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Title

‘Don’t Make Nanotechnology Sexy, Ensure Its Benefits, and Be Neutral’—Studying the Logics of New Intermediary Institutions in Ambiguous Governance Contexts

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Abstract

This paper suggests a new theoretical approach to study intermediary institutions, particularly intermediary institutions at the science policy nexus. These intermediary institutions that have a mediating role between science and politics have often been approached from the perspective of 'boundary organizations'. But this model, that incorporates assumptions of principal-agent theory, is not fit for capturing case studies (of intermediary institutions) in ambiguous governance contexts. I argue that to understand new intermediary institutions, we need a new theoretical vocabulary to grasp how intermediary institutions emerge and how they work in practice. For example, discourses such as 'responsible development of innovation' can sediment in new institutional settings, including for example new monitoring and observatory institutions. However, there is a lack of systemic studies of the material implications that the rise of these new governance actors –such as intermediary institutions—has for governing emerging technologies. This paper addresses this gap by analysing the shortcomings of a nanotechnology observatory project. Along the example of this observatory institution for nanotechnology, I will show that political discourse theory allows us to explain critically the conditions of possibility for the emergence of such institutions. Complemented with actor-network *theory, these anti-essentialising approaches help us to see the materiality of intermediary governance actors.*

Introduction

The governance of scientific and technological development has been changing in the last two decades. Most striking is the increased number and heterogeneity of actors (Van der Meulen & Rip 1996), which is why science governance no longer can be seen as a twofold relationship between governments and sciences. The term 'governance' in itself acknowledges a rethinking of the studying of government power and a blurring of traditionally clear distinctions between state, societies, and markets. This context gave way to a range of actors who intermediate between research practice, policy, society, and economy. The increase of such intermediary actors has given rise to studying their roles in innovation (Howells 2006). Intermediaries take on abundant roles and functions ranging from 'knowledge brokers' (Meyer 2010) to 'translators of ideas' or 'bridging institutions' that link players within a technology system (Howells 2006). This paper focuses on a particular category of intermediaries that work as institutions (such as research councils, advisory bodies, or university organizations) at a strategic level between policy and research performance levels (Van der Meulen & Rip 1998:757).

The intermediary institutions that are placed at a strategic level between policy and science have classically been approached from principal-agent models and the perspective of 'boundary organizations (Howell 2006:717). This conceptualization might have been fit for the purpose of studying traditional intermediary organizations that operated mainly bilaterally, for instance between government and sciences or between research laboratories and small/medium sized firms (Van Lente, Hekkert, Smits & Waveren 2003). However, principal-agent theory and concepts such as 'boundary organizations' have been criticized. For Guston, such institutions function as sites of negotiating and demarcating scientific and political authority (Kearnes & Wienroth 2011:170). But Miller (2001) points out that this simplifies and overuniversalizes both science and politics without being able to account for context, fuzziness, and dynamics (483-484). Drawing on critical policy analysis, I aim to overcome these weaknesses by developing approaches to intermediary institutions that can provide contextualized explanations of the emergence and work of intermediary actors.

This article suggests a new approach to deal with the dynamics between intermediaries and science, government, and society. Such an approach would do justice to the new types of intermediary institutions that have emerged in the last decade, and 'that operate at network or system level, in contrast to the more traditional intermediaries that tend to focus on bilateral relations' (Van Lente et.al. 2003:243). Rejecting the idealized relation between principal and agent, I suggest considering the relationship between intermediaries and their environment as a back-and-forth of constructing demands, of localized and idiosyncratic interpretations of policy discourses, and of material and structural constraints in practice. To approach these dynamics I propose a discursive approach that refocuses analytical attention on the movement and translation of certain logics in a policy space. By drawing on the concept of logics, I assert that analysts are equipped with a new theoretical vocabulary that puts them in a position to analyse intermediary institutions from an anti-essentialising, dynamic perspective.

This article will first carve out the conceptual problems that existing approaches to intermediary institutions have in a context of governance. I will then show how a discursive-material approach responds to the challenges of studying governance institutions that adapt an intermediary role. In the remainder of the paper, I will illustrate the benefit of such a theoretical approach along the case study of an observatory project on nanotechnologies. The ObservatoryNANO was a European project with the goal of observing nanosciences and nanotechnology developments to support European policy-makers. The observations should range from economic and scientific analyses to consideration of social and ethical impacts, impacts on environment, health, and safety, as well as developments in regulation and standardisation[2]. My analysis will show how the formation of this new intermediary institution in the form of a nanotechnology observatory is interwoven with a discourse of responsible development. I will argue that the hegemony of 'responsible development' triggered new demands (such as keeping a balance between benefits and risks, anticipation,

[2] http://www.observatory-nano.eu/project/

monitoring, and early engagement) and therewith formed the condition of possibility for a new intermediary institution. In a second step, I will show with the case of the ObservatoryNANO how different logics are at work in the practices of intermediary institutions.

Theory: Toward a Critical Explanation

The study of intermediaries is of immediate interest for many research fields. One such is the relatively new field of transition studies, which considers intermediaries as vital in connecting various actors, projects, or policy goals in a multi-level-perspective to sustainable transition (Van Lente et al. 2003, Boon, Moors, Kuhlmann & Smits 2011). Typically, the relevant literature probes the functions of intermediaries, such as their capacity to weave together networks and actors, to articulate options and demands, and to enable learning processes. The study of intermediaries is also important in the study of science politics interfaces, which considers intermediaries as necessary actors for organizing the cooperation between politics and science (Guston 1999, Van der Meulen & Rip 1998, Kearnes & Wienroth 2011).

