Forum*.

Tinoco, R. A., Sato, C. E. Y., & Hasan, R. (2016). Responsible project management: beyond the triple constraints. *Journal of Modern Project Management*, *4*(1), 81–93. http://sro.sussex.ac.uk

van Oudheusden, M., & Laurent, B. (2013). Shifting and Deepening Engagements: Experimental Normativity in Public Participation in Science and Technology. *Science, Technology & Innovation Studies*, *9*(1), 3–22.

van Oudheusden, M. (2014a). Where are the politics in responsible innovation? European governance, technology assessments, and beyond. *Journal of Responsible Innovation*, *1*(1), 67–86. https://doi.org/10.1080/23299460.2014.882097

van Oudheusden, M. (2014b). Learning in, through, and about participatory technology assessment: the case of Nanotechnologies for Tomorrow's Society (NanoSoc). *Technology Analysis and Strategic Management*, *26*(7), 825–836. https://doi.org/10.1080/09537325.2014.902436

Wynne, B. (1993). Public uptake of science: A case for institutional reflexivity. *Public Understanding of Science*, *2*(4), 321–337. https://doi.org/10.1088/0963-6625/2/4/003

Wynne, B. (2014). Further disorientation in the hall of mirrors. *Public Understanding of Science*, *23*(1), 60–70. https://doi.org/10.1177/0963662513505397

Wynne, B. (2006). Public engagement as a means of restoring public trust in science - Hitting the notes, but missing the music? In *Community Genetics* 9, 211–220. https://doi.org/10.1159/000092659

Yun, J. J., & Liu, Z. (2019). Micro- and Macro-Dynamics of Open Innovation with a Quadruple-Helix Model. *Sustainability*, *11*(12), 3301. https://doi.org/10.3390/su11123301

References

Arnaldi, S., Quaglio, G. L., Ladikas, M., O'Kane, H., Karapiperis, T., Srinivas, K. R., & Zhao, Y. (2015). Responsible governance in science and technology policy: Reflections from Europe, China and India. *Technology in Society, 42*, 81–92. https://doi.org/10.1016/j.techsoc.2015.03.006

Ashley, H., Cohen, T., Gisborne, J., Goterfelt, F., Mckeon, A., Stilgoe, J., & Waud, A. (2019). *CAV public acceptability dialogue - engagement report*. Retrieved November 24, 2919, from www.traverse.ltd

Babcock, B. (1980). Reflexivity: Definitions and discriminations. *Semiotica*, *30*(1–2), 1–14. https://doi.org/https://doi.org/10.1515/semi.1980.30.1-2.1

Bellamy, R. (2014). Beyond climate control:'opening up'propositions for geoengineering governance. *Climate Geoengineering Governance Project Working Paper*, *11*.

Bellamy, R. (2016). A Sociotechnical Framework for Governing Climate Engineering. *Technology, & Human Values*, *41*(2), 135–162. https://doi.org/10.1177/0162243915591855

Bellamy, R., Chilvers, J., Vaughan, N. E., & Lenton, T. M. (2013). "Opening up" geoengineering appraisal: Multi-Criteria Mapping of options for tackling climate change. Global Environmental Change, 23(5), 926–937. https://doi.org/10.1016/j.gloenvcha.2013.07.011

Blue, Gwendolyn and Dale, Jacquie (2016) "Framing and power in public deliberation with climate change: Critical reflections on the role of deliberative practitioners," *Journal of Public Deliberation* 12 (1): 2.

Braun, K., & Kropp, C. (2010). Beyond Speaking Truth? Institutional Responses to Uncertainty in Scientific Governance. *Science Technology and Human Values* 35(6)*, 771-782 https://doi.org/10.1177/0162243909357916

Burget, M., Bardone, E., & Pedaste, M. (2017). Definitions and Conceptual Dimensions of Responsible Research and Innovation: A Literature Review. *Science and Engineering Ethics* 23(1), 1-19 https://doi.org/10.1007/s11948-016-9782-1

Correljé, A., Cuppen, E., Dignum, M., Pesch, U., & Taebi, B. (2013). The acceptability of shale gas? Values in the design of technologies , institutions and stakeholder interactions. *Proceedings of the 16th Conference of the European Roundtable on Sustainable Consumption and Production (ERSCP) & 7th Conference of the Environmental Management for Sustainable Universities (EMSU), 4–9 June 2013, Istanbul, Turkey*, 1–20.

Davies, S. R., & Selin, C. (2012). Energy futures: Five dilemmas of the practice of anticipatory governance. *Environmental Communication*, *6*(1), 119–136. https://doi.org/10.1080/17524032.2011.644632

Demers-Payette, O., Lehoux, P., & Daudelin, G. (2016). Responsible research and innovation: a productive model for the future of medical innovation. *Journal of Responsible Innovation*, *3*(3), 188–208. https://doi.org/10.1080/23299460.2016.1256659

Douglas, H. E. (2003). The moral responsibilities of scientists: (Tensions between autonomy and responsibility). *American Philosophical Quarterly*, *40*(1), 59–68. https://doi.org/10.2307/20010097

Fisher, E., & Maricle, G. (2015). Higher-level responsiveness? Socio-technical integration within US and UK nanotechnology research priority setting. *Science and Public Policy*, *42*(1), 72–85.

