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Upstream Public Engagement in Nanotechnology

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Article

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Abstract

Upstream public engagement with new science and technology is considered important but challenging. This article shows how engagement events are embedded in broader institutional and cultural contexts. By studying two different cases of upstream engagement in nanotechnology, we demonstrate how existing institutional responsibilities and cultural repertoires contribute much to the productivity of actual engagement events. Insight into these wider world dynamics will help science communicators (or event organizers) foster reflection and deliberation among relevant actors about whether and how upstream public engagement can have an impact on the governance of new science and technology.

Keywords

upstream public engagement, institutional practices, dialogical governance, responsible research and innovation, nanotechnology, civil society

Introduction

Upstream public engagement in the development of newly emerging science and technology has been on the policy agenda for some time. Whereas much

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policy and scholarly attention has been paid to actual engagement processes (e.g., Fisher & Rip, 2013; Irwin, 2014; O'Doherty & Einsiedel, 2012; Stilgoe, Locke, & Wilsdon, 2014), a new phase may be heralded—at least in Europe, North America, and Australia—in light of new policies that consider public engagement as an integral part of innovation trajectories (see also Fisher et al., 2015). The new European Research and Development framework program *Horizon 2020*, for example, includes public engagement in its approach in order to achieve *Responsible Research and Innovation* (RRI; European Commission, 2015). RRI, referring to a broad policy vision to better align science and society, not only emphasizes public engagement as an integral part of innovation trajectories but also demands that institutions of science and technology become more responsive to societal needs, issues, and concerns and include these issues in decision-making processes.[1] Thus, with new innovation policies such as RRI, the spotlight is also directed toward the broader institutional and cultural context in which public engagement events take place. However, this broader context is not automatically conducive to having civil society actors as new dialogue partners in innovation trajectories (Krabbenborg, 2013c; Stilgoe et al., 2014). What is involved here is a new situation for all actors concerned, and there are no routines or established best practices for actors to fall back on. So this makes it important that we consider how existing institutional and cultural contexts shape the processes and outcomes of actual upstream public engagement events in order to indicate ways forward.

By studying two heterogeneous public engagement events in their broader context, this article will examine the dynamics between what happened on actual dialogue floors and the broader context in which the events were embedded.

We conclude our article by providing suggestions about how science communicators, when organizing upstream public dialogue events concerning newly emerging technologies, can foster reflection and deliberation about the enabling and constraining conditions entailed in having civil society actors as new dialogue partners in innovation trajectories.

The Context of Upstream Public Engagement

Upstream public engagement, in particular when it is part of RRI, refers to a new governance vision in which citizens and civil society organizations (CSOs), right from the early stages of research and development trajectories, engage in dialogue with technology developers, such as scientists and industrialists, about the (tacit) assumptions, meanings, values, and consequences of new science and technology for society (Hanssen, 2009; Rogers-Hayden,

2010). The governance ideal behind upstream public engagement is that civil society should have a say in decision-making processes regarding the further development and embedding of new science and technology trajectories (Rogers-Hayden, 2010; Wilsdon & Willis, 2004). So, ideally, there should be feedback loops between what happens on specific dialogue floors and the spaces where decisions are made. The term *upstream* itself is a metaphor and is used to make a contradistinction with *downstream* public participation, that is, participation during the end phase of research and technological development trajectories, when the important decisions have already been made and products are ready to be introduced to the market.[2]

By now, upstream public engagement is not only a new governance ideal but also a concrete practice that is visible in societies. Especially in the field of nanosciences and nanotechnologies, upstream public engagement has been tried out in a number of countries and in different ways, ranging from 1-day events, in which nanoscientists and citizens meet, for example, CSIRO Nanotechnology Australia (Katz et al., 2009); to Constructive Technology Assessment workshops as part of the Dutch Research and Development consortium NanoNed (Parandian, 2012; Robinson, 2010); to a sequence of events, for example, Nanojury, United Kingdom, in 2005 (Pidgeon & Rogers-Hayden, 2007), the DEEPEN project (Davies, Macnaghten, & Kearnes, 2009; Macnaghten, Davies, & Kearnes, 2010), and Citizens Jury Les Nanos et Nous France (2007); up to fully fledged societal dialogues in France (Doridot, 2010), Germany (Pfersdorf, 2012), and the Netherlands (this article; see also Krabbenborg, 2012).

From the beginning, upstream public engagement events have been studied extensively by science and technology studies scholars and science communication scholars, resulting in a body of literature about this phenomenon, which is descriptive-analytical as well as normative (e.g., Davies, 2009, 2011; Jasanoff, 2004; Lezaun & Soneryd, 2007; Marres, 2007; Nowotny, 2007, 2014; Powell & Colin, 2008; Stilgoe et al., 2014; Stirling, 2008; Wilsdon & Willis, 2004; Wynne, 2001, 2006; Pidgeon and Rogers-Hayden 2005, 2007). A distinction can be made between literature that primarily focuses on the design and orchestration of actual engagement processes (e.g., Te Molder, 2011;Van Oudsheusden & De Zutter, 2012) and that studying public engagement events in a broader cultural, institutional, and political context (e.g., Bickerstaff, 2010; Burgess & Chilvers, 2006; Goven, 2006). With regard to the former, scholars have analyzed events such as focus groups and science cafés, and recommended a better allocation of time and resources (Davies, 2008; Powell & Colin, 2008), better moderation (Dortmans & Swierstra, 2013; Verhoeff & Waarlo, 2011), or broadening the scope of the debate by using scenarios and vignettes (e.g., Boenink, Swierstra, & Stemerding, 2010).

Scholars studying public engagement events in a broader context have pointed out that existing archetypical and deep-rooted cultural narratives influence public responses to nanotechnology (e.g., Felt, Schumann, Schwarz, & Strassnig, 2014; Macnaghten et al., 2010). Others have explored the linkages between national identity building on the specific design of public engagement exercises that are promoted (e.g., Horst & Irwin, 2010; Thorpe & Gregory, 2010). Horst and Irwin (2010) demonstrate how a historical process of national identity building in Denmark influenced the rise of the now famous "Danish consensus conferences." They argue that "consensusing" should not be seen as just an inherent feature of public engagement events but rather be understood as part of Denmark's larger aspirations to build a particular national identity, in which consensus seeking is positioned as a political and ideological goal to strive for.