The predominant theoretical approach for studying science politics intermediaries is the approach of 'boundary organizations' which David Guston developed based on a combination of the concepts 'boundary drawing' and 'boundary object' on the one hand, and principal-agent theory on the other (Guston 1999). Principal-agent theory sets out to examine the relationship between science and society. According to its structural framing, the government is the 'principal' and researchers are the 'agents.' In this contractual relationship, the principals *delegate* the work of generating knowledge and innovation to the researchers, who in turn receive incentives, such as research funds (Guston 1999:91). However, politicians are frequently unable to promote economically important innovations, and scientists are often incompetent in applying research to innovation. This is where intermediary organizations, such as technology-transfer offices, come in. They form what Guston calls 'boundary organisations' that create a space for mutual collaboration. Often, they include actors from both sides of the boundary, they are accountable to each side, and they form boundary objects that enable communication across these boundaries (Guston 2001:400-401).

With the turn to governance, abundant new institutions mediating between science and governments arose and it has become challenging to grasp them with an approach that is based on a rather clear-cut dichotomy between principals and agents. The problem is two assumptions implied by principal-agent theory. First, that every actor pursues his own self-interest and therefore needs monitoring. In contrast, individuals do not always act instrumentally and they do not necessarily have clear-cut preferences (Griggs 2006: 173ff). In addition, the focus on simplified, individual patterns of action oversees the uncertainties,

complexities and ambiguities in decision-making processes (ibid.:178) that increase in governance contexts. Second, principal-agent theory assumes that there are actors that can clearly be ascribed to the area of politics on the one hand and actors that belong to science on the other, and that we need institutions to mediate between these two sides. In this model, science, politics, and intermediaries are united in a mutual contract, and functions are delegated between these three classes of actors. In a governance context, however, new intermediary institutions arise in various different forms and contexts, such as science museums, stakeholder forums, or observatories. Importantly, these new institutions frequently have in common that they are made up of and intermediate between many different actors from science, government, and society. Thus, in a governance situation, a whole range of new actors, also intermediary actors, emerge that do not easily fit into the model of principal-agent theory. For instance, the delegation processes and functions are not clear-cut in complex and contingent governance settings. Hajer and Wagenaar (2003) highlight this in their influential work about governance in the network society:

> Characteristically, these new spaces of politics initially exist in an *institutional void:* there are no pre-given rules that determine who is responsible, who has authority over whom, what sort of accountability is to be expected. (Hajer & Wagenaar 2003:9)

As a result of the turn to governance, traditional approaches such as principal-agent models and 'boundary organizations' can no longer sufficiently grasp the interactions of intermediaries. As the quotation above by Hajer and Wagenaar illustrates, it is no longer clear who has authority over whom, who belongs to which side, which functions are distributed, and who is delegating what. For example, principal-agent theory provided the explanation that an intermediary institution emerged—such as the chemical division of a regulatory agency—because the government delegated power to control scientific and technological developments to this chemical regulations division. However, in a governance context, a multitude of heterogeneous actors are involved in scientific and technological developments as well as in the governance of research and development. Now, an intermediary institution might, for example, emerge without a clear mandate, so that the question of "why did this intermediary emerge" is suddenly an open question and is not reducible to an obvious process of delegation. In sum, it might no longer be clear who the agents, the principals, and the actors of intermediary institutions are, how they can be differentiated from one another, and what their functions are. This is due to a hetereogenization of actors and the emergence of a variety of mechanisms and strategies in new governance contexts (Gottweis 2005). We see that the turn to governance has increased uncertainty.

Considering this uncertainty, I propose shifting the focus of research away from idealized explanations of intermediary institutions toward the analysis of context-based case studies and to address specific questions: what were the conditions of possibility for a particular intermediary institution to emerge, what characterizes its practices, and how can we evaluate its success in this particular context? Hence, I argue that, in a governance context, we should

not strive for applying generalizable theoretical models such as principal-agent theory or 'boundary organizations'; instead, our analytical focus should be on the micro-level of specific cases of intermediary institutions. This suggestion is based on the assumption that reality does not precede the mundane practices in which we interact, but is rather shaped within those practices[3] (Mol 1999:75). Thus, all entities are produced in relation to each other (Law 1999:5f), and realities are 'historically, culturally and materially located' (Mol 1999:75). The ontology of such an approach acknowledges that the conditions of possibility are not given (Howarth 2000); thus, the approach would do justice to the radical contingency of reality and to the importance of context. In both actor-network theory (ANT) and political discourse theory (Howarth 2000, Torfing 1999, Howarth & Glynos 2007), we can find theoretical and methodological approaches that acknowledge ambiguity and contingency. Drawing on these two bodies of literature, I will outline a threefold framework for studying intermediary institutions that does justice to the uncertainty characterizing the governance contexts in which new intermediary institutions operate.

First, we should analyse the conditions of possibility for an intermediary actor such as the ObservatoryNANO to emerge. I suggest that studies of intermediary institutions must consider the contextual embedding and historical situating of each intermediary institution. In other words, if it is assumed that a nanotechnology observatory is needed, then we must analyse how the conditions of possibility (necessity) have been established. Thus, the first aim of the analyst of an intermediary must be to interpret social practices by situating their meanings in broader historical and structural contexts (Howarth 2000: 11–12). In this respect, the approach that this paper employs can be categorized as one branch within an 'institutional constructivism' that draws on recent post-structuralist approaches to policy analysis. When we approach intermediary institutions from this angle, they are understood as 'sedimented discourses' that, despite their contingent and fleeting political origins as products of hegemonic practices, have become relatively permanent and durable (Howarth 2000: 120). Importantly, for our purposes the term 'discourse' does not mean discussion or communication strategies; rather, discourse refers to a specific set of ideas, concepts, and categorizations that are produced, reproduced and transformed in social and political practices (Hajer 1997:110f). In short, a new intermediary institution emerges in a context in which a certain discourse, for instance the 'responsible development of nanotechnology,' became hegemonic.