Forsberg, E. M., Quaglio, G. L., O'Kane, H., Karapiperis, T., Van Woensel, L., & Arnaldi, S. (2015). Assessment of science and technologies: Advising for and with responsibility. *Technology in Society*, *42*, 21–27. https://doi.org/10.1016/j.techsoc.2014.12.004

Funtowicz, S. O., & Ravetz, J. R. (1993). Science for the post-normal age. *Futures, 25*(7), 739–755. https://doi.org/10.1016/0016-3287(93)90022-L

Grinbaum, A., & Groves, C. (2013). What Is "Responsible" about Responsible Innovation? Understanding the Ethical Issues. In *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society* (pp. 119–142). https://doi.org/10.1002/9781118551424.ch7

Guagnin, D., Hempel, L., & Ilten, C. (2012). Bridging the gap: we need to get together. In *Managing Privacy Through Accountability* (pp. 102–124). https://doi.org/10.1057/9781137032225

Guimarães Pereira, Â., & Saltelli, A. (2017). Post-normal institutional identities: Quality assurance, reflexivity and ethos of care. *Futures*, *91*, 53–61. https://doi.org/10.1016/j.futures.2016.11.009

Hughes, J., Martin, D., & Rouncefield, M. (2005). Some notes on the social organization of responsibility. In Mackie, J. & Rouncefield,M., *Proceedings of the The 5th Annual DIRC Research Conference,* Edinburgh, 2005 (pp. 100-110). http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=83A5D83E494A17B7AF7C29FA1D01C F7C?doi=10.1.1.576.648&rep=rep1&type=pdf

Llorente, C., Revuelta, G., Carrio, M., & Porta, M. (2019). Scientists' opinions and attitudes towards citizens ' understanding of science and their role in public engagement activities. *PLoS ONE*, 14(11), 1–20.

Lynch, M. (2000). Against Reflexivity as an Academic Virtue and Source of Privileged Knowledge. *Theory, Culture & Society*, *17*(3), 26–54. https://doi.org/10.1177/02632760022051202Maasen, S. (2018). Human Brain Project: Ethics Management statt Prozeduralisierung von Reflexivität? *Berichte Zur Wissenschaftsgeschichte*, 41, 222–237. https://doi.org/10.1002/bewi.201801901

Macnaghten, P., & Chilvers, J. (2014). The future of science governance: Publics, policies, practices. *Environment and Planning C: Government and Policy*, *32*(3), 530–548. https://doi.org/10.1068/c1245j

Murphy, B. Y. P. (2013). Dialogic Science and Democracy : the Case of Nanotechnology. In *Politics, Participation and Power - Civil Society and Public Policy in Ireland* (pp. 1–14). Dublin: Glasnevin Press.Nuffield Council on Bioethics (2013). *Novel neurotechnologies: intervening in the brain: short guide.* London. https://www.nuffieldbioethics.org/assets/pdfs/Novel-neurotechnologies-short-guide.pdf

Obar, J. A. (2015). Big Data and The Phantom Public : Walter Lippmann and the fallacy of data privacy self-management. *Big Data & Society*, 2(2), 1-19. https://doi.org/10.1177/2053951715608876

Orlikowski, W. J., & Yates, J. A. (2002). It's about time: Temporal structuring in organizations. *Organization Science*, *13*(6), 684–700. https://doi.org/10.1287/orsc.13.6.684.501Owen, R. (2014). The UK Engineering and Physical Sciences Research Council's commitment to a framework for responsible innovation. *Journal of Responsible Innovation*, 1(1), 113–117. https://doi.org/10.1080/23299460.2014.882065

Owen, R., Macnaghten, P., & Stilgoe, J. (2012). Responsible research and innovation: From science in society to science for society, with society. *Science and Public Policy*, *39*(6), 751–760. https://doi.org/https://doi.org/10.1093/scipol/scs093

Pallett, H., & Chilvers, J. (2015). Organizations in the making: Learning and intervening at the science-policy interface Organisations in this highly active and contested sphere have become interesting to. *Progress in Human Geography*, *39*(2), 146–166.

Pallett, H., & Chilvers, J. (2013). A decade of learning about publics, participation, and climate change: institutionalising reflexivity? *Environment and Planning A, 45,* 1162-1183.

Pansera, M., & Owen, R. (2018). Report from National Case Study: United Kingdom. Retrieved from https://www.rri-practice.eu/wp-content/uploads/2019/06/RRI-Practice_National_Case_Study_Report_UNITED-KINGDOM.pdf

Pellé, S. (2016). Process, outcomes, virtues: the normative strategies of responsible research and innovation and the challenge of moral pluralism. *Journal of Responsible Innovation*, *3*(3), 233–254. https://doi.org/10.1080/23299460.2016.1258945

Pellizzoni, L. (2004). Responsibility and Environmental Governance. *Environmental Politics*, *13*(3), 541–565.