The impact of public engagement events on decision-making processes is also analyzed (see Burgess & Chilvers, 2006; Emery, Mulder, & Frewer, 2014; Goven, 2006; Ross, 2007; Wynne, 2001). Goven (2006) analyzed large-scale dialogue processes concerning genetic modification in New Zealand. She showed how citizens' concerns that did not fit the hegemonic values of economic growth, commercial incentives, and competiveness were filtered out in official outcomes and reports of the dialogue exercise (Goven, 2006, pp. 587, 588). The work of Wynne (2001) and Ross (2007) on genetic modification demonstrates that while citizens were offered a stage to "hear and be heard" (Ross, 2007, p. 223), their issues and concerns were not taken up in the decision-making processes. Emery et al. (2014) provided some pointers for increasing the *likelihood* of policy impact resulting from public engagement, but they put the onus of responsibility for maximizing this impact on the political institutions, which would need to be clearer on how public engagement affects political processes.

Finally, several scholars showed how existing cultural norms influenced the outcomes of actual upstream public engagement events (e.g., Bickerstaff, Lorenzoni, Jones, & Pidgeon, 2010; Wickson & Wynne, 2012). An interesting example in this respect is provided by Bickerstaff et al. (2010), who show how the cultural norm of the autonomy of science, that is, science as a private affair not in need of any public discussion, appeared to be persistent throughout an upstream public dialogue event organized by the Royal Society in the United Kingdom.

Research Focus

In this article, we will build on the type of analysis provided by the authors cited in the previous section. For two upstream public engagement events in

the Netherlands, we studied how wider political and cultural contexts, in which the actual spaces were embedded, influenced the productiveness of the engagement events. Our aim is not to compare the cases but to gain insight—from different angles—into existing institutional and cultural constraints on having civil society actors serving as new upstream dialogue partners in the development and societal embedding of nanotechnology.

A prerequisite for tracing, and subsequently analyzing, the influence of wider world dynamics on the actual proceedings of upstream engagement events was that we needed to have access to the concrete spaces for interaction, ideally as an observer or otherwise, in retrospect, by interviewing the participants and analyzing the documents produced. In addition, we also needed the opportunity to gain insight into the wider political and cultural contexts in which the spaces for interaction were embedded.

The two cases we chose have a different design, orchestration, and time frame for stimulating upstream public engagement in nanotechnology. As a result, they reflect different dynamics between what happens on actual dialogue floors and in the wider world. Our first case, a 1-day stakeholder meeting in the Netherlands called *From Nano to Now*, sheds light on how the already established institutional roles, mandates, and responsibilities of nanotechnology developers and CSOs set constraints for engaging in early-stage dialogues. Our second case, which involves a longer term, 2-year Dutch national societal dialogue on nanotechnology, shows how the broader context of the Dutch political culture and the availability of a cultural repertoire to discuss and evaluate emerging technologies in society have led to ironies and missed opportunities, despite good intentions and a promising design for the societal dialogue.

Methodology to Study Case 1

The dialogue meeting was commissioned by Dutch organization RIVM (National Institute for Public Health and Environment), in cooperation with the RIKILT (Institute of Food Safety) and the project Nano4Vitality (a funding program, in which scientists and companies in the Netherlands collaborate to develop new products for the food and health industry). The actual organization of the event was delegated to a Dutch consultancy firm specialized in governance issues surrounding new technologies.

An explicit aim of the organizers was to stimulate at least one element of the current ideal for upstream engagement, namely, to create an active two-way interaction between technology developers and CSOs, in order to provide a balanced picture of the opportunities and potential risks of nanotechnology in the food sector. Nanoscientists, industrialists, and CSOs were invited by the consultancy to participate.

The actual proceedings of the 1-day dialogue event were studied by means of observation. Particular attention was paid to whether and how two-way interaction occurred between nanotechnology developers and CSOs: (1) Was there an opportunity for all actors to share their experiences, dilemmas, and issues? (2) Did actors question or probe each other during the meeting? To make sense of our observations, and to trace how the dialogue event was related to the existing roles and responsibilities of scientists, industrialists, and CSOs, we conducted semistructured interviews with three nanotechnology developers and two CSOs within 2 to 4 weeks after the event. Interviews were conducted in person or by phone, and lasted between 30 minutes and 1 hour. The following issues were addressed: (1) motivation to participate in the event, (2) evaluation of the dialogue event, and (3) requirements for engaging in early-stage dialogues. Finally, in order to interpret and verify our empirical findings, we drew on existing sociological literature regarding the socially constructed nature of assessment frames of technology developers and CSOs (e.g., Garud & Ahlstrom, 1997; Rip & Talma, 1998).

Methodology to Study Case 2

Our second case concerns a longer term upstream public engagement event, namely, the Dutch Societal Dialogue on Nanotechnology, which ran between 2009 and 2011. The Societal Dialogue on newly emerging nanotechnology was an attempt by the Dutch government to achieve upstream public engagement by opening up its policy-making process to bottom-up input from stakeholders and interested citizens. The Societal Dialogue was organized as a multilevel constellation. It was part of a broader governmental Action Plan on Nanotechnology (macro-level), and was shaped and organized by an independent committee (meso-level). The committee itself was not a partner in the interactions (except for a few ad hoc meetings) but enabled a variety of local spaces for interaction by funding proposals for the organization of various activities in society, where stakeholders and citizens could learn about technology and share their views, values, and dilemmas related to nanotechnology and its societal and ethical aspects (microlevel; CieMDN, 2009).

To learn about how wider world dynamics influenced the productivity of the whole dialogue, that is, the sum of the interactions and outcomes of the individual projects, we paid particular attention to the actions and considerations of the Dutch government and the committee. To gain insight into the activities and considerations of the Dutch government (macro level), we held an interview with a policy maker who was involved in organizing the Societal Dialogue, as well as with a policy maker who monitored the Societal Dialogue. In addition, we analyzed Dutch policy documents on the governance

of nanotechnology (produced between 2006 and 2011, thus prior to the event as well as after). For this analysis, we examined the rationales for the establishment of the Dutch Societal Dialogue as well as the question of how insights produced within the Dutch Societal Dialogue were inculcated in official policy considerations. One of the authors obtained permission to observe four internal committee meetings (meso level). Observation of four public meetings organized by the committee and document analysis of publicly available progress reports (see www.nanopodium.nl) together provided insight into how the committee exercised its mandate, negotiated what was at stake and what should be done, and how it aggregated results from the individual projects in its midterm and final reports. These four meetings included the public opening ceremony of the Dutch Societal Dialogue in 2009 in The Hague (CieMDN, 2009), the public closing event of the Societal Dialogue at the Science Center Nemo in 2011 (CieMDN, 2011), and two meetings organized by the committee for project leaders to meet one another and hear more about the different projects.