Nevertheless, in a second step, I argue that we must not take this 'sedimented terrain' (West 2011:428) for granted. Once a discourse has sedimented—and thus an intermediary actor has emerged—we must analyse what characterizes its social practices. The problem is that an intermediary can be taken as a black box and indeed often is recognized as a black box (Latour 2005:39). Thus, an intermediary actor is an actor that translates between actors, but '[h]ow the actors inside the black boxes transform or translate inputs into outputs becomes

[3] However, I think this assumption based on Actor-Network theory needs to be mitigated. I return to this below when I introduce the concept of logics.

unimportant' (Kaghan & Bowker 2001:258). This is a problem if, for example, we want to find out how illusive visions such as responsible development or reflective governance are translated into concrete policy practices. My argument is that we need to open this black box and interrogate into intermediary practices. Therefore, I suggest that Latour's definition of the 'mediators' (which he indeed conceptualizes as the opposite of intermediaries) provides a fruitful guiding definition for understanding intermediaries. To that end, read "intermediary institution" instead of "mediators" in the following quotation:

> Mediators, […], cannot be counted as just one; they might count for one, for nothing, for several, or for infinity. Their input is never a good predictor of their output; their specificity has to be taken into account every time. Mediators transform, translate, distort, and modify the meaning or the elements they are supposed to carry. (Latour 2005:39)

Hence, I introduce a definition of intermediary institutions that points to their contextuality and to the contingent, multidirectional practices they engage in when they translate information to different actor networks in the field. This definition also indicates why the application of principal-agent theory is a problem (and especially so in complex, dynamic governance contexts): *the intermediary institution can never be a clearly definable entity standing between actors, but it is indeed an actor network participating in different actor networks with a fluidity of memberships and roles.* It follows from this that in the study of intermediaries we should focus our analytical attention on the movements and translations of the intermediary institution. Focusing on the translation work done within the intermediary is important because intermediaries 'do not only move knowledge, but they also produce a new kind of knowledge: brokered knowledge' (Meyer 2010).

> Intermediaries are not passive […] They force, tear out, knit together; they have tools and techniques for isolating, measuring, testing. Nothing is given in advance for them. (Hennion 1989:402)

This quotation by Hennion alludes to the dynamics of movements and translations that occur in the practices of the intermediary. Therefore, we need to shift our analytical attention to the level of practice.

I have suggested that we should first analyse the conditions of possibility for an intermediary actor to emerge and that we should then study the intermediary's practices. However, a study that stops at that point would provide only detailed, context-based case studies without significance for the work of intermediaries in general. Thus, while idealized approaches run into danger of subsuming concrete cases under universal concepts (such as boundary organizations or principal agent), the empirical study as I have proposed it so far would likely

limit any explanation of an intermediary in question to the particular context of the case (Glynos & Howarth 2007).

Third, and finally, the theoretical and methodological approach of the study of intermediary institutions that I propose here therefore asks what is coherent in the analysed practices of the intermediary in question and what characterizes these practices on a more general level. It is because of this targeted context-based generalisation that we need a new theoretical vocabulary. To get at how to characterize practices, we must introduce the concept of 'logics'. In essence, 'logics' refers to a coherent or programmatic way of acting (Anderson 2010:78). In other words, logics characterize the purpose, form, and content of practices (Glynos & Howarth 2007:106). What makes the concept so useful is that logics always are 'contextual entities, arising in particular historical and political circumstances' (Glynos & Howarth 2007:137). In contrast to idealized accounts of intermediary organizations, logics thus allow us to consider context. But a logic nevertheless exceeds a specific case and characterizes a certain type of reasoning (Anderson 2010). Logics 'work through a 'mutual presupposition' between the logic and the concrete assemblages of actors (the state, consultancies, think tanks, etc.) involved in governing liberal life' (Anderson 2010:78). In other words, the logics concept bridges contingency and regularity, and it forms the third and final component of my threefold theoretical framework.

In the second part of the paper I will use a case study to try out this threefold framework. The case study is an Observatory project for nanotechnologies, which can be characterized as an intermediary institution. The ObservatoryNANO was a European research project established in 2007 to observe and monitor developments in the nanotechnology field. This large project counted about 16 members in ten countries. Its main task was to observe scientific and technological developments in the nanotechnology field, to inform decision-makers with this up-to-date information, and to integrate diverse actors and topics in nanotechnology governance (i.e., the observations ranged from observing economic trends to considering ethical and social issues of nanotechnology). I worked on this project for two months in 2011 within a work package through the Technical University of Darmstadt. Our task was to facilitate a critical self-evaluation by the participants of the project of the emerging model of a "nano-observatory"[4].

Methodologically, my first question (on the conditions of possibility for the emergence of an intermediary) can be answered by discourse analysis. In this paper, the respective section is based on a dissertation work on nanotechnology governance, including extensive document analysis and 35 narrative interviews (Åm 2011). Steps 2 and 3 (on practices and logics) ask for an enquiry into the situation of practices themselves (West 2011:423). Since our team from the Technical University of Darmstadt was involved in a work package of the ObservatoryNANO, we had good access to its practices as 'observers of the observers.'

[4] Indeed, I contributed to the work of that team first toward the end of the ObservatoryNANO. The main team members were Stefan Gammel and Alfred Nordmann.

Finally, I considered it useful to analyse reactions to the Observatory. For this purpose, I conducted interviews with 10 nanotechnology experts outside the Observatory and interviews with 4 governing board members.

