Disciplinarity and value commitment: disciplinary rationales and competing approach to knowledge creation and assessing new-emerging innovation.

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Abstract: The Horizon 2020 framework programme for research and innovation is promoting an approach referred to as *Responsible Research and Innovation* (RRI).[1] Mandates to implement and mainstream RRI are already evident, whereby **interdisciplinarity** and **integration** are treated as pre-given in accounts of what the RRI approach is in practice. In this paper, our point of departure is to ask what to expect realistically when experts and professionals are brought together across disciplines, institutions and national borders in practical attempts to achieve interdisciplinarity and integration of approach to innovation. We revisit Woolgar's and Ashmore's treatise on social epistemology in their development of the *reflexive thesis* in the late 1980s, and we revisit the *turn to practice* in STS in the early 2000s. We present our analysis of commitment to matters of practical sensitivity and reflexivity in reference to the philosophical influences and study objectives of the reflexive thesis and the practice turn and we consider how sociological studies have articulated expert practices and the use of knowledge and skill. We address the epistemological challenges innovation assessments face in justifying the relationship they draw between study objects, observation, interpretation and representation and in justifying ideologically and methodologically their own production of knowledge about how *others* produce knowledge. We address the implications this work has for the development of interdisciplinarity and integration in case studies we have observed, of evaluating new-emerging innovation domains. We argue that the consequences of advancing reflexivity (or awareness of it) as a progressive step forward, rather than a problem to remedy, is critical in shaping a more balanced approach to innovation, even though achieving interdisciplinarity and integration is fragmented and partial.

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[1] See https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation .

Introduction

This paper draws on research embedded in a larger project which was designed to better understand the roles of formal and informal assessment methods with the aim to '*contribute to shaping an integrated framework, conducive to a better and more balanced assessment of emerging sciences, technologies and related societal innovations*'.[2] The project partners have conducted four case studies of new-emerging domains of innovation to explore how different types of assessments come into play with reference to the promises and achievements of each of these domains: 1) wearable sensors for health and self care, fitness and wellbeing; 2) autonomy in robotic systems for care and companionship; 3) synthetic/in-vitro meat, and 4) the future smart grid. We will not dwell on the details of each of these cases, i.e., what they discovered about research and development trends and future visions within the respective innovation domains, nor what they reported of relevance to policy involvement and intervention. That information is readily available elsewhere.[3] The research presented addressed our agency of *observation* and *reflexivity* to support internal examinations within this larger project. of how the different assessment frameworks might achieve disciplinary approximations within each case study. More specifically, this paper explores how to make sense of the initial stage of establishing mutual working recognition of the assessments used amongst case study partners.

We argue that a carefully considered orientation to practice and disciplinarity is strongly suggestive of pathways towards better and more balanced assessments of the innovation domains in question. It provides the framing to discuss and reflect upon the *enablers* and *constraints* in different approaches, with a view to disciplinary approximations that are indicative of potential *complementarity*, *modularity*, *convergence* and *harmonization*. Ideally, this engagement with enablers and constraints should help in developing a sustained dialogue with innovators and research leaders, whose visions and products the assessments are evaluating. It should help develop a sustained dialogue with decision-makers in matters of innovation policy. Accordingly, in setting in motion this agency of observation and reflexivity, we draw attention to the ways in which expert practices are articulated, observed, communicated and performed in philosophical and sociological studies, and what the tenets of reflexivity have had to offer them. Our aim in this paper is to draw together a set of learnings from these studies and explain how they serve as building blocks for critical discussion with innovators and policy-makers as well as within the case study groups, in particular, on ways to integrate formal and informal assessments.

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[2]   EC FP7 Science in Society, Work Programme 2011.1.1.1-4.
[3]   http://epinet.no/content/epinet-project .