Moreover, we were ourselves project leaders and had to complete bimonthly progress reports, which allowed us a participant's insight into what the committee found important and how it wanted to operationalize its mandate for organizing a societal dialogue on "pressing ethical and societal issues" (Ministerial Decree on Implementation, 2009). To gain insight into deliberation processes that occurred in the actual spaces for interaction that were set up (micro level) and to analyze whether and how broader ethical and societal issues were articulated, we studied the projects funded. This was done by examining the reports of the respective project leaders, as well as by examining public relations material, websites, and video recordings of debates (available at www.nanopodium.nl). One of the authors was also present as a participant-observer in a number of activities organized by different project leaders. When we discuss the Societal Dialogue in more detail, we will also specify the methodological approach that we took to study the individual projects. However, it should be noted that our purpose was not to evaluate all the individual dialogue projects of the Dutch Societal Dialogue in detail, as our focus was on the influence of wider world dynamics.

All the quotes from the interviews were authorized by the interviewees. Their translation and interpretation are ours.

Findings Case 1: Dialogue Meeting: *From Nano to Now*

During the 1-day dialogue meeting *From Nano to Now*, about 75 stakeholders were present, ranging from participants from industry and science to government organizations, CSOs, and the media. Although the intention of the

organizers was to create a dialogue, which implies at least a two-way exchange between technology developers and civil society actors (Davies, 2011), what we found in practice was that little two-way exchange occurred between the participants. To some extent, this had to do with the way the meeting was orchestrated. The greater part of the event was characterized by a top-down structure, which stimulated one-way communication (transmission) instead of dialogue. The organizers, for example, initiated a "parliamentary debate" in which participants had to choose "for" or "against" certain issues. The issues for debate were defined beforehand by the organizers. Moreover, the invited speakers (four in total, three nanotech developers and one Member of the European Parliament) were each given 15 minutes to talk. Afterward, 2 minutes were allotted for the audience to ask questions for clarification. Due to this format, no window on the world of the audience, that is, on their worldviews, values, and experiences, was opened up. Nevertheless, there were also opportunities to exchange viewpoints and to explore the possible risks and benefits of nano and food in four parallel workshops. However, as we observed, in practice participants rarely responded to each other's visions and positions and did not question each other. Technology developers as well as CSOs were primarily sending their messages. Representatives from science and industry stressed the opportunities and promises of nanotechnology, and CSOs emphasized possible risks for human health and environment. These considerations on the part of CSOs were then downplayed by technology developers as unfounded and not deserving of serious attention or any further questioning. This is illustrated by the following quotes (translation by the authors):

> Why are we worrying about nano anyway? What kind of risks are out there? There are so many risks in life. . . . Our companies are very transparent. You will receive the data requested within the hour. (Industry representative)

> We have been eating nano-particles already for thousands of years. All fluids are on a nano scale. Does that all of a sudden make it nanotech; is that suddenly dangerous? (Dijkgraaf, 2008)

An environmental CSO asked what the risks were for the unborn child. There was some buzz in the room, and the question was not really addressed. During the break, a university scientist mentioned to one of the authors that the spokesperson for the environmental organization asked that question time and again. And he volunteered,

> CSOs often just want to hear arguments to support their own points of view, whereas, on the contrary, there is a need for an open dialogue, listening to each other.

Wider World Dynamics: Stereotypical Roles and Repertoires

Clearly, the format of the event could be improved on in order to stimulate an exchange between the participants, for example, through a better allocation of time and making sure that windows on the world of the audience were also opened up (e.g., Davies, 2011 on staging). However, we also saw that even when the participants had time and space to question each other and mutually explore risks and benefits, as in the workshops, this did not happen. Since the participants were the same, there is clearly more at stake than orchestrating the "micro-level" event itself. During the follow-up interviews, it emerged that the lack of two-way interaction is related to a more structural problem, namely, the fact that the roles and responsibilities of scientists, industrialists, and CSOs are currently not conducive for engaging in early-stage dialogues.

According to the two environmental organizations we interviewed, asking questions about the possible risks for human health and the environment is a necessary strategy, because government agencies do not come up with proper risk regulation (Mens, 2008). Therefore, CSOs see it as their responsibility to call for more regulation and precaution. This illustrates the traditional mode of operation of CSOs, namely, to lobby governments and/or take direct action to warn and inform the general public about possible risks and hazards. Engaging in early-stage dialogues, or sharing responsibility for the outcomes of negotiation and the decision-making process on emerging technologies, is a new and challenging situation for them, which might lead to tensions in their organizations, including the fear of cooptation by other types of actors, such as companies.

According to a nano-industrialist (personal communication, March 27, 2009), interactions with CSOs are possible only when products are entering the market. He stated,

> CSOs in general are badly informed about nano-particles in products. They have to educate themselves sufficiently and have to understand why these nano-particles are used. Not because it is fun, but because they have a function.

Comparably, a nanoscientist from the University of Groningen articulated in one of our interviews, "It is difficult to interact with CSOs because these guys lack sufficient scientific knowledge to judge new developments properly. They are against nanotechnology beforehand without knowing what they are talking about." This scientist did not participate in the dialogue meeting but is a leading researcher in nanoscience and is regularly invited to participate in public engagement initiatives, such as in our second case study, the Dutch Societal Dialogue.

These quotes illustrate a common sentiment among scientists and industrialists, namely, that CSOs lack adequate knowledge to make proper judgments about new technologies and that CSOs first have to educate themselves before one can engage in dialogue with them (as in the deficit model of communication; see, e.g., Hanssen, 2009; Ross, 2007; Wynne, 2001).

The nano-industrialist cited above continued,

> We know that CSOs want to interact in an earlier stage of the development. But they have to be aware that this is really difficult for us, because, in practice, the discussion can only start when the products enter the market. To enter early-stage debates is difficult because of the competitiveness of the market. Industrialists can only be transparent about their products after a commercial launch. The investments have to pay back, you see.

In a similar vein, a nanoscientist (in personal communication) declared that interactions with CSOs are only possible during the implementation phase of nanotechnology, because

> otherwise it would be a hindrance to the natural urge of scientists to learn. When a dialogue is about the development of the technology itself, you get a repetition of what you saw with GM [genetic modification] and embryonic stem cell research in the USA: it will be stopped.

As we could see in this case, the way nanotechnology developers and CSOs positioned themselves during the dialogue event and the mandates and responsibilities they articulated do not fit well with the current call from the policy-making world to create upstream public engagement. Early-stage dialogues with CSOs are seen by nanoscientists and nano-industrialists as a hindrance to doing "good science" and for "being competitive" in the market.

