



# Frictions in the bioeconomy? A case study of policy translations and innovation practices

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## Abstract

Building on a case study of a strategic funding initiative for biotechnology research and innovation, the paper analyses how policy objectives concerning innovation and value creation are responded to within the practices of researchers and governance actors. The paper employs an analytical perspective that centres on the interrelation between policy articulations and actors' daily work practices and provides a novel study of how innovation demands are negotiated and made sense of within the context of three different empirical sites: national policy and science governance, intermediary science governance, and research practices. The paper addresses a problematic 'hopeful' mode of governance in today's policy that is based on the idea of filling innovation deficits in current practices. As an alternative to this mode, the paper argues for the need for a more empathetic and practice-oriented policy discourse on innovation and value creation.

**Key words:** science governance; innovation; innovation practices; biotechnology; science policy

## 1. Introduction

Many European countries are currently finding themselves in a mode of transition. The challenge of climate change is pushing nations to search for ways to minimize their carbon footprint, a growing and ageing global population is raising concerns about limited food resources and increasing health-care demands, and a series of financial crises in recent decades has generated calls for economic reform and diversification. Within this broad context of concerns, the biotechnology research field is often called upon to provide new pathways for economic activity by making sustainable biological resources available for exploitation (Jansen and Gupta 2009; Bud 1989). Thus, biotechnology has become a focal point for investments across Europe, partly driven by expectations of how the field can deliver innovations that answer to societal challenges while at the same time fuelling our economies with new profitable businesses (e.g. European Commission 2002, 2013). In policy, we can find such expectations manifested in concepts that capture desired futures, such as *the bioeconomy* or *knowledge-based economies* (Bugge et al. 2016; Hausknot et al. 2017: 3; McCormick and Kautto 2013). Moreover, following recent policy developments, biotechnology has also caught attention within the context of what is now commonly referred to as third-generation innovation policies or innovation 3.0 frameworks, which focus on the need for policies to facilitate deep societal transformations (e.g. Kuhlmann and Rip 2018; Schot and Steinmueller 2016, 2018; Koch 2019).<sup>1</sup>

However, due to the infrastructures and resources locked into existing sociotechnical configurations, many argue for the need for public interventions to manage the transition towards such desired futures and actively steer research activities towards innovation and value creation objectives

(Weber and Rohrer 2012). This aspect of intervention raises an important issue regarding actors' ability to respond to the push for innovation and value creation in policy. That is, while governments across Europe are turning their heads to the biotechnology field in search of solutions, research funding agencies, universities, research centres, and biotechnology scientists are finding themselves in the spotlight and are expected to deliver on often complex innovation objectives. Accordingly, the aim of this paper is to study how policy objectives concerning innovation and value creation are taken up within the biotechnology research field. I address the following research question: how do actors within science governance and biotechnology research make sense of calls for innovation and value creation, negotiate them, and carve out responses within the context in which they work?

When it comes to studying innovation resulting from academic research, much attention has previously been on commercialization processes, and there is a substantial body of literature focusing on the relation between commercialization processes and knowledge production (e.g. Etzkowitz et al. 2000; Rothaermel et al. 2007; McMillan et al. 2000). A number of studies have explored how academics who are scientists navigate new university–industry relations and demonstrate shifts in the norms and values underlying academic work, as well as in how scientists choose their topics based on their involvement with commercial actors (Cooper 2009; Etzkowitz 1998; Holloway and Herder 2019; Owen-Smith and Powell 2001; Slaughter and Leslie 1997). Moreover, questions derived from observations of new entanglements involving finance and research have been prominent in studies of the biotech sector, such as those by Cooper (2008), Rajan (2006) and Birch (2017), who have studied how the

biotechnology industry emerged within the context of neoliberal political regimes. In sum, these studies tell a convincing story about how academic research is now undergoing important changes, pushed by an increased focus on innovation, value creation, and, more specifically, commercialization. Key concerns emerging from this body of work are that notions concerning public and private interests are being conflated to provide justifications for industrial collaboration and that economic framings of value are dominating biotechnology innovation discourses.

In this paper, I argue that there is also a need to develop greater sensitivity towards the flip side of this narrative of change in order to understand fully how new innovation objectives are becoming part of the biotechnology field. This concerns the struggle actors may face when asked to deliver on innovation and value creation, and how persistent work routines, additional demands, or conflicting ideas in and about science and science governance are part of shaping the answers actors are able to give in response to demands to increase their innovation activities. The paper's attention towards frictions offers a new perspective on the *innovation imperative* that dominates much of today's policy discourse and that channels resources towards high-tech solutions such as biotechnology research (Pfothenauer et al. 2019). While policy articulations might appear clear and sensible for actors within a given context, the travel of policy ideas has been shown to be an inherently contingent process, taking unexpected turns that lead to unpredictable outcomes (Freeman 2009; Mukhtarov 2014). Thus, rather than assuming linearity in policy implementation processes, the objective of this paper is to give attention to the situations in which calls for innovation and value creation are acted upon and to show how the circumstances in which actors work can create frictions that in turn change or alter the understanding and enactment of policy objectives (Åm 2019).

I turn to a case study of a recently established funding initiative for biotechnology research in Norway, called the Centre for Digital Life Norway (DLN). DLN represents substantial public investment in the biotechnology field by the Research Council of Norway (RCN), and the aim of DLN is to 'to create economic, societal and environmental value for Norway from biotechnological research and innovation' (The Research Council of Norway 2014: 4). Accordingly, the initiative represents a pertinent case for studying efforts to initiate shifts towards more targeted innovation and value creation activities. In this paper, I use DLN both to study the process of integrating policy objectives into scientific research projects and to demonstrate how the dynamics and interactions between a variety of actors, including governing actors such as the RCN and the DLN administration and biotechnology scientists, are partly responsible for shaping the process. The line of inquiry in the paper is as follows. I start by situating the DLN funding initiative within the broader context of Norwegian biotechnology policies to show how the initiative has emerged from objectives articulated for the field in the national political arena. Thereafter, I follow these objectives as they impinge on the daily workings of the biotechnology research field and analyse how actors within different sites related to DLN, in both science and science governance, have made sense of, negotiated, and responded to them. Thus, the aim of the paper is to link the sense-making and self-interpretation of the actors to the social and material context

in which they are situated and to provide a practice-oriented analysis, which is largely missing from today's innovation policy discussions (Griggs et al. 2014; Åm 2019).