Pidgeon, N., Harthorn, B. H., Satterfield, T., & Demski, C. (2017). Cross-national comparative communication and deliberation about the risks of nanotechnologies. In *The Oxford Handbook of the Science of Science Communication* (pp. 147–155). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780190497620.013.16

Psathas, G. (1980). Approaches to the study of the world of everyday life. *Human Studies*, *3*(1), 3–17. https://doi.org/10.1007/BF02331797

Radatz, A., Reinsborough, M., Fisher, E., Corley, E., & Guston, D. (2019). An assessment of engaged social science research in nanoscale science and engineering communities. Science and Public Policy, 0(0), 1–13. https://doi.org/10.1093/scipol/scz034

Raffel, S. & Sandywell, B. (2016). *The Reflexive Initiative: on the Grounds and Prospects of analytical theorizing.* New York: Routledge.

Ryan, G., & Bernard, H. (2003). Techniques to Identify Themes. *Field Methods*, *15*(1), 85–109. https://doi.org/10.1177/1525822X02239569Salles, A., Evers, K., Farisco, M. (2018). Neuroethics and Philosophy in Responsible Research and Innovation: The Case of the Human Brain Project. *Neuroethics, 12*, 201–211. https://doi.org/10.1007/s12152-018-9372-9

Schippers, M. C., West, M. A., & Dawson, J. F. (2015). Team Reflexivity and Innovation: The Moderating Role of Team Context. *Journal of Management, 41*(3), 769-788.

Scott, W. (1987). *Organizations: Rational, natural, and open systems* (2nd ed.). Upper Sadle River, NJ: Prentice Hall.

Smith, Adrian and Stirling, Andy (2007) Moving Outside or Inside? Objectification and Reflexivity in the Governance of Socio-Technical Systems. *Journal of Environmental Policy and Planning* 9(3-4), 351-373.

Stilgoe, J. (2018). Machine learning, social learning and the governance of self-driving cars. *Social Studies of Science*, *48*(1), 25–56. https://doi.org/10.1177/0306312717741687

Stilgoe, J., Lock, S. J., & Wilsdon, J. (2014). Why should we promote public engagement with science? *Public Understanding of Science*, *23*(1), 4–15. https://doi.org/10.1177/0963662513518154

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. *Research Policy*, *42*(9), 1568–1580. https://doi.org/http://dx.doi.org/10.1016/j.respol.2013.05.008

Stirling, A. (2006). Precaution, foresight and sustainability: reflection and reflexivity in the governance of science and technology. In J.-P. Voß, D. Bauknecht, & R. Kemp (Eds.), *Reflexive governance for sustainable development* (pp. 225-272). Cheltenham, Glos, UK; Northampton, MA: Edward Elgar.

Valdivia, W. D., & Guston, D. H. (2015). Responsible innovation: A primer for policymakers. *The Brookings Institute*, (May), 1–20.

Van Oudheusden, M. (2014a). Where are the politics in responsible innovation? European governance, technology assessments, and beyond. *Journal of Responsible Innovation*, *1*(1), 67–86.

https://doi.org/10.1080/23299460.2014.882097

Van Oudheusden, M. (2014b). Technology Analysis & Strategic Management Learning in, through, and about participatory technology assessment: the case of Nanotechnologies for Tomorrow's Society (NanoSoc). *Technology Analysis & Strategic Management*, *26*(7), 825–836. https://doi.org/10.1080/09537325.2014.902436

Von Schomberg, R. (2011). *Towards Responsible Research and Innovation in the Information and Communication Technologies and Security Technologies Fields*. *European Commission-DG Research and Innovation*. 1-218 https://doi.org/10.2139/ssrn.2436399

Von Schomberg, R. (2013). A Vision of Responsible Research and Innovation, in: Owen, R., Bessant, J., Heintz, Maggy (Eds.), *Responsible Innovation. Managing the Responsible Emergence of Science and Innovation in Society* (pp. 51–74). John Wiley & Sons, Ltd.

Voß, J.-P., Bauknecht, D. & R. Kemp. (2006). *Reflexive governance for sustainable development.* Cheltenham: Elgar.

Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. (2005, July). Organizing and the process of sensemaking. *Organization Science*, 16(4) 409-421 https://doi.org/10.1287/orsc.1050.0133

Wynne, B. (1993). Public uptake of science: A case for institutional reflexivity. *Public Understanding of Science*, *2*(4), 321–337. https://doi.org/10.1088/0963-6625/2/4/003

Wynne, B. (2006). Public engagement as a means of restoring public trust in science - Hitting the notes, but missing the music? In *Community Genetics* 9, 211–220. https://doi.org/10.1159/000092659

Wynne, B. (2014). Further disorientation in the hall of mirrors. *Public Understanding of Science*, *23*(1), 60–70. https://doi.org/10.1177/0963662513505397