How technology developers and CSOs articulate their (partly self-ascribed) role and responsibility is part of a strong division of labor between technology developers and CSOs that is established within our current (Western) society, as described in, for example, Garud and Ahlstrom (1997), Deuten, Rip and Jelsma (1997) and Rip and Shelley-Egan (2010). At least in Western countries, there is a distribution of responsibilities, mandates, roles, and actions visible among institutions like science, industry, CSOs, and government agencies in relation to the development and embedding of newly emerging technologies. Scientists have a mandate to enact a new science because of their purported responsibility to work toward progress and knowledge production. Industrial actors have a mandate to enact new technologies in order to create new market opportunities, and generate profit and create commercial success. There is also the position of comparative selectors who

evaluate, sponsor, or regulate the new technology without directly engaging in the development. These are, for example, particular government and funding agencies, as well as CSOs, such as environmental groups, patient organizations, and consumer groups. Comparative selectors can play a role because, when confronted with promises and novelties, they are, in principle, in a position to compare and select between different options up to the point of not stimulating any new science and technology development at all, for example, by not buying particular products or through public protest. Traditionally, the (partly self-defined) mandate of CSOs is to function as a "watchdog" or "voice of civil society" by posing critical questions about claimed promises and by showing alternatives.

What we saw is that these existing mandates and responsibilities shape interactions between technology developers and representatives of civil society. Thus the quotes shown here, from actors that participated at the Dialogue Meeting, are not necessarily the result of individual preferences but illustrate established practices, that is, the set of rules at the collective level with regard to how to conduct "good science," make profit as a company, or behave as a "good" CSO. With regard to the last, the uneasiness of CSOs with engaging in a dialogue—or even the reluctance to do so—is also shown by Marris, Joly, and Rip (2008) in their analysis of an interactive technology assessment exercise between biotechnology developers and civil society actors on genetically modified (GM) vines in the Alsace, France. Nongovernmental organizations (NGOs) decided to participate, but as the exercise evolved, participants linked to NGOs became reluctant to be seen as actively involved with the interactive technology assessment exercise, especially when their contribution was praised by French government ministries as a good example of how NGOs could collaborate with technology developers (Marris et al., 2008; see also Rip, 2012). Another example in this respect is how an international coalition of more than 20 NGOs and trade unions (e.g., Friends of the Earth, Greenpeace, and ETC Group) developed a position paper (Civil Society-Labor Coalition, 2007) to condemn a 3-year partnership between chemical company DuPont and Environmental Defense Fund. This partnership was set up to develop a joint risk framework for engineered nanoparticles. According to the international coalition of NGOs, however, a company and an NGO partnering together should be seen as a "tactic" to forestall wider public involvement in the development and governance of nanotechnology (Krabbenborg, 2013b).

Technology developers, on the other hand, see the new technology as promising as such, and as progress in general. They position themselves as insiders who know much more about the technology and, as they also claim, about its embedding in society (Garud & Ahlstrom, 1997). Actors that articulate hesitations, doubts, or raise questions with regard to the promises are

positioned as shortsighted and irrational and thus not deserving of serious consideration (in line with Wynne, 2001).

So, although we analyzed just one case, our findings reflect a broader pattern that is visible in society. What can be concluded, based on our analysis of this case in its broader context, is that in order to have civil society actors as new dialogue partners in innovation trajectories, it is not sufficient to create just more and better public dialogue events. These events will remain symbolic exercises (cf., Burgess & Chilvers, 2006; Marris et al., 2008) as long as established practices at the level of institutions with regard to conducting "good science" or "being competitive in the market" are not opened up for discussion and do not allow for change. This is part of what Nowotny (2007), Wynne (2007), Powell & Colin (2008), Bickerstaff et al. (2010), Shelley-Egan (2011), and Chilvers (2013) describe as a need for institutional reflexivity, not just individual reflexivity.

Findings Case 2: Dutch Societal Dialogue on Nanotechnology

In order to better understand the particular choices made by the Dutch government in initiating the Societal Dialogue on nanotechnology, we need to take a step back and consider the Dutch history in organizing Societal Dialogues on new technologies. Societal dialogues are ambitious attempts to create larger scale, in-depth, and often longer term interactions among citizens, technology developers, and other stakeholders to inform policy makers. A government organizing this is thus, in principle, expected to do something with the outcomes. In the mid-1980s, the Dutch government organized a longer term societal dialogue on nuclear energy, and another such dialogue on biotechnology and food in the early 2000s (Van Est, Van Eijndhoven, Aarts, & Loeber, 2002). In both cases, the Dutch government underwent criticism. Concerning the debate on nuclear energy, the Dutch government was criticized for not acting on the outcomes (see Hajer & Houterman, 1985). In the case of the societal dialogue on biotechnology and food, the complaint was that the Dutch government was too biased in favor of GM products, and that there was no opportunity to discuss broader ethical and societal aspects in relation to GM, such as the role and value of organic farming (see Hagendijk, 2005; Hanssen, 2009).

As can be read in policy reports on the governance of nanotechnology (Rijksoverheid [Dutch Government], 2006, 2008), in preparing for the Societal Dialogue on Nanotechnology, the Dutch government took this criticism on board and used it as input to do things "differently" and

"better" with nanotechnology. First, the proposal was to approach risk and safety issues (e.g., toxicity of synthetic nanoparticles) and "broader ethical and societal issues" in different ways. To identify risks to human health and the environment, a *Klankbordgroep* (sounding board) with representatives from industry, science, and environmental organizations was established in 2008. The Societal Dialogue, in addition, was supposed to identify and categorize pressing broader ethical and societal issues that had not yet been taken up by other institutions (Rijksoverheid [Dutch Government], 2008).

Second, reflecting on its past experiences and on recent analysis of upstream public engagement activities in the United Kingdom and Germany, the Dutch government emphasized that more should be done than just providing information (as in a deficit model of communication).

Third, as can be read in a ministerial decree on the societal dialogue on nanotechnology, the Dutch government committed itself, to a certain extent, to employing the outcomes of the societal dialogue in their decision-making processes on nanotechnology by stating,

> The opinion of Dutch citizens matters. (. . .) Societal acceptance can only be established when input from citizens is used to shape R&D trajectories and risk evaluations. (Rijksoverheid [Dutch Government], 2006, p. 28, 29)

This commitment can be seen as a response to the criticism they received after the societal dialogue on nuclear energy. At the same time, the Dutch government also stated explicitly that the societal dialogue on nanotechnology would not be the sole source of policy development.

Finally, given the criticism the Dutch government had received earlier of being too biased in favor of GM products during the societal dialogue on GM and food, this time it did not want to play an active role in the societal dialogue itself. Instead, an independent committee was appointed to design and orchestrate the dialogue.