Conditions of Possibility for the ObservatoryNANO

By taking the above suggested threefold framework into account, I will demonstrate in this sub-section the conditions of possibility that allowed the ObservatoryNANO to develop. First, however, we need a brief explanation of what nanotechnology is and how it is perceived and implemented. Nanotechnology is considered to be a systemic technology that induces pervasive transformations in society. In general, the characteristics of elements change at the nanoscale, because mechanical physical laws are interfered with by quantum mechanics (Kulinowski 2006:16). Nanotechnology seeks to use these changed characteristics for new products and new manufacturing processes that manipulate atoms and molecules. As a discipline, nanotechnology cuts across heterogeneous and previously unrelated research fields ranging from physics and micro-electronics to chemistry or molecular biology (Williams 2006:331). In addition, nanotechnology appears to have endless possibilities of application. The potential applications of nanotechnology are so broad that nanotechnology is considered by some to be a panacea for almost any problem humankind faces (Kearnes & Macnaghten 2006:282). Therefore, nanotechnologies take high priority in many research and development policies worldwide that consider nanotechnologies to be key technologies for the 21st century.

However, appeals to the advances offered by nanotechnology cannot be divorced from the potential negative flipside of using these new properties that arise only at the nanoscale deliberately in nanotechnology. In short, it is uncertain but possible that nanomaterials bring new risks. For example, the element gold, which is yellow and inert as a bulk material, becomes red and toxic (Hunt 2006:49) in a certain particulate form. Since 2002, discussions have arisen about the environmental, health, and safety aspects of nanomaterials, as well as about the social and ethical impacts of nanotechnology. These discussions have been driven by rising dystopian fears that nanotechnology may be yet another technological development that could spin out of control and threaten life on earth, including humankind (Joy 2000, ETC Group 2003, Crichton 2002). To understand these fears, we should consider that nanotechnology emerged in the shadow of strong and pertinent environmental movements, public protests against genetic engineering, and a loss of trust in public institutions after the BSE crisis (Pidgeon & Rogers-Hayden 2007:194). Part of this policy legacy of the GMO and BSE experience is that the public dialogue on science-based policy-making and on the ethical, legal, and social aspects (ELSA) of science development became increasingly commonplace in Europe, eventually settling as a legitimate and expected feature in policy-making of technology governance. Policy-makers now often assume that greater public consultation can eliminate opposition to technical change by creating social consensus which is conceived as a

necessary condition for the political acceptance of emerging technologies (Gottweis 1998:276, Irwin 2006:299).

Against this historical context, nanotechnology became largely regarded as offering an opportunity to apply ‘learned lessons’ in politics and ‘to get it right the first time’ (see, e.g., Goldenberg & Einsiedel 2006, Balbus, Denison, Florini & Walsh 2006, Kenneth & Thompson 2008, Metha 2006). From the first publications in nanotechnology governance and onward, the concept of responsible development has characterised the nanotechnology policy field. For example, the well-known UK Royal Society and Royal Academy of Engineering (RS/RAEng) report on nanotechnology published in 2004 introduced the concept of responsible development, which it referred to as the means to “address many of the potential ethical, social, health, environmental, safety and regulatory impacts, and help to ensure that nanotechnologies develop in a safe and socially desirable way” (RS/RAEng 2004: 83). Since then, policy statements on nanotechnology frequently offer a thorough discussion of the ethical, societal, and health implications of a technology that is, supposedly, still in its infancy. Nanotechnology-related policy documents routinely recommend that nanotechnology should be handled responsibly, transparently, and with a willingness for dialogue. We see that the discourse of 'the responsible development of nanotechnology' managed to gain hegemony:

> [T]he various initiatives that constitute the emerging governance landscape of nanotechnology have culminated in the discourse of 'responsible development' which has materialized in recent years in nanotechnology policy. The discourse operates as a meta-framing of the governance of nanotechnology, emphasizing mechanisms that enable the 'benefits' of nanotechnology to be realized whilst innovating strategies for avoiding possible negative consequences. (Kearnes & Rip 2009: 114)

As the quotation by Kearnes and Rip indicates, responsible development incorporates both advocates of nanotechnologies and its critics. The idea of a *balance* is crucial to the responsible development of nanotechnology: Its promise is to guarantee benefits and to ensure that there will not be negative effects. The ‘responsible development of nanotechnologies’ enacts a ‘coalition of ‘yes’-sayers’ that includes a range of actors from technophiles to sceptics (Nordmann & Schwarz 2010). The ‘responsible development’ concept is well-suited for this function, because it is an ambiguous concept that involves multiple meanings so that different views and opposing policy desires can be integrated (Jasanoff 2004: 27, Stone 2002: 158). Central to the stabilization of responsible development as the hegemonic project in the nanotechnology field was, in addition to its ambiguity, the historical context of experiences with GMO. Nanotechnology governance came to be hailed as a turning point in approaching new technologies, whereas the governance of genetic engineering became cast as the dismissed Other. Policy-makers imagined that public protests could become a barrier to nanotechnology development, so united in the 'responsible development of nanotechnologies,' they endeavoured to pre-empt this threat (Åm 2011).

