Sci Eng Ethics
DOI 10.1007/s11948-011-9323-x

ORIGINAL PAPER

Engagement Agents in the Making: On the Front Lines of Socio-Technical Integration

Commentary on: "Constructing Productive Engagement: Pre-engagement Tools for Emerging Technologies"

Shannon N. Conley

Received: 6 November 2009 / Accepted: 3 October 2011

Abstract This commentary builds on Haico te Kulve and Arie Rip's (2011) notion of "engagement agents," individuals that must be able to move between multiple dimensions, or "levels" of research, innovation, and policy processes. The commentary compares and contrasts the role of the engagement agent within the Constructive Technology Assessment and integration approaches, and suggests that on-site integration research represents one way to transform both social and natural scientists into competent and informed "engagement agents," a new generation of researchers that possess the knowledge and capacities to forge "novel linkages" between the oftentimes disparate terrains of science, politics, and policy.

Keywords Engagement · Integration · Genetics · Constructive technology assessment

Haico te Kulve and Arie Rip (2011) discuss the importance of what they term "engagement agents," that is, actors who can move fluidly among the discourses and terrains of scientific, industrial, and political activity. As advances in science and technology continue to outpace regulatory and policy efforts, there is a growing need for individuals who possess interactional scientific competence and who can also navigate political, governmental, and industrial terrains. Such individuals to some degree already operate within industry itself and thus have become the focus of engagement exercises. The authors also acknowledge their own role as engagement agents when facilitating these exercises. Thus, engagement agents are appropriately the focus of several important questions: Who are these agents,

S. N. Conley (✉)
Center for Nanotechnology in Society, Arizona State University, Interdisciplinary B Room 366, 1120 S Cady Mall, Tempe, AZ 85287-5603, USA
e-mail: snconley@asu.edu

Published online: 09 November 2011

how do they acquire their knowledge and experience, and, as Jasanoff (2011) saliently highlights, to what ends and for what reasons are they engaging? Engagement agents should understand the roles they play, potentially and actually, in helping to develop not only their own capacity—but also the capacities of those with whom they interact—to integrate engagement results into established cultural and institutional practices.

While the term "integration" can refer to the objectives of product creation management, as in the case of "'integration' in relevant industries and markets" (te Kulve and Rip 2011), the term can also be used in contrast to "engagement." For instance, "integration" can signify a move beyond externally orchestrated and temporary engagement forums—which can be both necessary and productive—into more sustained and ongoing collaborative partnerships, for instance between social scientists and natural scientists—which can play a different, albeit complementary, role. According to this understanding, integration activities seek to provide a venue for feeding the kinds of societal considerations that arise during engagement activities back into the research and development (R&D) process itself—an idea that can be traced back to Rip's work with Schot (1997) that has been empirically developed in the Socio-Technical Integration Research (STIR) project (Schuurbiers 2011).

Integration work thus attempts to expand the considerations that scientists take into account while in the R&D phase, and integration research attempts to understand the conditions for such work. Currently, integration activities center around social scientist/natural scientist collaborations, with Fisher's (2007) laboratory engagement study serving as a principal example. This understanding of integration also features as one component of "anticipatory governance," a recent conceptual paradigm that emphasizes a prospective approach to building broad-based, multi-level societal capacities for governing new and emerging technologies (Barben et al. 2008; Guston 2008). In this respect, integration is similar to the Constructive Technology Assessment (CTA) objective of "broadening decision and policy making processes" (te Kulve and Rip 2011) except that integration activities are embedded within those very decision processes themselves—whether they take place at the research bench or elsewhere.

Te Kulve and Rip emphasize, through their analysis of the multi-level dynamics associated with nano food packaging, that effective engagement activities must take into account the perspectives of actors from multiple domains, and that these domains ought to be treated as having the ability to act simultaneously on one another. This emphasis on the importance of multi-level engagement gives rise to a key question: Who are the individuals who are capable of such multi-level dynamic engagement? Te Kulve and Rip call these individuals "engagement agents" and suggest they must be able to move between multiple dimensions, or "levels" of research, innovation, and policy processes. Although te Kulve and Rip discuss the role of engagement actors at length in their paper, at the end suggesting that those who orchestrate and facilitate engagement exercises can themselves become multi-level engagement agents, these agents remain somewhat mysterious. Who are these individuals? Do they have a particular discipline, particular training? Do engagement actors develop "naturally," or do they need to be consciously encouraged?