The Committee and Its Work

The mandate of the committee was to develop a strategy that would bring "focus" and "concreteness" to the Societal Dialogue (Ministerial Decree on Implementation, 2009, p. 3). First, the committee had to develop, in cooperation with stakeholders from science, industry, and CSOs, a priority list (called "public agenda") of ethical and societal issues that should be discussed in the Societal Dialogue. This priority list was also to be linked to concrete developments in and applications of nanotechnology.

Then, based on that list, the committee was directed to find ways to engage both stakeholders and citizens, in that order of importance: The main focus should be on stakeholders, though interested citizens should be enabled to participate as well. Furthermore, it was up to the committee to decide on the structure and implementation of the dialogue to ensure this engagement (Ministerial Decree on Implementation, 2009).

As we will show, the committee operationalized its mandate in a potentially promising design, but, as the Societal Dialogue proceeded, the original mandate became sidelined.

To prepare for the Dialogue, the committee conducted a stakeholder meeting, as demanded by the government. This stakeholder meeting was set up to develop the priority list of the main topics, questions, and uncertainties in the field of nanoscience and technology and to discuss what would make fruitful dialogue processes.

Call for Proposals

In the call for proposals, the committee tried to concretize the Societal Dialogue by specifying five themes, for example, particular application areas of nanotechnology, such as "well-being, food, and health care" and "sustainable economic growth." Furthermore, the committee articulated emerging ethical and societal issues, such as "Who or what institution can be held liable in the event of nanotechnology and nanoparticles causing harm to human health?" They did so for all five themes identified by the committee (see call for proposals: CieMDN, 2009, p. 8).

In order to establish a dialogue with citizens, the committee proposed a two-stage approach. The first phase would focus on providing information and raising awareness about nanotechnology, and its associated ethical and societal aspects. This was decided because a baseline measurement conducted by the committee showed that Dutch citizens had a low level of awareness about nanotechnology and its products. In the second phase, a dialogue would be initiated based on insights from Phase 1 (CieMDN, 2009). The call for proposals was announced through mass media advertisements and during the official launch event of the dialogue.

Salient in the call for proposals was the committee's primary focus on the citizen as layperson who needs to become acquainted with nanotechnology, thus there was less focus on stakeholders, as had been the suggestion of the Dutch government. Companies, research institutes, and government agencies were mentioned in the call for proposals, but they were positioned by the committee as actors that could take up the outcomes, not as active dialogue partners (CieMDN, 2009, p. 5).

Developing Selection and Evaluation Criteria

Over time, the two-stage strategy of the committee, that is, first providing information and then stimulating an informed dialogue, shifted toward providing information and awareness building as the main priorities, operationalized as outreach. The Chair of the committee positioned himself as the "process manager" of the Societal Dialogue (Malsch, 2011), letting society decide on the content and formats of dialogue projects, and strongly advocated outreach.

The name chosen for the Dialogue, "Nanopodium" ("Nano-Stage"), reflects this frame.

During committee meetings, there were discussions among the members and the secretariat on how to define and measure the scope of projects, but most of the committee members did not challenge the focus on outreach and knowledge transfer. Some committee members wanted to pursue a more reflexive approach in the Societal Dialogue, and, according to them, the main challenge was to define a meaningful Societal Dialogue. During a discussion among committee members about how to visualize the outreach of the individual projects, one of the committee members stated (translation by the authors),

> The focus on numbers makes me feel uncomfortable. We should be more creative: What do we intend to have by 2011? For me, it should be more than tables and graphs. I do not want to say that it is easy, but I do want to show that a public dialogue cannot be captured in numbers and tables only.

The committee applied this focus on outreach by selecting and monitoring the individual projects. In total, the committee received around 120 proposals. Seventy submitting parties were asked to send in full proposals. In the final stage, 35 projects were selected. The committee had two important selection criteria: the distribution of selected proposals over the five themes and sufficient outreach for each project (CieMDN, 2011). The main feedback that the committee gave to the project leaders who were asked to submit full proposals was to increase outreach and/or find a more balanced approach (i.e., pay attention to both positive and negative aspects; interview, Secretariat, March 2011).

Monitoring of Projects

The secretariat, assisted by committee members, kept in close contact with the projects, and bimonthly progress reports were required. The items to be

addressed in the progress reports indicate what the committee found important and wanted to have implemented. Project leaders had to indicate the outreach of their project (how many people were reached, directly and indirectly), how much media attention they received, and how much publicity they created and by what means. Remarkably, there was no direct question about which "ethical and societal issues" were discussed and in what way. There was a question about "matters relating to content," but this was interpreted in many different ways by the project leaders.

One could say that the committee interpreted the mandate it had—to approach and stimulate stakeholders and interested citizens to conduct dialogue activities—as keeping its distance from the content and focusing on managing the process. As already described in Krabbenborg (2012), in the final evaluation forms of each project, the committee did request that project leaders describe which themes were discussed and in what way. The response was uneven, because it was up to each project leader to determine how much effort he or she was willing to put into this report.[3]

The committee, in turn, used these project descriptions as the main input to write their official reports.

The Projects

A variety of interaction spaces was organized with the aim of providing information and raising awareness on nanotechnology and its ethical and societal aspects (first round of the Societal Dialogue) and, subsequently, in the second round, stimulating an informed dialogue using insights and materials from the projects undertaken in the first round.

The individual projects that were selected were TV programs, the development of educational materials, a special issue of a popular science magazine, science cafés, Internet polls, stakeholder workshops, and the development of vignettes and scenarios about the co-evolution of nanotechnology and morality. For this article, we will not go into detail about the content and orchestration of individual projects, as our focus is on the influence of broader dynamics at the meso- and macro levels. Instead, we will provide a general picture of the type of projects that were conducted.

Tables 1 to 3 provide an overview of the interaction format and the content of the individual projects. To classify the projects, we used the distinction provided by Hanssen (2009) between "communication as transmission" and "communication as transaction," and we followed the distinction made by the committee between projects that were aimed to provide information (communication as transmission) and projects that were aimed to stimulate a dialogue between different actors about meanings, values, and consequences of newly emerging nanotechnology for society (communication as transaction).

Table 1. Projects Focusing on Producing Materials (Thus, Almost by Definition Communication as Transmission).

	Communication as	
Issues addressed	Transmission	Transaction
Risk and cost-benefit discourse	10	3
Broader ethical and social aspects	2	3

Table 2. Projects Aiming to Stimulate Interaction Between Actors Involved in the Development of Nanotechnology and Civil Society Actors.

	Communication as	
Issues addressed	Transmission	Transaction
Risk and cost-benefit discourse	3	
Broader ethical and social aspects	2	3

Table 3. Projects Aiming to Stimulate Interaction Between Citizens.