Once the idea of the responsible development of nanotechnology caught on, the question emerged of how nanotechnology can be operationalized. Important elements in its operationalization are to anticipate developments and to come in early to steer developments before they veer in a negative direction. Therefore, *upstream engagement*, *monitoring*, and a better and wider foresight (*anticipation*) are (next to keeping a *balance*) important elements of the responsible development of nanotechnology. For the implementation of these elements, nanotechnology governance is marked by a search for appropriate institutional settings. For instance, the governance and regulation of nanotechnology reveal a proliferation of a range of voluntary mechanisms, particularly 'codes of conduct' for the 'responsible development' of nanoscience and technology. In addition, a range of intermediary organizations have been created – for example, the UK 'Nanotechnology Stakeholder Forum', the German 'Nano-Commission', the ObservatoryNANO – to mediate between the research community, society, and policy-makers in the development of nanotechnologies. In the ObservatoryNANO, the balance, monitoring, and anticipatory elements are strongly present.

In the ObservatoryNANO, we see efforts to maintain a balance in that the observations of the nanofield were planned to take place within a broader framework that also took account of ethical and societal issues; potential health, safety and environment impacts; and new regulations, legislations, and standards (ObservatoryNANO Proposal). The project operationalized "responsible development" in that the list of work packages included social and ethical issues, health and safety issues, as well as regulations, although the analysis of scientific, technological, and economical developments in the nano area was at the heart of the ObservatoryNANO project. Early drafts of the ObservatoryNANO project proposal show that the applicants were eager to demonstrate that potential eco and human risks of nanotechnologies received as much attention as the potential benefits of nanotechnologies. The applicants considered this balance to be essential for a successful proposal.

In sum, we see that responsible development constitutes a hegemonic discourse that forms the conditions of possibility for institutions such as an ObservatoryNANO to emerge. In the next section, I will analyse how subjects in fact translated the discourse of 'responsible development' into practices by operating as an ObservatoryNANO intermediary institution. Responsible development and reflexive governance are highly valued, frequently cited, and yet ill-defined policy goals. How these elusive visions are translated into concrete policy practices, has been studied relatively little. A critical eye on the practices allows us to show how hegemonic discourses are reinforced but perhaps also resisted and loosened (West 2011:428). Thus, rather than black-boxing the ObservatoryNANO as 'responsible development' institution, I will shed light on the ongoing work within it.

Case Study: The ObservatoryNANO Project

In 2008, the members of the newly established ObservatoryNANO project met for the first time in a workshop designed for them to get to know one another and to plan the work to be done in the next four years[5]. The project was funded by the EU FP7 programme. Its mandate was

> [t]o create a European Observatory on Nanotechnologies to present reliable, complete and responsible science-based and economic expert analysis, across different technology sectors, establish dialogue with decision makers and others regarding the benefits and opportunities, balanced against barriers and risks, and allow them to take action to ensure that scientific and technological developments are realized as socio-economic benefits. (http://www.observatorynano.eu/project/about/)

The task assigned to the ObservatoryNANO was, thus, to inform European policy through an 'objective analysis' of nanotechnology development. In addition, we see in the quotation above that the mandate assigned the Observatory a proactive role to promote technological progress. The ObservatoryNANO brought together a range of actors[6] who had been selected as part of an effort to collect leading European nanotechnology experts. From the beginning, six working groups were formed that would independently assess the impact of nanotechnology in various fields. In this composition of work packages, the nanotechnology field was organized as follows: science and technology assessment; economic impacts; ethical and societal impacts; regulation & standards; and environmental, health and safety impacts. Our team from the Technical University of Darmstadt was tasked with providing a critical self-evaluation of the project and thus to prepare the kind of reflection that is developed here. The composition of work packages reflects that the Observatory also wanted to monitor ethical and social issues of nanotechnology, as well as risk and regulatory aspects. We see thus how the project translated particular demands of a responsible-development discourse into the Observatory's structure.

We observed that the project quickly met the challenges of defining the object of interest, the methods, and the baseline against which learning and feedback mechanism shall occur: What

[5] Initiators (the EC DG Research) established the observatory as a short-term project-based activity. But the successful applicants who received the grant hoped that the observatory could be established as a new, permanent institution within four years. However, the ObservatoryNANO ran out in March 2012 and will not be continued.

[6] The ObservatoryNANO project was mostly led by the Institute of Nanotechnology (IoN) (UK), and it included (with partly shifting membership): VDI Technologiezentrum (DE), Commissariat à l'énergie atomique (CEA) (FR), Institute of Occupational Medicine (IOM) (UK), Malsch TechnoValuation (MTV) (NL), triple innova (DE), Spinverse (FI), Bax and Willems Consulting Venturing (B&W) (ES), Dutch National Institute for Public Health and the Environment (RIVM) (NL), Technical University of Darmstadt (TUD) (DE), Associazione Italiana per la Ricerca Industriale (AIRI) (IT), Nano and Micro Technology Consulting (NMTC) (DE), Swiss Federal Laboratories for Materials Testing and Research (EMPA) (CH), University of Aarhus (DK), MERIT - Universiteit Maastricht (NL), Technology Centre AS CR (CR). http://www.observatorynano.eu/project/about/

is it a nanotechnology observatory observes? An ideal observatory project or monitoring unit – be it on nanotechnologies, environmental pollution, or economic growth – should start its work by identifying knowledge gaps and with defining its object of interest. The problem of finding a focus was reinforced by the complexity of defining nanotechnologies. One governing board member brought the delicacy of the problem of defining nanotechnology to the point:

> If in three years, 'nanotechnology' as a term disappears, what's the point of having a "nano-observatory"? There is no object of observation. The Observatory in this case would need to grasp the cross-linkages but this is difficult. (Interview material: Governing board member)

We witnessed that the ObservatoryNANO discussed the issue of the object of observation in at least three distinct ways: One can, for example focus on a technology (focusing on the transfer from basic capabilities to selected applications), on a sector (focusing, e.g., on how the 'green car' is developing), or on policy instruments (focusing on their effect on technologies or sectors).