## 2. Situating innovation

In order to study situated responses such as those mentioned in the preceding section, I employ an analytical framework that mainly focuses on the practices of scientists, policy-makers, and research administrators. This represents an alternative conceptualization of science and innovation governance processes compared with traditional system perspectives that have dominated both innovation studies and innovation policies since the 1980s (Godin 2009; Schot and Steinmueller 2018). Generally, such perspectives have been geared towards processes of optimization, trying to develop policy instruments that can help to increase an innovation system's performance by improving interactions and flows of knowledge and resources between institutions and organizations (Crow and Bozeman 1998; Nelson 1993; Lundvall 1992; Lundvall et al. 2002; Freeman 1981; Sharif 2006). However, it is a problem that such system perspectives do not address the complexity of the institutions and organizations that are targeted by the policies. Therefore, in this paper, the analytical focus is shifted from the institutions and organizations to the actors within the sites targeted for change and analyses the work they carry out. In this way, the analysis follows an interpretative and action-oriented approach aimed at studying policy implementation processes 'in the making' by eliciting how actors engage with and act upon policy demands on a daily basis (Latour 1987). This shift towards the actors aligns with interpretative approaches to policy analyses. Such studies highlight the complexity involved in policy-making and in policy implementation processes, how actors construct meaning differently in different contexts, and accordingly, that there is a fundamental uncertainty involved when it comes to the interpretations and effects of policies (Freeman 2009). A key argument is that relations of governance do not act on unfree or passive actors, rather, all acts of governance bring with them a 'diversity of potential reactions' (Griggs et al. 2014: 7).

The approach of this paper gives an opportunity to study actors' responses to policies in relation to the work practices of which they are a part (Felt 2009). The concept of practice is important because it also draws attention to how certain activities and social orders are maintained and reproduced through habits and routinized behaviour that are not necessarily subject to much reflection by the actors themselves (Thévenot 2001: 64; Schatzki 2001, 2002; Shove et al. 2012). Thus, for the purpose of my analysis, to give significance to practices means to be analytically attuned to how new innovation demands are made sense of as part of persistent work routines and established ways of steering and organizing research activities. These practices are part of ordering actors' realities in the sense that they shape what is perceived as possible to act upon practically within a given context. As an example, a principal investigator leading a research project with several PhD students is dependent on producing results that can provide scientific publications according to fixed and routinized ways of evaluating doctoral theses. In this way, work practices can also constrain individual activity

by shaping how actors experience their agency (Felt 2009; Schatzki 2001: 14).

Thus, the objective of the analysis is to address how such context-specific aspects shape how actors manage and respond to innovation demands. Importantly, this includes being attentive to the relations between actor groups and sites and to how policy ideas travel between sites. The concepts of innovation and value creation can be understood differently within different sites of the biotechnology field, and innovation and value creation objectives will be attributed varying degrees of importance depending on the context the actors work in and how they perceive their agency, responsibilities, and obligations. Thus, to grasp fully how the focus on innovation and value creation is part of shaping the field, its impacts need to be studied within multiple sites and with attention to the interplay between sites and the roles each site play (Marcus 1995). An increased focus on innovation and value creation not only implies new demands being placed on biotechnology researchers but also represents new expectations and responsibilities that funding agencies and research administrators need to manage. In this regard, and following Åm (2013), there is a need for contextualized accounts of the work done by actors and organizations in order to discuss critically their role in research and innovation processes. This leads to important questions for consideration in the analysis: What conditions of possibility do new actors and organizations emerge from? What are their practices? What logics characterize these practices? (Åm 2013). Moreover, we should expect differences and tensions between understandings in national policy, research funding agencies, research centres, and research projects because these are sites marked by a diverse set of objectives. Thus, a multi-sited and action-oriented approach opens up for studies of innovation in relation to other aspects that also are part of conditioning the work of scientists and governance actors in the biotechnology field, such as career development plans, publication demands, time and resource restraints, and personal motivations (Felt 2009).

In sum, this paper offers ways to think about innovation policy processes and science governance that problematize ideas about merely filling ‘deficits in innovation capacity’ (Freeman 2009; Åm 2019; Åm et al. 2021). Responses to policy demands represent trade-offs between different desires and demands and are shaped by the given social and material conditions. This introduces an uncertainty of policy implications that makes it necessary to explore such processes empirically and continuously (Freeman et al. 2011). Accordingly, in the following, when I question how actors make sense of, negotiate, and respond to innovation and value creation demands, my starting point is that change is not something that merely happens to actors but something that happens through the work of the involved actors (Cooper 2009).

### 3. Methods: studying DLN and its context

The study on which this paper is based followed a multi-sited approach, and the analysis draws on several empirical resources, including policy documents, observations, and 14 in-depth qualitative interviews. Seven of these interviews were conducted with principal investigators (n6) and researchers (n1) working within research projects connected to DLN.

The remaining seven interviews were conducted with people that had been involved in the innovation work of DLN or in the policy work leading up to the establishment of DLN. This included staff working within the DLN administration and representatives of innovation facilitator organizations that had collaborated with DLN (n5) and lastly members of the RCN administration and the governing board of BIOTEK2021, which was the funding programme for biotechnology research in Norway at that time (n2). Additionally, together with a representative from DLN, I held individual meetings with twelve principal investigators of DLN research projects during which the main aspects of their research projects were presented and discussed. The observational study consisted of participatory observations of innovation workshops and other innovation-relevant events organized through DLN. As of the time that this study was initiated, the DLN initiative consisted of a network of in total thirteen biotechnology research projects and one social science project in addition to the competence hub referred to as Centre for Digital Life Norway.

In addition, the analysis also draws on what can be characterized as an informal organizational ethnography of DLN (Ybema et al. 2009). My research originates from a concomitant research project of the DLN initiative, which has offered me a unique insight into the organization and dynamics of DLN. However, this also represents a special position from where the research has been conducted that demands a high level of reflexivity. Over a period of 2 years, I have had several informal encounters and conversations with people related to DLN and have gained knowledge from reports, newsletters, and communication coming from the initiative. For people connected to DLN, it has been open knowledge that I have been involved in a project doing research on the initiative *per se*. The material I encountered during these 2 years was helpful for developing a holistic understanding of the multi-layered processes of sense-making that has taken place within DLN, and the insights gained from this informal ethnography have provided an important backdrop for the analysis presented in this article. However, only quotes and direct information that has been given under consent have been included in this paper.