In the following sections, we first proceed with our review of studies of practice and the reflexive thesis. We begin by explaining some of the philosophical influences and study objectives. In particular, we consider the example of how sociological studies have articulated expert practices, the use of knowledge and skill, and we discuss the implications of this example for various kinds of reflexivity emerging in reference to study interest in expert practice and in reference to the epistemological challenges disciplines are generally faced with in:

1. justifying the relationship they draw between study objects, observation, interpretation and representation;

2. justifying ideologically and methodologically the production of knowledge about how *others* produce knowledge.

We then draw together some of the consequences of depicting reflexivity as a problem to be solved rather than advancing necessary reflexivity (or awareness of it) as a progressive step forward, and we explore some of the implications the key learnings have for methodological development aiming towards interdisciplinarity in the development of innovation assessments. Finally, we discuss our concerns with the shaping of an integrated framework, with the need to clarify enablers and constrains, and respective roles of formalities and informalities in shaping a more balanced approach to innovation.

A note on practice theories and the reflexive thesis

> No comparison is legitimate if the parties compared cannot each present his [*sic*] own version of what the comparison is about; and each must be able to resist the imposition of irrelevant criteria. In other words, comparison must not be unilateral and, especially, must not be conducted in the language of just one of the parties (Stengers, 2011, p. 56).

Of particular relevance to our explorations of practice studies and the reflexive thesis, is to outline the consequences of disciplinary favouritism, boundary work and reflexivity in orienting to, approaching and practising expertise. To this end, we address the influence of Wittgenstein's later philosophy in a '*turn to practices*' within various branches of sociological and adjacent disciplinary interests in expert knowledge and skilled practice. Certain traditions within Science and Technology Studies (STS) are more often implicated here than others, including studies of laboratory work and the ethnomethodology of technical labour. In particular, a glimpse into historical shifts in the sociology of S&T knowledge and expertise can help to elaborate the relevance of these influences for the case studies we have been observing, including a glimpse

into incommensurable readings of Wittgenstein's later philosophy and the implications thereof for thinking about practice and reflexivity.

Wittgenstein's *Philosophical Investigations* support a philosophical shift away from theories of universal truths and general explanatory principles of how we establish meaningful knowledge of the world. In his investigations, Wittgenstein invites his readers to look carefully at everyday practices in which we engage with ordinary phenomena and use language about it. This interest in practice has an empirical application with emphasis on looking 'at particularities of events, to *consider* what is happening *from close by'* (Wittgenstein, 1953, § 51). As Wittgenstein also puts it, we are observing a *form of life* in which objects and their meaning, i.e., how they are interpreted – rules and rule following – are negotiated and established in and through actual *use*.

Early influence of Wittgenstein in sociology (Winch, 1990[1958]) is implicated in a significant shift in thinking about scientific knowledge claims during the 1970s and early 80s (e.g. Barnes, 1974; Bloor, 1976; Collins, 1981; Collins, 1983). Sociologists of Scientific Knowledge (SSK) were breaking with the classical rational-irrational distinction of how and why we come to believe in facts or false claims. They were taking interest in the *epistemological contents* of science as a legitimate topic for sociological analysis and they were arguing that *all* knowledge claims (true or false, scientific or common sense) are socially constructed or, in any event, thoroughly socially constituted. In this tradition, Wittgenstein's claim that we are observing a *form of life* and that we should not be asking for *meaning* but looking at *use* (i.e. practice), was employed by the SSK programme to 'crack the mystery' of the so-called *indeterminacy thesis* (Quine's (1992) indeterminacy of translation). The long-standing philosophical scepticism that problematises how a rule can be followed or how one can know the world more generally, translated into a particular reading of Wittgenstein's call for looking at *use*—at *forms of life*. Namely, it gave sociologists the means to grant *the social* an ontological status of a fundamental explanatory principle for how we can interpret, as in how we can follow a rule, attribute meaning, know the world, and so on.