Interesting about the ObservatoryNANO were the dynamics of how the project responded to the dynamic of the governance context in which it operated, when it was confronted with altered demands. Particularly interesting were, for example, the different moves the Observatory made in presenting results. In the beginning, the question of the addressees was prevalent, as when the setup of the homepage was discussed: Did the Observatory generate information for 'the' public, for the European Commission (EC), for the European Parliament, or for other researchers? However, the Observatory slowly adopted a consulting function mainly addressing the EC's Department General (DG) for Research. The project also adapted to this addressee. After the first year, the project partners realized that policy-makers do not read 100-page reports. This initiated a learning process, which resulted in shorter, crispier reports that focused on what was considered to be hard facts. Two-page fact sheets became key deliverables. But the problem remained of how to convert a 100-page report into fact sheets. This process necessarily resulted in many omissions from and simplifications in the fact sheets. The full explanations and nuances remained in the long reports that the policy-makers did not read. The process of changes in the ObservatoryNANO, the adaptations and attempts to optimize and a lack of discussion of the implications of these changes struck us in our participatory observations. That does not mean that there were no discussions at the ObservatoryNANO meetings. Indeed, dissonances occurred during the work period; for example, some participants were critical about what they perceived as an overemphasis by the Observatory on gathering economic data. The project leaders justified that focus by referring to the European Commission's articulated demands. In fact, the project revealed the inherent difficulties of a holistic observatory that attempts to cover all aspects of nanotechnology.

By 2012, the ObservatoryNANO had translated its observatory data into texts, including a map locating nanotechnology industries around the world, an ethical toolkit, and a European Nanotechnology Landscape Report. The results produced by the various working groups range from general sector reports on 10 selected technology sectors[7] to briefings, factsheets, newsletters, and annual reports. These outcomes are of central importance for a theoretical perspective that considers the material effect of the institutionalisation of new intermediary institutions because these texts participate in a 'circulation of transformations' (Latour 1999:22) in which nanotechnology is translated into texts and figures. The Landscape report is an illustrative example of how the Observatory worked. The report aimed at showing how nano-enabled solutions might contribute to solving so-called global challenges (such as an ageing population or a sustainable energy economy). This focus implies choices about what an observatory is actually observing:

- Assessing potential nano-enabled solutions is not the same as assessing the state of nanotechnology in general.
- Dead ends or slow developments are not registered.
- Nanotechnology applications are not evaluated against, for instance, stated expectations and promises.
- Nanotechnologically enabled solutions are not evaluated against other solutions, including non-technical ones.
- The Observatory risks to reiterate stereotypical commonplace diagnosis of society's problems.

This list covers only the most critical problems with this kind of reports. In the following, I will critically explain problems as these on a more general level.

Logics Employed by ObservatoryNANO in Navigating the Paradox Demands of the Governance Context

In this section, I will examine the practices the Darmstadt team identified in the ObservatoryNANO on a more general level. The aim is to elicit what is coherent in these practices and to identify how these practices may be generic for certain kinds of intermediary institutions. To bundle and name these characteristics, I employ the logic concept. For this critical explanation, we complemented our own observations with an evaluation of the

[7] Aerospace, automotive, and transport; agrifood; chemistry, materials, and construction; energy; environment; health, medicine, and nanobio; information and communications; security; textiles; patent analysis; and publication analysis.

ObservatoryNANO by nanotechnology stakeholders, in particular, whether they found the kind of operation and functioning of the ObservatoryNANO to be productive or not.

To start this critical explanation of the observed practices, it is useful to reflect on how the intermediary translates its object of interest (i.e., nanotechnology) into texts. In the case of the ObservatoryNANO, the intermediary institution does not only translate between human actors but also between nanotechnology ('thing') and complex assemblages of actors, such as the European Union. At the same time, the ObservatoryNANO does not represent 'a nanotechnology' because nanotechnology is not 'out there'. In fact, the observers are forced to translate what nanotechnology is and might be 'into [a] more or less standardized form in which its properties can be measured, recorded and made visible' (Barry 2001:154). In the world that an observatory observes, nanotechnology is enacted in many different ways and places; 'there are myriad practices which to the outside observer (and even to those immersed in those practices) appear to be trained on the same object but which are, in fact, enacting subtly different 'realities'' (West 2011:424). Thus, an observatory knits together pieces of information, producing a particular perspective on nanotechnology. Therefore, such an initiative would necessarily strive for a grid, which makes nanotechnology measurable and comparable. But this is exactly what the ObservatoryNANO did not manage; it did not compare and it could not compare due to shortcomings such as those listed in the bulleted list above.

Therefore, the main addressee of the intermediary, the European Commission, was dissatisfied about the outcome of the Observatory. At the final workshop of the ObservatoryNANO, Christos Tokamanis, Head of Unit 'Nano and converging Sciences and Technologies' at DG Research, EC, took issue with the Observatory not devising a model of measuring progress. He wanted to know what products were on the market, what its nano-content was, where they came from, why certain applications never become marketed, and what role public demands play in the process[8]. Tokamanis's statement shows how governing institutions 'are anxious to ensure that economies are performing technologically and that measures exist to monitor their performance, in order that it might be improved' (Barry 2001:210). Unfortunately, the Observatory did not and could not satisfy these demands because of the complexity of the nanotechnology field and because of competing expectations about its performance.

Indeed, the output of the Observatory could not reduce uncertainty because its work did not merely describe nanotechnology; rather, it contributed to bringing a certain perspective on nanotechnology into being. This might be particularly true for the Observatory's estimation of future developments. As a matter of course, ObservatoryNANO included forecasts in its work. A *logic of forecasting* could be said to characterize the Observatory's reports on science and technology developments. Indeed, many intermediaries take on the task of foresight.