I oriented my approach to the analysis of the research material towards a grounded theory development (e.g. Charmaz 2006; Corbin and Strauss 1990), using the analytical software Nvivo to code policy documents, interview transcripts, and field notes thematically. The aim of the analysis was to elicit how different understandings of innovation and value creation emerged from the material, including problem definitions, as well as suggestions for solutions and role distributions in innovation processes. There is thus a close link between the analytical process and the explorative methodological design of the study. As an example, the interviews were structured around open questions that allowed the interviewees to give their own accounts of how they understood the concepts of innovation and value creation and in what way innovation and value creation objectives were made part of their daily work practices (Weiss 1995). The analysis accordingly aimed to elicit how the different actors accounted for their innovation and value creation practices, what actors the interviewees made links to and saw as relevant for such practices, how they accounted for their own roles and responsibilities in the context of their own work to engage with innovation and value creation and what they perceived as drivers

and barriers. Importantly, the analysis explored how different understandings would emerge within different empirical sites and how such understandings translated between the sites. When analysing and reporting on this empirical material, I have prioritized the anonymity of the participants. Since the funding initiative is named in the study, I have limited my use of direct quotes and only indicated the positions held by the quoted interviewees where this is crucial to the argument.

#### 4. Site 1: a hopeful governance of Norwegian biotechnology research

The first step of the analysis presented in this paper is to unpack the context from which present-day attention to innovation and value creation objectives has emerged. In this respect, a crucial political document is the *National Strategy for Biotechnology* that was issued by the Ministry of Education and Research in 2011 (Norwegian Ministry of Education and Research 2011). The purpose of the document is both to provide a framework for the development of the field that can support the work of advisory and legislative bodies and to set a direction for allocating research resources. The strategy points to how biotechnology could contribute to address important societal challenges and drive national industrial growth, and based on these visions, it establishes innovation and value creation as key political objectives for biotechnology research investments. The document also articulates a need for new policy instruments that in a more targeted way could help to build innovation capacity, particularly by facilitating more collaboration between research and industry.

The objectives of the 2011 strategy are mostly described through visionary and general statements such as claims that '[b]iotechnology will be instrumental in enhancing the competitiveness of many of Norway's most important industries and may generate new industrial opportunities nationwide' (Norwegian Ministry of Education and Research 2011: 39) or by describing a mode of collaboration between research, industry, and policy that focuses on a shared interest among the actors to work towards innovation. As an example, the document points to how 'the specialist scientific communities should act as national resource centres, serving as partners to companies and research groups throughout Norway' and that 'public instruments should lay the basis for productive dialogue with various players when initiatives are being designed' (Norwegian Ministry of Education and Research 2011: 12). However, the strategy provided few details in terms of what the public instruments should comprise. Sørensen (2019) describes how such policies fit within a *hopeful mode of governance*, wherein policy documents contribute to articulating new and ambitious goals but do little to follow up on visions with concrete content or discuss tensions that might arise between goals. For the Norwegian biotechnology research field, the hopeful governance had practical implications, as it largely delegated responsibility for the translation of the visions into policy instruments to the nearest organizations, in this case the RCN. Thus, the question of how the visions travelled between the strategy and the RCN is important for understanding how innovation and value creation objectives started to manifest themselves into the governance of the biotechnology research field.

Within the RCN, the signals from the 2011 strategy were picked up directly, and the strategy was used to legitimize a new and more active governance approach. An interviewee working in the RCN administration explained how the strategy was interpreted as a call for change in how the biotechnology field was funded and in particular the interviewee experienced it as meaning that the government expected the RCN to focus more on facilitating academia–industry collaborations and to make efforts to increase the pace of innovation of the government-funded research projects. There was a 'a clear expectation from government that more should come out from the universities, that they [the government] were impatient, it [the innovation process] was going too slowly, and that value creation should happen in the form of more innovation' (Interviewee 6), and within the RCN, 'we had a clear mandate from the national strategy to change ourselves, to turn from academia to industry, and this was challenging' (Interviewee 6).

In 2012, the RCN established a new funding programme for biotechnology research called BIOTEK2021, which was intended to 'follow up on the strategy that had been issued the year before' (Forkningsrådet 2018). The BIOTEK2021 programme plan repeated the visions of the strategy and described how the new programme would Forskningsrådet give 'priority to projects that have the possibility to succeed with innovation from cutting-edge science' (Forkningsrådet 2018: 8). The RCN also brought industrial competence to the steering of the programme. Furthermore, it decided that the governing board of BIOTEK2021 should have an overweight of representatives from industry, and they recruited a chair for the board that had an experience of the commercialization of research. The RCN also initiated a range of policy experiments within the programme that were supposed to bring Norwegian research communities closer to industry and encourage them to work more explicitly with innovation. It formulated funding calls, asking applicants to address needs in society and to explain their potential for value creation, and encouraging applicants to implement industrial or other non-scientific actors in their project consortiums. The innovation potential of the projects was also made part of the evaluation of the projects. In addition, the RCN launched a funding instrument targeted at projects in later stages of development, to provide funding for optimization processes of research outcomes towards commercialization.

The above-described line of policy experiments led the RCN to launch the DLN initiative in 2016. DLN is considered to be the BIOTEK2021 programme's flagship project, in which the objective is to establish a 'lighthouse' initiative for economic, social, and environmental value creation in Norwegian biotechnology. The chair of the BIOTEK2021 programme framed the initiative as a continuation of its effort to incorporate a 'significantly greater focus on innovation and value creation' in Norwegian biotechnology and that DLN should strengthen Norway's innovation capacity and benefit national trade and industry in general (Research Council of Norway 2014: 3).

However, with the DLN initiative, it became apparent that there were some initial friction between the national strategy's ambitious innovation agenda and the complex practices of the RCN. Within the context of the RCN, the innovation and value creation objectives became linked to other science policy

objectives. As an example, a member of the governing board of BIOTEK2021, who was a well-established biotechnology researcher, explained how he had strongly supported the idea of DLN because he perceived it as a strategically important move to help Norwegian research communities become more interdisciplinary. He had previously been unhappy with the fact that RCN not sufficiently had recognized how cutting-edge ‘biotechnology was evolving through the connection between life science, mathematics and engineering’ (IW12). For him, DLN thus represented an important change in the approach to funding biotechnology research where RCN could initiate a shift towards the use of digital tools and mathematical modelling and encourage more interdisciplinary approaches that could bring together expertise from computer science, statistics, medicine, biology, and genetics. When recruiting projects to the initiative, the RCN developed funding calls that asked applicants to incorporate the desired focus on digital methods and to establish transdisciplinary project consortiums, in addition to the expectation of the projects being relevant for innovation and value creation.<sup>2</sup> Moreover, the RCN wanted to encourage socially responsible research practices by establishing Responsible Research and Innovation as a cross-cutting principle for biotechnology research activities. In the strategy document leading to the establishment of the initiative, the overarching objective of innovation and value creation was used to provide support also for the other changes (Research Council of Norway 2014: 4).