Currently, basic research is underway into such questions. The idea of engagement agents as individuals who can fluidly move among multiple sites, domains, and levels of R&D, innovation, and policy processes presents a number of parallels to integration activities, like STIR, that are currently taking place at the Center for Nanotechnology in Society at Arizona State University (CNS-ASU) and elsewhere. Given these parallels, it is worthwhile to explore different modes of engagement, such as those undertaken in CTA and STIR, and the different types of engagement agents that these different approaches produce.

The two-step process of pre-engagement and engagement itself involves preparing engagement agents for the engagement process. Engagement in the form of Constructive Technology Assessment focuses on bringing actors together outside of their day-to-day environments in workshop-type formats focusing on scenarios and scenario development (Rip and te Kulve 2008). In the process of pre-engagement, the engagement agent gains a thorough understanding of a particular area of science and technology and of potential socio-technical future trajectories associated with this area, prior to the actual engagement. They seek what appears to be a level of technical understanding that is akin to Harry Collins and Robert Evans' interactional expertise—the ability to dialogue competently with natural scientists, engineers and technicians about their work (Collins and Evans 2002). They also use the scenarios to represent and reflect back their sociologically informed understanding of the structures and dynamics at work within the given area (cf. Rip and te Kulve 2008). The focus is on dialogue, not practical experiential knowledge, so this type of pre-engagement does not necessarily require engagement agents to immerse themselves in laboratory life or to understand the hands-on practical aspects of a particular scientific enterprise. The interactional expertise gained in pre-engagement differs from contributory expertise (Collins and Evans 2002), i.e., "the ability to contribute to the science" (Collins et al. 2006, p. 658), whether the contribution is to experimentation at the laboratory bench, or to theoretical discussions.

The STIR approach provides another venue for cultivating and exploring the role of engagement actors within the R&D process itself (http://cns.asu.edu/stir/). STIR, in contrast to CTA which focuses on bringing actors out of their R&D work settings into a workshop setting, identifies R&D work settings, such as the laboratory, as important and overlooked sites for "incorporat[ing] societal concerns into the practice of science" (Schuurbiers and Fisher 2009). Often, the laboratory is left out of conversations of modulating scientific practice to be more socially robust and reflexive, with the "upstream" (e.g., research priority setting) and the "downstream" (e.g., regulation and use) aspects of R&D and innovation processes serving as the primary foci of interest. Ironically, the laboratory can be unexamined as a site for reflexivity and modulation (Fisher et al. 2006). As opposed to the upstream and downstream focus, STIR investigators focus on the "midstream" of the R&D policy process—including the dynamics and capacities for change within the boundaries and limits of the laboratory. These "integration scholars" seek to understand, through collaborative partnerships with laboratories in Asia, North America, and Europe, the capacities for reflexive modulation within midstream systems as found within a variety of political cultures.

In order to understand these capacities, integration scholars, several of whom see themselves as "embedded humanists," engage scientific researchers in the day-to-day context of the laboratory, both in ongoing casual encounters and also in semi-structured weekly interviews and exercises that focus on researchers' decisions and on how material, social, and political practices might be broadened and productively re-shaped (e.g., see Schuurbiers 2011). These laboratory engagements are ongoing and intensive, and typically last for a three-month period. During this time, as the STIR investigator and scientific researchers interface on a regular basis, each becomes more familiar with the other's worldview and perspectives, and embedded within each other's day-to-day tasks.

Integration, in the STIR context, does not formalize its pre-engagement in the same way as the CTA activities described by te Kulve and Rip. While STIR researchers, too, bring a wealth of knowledge gleaned from their diverse social scientific and humanistic backgrounds (Fisher and Miller 2009), their preparation includes building interactive and reflexive skills as well as mapping the local and national public policy discourses that contextualize the lab work. While some choose to take scientific courses in order to prepare for their laboratory experience, others do not. Thus, other than reviewing laboratory publications and websites, STIR researchers can feel like *tabula rasas* who gain their understanding of the scientific language, research, and day-to-day laboratory practicalities by virtue of their embedded nature within the laboratory, and within which they "find themselves."