[8] ObservatoryNANO Final Workshop, 1 March 2012, Brussels; compiled from notes by participants.

Exercises in foresight are part of consulting governments on how to set priorities in science policy (Van der Meulen & Rip 1998:758). This fits a general trend in governance contexts that governments, in order to act as a centre, must accumulate facts, particularly in the form of statistics, about the field being governed (Miller & Rose 2010:66). These calculations act upon reality in a particular way. Ebeling (2008) concluded that foresighting into the nanomarket essentially contributed to creating the field. In the effort to build a new technological market out of nanotechnologies, actors make a multiplicity into a singularity - nanotechnologies become 'nanotechnology' - and a widely dispersed marketing potential becomes a single market (Ebeling 2008: 346).

If we accept that there are various forms to enact ‘nanotechnology observing’, it might seem obvious that participants of the Observatory make a choice. However, the nanotechnology observers did not acknowledge the extent to which they operated as filters, because they presumed that doing so could take away their legitimacy. Thus, many practises linked to the ObservatoryNANO were marked by a strong belief in – what was considered neutral – expert knowledge and wish for scientific procedures. The aim of the ObservatoryNANO project was to deliver ‘facts’ without recommendations. I conceptualize these practices as governed by *a logic of scientification*, a term that captures how the social practices of the observatory members – and especially of the leadership– were marked by demands for factuality and evidence-gathering. In such moves of scientification, nanotechnology is articulated as technical matter (in contrast to it being a potentially controversial, political matter) (Åm 2011). However, this ignores the profound interventions of intermediaries. The results of observatories influence decision-making. At the same time, observatories take important decisions themselves, which may include decisions on structures, on focus, on which information to choose, as well as decisions on methods or on the presentation of methods. To guarantee the legitimacy of the results produced, it is therefore tremendously important to provide for rigour and transparency in these constituting decisions.

The question then is whether the ObservatoryNANO established and followed protocols for taming the differences and confronting them, or whether differences were simply held in abeyance and with what consequences (West 2011:425). We observed that these decision moments were not explicit in the Observatory’s work. Even for those who were part of this project, these moments were not detectable. Categorisations and the way forward developed continuously and over time. But we do not wish to criticize this here. In fact, our practice-oriented approach assumes that decision-making necessarily is messy, unplanned, and often silent. However, it is important to acknowledge that the ObservatoryNANO did not reflect upon this.

There is in fact an irony in that the ObservatoryNANO operated along *a logic of scientification* when at the same time it was committed to ‘responsible development’ that promotes constant awareness of the implications of actions. In contrast to the responsible development demands for transparency and dialogue, the belief in science and neutral

knowledge, expressed in a logic of scientification, masked practical problems and human decisions in defining the field, the variables, and the methods. Actors explained away the multiplicity (West 2011:422). This contradiction led to ambivalent evaluations of the Observatory by our interviewees; several of whom addressed the intransparency of choices and the lack of reflectiveness as issues.

This problem that the *logic of scientification* constitutes to responsible development is founded in the ambivalent mandate of the Observatory that wants the intermediary to provide for impartial expert analysis but at the same time demands that it take action to support nanotechnology's development. One interviewee made a general recommendation for any kind of observatory:

> Everything which is connected to lobbying or which has a touch of clientelism has to be eliminated; otherwise the information provided is not legitimate for political consulting. (Interview material: Economist)

And another interviewee said explicitly about the ObservatoryNANO:

> If you are observing, you should just observe. Don't make nanotechnology sexy, don't make the public trust, but make nanotechnology trustworthy. An observatory should stand above the pro and the con side. (Interview material: ELSI expert)

The last quotation reveals that, in the interviewee's opinion, the Observatory did not live up to the ideal of maintaining the balance between risks and benefits that is central to responsible development. Both of these quotations illustrate that intermediaries are faced with strong demands for impartiality. In fact, a neutral and independent position of intermediary actors is generally presumed (Klerkx & Leeuwis 2009). That is, a *logic of scientification* might be a generic feature of the practices of intermediary institutions, even though my analysis stresses that this aim is not achievable because of all the choices involved in knowledge production.

In addition, the ObservatoryNANO's ignorance about its own role as an actor reveals the key paradox of new intermediary institutions in governance contexts: The organization does not operate along a clear-cut line of who the actors and who the intermediaries are, as supposed by principal-agent theory. Indeed, there is no difference between the observers, the observed, the actors, and the stakeholders in the ObservatoryNANO. Apparently no one in the organization considered it necessary 'to describe the social world from an 'exterior' position that removes the observer from the world being described' (Laurent 2011). This is in fact the main problem of observing: There are no observations without an observer. Hence, there are no observations without interventions. This is a general problem of new intermediaries in governance contexts: 'the position of intermediary organizations is contested because they are in interaction with a heterogeneous set of actors, and their objectives and functions are not as

well-defined as those of other actors in the innovation system' (Boon et al. 2011:250). Paradoxically, intermediaries are often demanded, but once they have been established, actors do not know how to use them and the intermediaries can become to be perceived as expending funds on a process that would be achieved anyway by other means (Klerkx & Leeuwis 2009:857). One of our interview quotes illustrates this paradox clearly:

> For me, the ObservatoryNANO is not a source I would consult, when I am looking for something. When I need information, I go into my networks. There are already so many actors around. And these actors, that are there, they are trustworthy and they make relevant statements. And … I have never heard anybody (and I am really much around in Brussels and other areas) who would refer to the ObservatoryNANO. Nobody quotes these reports. Hence, this is no source [that] I would use. (Interview material: Industry representative)