In sum, the RCN not only modified but also largely continued the hopeful governance from the national strategy. The RCN’s responses to the national strategy showed a continuation of the vision production of the strategy, and the strategy gave support for a top-down and active steering practice towards the biotechnology field. However, when the hopeful narrative met the reality of the RCN’s daily practices, it became evident that it was a challenging task to translate the visions into action. Firstly, it was not clear which kinds of policy instruments could be effective in steering research projects more targeted towards innovation and value creation objectives, and for this reason, the RCN adopted a mode of experimentation in their policy development. Secondly, the innovation and value creation objectives became intertwined with other practices within the research council, such as fostering excellent and socially responsible research. Interestingly, these entanglements also highlighted the research communities’ involvement in shaping the policy discourse, like the member of the BIOTEK2021 board explained how he had supported DLN to further push the idea of convergence in research. In this way, the innovation and value creation objectives of DLN were not only originating from the political arena but co-produced with the scientific community and used to support also other objectives, like convergence in research and RRI (Jasanoff 2004). The RCN thus continued in a mode of hopeful governance in terms of the innovation and value creation work consisting of a mix of policy instruments that were aimed towards several objectives, which as I discuss later were potentially conflicting. Similar to the way that the 2011 national strategy had left it to the RCN to follow up on the visions with more specific content, the RCN developed instruments to incentivize the research communities but still left room for interpretation in terms of fulfilling the innovation objectives with practical meaning.

## 5. Site 2: an arena of facilitation, experimentation, and inspiration

Within DLN, the innovation and value creation work transitioned into a different mode, as people working within the initiative faced the practical task of translating the visions and incentives into actions. Approximately EUR 50 million had been allocated to biotechnology research partly based on broad visions of creating value for the Norwegian society. However, the question of how to *do* innovation and value creation from Norwegian biotechnology research projects was still left rather open.

Keywords for the new mode became *facilitation*, *experimentation*, and *inspiration*. To help govern the DLN initiative, the RCN had funded a competence hub for the DLN initiative, which is now called the Centre for Digital Life Norway. Funding such a centre was a new approach to science governance from the RCN and was supposed to support the visions of DLN and facilitate collaboration and synergies between the research projects funded through the initiative. As explained by the member of the BIOTEK2021 governing board, one ambition of DLN and the DLN centre was to help ‘create a more uniform voice’ (Interviewee 12) from the Norwegian biotechnology community that could function as a channel for communication with decision-makers and help to generate political momentum for the field. The centre was not formally responsible for the research projects but worked as an intermediary actor towards increasing the public visibility of DLN and more directly towards the research projects by offering expertise and organizing activities that could help the researchers in their work. As an example, the centre had a workgroup dedicated to innovation and industry involvement and that was intended to help the research projects in the ‘transferring of research activities and results into innovation and value creation’.<sup>3</sup>

However, the work of the DLN centre demonstrated frictions for the hopeful biotechnology innovation narrative articulated in the policies. For DLN, the big question became what was it practically possible to do within the context in which they now operated? As an example, compared with the ambitious stories about innovation in the policy documents, the accounts one DLN employee provided from meeting with the research projects represented a much more modest focus on innovation within the research projects:

All the projects have an idea about where they are going commercially or in terms of innovation. They have a clear idea of what the value is in their project. But a lot of them think it is way too early to start talking to trade and industry. A considerably fewer number of the projects than I initially thought collaborate with industry and of the ones that do it, the industry is not a very active partner. [...] I think none of them want to go out and try to sell something that is just half done. (Interviewee 1)

The projects had been selected for funding partly based on how they aligned with the innovation and value creation objectives on a discursive level but it was hard for the above-quoted DLN centre employee to point to the practical implications of this innovation focus and how the scientists acted upon this broader innovation and value creation ambition within the daily practices of their research projects.

The realization that there was no one-to-one correlation between the objectives in the science policies and the work of the projects had obvious implications for the DLN centre. Rather than to act in a support function to research projects that were already working on such aspects themselves, the work of the DLN centre had to be generative in the sense that it needed to help facilitate and inspire the scientists to involve themselves actively in innovation and value creation activities. This included experimenting with different kinds of activities. One of the first things that were done was to start a process of mapping innovation needs in the industry and the ongoing innovation activities of the projects.<sup>4</sup> In addition, the centre conducted a benchmarking survey asking about the innovation outputs of the projects, such as the number of patents that they had acquired, business development processes, and ongoing collaborations with the industry. The centre also tried to address the lack of targeted innovation activities within the projects by inviting scientists to participate at different kinds of innovation learning sites. As an example, during the first few years of its existence, the centre has, in collaboration with other innovation facilitator organizations, offered tailored innovation workshops to biotechnologists. The workshops have been aimed at teaching the scientists specific innovation tools such as how to cultivate an open and creative mindset within their research group and how to set up a business model for their research projects. These workshops clearly targeted the individual scientists and their motivation for engaging in innovation activities. As an example, for one workshop that DLN organized in collaboration with a number of other innovation facilitator organizations, the biotechnology researchers were approached through invitations posing questions like ‘Are you doing science with a hidden business idea and innovation potential? Do you have a great idea? but lack the tools and methods to go ahead?’<sup>5</sup> In addition, the centre has organized workshops on intellectual property protection and invited scientists to participate at sites where they can come into contact with representatives of industry, such as biotechnology and health technology conferences. Additionally, the DLN centre has engaged extensively in networking activities in an attempt to increase the visibility of the research projects among potential industrial collaborators.