	Communication as	
Issues addressed	Transmission	Transaction
Risk and cost-benefit discourse	2	1
Broader ethical and social aspects		6

We analyzed how and what kind of information was provided, and whether and how the individual projects offered occasions for nanotechnology developers and civil society actors to assemble in order to engage in a dialogue and share visions, values, and dilemmas in relation to nanotechnology and its ethical and societal aspects. We conducted this analysis on projects that aimed at organizing face-to-face or online interactions, as well as on projects that were aimed at developing materials, for example, films, vignettes (short written narratives), educational materials, and brochures. We studied whether and how the materials paid attention to the visions and dilemmas expressed by technology developers as well as civil society actors.

The differentiation between "broader ethical and societal issues" and "risk issues" that the government wanted to achieve is not straightforward. Making such a distinction sometimes reduces the complexity (e.g., Wickson & Wynne, 2012; Wynne, 2001), as if no ethical questions can be asked about

current risk assessment methods. Nevertheless, in order to classify the projects and to examine which of the topics (risks/benefits, or broader ethical and societal issues) were at the forefront in each of the projects, our practical solution was to follow the way in which the committee and the Dutch government differentiated between these two categories. To broaden our understanding of societal issues that could become topics for discussion, we added criteria mentioned by Swierstra and Te Molder (2012) and Hanssen (2009; Hanssen, Langeslag, Vos, & Walhout, 2011). These authors differentiate between traditional promises and risk discourses, and broader ethical and societal aspects. The former cluster of issues refers to economic benefits, toxicology, labeling, and precautions; the latter cluster includes broader issues such as changing societal values, norms, and relations; boundary shifts between dichotomies as natural-artificial, public-private, and responsible-irresponsible; and the governance of nanotechnology (e.g., a new distribution of roles, responsibilities, and mandates between actors).

The sources used were the project summaries as published on the Nanopodium website and public relations material developed by each project leader. In addition, we used descriptions of the projects by the Rathenau Institute (Hanssen et al., 2011). Our aim was not to reconstruct what happened in detail but to obtain a general picture. Both authors and one colleague each independently assessed which category of communication was used and which type of issue was addressed in each project, and then reached consensus.[4]

As Tables 1 to 3 show, despite the original aim of the Societal Dialogue to create an exchange on "broader ethical and societal aspects," the majority of the projects were designed as communication as transmission from science to society. Risk and safety issues were the main topics for debate. However, there were also projects that did try to inquire, explore, imagine, and discuss broader ethical and societal issues related to nanotechnology. In total, there were 12 projects out of the 35 that were both interactive and focused on broader ethical and societal aspects: 3 of those projects delivered materials, 3 other projects organized interactions between developers and civil society actors, and 6 projects organized interactions between citizens. For example, the Association of Reformational Philosophy produced a special issue of their journal on nanotechnology, in which different stakeholders, such as nanoscientists, philosophers, and a nano-industrialist, articulated their stakes and visions and the dilemmas faced in the study, control, and manipulation of matter at the atomic and molecular scale, and discussed how this may or may not challenge the Creation narrative. A project called "Interreligious Dialogue" used the film *Gattaca* (about genetic enhancement) to stimulate discussion between people with different religious backgrounds on the question of which values or convictions behind the development of nanotechnology can be considered

acceptable or not. The University of Groningen organized a stakeholder debate, in cooperation with the project leaders of "Nanotopia," on the "nano-pill," a lab-on-a-chip for early diagnosis of intestinal cancer (www.utwente.nl/mesaplus/). The focus of the meeting was on how the nano-pill might change current health care practices, and how responsibilities might shift from health care professionals to patients.

Wider World Dynamics: From Individual Projects to Official Reports and Policy Documents

While broader ethical and societal issues and considerations were articulated in the projects (e.g., on good care, and changing roles and responsibilities), almost no such issues were mentioned in the official reports produced by the Committee. In the final report, called "Responsibly Onwards With nanotechnology" (CieMDN, 2011), the main conclusions were, "The knowledge of Dutch citizens increased by ten percent between 2009 and 2010"; "Dutch citizens see opportunities but also risks, especially within the field of nanotechnology and food"; and "Dutch citizens think transparency of information is more important than precaution." The difference in percentage was the result of two surveys conducted by the committee: a baseline measurement and a survey at the end of the Dialogue to evaluate if and how the Societal Dialogue had had any effect on the level of knowledge and attitudes of Dutch consumers (CieMDN, 2011). With regard to nanotechnology and health, the main conclusion was (translation by the authors),

> Citizens see potential, but there should not be many side effects, and it must be safe. (CieMDN, 2011, p. 10)

The final report produced by the committee served as input for the Dutch government to further develop its policy on nanotechnology. In September 2011, the government published a progress report on nanotechnology (Rijksoverheid [Dutch Government], 2011). The progress report contained an explicit response to the work of the committee, but only to isolated items, and otherwise framed the contents in general terms, such as (translation by the authors),

> We endorse the recommendations of the committee, and we find it important that Dutch citizens should be adequately informed about developments in nanotechnology and nanoparticles. (Rijksoverheid [Dutch Government], 2011, p. 8)

Ethical and societal issues and considerations related to nanotechnology are not mentioned explicitly in the government's progress report. One of the

sections in this report is titled "Societal Questions." However, in this section, these questions are related no longer to nanotechnology but to converging technologies in general, and it is stated that in this respect it is too early to anticipate societal issues. One can see this shift as policy learning but also as policy forgetfulness or procrastination. In general, what happens with the outcomes of public engagement once they have entered the policy realm is not well described in the literature (Emery et al., 2014). Moreover, the political context in which governments have to work changes rapidly. So by the time the results of a societal dialogue become available, it might well be that the stakes and priorities of the government have changed.[5] In the midst of the Dutch Societal Dialogue on Nanotechnology, a new government was formed after elections. However, whether and how this affected the proceeding of the Dutch Societal Dialogue is beyond the scope of our research.

It can be concluded that the Societal Dialogue has been successful on its own terms, for instance, in raising awareness and providing information on nanotechnology. But, as we showed, the main aim of the Dutch government when setting up the dialogue was not fully met.

The original aim was to map "broader ethical and societal aspects" by means of societal dialogue. While broader ethical and societal issues were articulated in a number of projects, in evaluating and monitoring the projects, the committee had recourse to a more traditional focus on outreach, media attention, and knowledge increase. Subsequently, the Dutch government did make reference to the Dutch Societal Dialogue in its progress report but not to ethical and societal aspects, in spite of the emphasis placed on these when the government commissioned the Dialogue. In Krabbenborg (2012), this is called "reverse refraction," based on a well-known effect in top-down multilevel configurations called "refraction" (Vickerman, 2007). Whenever objectives developed at the top have to be implemented at the meso- and micro levels, there will be miscommunications, different interpretations, time constraints, and strategic behavior. Thus, "refraction" occurs in the implementation of the objectives. In this case, similar refraction occurred but also in the other direction: While the ethical and societal aspects were articulated at the micro level in the individual projects, these were not given visibility.