The STIR program emphasizes "hands-on" interactions as an important and necessary step in developing interactionally competent "integration agents," who can both understand and participate in the linking together of upstream, midstream, and downstream R&D policy process stages.

Throughout the engagement and integration process, the social and natural scientist collaborators progress towards what could be called interactional knowledge, competence, or even as Collins and Evans (2006) term it, "interactional expertise." The collaborators sometimes surprise each other (and themselves) in the knowledge and interest they gain in the other's domain of practice. Moreover, STIR presents an additional possibility, too: the potential for the engagement agent to progress towards what Collins and Evans term "contributory expertise"—the ability to engage in the practice of lab science, to sit side-by-side with scientific actors at the bench, to discuss questions of public value while simultaneously engaging in hands-on research activities. Such embeddedness provides the STIR engagement agents with access to multiple world views. While they can dialogue with scientists in their own language, and gain an embodied understanding of scientific practices that would be difficult to obtain outside of an embedded context, they also are able to observe and document some of the transformational effects of the interactions that occur in both subtle and, sometimes, dramatic ways over time.

I experienced the embedded form of engagement through my own participation in STIR, during my time embedded in a Canadian reproductive genetics laboratory. In one case, after a laboratory member and I shared impromptu exchanges on the topic of "responsible innovation" for scientific practitioners, we began exchanging articles that each thought the other would find interesting. For instance, following a

conversation regarding the limits and boundaries of responsible scientific practice, my collaborator dug through some old papers for a Bill Joy piece that had a particularly strong impact on her thinking about science and boundaries. When she finally found it, she placed it at my workspace with a post-it note saying, "Shannon, I found that article!" Not satisfied to wait for me to find it on my desk, she made sure to tell me the moment I walked into the laboratory. Due to her enthusiasm and willingness to dialogue with me on the topic, I provided her with a selection of articles on integration and anticipatory governance, which in turn led to a discussion of how these ideas could help inform and illuminate aspects of the article she had supplied, as well as more context-specific issues that we had encountered in our "benchside" conversations.

The above vignette is typical of the kinds of mutually pursued and sustained interactions that other STIR researchers have encountered. While it did not lead to any immediate changes in research practice, I choose to relate it because it arose out of my participation in established laboratory routines, which in turn led to a dialogue within my own "domain." Collaboration, however, cannot be a one-way street. Just as my natural science collaborators express interest (and sometimes confusion) in my work, I have expressed an interest in their work, and have consequently gained interactional competence in the process. At one point, when, in a casual venue outside of the lab, I signaled my intention to audit a molecular genetics course in order to deepen my understanding of some of the laboratory's experiments, I was confronted by a member of the lab who had learned of my expressed interest. "Why would you want to do that?" he demanded. After I explained my motives, another lab member accompanying us asked if I had "done a PCR" (polymerase chain reaction), a technique that is commonly used to amplify regions of DNA. When I responded that I had not, my collaborators immediately suggested that I try my hand at one. Within a matter of days, donning a lab coat and rubber gloves, and armed with a pipette, I was doing my own PCR, no longer "benchside," but at the bench itself.

As a result of studying the laboratory and its practices from multiple viewpoints and perspectives, including an embedded one, I have gained both experiential and formal knowledge, observed the effects of my interactions on laboratory practices and policies, and I have come to appreciate the ways in which lab scientists are themselves embedded within a much broader network of actors and institutions. As we progressed together in our expanding awareness of the social contexts in which we found ourselves embedded—me in the laboratory, the scientists in a public policy context—I feel my collaborators and I rediscovered our social relations, our political identities, and even the manner in which we went about our research. A notion such as "expertise" may help create a stable professional identity, but it also can contribute to the barriers to broader dialogue and social learning that integration engagements try to blur.