Analysis of the work of the DLN centre highlights the need for contextualized empirical accounts of intermediary organizations in order to discuss constructively their role in research and innovation processes (Åm 2013). The DLN centre emerged from a particular condition of possibility where there was a perceived need to build a new governance structure for Norwegian biotechnology research in order to facilitate and mobilize research efforts more efficiently towards innovation policy objectives. The centre used its available instruments and resources to respond to the new innovation and value creation demands. However, the centre’s practices show how this process of translation took unexpected turns as it was largely defined by the challenges emerging from the hopeful governance identified in the preceding sections. That is, the work of the centre shows that both the targets, in terms of what the innovation activities should be aimed towards, and the innovation processes, in terms of who should be doing what at what time, were unclear. A big challenge was to narrow down the broad and ambitious agenda articulated in the policy work to clearly defined activities within the context

of their operation. Thus, what followed within DLN was a process of translation and negotiation of the objectives that had been articulated in the policies. In this respect, the centre ended up addressing the individual research projects and operating according to a logic of commercialization. Accordingly, the DLN centre worked strategically to push and inspire the scientists to enter into a new role as innovators, but there was clear friction between the image of the entrepreneurial scientist as a driving force for innovation and value creation and the scientists’ self-interpretation of their roles and responsibilities. In the next section I move on to describe more closely the ways that the research projects responded to the innovation and value creation demands of the DLN initiative and thus the main question addressed are as follows: Why did this friction emerge? Were the scientists merely reluctant to change?

## 6. Site 3: the self-governance and negotiation of innovation

As discussed in Section 5, the DLN projects generally found it challenging to create space within the organization of their projects to work directly with innovation and value creation objectives. While the DLN centre aimed to stimulate innovation activities by offering arenas for learning and knowledge exchange and by partly guiding the research projects directly, the scientists tended to distance themselves from the commercialization focus of the DLN centre. They often argued that they were in a too early phase of their scientific development to be thinking about matters such as markets and industrial partners, and they expressed discomfort about being expected to deliver specific innovation or value creation outcomes within the time frame of their projects.

Thus, from the perspective of the scientists, there was friction between the expectations articulated in the science policies and what they experienced as practically possible to achieve within the frame of the research projects. The policy discourse was tuned towards processes of optimization, presenting the argument that there was a need to make research activities more targeted towards innovation. On a discursive level, as expressed in the DLN project descriptions,<sup>6</sup> the scientists aligned with this policy objective of producing either research with social relevance or research that could be the basis for industrial development. However, the scientist did not align with the hopeful mode of governance expressed in the policies, which aimed to take better control over the research process and direct it towards certain targets. The scientists’ experience of their own work was as an open-ended and serendipitous process in which it was difficult to predict whether something specific, such as a product, a business, or a patent, would come out in the other end.

Rather than discussing such specific outcomes, the scientist talked mainly about the integration of innovation and value creation objectives in their research projects in abstract terms. Innovation and value creation were something that belonged to the future and existed as possibilities and intentions in their work, and few interviewees provided specific accounts about what innovation activities would consist of or pointed to how the innovation focus was shaping their daily scientific practices. The leader of one project working towards the development of a new pharmaceutical product stated:

We work more with the research part of the innovation, than the innovation itself. [...] as a business you need to work differently than what we do [...] I mean the attention towards the market. We don't have that in our project. We do not write a real business plan, as an example. There are different demands that determine whether you are successful in a big research project. The main focus is on publications. (Interviewee 9)

It is evident from the quote that innovation was integrated into the project in a passive way; it was articulated as a long-term goal for the research activities, but it was not something the project team members spent much time on in their daily work. Thus, the scientists within DLN could easily agree on the importance of innovation and making science societally relevant, but this compliance was often moderated by statements about the need to make scientific progress first. The scientists felt that they needed to prioritize research, and therefore, the innovation work was conditioned by other demands in the interviewees' academic work, such as the need to publish results in scientific journals. In sum, this resulted in them drawing boundaries in their work between what was considered productive time spent on research and less productive time spent on engaging in innovation activities, such as interacting with industry representatives or taking part in innovation workshops organized by the DLN centre. From the scientist's accounts, it was apparent that their work was an arena of negotiations where they had to make sense of a broad range of policy objectives, formal funding requirements, and their own personal desires and career development and decide for themselves which paths to follow.

The narrative of distancing was dominant among the scientists, but the efforts made to promote innovation and value creation within DLN still introduced new aspects to their scientific work. They were frequently exposed to innovation and value creation as a topic, they were challenged by the DLN centre in their innovation thinking, had excess to new types of expertise and resources, and were invited to participate in new types of networking arenas. Also, even though many projects backed away from demands, it is important to emphasize that there was variety in how those demands were interpreted, ranging from vocal resistance to efforts to align. As an example, team members of one project had participated in several of the innovation workshops organized by the DLN centre. Moreover, they had started to work on developing a business plan for their project in collaboration with the centre. One member of the project explained that innovation had been taken seriously from the beginning of the project; in particular, the team would focus on exploiting the commercial potential of their project, and he experienced that as a premise for the funding the project received:

Like the Norwegian Research Council understand it, and like many of us understand it, if we are supposed to do innovation, then the idea is not that this is only scientific innovation, it is as an actual commercial exploitation of the research, that the idea is possible to bring into life, that someone is interested in that it is actually useful [...] From the very beginning, we applied for funding on the criteria that we would pursue the commercial potential of the project. (Interviewee 3)

Another interviewee, who was working on a different project, explained how he was collaborating with the technology transfer office at his university to analyse the market potential of the different segments of the industry in which the project was operating:

So basically, you find the companies or the industries that work with these types of nanoparticles and you can access all their statistics and numbers. [...] Because when you look into the applications that you can gain from these nanoparticles you will get hundreds of them, but you will not know which one is more, gives you more money or which one is used more in our world. So that's why we had to access these numbers to pick the top three or top four industries to go for. (Interviewee 5)

It is evident that the project team was trying to align the project's trajectory with the needs in the most promising markets. The project teams that both participated in the innovation activities and aimed towards actively integrating an innovation focus in their daily work had been able to make sense of the innovation and value creation demands within the contexts of their projects. In this respect, they had also encountered problems in translating the innovation work into daily scientific practices, such as when tensions surfaced between publication demands and patenting. As an example, one interviewee explained that commercialization processes could be a problem for junior research staff who needed to have their work published frequently in order to be able to advance their careers:

We have experienced that it is a challenge to make the project function both as an innovation project and as research project where we [...] we hire quite a few PhD students. When you start as a PhD in a research project your primary motivation is to finish your PhD, not to pursue all other kinds of sidetracks. (Interviewee 3)

However, even though the projects could struggle with finding practical solutions, the commercialization focus of the DLN centre fitted with the projects' objective of developing a well-defined technological product that the team members could use to target established markets, and they welcomed the resources that the DLN centre offered them. The problem from the DLN centre's perspective was that far from all of the DLN research projects worked within such defined frames of what the applications of their research would be.