How could this happen? To begin with, there were mutual dependencies in this multilevel constellation, which might have contributed to missed opportunities. The committee interpreted its mandate as "building awareness by creating outreach" and "only managing the processes." Furthermore, in order to write their official reports, the committee decided to rely on the input of project leaders. With this choice, the committee made itself dependent on how much time and effort project leaders were willing to put into their progress reports. While the phenomenon of refraction might to a certain extent be

attributed to internal organizational dynamics within the committee, the broader political and cultural context in which the Societal Dialogue took place also played a role. First, the history of the Netherlands with regard to societal dialogues shaped the way the Dutch government acted. Drawing lessons from the GM debate in 2002, the Dutch government interpreted its self-imposed role in the debate on nanotechnology as "not being an actor in the debate" and subsequently took a wait-and-see approach. Staff from the relevant Ministries were present as observers in committee meetings, but they did not interfere with the course the committee took, even when deviations from the thrust of the mandate were noted. Independence of the committee had priority (see also Krabbenborg, 2012). We do not have a simple solution for how to overcome such mutual dependencies in a multilevel constellation. However, given the fact that refraction occurs anyway, one can think of incorporating moments of reflection to consider the questions: Are we still on track? Are we reaching our goals?

Second, what we also saw in this case is the reduction of broader ethical and societal issues into risk and safety issues, and the focus on disseminating knowledge from the world of nanotechnology to civil society. We have seen that the committee initially put forward broader issues in their call for proposals, as articulated in its preparatory interaction with stakeholders from industry, nanoscience, policy, and CSOs. In many projects, though, the focus was on understanding nanotechnology and on risk and safety issues. In addition to the reduction of broader societal issues by project leaders, the committee itself explicitly narrowed its focus. In developing the monitoring and evaluation criteria, and in writing the official reports, the committee moved away from the specific questions and issues originally put forward in the call for proposals, toward more generic questions about nanotechnology. What we saw is that in developing the design and orchestration requirements, the committee tried to stimulate two-way interactions, but in selecting and monitoring the individual projects, its focus was not so much on stimulating inquiry and further articulation of the priority list as on stimulating outreach and awareness raising.

We do not want to claim that the focus on outreach and process management is not relevant or valuable. Especially when the level of awareness is low, as is the case with nanotechnology (and in general with newly emerging science and technology), one has to provide information and understanding of the technology involved: If absent, there is little basis for two-way interactions between science and society. However, if the focus is on inquiry into ethical and societal aspects by stimulating a dialogue (as in the case of the Dutch Societal Dialogue), then the focus on outreach and process management is too limited.

In the case of the Dutch Societal Dialogue, having recourse to communication as transmission and using concepts and frames from evaluations of traditional mass media campaigns certainly had to do with the preferences of the individual committee members, but, as we assess this, having recourse to this as well as the reduction of broader societal issues into risk issues is also stimulated by the fact that a cultural repertoire is available for these items, which actors can fall back on.

The notion of cultural repertoire is already used by Ann Swidler (1986) to point out that culture influences people's actions not by providing ultimate values, toward which people orient their actions, but by providing a repertoire or tool kit of a historically transmitted and publicly available system of symbols, myths, habits, skills, and worldviews. Actors can (strategically) pick items from this tool kit to make sense of particular situations and solve various problems. Inspired by the work of Swidler (1986), Rip and Talma (1998), and Swierstra and Rip (2007) showed that there is, at least in Western societies, an entrenched cultural repertoire available to discuss and manage emerging technologies. Such a repertoire enables and constrains how emerging technologies like nanotechnology can become a topic for deliberation between different stakeholders. Risk and privacy issues related to emerging technologies can be discussed relatively easily, because there are examples from earlier technologies that can be mobilized by participants in public engagement events. Moreover, there are professional institutions that have mandates and responsibilities to study toxicity of chemicals, including nanoparticles, and/or to monitor and inform citizens about health risks and environmental damage. In turn, in concrete dialogue events, participants can use the reports produced by these institutions as topic for discussion.

The same holds for communication as transmission, as this is the "traditional" way of science-society interaction. Concepts and methodologies to shape communication as transmission are already available, and people have experience with it, so recourse to it may occur easily. The Chair of the committee, for instance, had long experience as director of a Dutch research council, in which science communication as transmission is much more common than interactive forms of science communication. For items related to upstream public engagement, like evaluating a dialogue and inquiry into broader ethical and societal aspects, there is much less of a tool kit available for actors to pick items from, since upstream public engagement is a relatively new phenomenon. Moreover, if we look at upstream public engagement events organized in other countries, such as New Zealand (e.g., Genus & Rogers-Hayden, 2005; Goven, 2006) and the United Kingdom (e.g., Bickerstaff et al., 2010; Doubleday, 2007; Pidgeon & Rogers-Hayden, 2007), we see a pattern similar to what happened in the Netherlands with the Societal Dialogue. For a

Nanojury exercise in the United Kingdom, for instance, Rogers-Hayden and Pidgeon (2006), and Pidgeon and Rogers-Hayden (2007), who were present as observers, found that in the final recommendations broader societal issues were reduced to the promises and risks of manufactured nanoparticles only. This indicates that having recourse to communication as transmission, as well as the reduction of broader societal issues into risk issues, is not just a contingent phenomenon but is related to more general difficulties when emerging technology is the topic for a societal debate.

Conclusion and Discussion

By studying how two upstream public engagement initiatives in the Netherlands were embedded in broader institutional and cultural contexts, we learned that already established practices, roles, cultural ideologies, and available repertoires contribute much to the (lack of) productiveness of upstream public engagement events.

In the first case, the dialogue meeting *From Nano to Now*, we saw that existing roles and responsibilities of technology developers and CSOs do not match well with new governance ideals of early-stage dialogues. In the second case, the longer term Dutch Societal Dialogue on nanotechnology, we saw that the organizing committee fell back on the cultural repertoire that is available in society to steer and evaluate newly emerging technologies. This led to ironies and missed opportunities in a dialogue aimed at discovering broader societal and ethical aspects of nanotechnologies to take into consideration when making new policies. We saw that these broader societal and ethical aspects remained underexposed by having recourse to the prevailing risk-benefit discourse. Those ethical and societal aspects that did emerge were not reported in official reports because of a focus on traditional outreach scores.