This quotation points to the prevalent heterogeneity of governance actors and exemplifies why our critique of the ObservatoryNANO must be balanced against the governance context in which intermediary institutions operate today. Shortcomings are grounded not merely in the logics of the Observatory but in its context, as well. In general, the 'attention-deficit' of policy-makers was a topic of concern for those involved in the Observatory. In the beginning, the Observatory was dedicated to delivering facts and it provided long and detailed reports. However, the project members learned that policy-makers do not take the time to read such lengthy reports. A respondent said:

> This is a general problem, and indeed the question of mandate (neutral knowledge, information generation) and policy-making cannot be resolved. Policy-makers give money to produce information, but then they don't want to read the reports. But they also do not read the factsheets. In fact, what they need are indications [of] whether they should do something or not. The best you can expect from an Observatory as this one is to create awareness of possible issues. (Interview material: ELSA expert)

In a similar vein, Bernadette Bensaude Vincent wrote in a critical comment on the Observatory in 2012 that the European Commission required that the reports be shorter and shorter, but even two-page factsheets proved too long to receive attention. Therefore, we must consider in the analysis of intermediary institutions that intermediaries are in competition for the attention of policy-makers in a governance landscape marked by a multitude of actors. Governance is about not only a functional re-organization of politics but also about power relations. Certain developments in the ObservatoryNANO that changed the mandate of providing knowledge into the practice of providing recommendations (such as the move to factsheets) must be seen as strategies to meet these challenges.

Conclusion

In this paper, I introduced a theoretical perspective to address the conditions of possibility for the emergence and practices of a new intermediary institution. The issue at stake for intermediaries in a governance context is uncertainty (expressed in contingency, contextuality, and a heterogeneity of actors). The issue at stake for *studies on* intermediaries is that a principal-agent approach is not fit to grasp and explain the work of new intermediary actors that emerge in dynamic governance contexts. Taken together, my approach enables a mode of enquiry that aims to understand the conditions of possibility for the rise of new intermediary institutions, their programs or governing instruments, and their contingent, multidirectional practices of operation. I first provided a discursive understanding of conditions of possibility for the emergence of the ObservatoryNANO project by situating it within the context of the hegemonic discourse 'responsible development of nanotechnologies.' I then showed how the 'responsible development of nanotechnology' is translated into practices by the ObservatoryNANO. I argued that the Observatory—necessarily—enacted nanotechnology and 'nanotechnology observing' in a particular way, although without awareness. The Observatory subscribed to a strong belief in scientific, and thus supposedly neutral and objective, knowledge in order to gain legitimacy. But this was exactly how it lost legitimacy: It did not acknowledge its own role as actors and thus disappointed demands of a 'responsible development' discourse such as transparency and reflectiveness. Finally, it could not commit enough actors to stabilize the project so that it did not turn into a permanent institution.

I introduced logics as new theoretical vocabulary for the study of intermediaries. By way of summary, I characterized the operation of the ObservatoryNANO, which is an ambiguous intermediary institution, along two concepts. For the first dimension, I used the label *logic of forecasting*, which refers to how the practices of the Observatory are characteristic of a certain type of reasoning that brings the future in a calculable form by estimating how nanotechnology-related markets would develop. The second dimension I labelled *logic of scientification*, which captures how the Observatory assumed that the assemblage of actors for which the results of the Observatory should be relevant (e.g., the EC's DG Research) expected statistical calculations, and how it aligned its practices along these presumptions. What makes the concept so useful for future studies of the governance of science is that 'logics' are contextual entities. They exceed the particular case and provide a link to context. For example, the *logic of foresight* shows that broader foresight assessments, which I observed in the practices of the case study, are an expression of a particular historical and political circumstance (viz., the responsible development of nanotechnology). At the same time, I argue that both logics observed in this case say something more general about how new intermediary institutions work at the science policy nexus: Intermediaries want to provide policy guidance with evaluations of future developments, and they claim to provide neutral expert knowledge. In other words, the 'logic' approach is important because it reveals what characterizes the practices of intermediary institutions beyond my analysed case. In sum,

the logic concept is important to get a grip on the complexity, contingency, and materiality of practices and to show how the practices are intertwined with certain conditions of possibility.

Certainly, my claims with respect to employing this three-fold framework combining political discourse theory and actor-network theory to the study of intermediary institutions necessitate testing regarding for their applicability. It is important that the analysis suggested here not be misunderstood. For one, I do not at all suggest that one should analyse how much intermediaries act according to a logic of scientification or forecasting. Rather, I suggest that the emergence and work of any intermediary institution first has to be comprehended within its context. If an analyst, for instance, studies architects in consultant companies and their intermediary role in households' climate adaption, she must understand the context of the building sector in a certain region and issues such as occupational identity. Second, if we too quickly come to assume that an intermediary works according to its mandate or program, we will gloss over idiosyncratic interpretations of policy discourses or over new and unexpected practices and over the logics informing them. An architect consultant that presents himself as a sustainable actor might, for instance, in fact engage in 'green-washing' while other architects might promote energy efficient solutions without promoting her sustainable consultancy role. Third, we must evaluate the work of the intermediary against its context and supposed function, because an intermediary does not become an actor by itself. Indeed, it is the intermediary's subjectivity, intentionality, and morality and how it hooks up with other circulating entities that provides an intermediary with actoriality (Latour 1999:19). Therewith, this paper is also an appeal for researchers of the governance of science to study intermediaries empirical with ethnographic, praxis-oriented methodologies. Digging into the 'complexity of the empirical' (Barry 2001:22) offers the only way to identify the potential gaps between intended policy program, such as responsible development, and the contingency of how messy practices turn out to be.

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