At the opposite end of the continuum, the commercialization focus potentially could create friction with the scientific objective of a research project. Such frictions were elicited through the tailored innovation workshops organized by the DLN centre. Within the context of those workshops, innovation was interpreted narrowly as the process of developing research results into start-up companies. The scientists were situated as the key actors in this process and, as discussed above, the workshops aimed to develop the entrepreneurial mindset of the scientists and give them insights into how to develop marketable products and businesses of their own. As an example, during one workshop, the lecturer engaged the workshop participants in exercises in which the goal was to specify and elaborate on the aspects of their research projects that were most likely to generate commercial success and to

explain how they could work further on those aspects. The participating projects from DLN were in their early phase of development, and even though they had initially been framed towards a certain societal challenge, it was still open as what could come out of them. One project was aimed towards developing a new pharmaceutical compound in a particularly challenging market segment but where there was a high societal need for new types of medications to be developed. One project was aimed towards developing a new pharmaceutical compound in a particularly challenging market segment, but where the drug itself had a high societal need. However, the ‘take-home’ message from the exercises was that the projects would be better off commercially if their technological parts were developed into a more generic start-up for drug discovery that could target markets with more promising prospects instead of developing the compounds they initially had planned. In other words, using the market as a framework shaped what were perceived as viable innovation trajectories. Moreover, the recommendations that the scientists received, in short to ‘follow the money’, could also result in them abandoning their initial research focus in favour of another one.

Thus, moving from the broad innovation agendas articulated in the policy documents to the practices of the research projects and the specific innovation activities organized through the centre elicits important challenges for innovation and value creation work. The DLN centre’s focus on commercialization created frictions, especially in terms of the scientists being placed in a position where they needed to negotiate between potentially competing policy demands. The accounts of the scientists told a story of how the open-ended and hopeful mode of governance identified at the national level generated a need for context-specific processes of negotiations within the research projects and how the innovation work largely became a matter of the individual projects’ active alignment with the policy objectives. Thus, within the site of the research projects, the self-governing practices of the research projects become of major importance for understanding their responses to innovation objectives. Importantly, their practices of self-governance were shaped by competing demands in the scientists’ work practices.

## 7. From hopes to empathy—the need for a more practice-oriented innovation policy discourse

I started this article by describing an increased push towards innovation and value creation objectives in today’s biotechnology science policies and asking the question of to what extent actors find themselves able to respond to this policy push. This research question has been sparked by recent discussions about a hegemonic discourse of innovation in current science policies in general and in biotechnology research policy in particular. We can observe that vast resources are being allocated to fields of emerging technologies with expectations of facilitating research activities that are targeted towards specific innovation and value creation objectives. Moreover, we can rightfully conclude that such an *innovation imperative* has wide consequences in terms of guiding policy actions towards technological solutions to frequent complex sociotechnical

challenges (Pfothenauer et al. 2019). However, there is little knowledge about how these objectives are addressed within the practices of science governance and research projects.

The case study of DLN shows a different side of the imperative by eliciting the diverse ways in which innovation and value creation objectives have been made sense of and how actors might struggle to translate the objectives within the context in which they work. From a science governance perspective, this provides nuances to the process of introducing new innovation and value creation demands into existing practices of science and science governance. Rather than representing a clear change towards innovation and value creation in Norwegian biotechnology research, the empirical analysis shows how the DLN objectives also have taken unexpected turns and that the policy objective also has been co-produced by policy-makers and scientists in relation to other policy objectives, subjected to differing interpretations and modifications, and subsequently to self-governing practices. Innovation and value creation have been addressed in different ways within different sites that are marked by distinctive governance approaches and configurations of innovation and value creation work.

The question that remains is: What do the observations mean for our understanding of the innovation policy discourse? Over the last three decades, work within Science and Technology studies have pointed to how scientific practices have transgressed into a Mode 2 of knowledge production, bringing together a wide set of actors that are located beyond the traditional boundaries of the university and organized according to the demands of an application or practical problem (Gibbons et al. 1994). The models of the triple helix and the national innovation system have similarly suggested that university, industry, and government are becoming increasingly interdependent and co-evolving spheres (Etzkowitz and Leydesdorff 1995; Lundvall 1992). These analyses have been prescriptive for policy-making, suggesting the need for collaboration across domains and articulating a third mission for universities: to contribute to economic growth through what Etzkowitz (2003) refers to as entrepreneurial science. The literature on technoscientific capitalism has on the other hand been important in pointing out what costs such an expansion of scientific practices might bring with them, arguing that the organization of knowledge and technology development has become deeply embedded with a problematic capitalistic logic (Slaughter and Leslie 1997). The case study of DLN makes an important contribution to this body of literature by emphasizing how frictions between different conceptualizations and practices of innovation and value creation must be taken into consideration when discussing these broader processes of change.

To recognize that policies are unpredictable and notoriously difficult to implement is of course not new; this is an often hard-earned experience made by most practitioners in policy-making and something that has been demonstrated through a substantial body of work within the field of critical policy studies, among others (see, e.g., Griggs et al. 2014; Freeman et al. 2011). The contribution of this paper lays in its attention to the level of the practices of science governance and research projects to observe how actors might struggle to respond to innovation demands and how new



experimental approaches to both governance and research emerge as outcomes of such struggles.

This is a perspective that will add to our knowledge about innovation governance. Studies with an institutional or system focus have been important to show the role well-functioning institutions, like national funding agencies, play in providing an economic premise for innovation activities, like incentivizing and creating opportunities for the kinds of public–private partnerships that have been important in the development of the biotechnology industry (McMillan et al. 2000). However, it is important that the innovation policy narrative does not get detached from the daily work of scientists and governance actors.

Staying close to the ‘ground work’ of innovation also opens up for a new set of critical questions in relation to the dominance of innovation in today’s policy that draws on the same critique of deficit logics that has been central to previous work in the field of Science and Technology studies (e.g. Callon 1998; Wynne 1992). First, to what extent are emerging policy discourses on innovation representing actual changes in research and innovation practices or merely illusions of governance? Second, and on a more general level to initiate change successfully, how can bottom-up analyses of research and innovation practices become integral to policy-making processes?