Based on our cases, we conclude that upstream public events should thus be seen not as an occasion of what Rip and Joly (2004) call open-ended fluidity, in the sense of "everything is possible," but—as they state—as a process, in which certain actions and forms of interactions are more easy to perform than others. In order to have upstream public engagement events as an integral part of innovation trajectories, as is now promoted by the new European Union research and innovation governance concept of RRI, one must not just focus on organizing more and better individual engagement events but also consider how the social and political context, in which the events take place, shapes the process and outcomes, and vice versa.

How can science communicators, when responsible for organizing upstream public engagement events, gain insight into these wider world dynamics and eventually address these?

First, while established rules and practices are not easy to change, they are not static and do not determine everything (Shelley-Egan, 2011). They evolve and can be adapted to new and changing circumstances. Actually, when organizing or moderating concrete upstream engagement events, science communicators can facilitate the space for interaction so that it becomes a platform for technology developers and civil society actors to reflect on and even experiment with possible new roles, responsibilities, and collaborations. One implication for science communicators then is that they have to know what is at stake for the actors involved. For example, they must have insight into how new governance ideals such as RRI might change existing institutional practices. A science communicator can become acquainted with existing institutional practices by moving in and around the different "worlds" actors are working in (e.g., laboratories, companies, and government agencies) and can observe, ask questions, and study what is happening (Krabbenborg, 2013a; Robinson, 2010). Based on this empirical fieldwork, the science communicator can develop a diagnosis of what is or might be at stake. This diagnosis can then become a starting point for discussion and reflection in the concrete upstream dialogue event. The effectiveness of this type of moderation and organization of interaction events between technology developers and civil society actors has already been proven in a number of Constructive Technology Assessment exercises (e.g., Parandian, 2012; Robinson, 2010).

Science communicators can thus play a role in making wider world dynamics visible, and turn these into topics for conversation and reflection (see also Macnaghten, Kearnes and Wynne, 2005).

We recognize that the activities we attribute to science communication professionals may require additional skills or external support. Our point is that science communicators, exactly because of their intermediary position at the science-policy-society interface (cf. Chilvers, 2013), can do more than "just" organizing a public engagement event. Indeed, citing Chilvers (2013), science communicators can play a role in making "governance actors and institutions responsive, responsible, and accountable to public values, social implications, and uncertainties of science and technology *and* of public participation itself" (Chilvers, 2013, p. 305).

However, other types of actors also play a role in this respect. Government agencies, for instance, can do more than just provide resources to organize concrete events. They can actively push for new roles and responsibilities, which then create affordances for technology developers as well as civil society actors to actually consider these new roles and responsibilities and experiment with them. In fact, creating such affordances is currently also happening. The European Commission, through the Directorate-General for Research

and Innovation (Commission of the European Communities, 2008), has been actively pushing for new responsibilities, for example, with its proposed Code of Conduct for Nanoscience and Nanotechnologies Research and the new policy discourse on RRI. RRI is now a crosscutting theme throughout the research and innovation framework Horizon 2020 (European Commission, 2015). In the health care context, funding agencies such as ZonMw in the Netherlands and the National Institutes of Health in the United States now actively push researchers and clinicians to involve end users (i.e., patients and patient organizations) as new dialogue partners in decision-making processes with regard to translating fundamental research into the development of new drugs, treatments, or methods of prevention (e.g., a call for translational research; Maienschein, Sunderland, Ankeny, & Robert, 2008).

From these additional considerations, we derive a second implication for science communicators. In advancing upstream engagement it makes sense—prior to organizing an event—to actively search for such openings at the level of institutions. An example of this is to ask actors who have mandates to set changes in motion, like directors of universities and firms, whether and how dialogic governance of new technologies with civil society actors as new dialogue partner could fit their (corporate) strategy. The opinions and possible presumptions obtained can then be taken up as input for further reflection and discussion in the concrete spaces for interaction.

Furthermore, another important element for the field of science communication is to develop and apply suitable evaluation criteria. Instead of focusing solely on outreach in public dialogues, as was done in our second case, more attention should be paid to how and which articulated issues, stakes, and concerns are taken together leading to overall outcomes, and also to make sure that these outcomes become visible and disseminated in the public sphere. In this way, other actors, who did not participate in the actual space for interaction, can consider the outcomes in their decision-making processes.

Thus, for public engagement events to become part of innovation trajectories, the events should be organized with a keen eye for constraints and possibilities in the wider world, while connections between different levels, such as those between engagement events and the policy domain, should be taken into account.

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Notes

1. As Fisher and Rip (2013) and Rip (2014) argue, RRI is still an open proposition. This implies that how RRI will take shape, and what the most productive division of labor between technology developers and civil society actors will be, is something that must be worked out and experimented with. Nevertheless, based on policy (e.g., Von Schomberg, 2012, 2013) and scholarly discussions (e.g., Owen et al. 2013; Stilgoe, Owen, & Macnaghten, 2013), four key issues can already be identified: (1) improved institutional responsiveness toward societal issues, (2) improved anticipatory capacity, (3) inclusive stakeholder deliberation, and (4) improved reflexivity in scientific culture.
2. Actually, as already argued by Fisher, Mahajan, and Mitcham (2006), using the "stream" metaphor has its limitations. The metaphor suggests linearity and that the technology will eventuate, while, as several scholars have demonstrated by now, technology development is rather complex and dynamic with diverse groups of actors pushing and pulling in different directions (e.g., Barben, Fisher, Selin, & Guston, 2007; Marris et al., 2008; Stirling, 2008). Whether and how a technology will eventuate depend on what kind of considerations, decisions, and actions are made by actors with roles and mandates to develop and embed new technology, like scientists, government agencies, and industrialists.
3. That the response was uneven can be seen from the summaries that the Rathenau Institute made of the final reports of the projects (Hanssen et al., 2011). Some give a detailed description of the setup of the project and describe the content of the interactions, and others only mention generalities. We have seen four original final reports; these varied from a few pages to detailed descriptions and excerpts of interaction processes.
4. For one project we could not reach a consensus, so it was not included in the tables. For two other projects, there was too little information available to assess them. One project consisted of two parts and another of three parts, which were assessed as separate projects, bringing the total to 35 projects again.
5. This was, for instance, the case in the 1980s during the societal dialogue on nuclear energy in the Netherlands. There was political unrest, resulting among others in the formation of a new cabinet. As Hajer & Houterman (1985) showed, this new cabinet changed direction, and less value was attached to citizens'

opinions. Instead, in order to decide on how to proceed with nuclear energy, the new cabinet chose to rely on the perspectives and decision-making capacities of politicians and multinationals. So by the time the results of the societal dialogue became available, the new cabinet could set aside citizens' recommendations quite easily.

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