Other philosophers had similarly paved the way for sociological interest in technical work during this time period of the late 1970s and early 80s (e.g. Polanyi, 1962; Kuhn, 1962; Feyerabend, 1975). Early technology studies are diverse in approach and the claims they make, and so are the philosophies. But, what many of these early studies share with the SSK programme is how sociologists found in philosophy of the day the means to hold *the social* responsible for conditions, decisions and concerns of technologists and technical labourers (see discussion in Lynch, 1982). In other words, the empirical study programmes that developed, and are now well

established in Science and Technology Studies, were all attempts to break open the `black boxes' of technology. Sociological reasoning was put at the top of the agenda to explain technical artefacts, systems and technical work on the basis of social-historical origins, circumstances and social epistemology.

However, there are different ways in which we can 'turn to practice' (see Schatzki, Knorr-Cetina and von Savigny, 2001).[4] The object of enquiry can be the epistemological contents of science, technical expertise and labour. It can be the making of artefacts, a know-how, a set of presuppositions, paradigms and skills. Furthermore, any practical action will quickly exceed that which can be made explicit which then is typically explained by referring to *other* dimensions that comprise *the missing components*. According to this line of reasoning, such components remain largely unseen and are inexplicable except by a simple and generalised reference to practice—socialised, enculturated, discursive and embodied practice.[5]

Some of the early laboratory studies are very particular about the social nature of this 'tacit dimension'. They argue that the unique epistemological quality of doing expert work is grounded in social interaction, more precisely, in personal contact, discussion and demonstration (e.g. Knorr-Cetina, 1981; Collins, 1992). Collins, for instance, takes an example of replicating an engineering know-how which, he argues, necessarily required personal contact and discussion to obtain 'a crucial component of the requisite knowledge' (Collins, 1992, p.55). However, the so-called practice turn in STS generally resists this reduction of tacitness to merely social interactions. Interest in technological developments and change had already drawn attention to the role of matter, objects and embodiment and the practices of refiguring environments and social-material relations (e.g. Latour, 1987; Pickering, 1992; Bijker and Law, 1992; Knorr-Cetina, 1999). In other words, the tacit embodied practices of interacting with objects, instruments and environments were already an important source of explanation and theoretical grounding of knowledge and skill before the so-called *practice turn*.

A lurking problem here which is relevant to the case studies we observe, is how sociologists have positioned themselves as legislators who identify and codify the norms, rules and regularities that are followed by practitioners of various other disciplines (e.g. Bauman, 2003). For example, a general disposition among sociologists has been to interpret practical action as either behavioural regularities which are described from an observer's (their) point of view or they are interpreted (by them) as subjected to norms that can justify behaviour in terms for which

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[4] Stengers remarks that in the 'practice turn', the direction that is to be abandoned is much more clear than the direction that is to be taken (Stengers, 2006).

[5] See also Polanyi (1966) on the essential 'tacit dimension' of practical action as knowing how to proceed in certain situations on the basis of one's mastery of relevant skills, knowledge and paradigms.

correctness is measured and sanctions administered.[6] Turner (2001) talks about sociologists imposing a tacit book of rules on practices. Jordan and Lynch also point out how the project of opening up the 'black boxes' of technology during the 1980s became a *rallying cry* to contextualise the technical by revealing hidden motives, interests and origins in a social domain (Jordan and Lynch, 1992; see also Lynch, 1982, 1985; Lynch, 1993, pp.265-271).