The case study of the DLN funding initiative clearly demonstrates the necessity to address both questions. In Norwegian science policy, biotechnology has been framed as a key area for research and development investments that can drive Norwegian societal progress but where progress has been hampered by an imagined deficit in the innovation capacity of the existing research communities. Thus, while resources are mobilized into biotechnology with an expectation of stimulating innovation and value creation, this push has been accompanied by an additional expectation that research needs to be done differently to fulfil innovation objectives. However, this paper shows how a deficit way of thinking about the innovation capacity of the research communities is problematic because it simplifies and partly neglects the practices of the implicated actors (Åm et al. 2021; Solbu 2018). Governance actors and scientists may experience their own practices as persistent and accordingly perceive their own agency to initiate this change as limited. To address the second question posed above, this paper shows how successful governing strategies need to address, in a manner that is empathetic and attentive towards the particular contexts actors are situated in and how constraints might limit processes of change and therefore strive to enable actors to accommodate policy objectives. Put shortly, there is a need for a more nuanced discussion of what both governance actors and researchers are expected to be capable of doing.

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## Notes

1. The Transformative Innovation Policy Consortium (TIPC) is a good example of this tendency, gathering innovation ministries and funding agencies from Colombia, Finland, Norway, South Africa, and Sweden, with affiliated programmes in China, Brazil, Senegal, Ghana, and Kenya, with the aim to experiment with transformative innovation policies (e.g. <https://www.tipconsortium.net>).
2. Project calls for BIOTEK2021 retrieved from <https://www.forskningsradet.no/no/Utlysning/BIOOTEK2021/1254035590730/p1173268235938?visAktive=false>.
3. For more information, see the DLN web resource: <https://www.digitallifenorway.org/services/innovation/index.html>.
4. The report ‘Digital biotechnology in Norway’ was published by the DLN centre in 2017, as a result of the mapping of the industrial needs in Norway (Evjen et al. 2017).
5. For more information, see <https://www.digitallifenorway.org/events/design-thinking-from-research-to-innovation-in-life-science.html>.
6. For more information, see <https://www.digitallifenorway.org/research/>.

## References

- Åm, H. (2013) ‘Don’t Make Nanotechnology Sexy, Ensure Its Benefits, and Be Neutral’: Studying the Logics of New Intermediary Institutions in Ambiguous Governance Contexts’, *Science & Public Policy*, 40: 466–78.
- (2019) ‘Limits of Decentered Governance in Science-society Policies’, *Journal of Responsible Innovation*, 6: 163–78.
- Åm, H., Solbu, G., and Sørensen, K. H. (2021) ‘The Imagined Scientist of Science Governance’, *Social Studies of Science*, 51: 277–97.
- Birch, K. (2017) ‘Rethinking value in the bio-economy: Finance, asseztization, and the management of value’, *Science, Technology, & Human Values*, 42: 460–90.
- Bud, R. (1989) ‘Janus-faced Biotechnology: An Historical Perspective’, *Trends in Biotechnology*, 7: 230–3.
- Bugge, M. M., Hansen, T., and Klitkou, A. (2016) ‘What is the Bioeconomy? A Review of the Literature’, *Sustainability*, 8: 691.
- Callon, M. (1998) ‘An Essay on Framing and Overflowing: Economic Externalities Revisited by Sociology’, *The Sociological Review*, 46: 244–69.
- Charmaz, K. (2006) *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis*. London: SAGE.
- Cooper, M. (2008) *Life as Surplus: Biotechnics and Capitalism in the Neoliberal Era*. Seattle, WA: University of Washington Press.
- Cooper, M. H. (2009) ‘Commercialization of the University and Problem Choice by Academic Biological Scientists’, *Science, Technology & Human Values*, 34: 629–53.
- Corbin, J. M. and Strauss, A. (1990) ‘Grounded Theory Research: Procedures, Canons, and Evaluative Criteria’, *Qualitative Sociology*, 13: 3–21.
- Crow, M. and Bozeman, B. (1998) *Limited by Design: R&D Laboratories in the U.S. National Innovation System*. New York: Columbia University Press.
- Etzkowitz, H. (1998) ‘The Norms of Entrepreneurial Science: Cognitive Effects of the New University–Industry Linkages’, *Research Policy*, 27: 823–33.
- (2003) ‘Research Groups as ‘Quasi-firms’: The Invention of the Entrepreneurial University’, *Research Policy*, 32: 109–21.
- Etzkowitz, H. and Leydesdorff, L. (1995) ‘The Triple Helix—University-Industry-Government Relations: A Laboratory for Knowledge Based Economic Development’, *EAAST Review*, 14: 14–9.