This brief commentary has focused on the importance of cultivating engagement agents in different contexts. Different contexts and approaches can potentially produce different kinds of engagement agents and different outcomes. Within the CTA context, a certain kind of engagement agent is cultivated—an individual fluent in the language, sociology and visions of science, but not necessarily the embedded

practices of it. The CTA engagement agent must be able to bring actors outside of the laboratory to engage with each other, explore scenarios, and through that process, hopefully instill within scientific actors reflexivity that they will take back to their R&D work contexts. STIR brings the engagement agent to the R&D work context itself. The STIR approach gives rise to another kind of engagement agent and another kind of outcome. The engagement agent in the STIR context acquires both technical knowledge and also cultural knowledge through immersion. Because of the intensive, embedded nature of the STIR experience, the STIR engagement agent can experience the laboratory from the perspective of a laboratory member. A political scientist garbed in a lab coat, mixing ethedium bromide agarose gel, learning first hand about the carcinogenic properties of ethidium bromide and how to dispose of it properly, would only be possible in the kind of hands-on collaboration-intensive context that STIR provides. This is not to say that all social scientists need to physically engage in day-to-day material practices, but it does suggest at least the following practical outcomes.

The direct experience with laboratory practices afforded by sustained integration work can develop into a type of competence that allows engagement agents to follow, critique, and contribute to social and material practices on multiple activity levels, to the extent that the engagement agents themselves can potentially interact on a contributory basis. This competence, born from first-hand experience and situated dialogue, can provide insights into which material variables and strategic considerations may be modified, under what conditions, and at what costs, as alignments (especially those entailing broader social, political and ethical concerns) are sought. Additionally, such ongoing and embedded interactions with outsiders (i.e. the engagement agent) who possess or are in the process of acquiring this kind of competency can expose natural science practitioners—who themselves may not already be "dedicated alignment actors"—to the ways in which levels are already linked and to opportunities that already exist for them to integrate broader considerations into their work. On-site integration research represents one way to transform both social and natural scientists into competent and informed "engagement agents," a new generation of researchers that possess the knowledge and capacities to forge "novel linkages" between the oftentimes disparate terrains of science, politics, and policy.

References

Barben, D., Fisher, E., Selin, C., & Guston, D. H. (2008). Anticipatory governance of nanotechnology: Foresight, engagement, and integration. In E. J. Hackett, O. Amsterdamska, M. Lynch, & J. Wajcman (Eds.), *The handbook of science, technology studies* (Third Edition ed.). Cambridge: MIT Press.

Collins, H., Evans, R., Ribeiro, R., & Hall, M. (2006). Experiments with Interactional Expertise. *Studies in History and Philosophy of Science, 37*, 656–674.

Collins, H. M., & Evans, R. (2002). The third wave of science studies: studies of expertise and experience. *Social Studies of Science, 32*(2), 235–296.

Fisher, E. (2007). Ethnographic invention: Probing the capacity of laboratory decisions. *NanoEthics, 1*(2), 155.

Fisher, E., & Miller, C. A. (2009). Contextualizing the engineering laboratory. In S. H. Christensen, M. Meganck, & B. Delahousse (Eds.), *Engineering in context* (pp. 369–381). Palo Alto, CA: Academica Press.

Fisher, E., Mahajan, R. L., & Mitcham, C. (2006). Midstream modulation of technology: Governance from within. *Bulletin of Science, Technology & Society, 26*(6), 485–496.

Guston, D. H. (2008). Innovation policy: Not just a jumbo shrimp. *Nature, 454*(7207), 940.

Jasanoff, S. (2011). Constitutional moments in governing science and technology. *Science and Engineering Ethics*, *17* (this issue).

Rip, A., & te Kulve, H. (2008). *Constructive Technology Assessment and Socio-Technical Scenarios. The Yearbook of Nanotechnology in Society, Volume 1: Presenting Futures* (pp. 49–70). Berlin: Springer.

Schuurbiers, D. (2011). What happens in the lab does not stay in the lab: applying midstream modulation to enhance critical reflection in the laboratory. *Science and Engineering Ethics*, *17* (this issue).

Schot, J., & Rip, A. (1997). The past and future of constructive technology assessment. *Technological Forecasting and Social Change, 54*(23), 251–268.

Schuurbiers, D., & Fisher, E. (2009). Lab-scale intervention. *EMBO Reports, 10*(5), 424.

STIR: SocioTechnical Integration Research. http://cns.asu.edu/stir/.

Te Kulve, H., & Rip, A. (2011). Constructing productive engagement: Pre-engagement tools for emerging technologies. *Science and Engineering Ethics*, *17* (this issue).