These sociological dispositions and the studies that follow that tradition have typically produced 'disqualifications' of *others*, that skilled and knowledgeable practitioners do not sufficiently understand their own practices. As Lynch has argued, the very 'criticalness' of these efforts is indeed achieved by portraying practitioners as if they lack in ability to *access the circumstances of their own work*—the essential 'social dimension' within which the knowledge and the skills they perform are constituted. One can argue that these are essentially depictions of inadequacy and as such they risk insulting the practitioners whose practices come under scrutiny, rather than contributing to the ongoing work in ways which are useful and sensitive, engaging and amplifying. Depictions of inadequacy shift the attention away from the ways in which practitioners rely on each other's competencies in the course of some actual shared working practice. The risk is also that casting tacit embodied knowledge in terms of generalisable in-practice phenomena is simply filling a void when practitioners give no explicit account of the circumstances of their work—a void which then grants sociologists their claims about, say, *socially governed unconscious choices* (see discussion in Lynch, 1993, p.266). The lesson here for our observations is twofold. It turns on the commitment each partner has to evaluating the claims and the practices of scientists and innovators whose innovation practices have come under scrutiny in one or another of the four case studies. It also turns on the commitment the partners have to one another, in exploring and better understanding the respective roles of their methodological and ideological approaches to innovation and assessments of what they find. In acting on these commitments, the ideal disposition is to demonstrate an adequate level of sensitivity and engagement across disciplinary boundaries, if only for the key purpose of identifying and developing an epistemic networks of innovation, policy and assessment.

Understanding reflexivity

We now turn to different understandings of reflexivity and its association with relativism and interpretivism. As Woolgar once argued (1988a), there is much loose talk about reflexivity and

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[6]   Rouse has explicitly distinguished these two 'concepts of practice' in his contribution to the practice turn (Rouse, 2001).

the term is still applied in many and often confusing ways. For example, reflexivity is taken to mean the kind of introspection and reflection that forces practitioners to pause and critically explore the *modes of doing* that dominate their work. Reflexivity is called for in relation to one or another controversy in which the approach of some practical involvement becomes itself a part of the problems associated with that controversy and with sorting it out. It takes the shape of 'self-reflective' gestures among practitioners with reference as well to the potentials and limits of 'self-knowledge' within governing bodies and other institutions (e.g. Barben et al, 2007; Voss, 2006; Wynne, 2002). To summarise, reflexivity is targeting what amounts to a demand for *much more careful thinking about what one is doing*, to see confessions, inside stories, and other addenda which is the product of benign in(tro)spection aimed at improving the adequacy of connections between analysts' statements and the objects of those statements—more generally, the improvement of a practice and its accountability.

One can argue that the kind of reflexivity we have described so far is primarily psychological in its thrust and does not lead to further epistemological investigations, challenges and recommendations. Therefore, we offer in addition – and emphasise – considerations for the kind of reflexivity that can be found embedded in the very constituents of practice. We shall draw attention to reflexivity which is integral to certain aspects of *practice-in-action* (expert or otherwise), including the constitution of ordinary logics used to formulate and articulate knowledge, i.e., reflexivity as logical necessity.

In Woogar's edited volume on reflexivity (Woolgar, 1988b) we find discussions of post-hoc and general reflexivity, infra-reflexivity, meta-reflexivity, constitutive and immediate reflexivity. Regarding the last two on this list, we can also consult discussion in Garfinkel's treatment of *reflexively accountable action* and the *documentary method of interpretation* (Garfinkel, 1967; also Lynch, 1993). We shall take stock of some of these elaborations as we articulate the epistemological challenges of reflexivity that seem most relevant to progressing the assessment case work.

Relativism, interpretivism and reflexivity

In the introduction to the reflexive project, Woolgar and Ashmore (1988) situate reflexivity as the *Next Step* in explorations of a relativist and constructivist tradition. In particular, the shift towards studying the epistemological contents of scientific claims and technical work had already introduced new forms and methods of relativising both scientific and sociological research. A

connection here between relativism and reflexivity is demonstrated in the ways in which researchers construe a relationship between observed phenomena and representations of them, as well as how they conceive of the agent of representation (the observer, the analyst and interpreter). However, according to Woolgar (1988a), relativism does not necessitate reflexivity. Rather, we can find necessity in the connection between the two by virtue of discovering the relevancy constraints that tie us to a particular set of interpretations on a case-by-case basis—of identifying differences and similarities among objects, meanings and social-cultural roles, albeit with interpretative flexibility.