- Etzkowitz, H., Webster, A., Gebhardt, C., et al. (2000) 'The Future of the University and the University of the Future: Evolution of Ivory Tower to Entrepreneurial Paradigm', *Research Policy*, 29: 313–30.
- European Commission (2002) 'Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions: Life Sciences and Biotechnology – A Strategy for Europe', COM(2002) 27 final. Publications Office of the EU <<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52002DC0027&from=EN>> accessed 26 May 2021.
- (2013) *A Bioeconomy Strategy for Europe: Working with Nature for A More Sustainable Way of Living*. Publications Office of the EU <<https://op.europa.eu/en/publication-detail/-/publication/26b789d4-00d1-4ee4-b32e-2303dfd2207c>> accessed 26 May 2021.
- Evsjen, T. J., Dick, G., Skogli, E., et al. (2017) *Den digitale bioteknologien i Norge: Muligheter for verdiskaping, kompetansebehov og utfordringer i næringsutvikling*. Oslo: Senter for digitalt liv Norge, Universitetet i Oslo.
- Felt, U. (2009) *Knowing and Living in Research: Convergence and Heterogeneities in European Research Cultures*. Prague: Institute of Sociology, Czech Academy of Sciences.
- Forskningsrådet (2018) *Program plan BIOTEK2021: Gjelder Fra 2018* (Lysaker: Norges forskningsråd). <<https://www.forskningsradet.no/contentassets/f5cbb2227ab149378253553571129ede/biotek2021-revidert-programplan-2018.pdf>> accessed 26 May 2021.
- Freeman, C., ed. (1981) *Technological Innovation and National Economic Performance*. Aalborg: Aalborg University Press.
- Freeman, R. (2009) 'What is "Translation"?' *Evidence & Policy*, 5: 429–47.
- Freeman, R., Griggs, S., and Boaz, A. (2011) 'The Practice of Policy Making', *Evidence and Policy*, 7: 127–36.
- Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., and Trow, M. (1994) *The new production of knowledge: The dynamics of science and research in contemporary societies*. Sage.
- Godin, B. (2009) 'National Innovation System: The System Approach in Historical Perspective', *Science, Technology & Human Values*, 34: 476–501.
- Griggs, S., Norval, A. J., and Wagenaar, H., eds. (2014) *Practices of Freedom: Decentred Governance, Conflict and Democratic Participation*. New York: Cambridge University Press.
- Hausknost, D., Schriebl, E., Lauk, C., et al. (2017) 'A Transition to Which Bioeconomy? An Exploration of Diverging Techno-political Choices', *Sustainability*, 9: 669.
- Holloway, K. and Herder, M. (2019) 'A Responsibility to Commercialize? Tracing Academic Researchers' Evolving Engagement with the Commercialization of Biomedical Research', *Journal of Responsible Innovation*, 6: 263–83.
- Jansen, K. and Gupta, A. (2009) 'Anticipating the Future: "Biotechnology for the Poor" as Unrealized Promise?' *Futures*, 41: 436–45.
- Jasanoff, S., ed. (2004) *States of Knowledge: The Co-production of Science and the Social Order*. London: Routledge.
- Koch, P. (2019) *Tredje generasjons innovasjonspolitik - hva er det?* (Oslo: Forskningspolitikk) <<https://www.fppl.no/tredje-generasjons-innovasjonspolitik-hva-er-det/>> accessed 20 Apr 2020.
- Kuhlmann, S. and Rip, A. (2018) 'Next-generation Innovation Policy and Grand Challenges', *Science & Public Policy*, 45: 448–54.
- Latour, B. (1987) *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, MA: Harvard University Press.
- Lundvall, B.-Å. (1992) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Pinter.
- Lundvall, B.-Å., Johnson, B., Andersen, E. S., et al. (2002) 'National Systems of Production, Innovation and Competence Building', *Research Policy*, 31: 213–31.
- Marcus, G. E. (1995) 'Ethnography In/ of the World System: The Emergence of Multi-sited Ethnography', *Annual Review of Anthropology*, 24: 95–117.
- McCormick, K. and Kautto, N. (2013) 'The Bioeconomy in Europe: An Overview', *Sustainability*, 5: 2589–608.
- McMillan, G. S., Narin, F., and Deeds, D. L. (2000) 'An Analysis of the Critical Role of Public Science in Innovation: The Case of Biotechnology', *Research Policy*, 29: 1–8.
- Mukhtarov, F. (2014) 'Rethinking the Travel of Ideas: Policy Translation in the Water Sector', *Policy and Politics*, 42: 71–88.
- Nelson, R. R., ed. (1993) *National Innovation Systems: A Comparative Analysis*. New York: Oxford University Press.
- Norwegian Ministry of Education and Research (2011) *National Strategy for Biotechnology for the Future of Value Creation, Health and Environment: Strategy 2011–2020*. Oslo: Ministry of Education and Research.
- Owen-Smith, J. and Powell, W. W. (2001) 'To Patent or Not: Faculty Decisions and Institutional Success at Technology Transfer', *The Journal of Technology Transfer*, 26: 99–114.
- Pfotenhauer, S. M., Juhl, J., and Aarden, E. (2019) 'Challenging the "Deficit Model" of Innovation: Framing Policy Issues under the Innovation Imperative', *Research Policy*, 48: 895–904.
- Rajan, K. S. (2006) *Biocapital: The Constitution of Postgenomic Life*. Durham: Duke University Press.
- Research Council of Norway. (2014) *Strategic Initiative: Digital Life – Convergence for Innovation*. Lysaker: Research Council of Norway.
- Rothaermel, F. T., Agung, S. D., and Jiang, L. (2007) 'University Entrepreneurship: A Taxonomy of the Literature', *Industrial and Corporate Change*, 16: 691–791.
- Schatzki, T. R. (2001) 'Introduction: Practice Theory', In: T. R. Schatzki, K. D. Knorr-Cetina, and E. von Savigny (eds) *The Practice Turn in Contemporary Theory*, pp. 1–14. London: Routledge.
- (2002) *The Site of the Social: A Philosophical Account of the Constitution of Social Life and Change*. University Park, PA: Pennsylvania State University Press.
- Schot, J. and Steinmueller, W. E. (2016) *Framing Innovation Policy for Transformative Change: Innovation Policy 3.0*. Brighton: SPRU Science Policy Research Unit, University of Sussex.
- (2018) 'Three Frames for Innovation Policy: R&D, Systems of Innovation and Transformative Change', *Research Policy*, 47: 1554–67.
- Sharif, N. (2006) 'Emergence and Development of the National Innovation Systems Concept', *Research Policy*, 35: 745–66.
- Shove, E., Pantzar, M., and Watson, M. (2012) *The Dynamics of Social Practice: Everyday Life and How It Changes*. London: SAGE.
- Slaughter, S. and Leslie, L. L. (1997) *Academic Capitalism: Politics, Policies, and the Entrepreneurial University*. Baltimore, MA: Johns Hopkins University Press.
- Solbu, G. (2018) 'Managing Science and Managing Society in Norwegian Bio- and Nanotechnology Research', PhD thesis, NTNU, Trondheim.
- Sørensen, K. H. (2019) 'Mas, mas, mas-over hele linja', In: A. Tjora (ed.) *Universitetskamp*, pp. 450–80. Oslo: Scandinavian Academic Press.
- Thévenot, L. (2001) 'Pragmatic Regimes Governing the Engagement with the World', In: T. R. Schatzki, K. Knorr-Cetina, and E. von Savigny (eds) *The Practice Turn in Contemporary Theory*, pp. 56–73. London: Routledge.
- Weber, K. M. and Rohracher, H. (2012) 'Legitimizing Research, Technology and Innovation Policies for Transformative Change: Combining Insights from Innovation Systems and Multi-level Perspective in a Comprehensive "Failures" Framework', *Research Policy*, 41: 1037–47.
- Weiss, R. S. (1995) *Learning from Strangers: The Art and Method of Qualitative Interview Studies*. New York: The Free Press.
- Wynne, B. (1992) 'Misunderstood Misunderstanding: Social Identities and Public Uptake of Science', *Public Understanding of Science*, 1: 281–304.
- Ybema, S., Yanow, D., Wels, H., eds. et al. (2009) *Organizational Ethnography: Studying the Complexity of Everyday Life*. Los Angeles, CA: SAGE.