The cultural relativism which is traditionally associated with cultural anthropology is of some consequence here, i.e., in the espousal of its scholarship in which achieving *knowledge of others* is manifest as an explicit epistemological concern for the ways in which *interpretations of others* are constructed and represented. One could argue that the problem of understanding beliefs and the actions of *others* is primarily a problem of logics in translating the reasoning of one culture into another. However, that *cultural other* is typically treated as a distinct analytic object.

The espousal of cultural relativism enabled sociologists of science and technology to treat their subjects' achievements, beliefs, knowledge claims and artefacts as socially/culturally contingent products, as seen through the lens of sociological reasoning. For example, the production scientific facts became an accomplishment that could only be achieved within the culturally distinct settings of science laboratories. But the general lesson is that a group of investigators can interpret a culture as clearly distinct from their own, and it is in this distancing of social-cultural roles that they can legitimise their own production of facts about how the others produce *their* facts. The investigators appear to operate at a higher epistemological level than their subjects, so to speak, which is exacerbated by a tendency towards exoticism in describing the subjects and articulating knowledge about what they know and do. In other words, analytic distance privileges and sets apart the method of the observer from the method of the observed. However, as this scholarly tradition is increasingly informed by and symptomatic of long-standing critiques of idealised *points of view* in observation, interpretation and representations of culture, a question remains of how research ideals and methodologies deal with the postulates of distinctiveness and similarity, and what kind of reflexivity survives. Blanket faith in fieldwork objectivity has vanished and *all* achievements, beliefs, knowledge claims and artefacts *can* be treated as socially/culturally contingent. The indication is that antagonisms in descriptive-analytic representations highlight, at least momentarily, the ambivalence in the interpretative process, as scholars position the interpretative work they do somewhere on a continuum between benign introspection and constitutive reflexivity. We shall now take a closer look at the shifts in

sociological traditions of reasoning about scientific knowledge claims and technical expertise, to further shed light on the different manifestations of reflexivity.

Post-hoc reflexivity

The SSK programme and emerging traditions in technology and laboratory studies at the time, made the general argument, using social-cultural relativism, that scientific knowledge claims and technical expertise are the contingent products of various social, cultural and historical processes. That particular sociological knowledge, however, was not addressed using the same logics, which is what Collins refers to as compartmentalisation (see Collins, 1992, methodological appendix).

Some of the consequences of these relativised orientations are explored in Woolgar and Ashmore's introduction to the reflexive project (Woolgar and Ashmore, 1988). We learn that a general issue of reflexivity emerges once it is recognised that sociological knowledge can also be understood as a contingent product of various social, cultural and historical processes. Furthermore, the relationship between sociological research methods and the research object being sociological in nature, necessitates assumption about similarities which points to constitutive reflexivity.

What resulted from a shift in the sociological study tradition, was inconsistency between realist studies of social factors and relativised studies of findings in nature and in technological constructs. Reflexivity emerged as a demand for symmetry and consistency. As Woolgar and Ashmore also point out, the methodological attitude made SSK and related study programmes inherently vulnerable when sociological reasoning about the reasoning of others became too easily turned back onto itself (also Woolgar, 1988a; Ashmore, 1989). Nevertheless, the dominant recommendations have been to assume cultural and methodological distinctions, rather than similarities, and leave the reflexive tenet out of the course of the essential explanatory task of the sociological discipline—i.e., to explain expert knowledge in the making, explain closures, and so on. As Latour has argued, sociologists continue to depict *the social* as if it were a *glue* that holds the world together. They have granted it an unquestioned fundamental status of an explanatory principle in a quest for new kinds of truths, in this case, about natural and technical knowledge (Latour, 2005). To this end, nature remains uncertain while society does not, or as Callon put it: 'When the society described by sociologists confronts nature, society always has the last word' (Callon, 1986: p.198).

Constitutive reflexivity

While the introspective version of reflexivity serves primarily as a quality control and governance tool, it also reinforces idealisations of representation, of natural and social realism (philosophically speaking). Such idealisations are perhaps useful in the sense that they are conducive to involving scientists in speculative reflections about their work. Scientists can typically assume without hesitation that observers and the studied objects are of essentially different kinds. For example, constitutive reflexivity could only occur in physics if physicists had to take into account that atoms have belief systems, theories about their own nature, their interactions, and so on. Constitutive reflexivity in their work has an entirely different focus. It concerns, among other things, the ways in which the variables they build into their experimental systems dictate what those same systems can and cannot deliver.

Other manifestations of constitutive reflexivity hinge in this way as well on how the postulates of differentiation, similarity and, last but not least, *interdependence*, are managed in the face of immediacy and circularity in a reflexive constitution. As we have seen, reflexivity emerges with reference to the observer and the observed, object and interpretation, object and representation. It also emerges in reference to object and measurement, cause and effect, a rule and its following, an object and its context, and numerous other relational interpretations which traditionally are assumed to be held together by entities that are otherwise independent one of the other. These conventional assumptions are not just intuitive truths arising from expert and ordinary reasoning alike, and ultimately based on how we learn from childhood to order the world and depict aspects of it. They are studied ontological statements about entities in the world and their relations, and they are studied epistemological statements about how we can know them and what they do. They suggest methods to formulate propositions and articulate problems, make use of criteria and decision rules, all of which tie research designs into scholarly traditions (see related discussion in Hacking, 2002). But there are problems which are difficult to resolve. Measurements are always indirect, empirical references never completely adequate and, with respect to sociality, one could argue that law-like statements are not adding anything to what is already ordinarily observable at a site of activity. In sociological research more specifically, there is no escape from *common-sense* reasoning about social phenomena even if the objective of a sociological investigation is to develop credible *sociological reasoning* about social phenomena. All persons use a method in their reasoning, for example, to assess what is definitely going on in a given event or an instance of action. To this end, the so-called *documentary method of interpretation* is seeing and treating

an actual instance as a document of some recognised or presupposed pattern, which in turn is confirmed and legitimised because of an actual instance that occurs (e.g. Garfinkel, 1967, p.76-103). This way, anyone can identify what appears to be a norm, what the general conditions are in a given setting, what an instance is an instance of, and so on.

To sum up, it may appear that philosophical scepticism will have the upper hand if the conclusion here is, that hypothesising stable theoretical arrangements to measure against remains essentially indeterminable for the purposes of identifying an idealised standpoint for a practice or a practitioner, to find a way to follow a rule, measure an object, observe, represent, and so on. But, to come back to the influence of Wittgenstein's later philosophy, the counterargument, and a substantively different reading of Wittgenstein, is to say that indeterminacy is not a theoretical or inductive problem for which a remedy is needed, say, *the social* or some other principle of fundamental explanatory status. For example, we run into problems explaining why controversies close or not because the supposed *cause* is not independent of the *effect* to be explained. Constitutive reflexivity is manifest in immediate circularity and interdependence which suggests that research processes always assume some of the answers they set out to find which, notably, is also what people normally do. So, the 'next step' could be to treat the *indeterminacy* thesis as completely internal to the sites in which objects and observation, measurements, interpretations, rules and context, cause and effect, so on and so forth, are effectively (re)negotiated and (re)established over time—the sites of reflexivity and reflexively accountable action (see Lynch, 1993).

Reflexivity: a problem or progression forward

From what we have learnt, it appears that discussions about reflexivity primarily portray it as a problem and a source of difficulty, rather than a progressive step forward in the relativised and reflexive project of generating knowledge about how knowledge takes shape across disciplinary boundaries. SSK researchers adopted a formulaic approach as a 'solution' to the 'difficulty', which enabled them to be relativist about scientists' knowledge practices but realist in the production of their own research. Constitutive reflexivity only applied at the epistemological level *post-hoc* but was disengaged from standardised practice because abandoning the relativist pole was the dominant recommendation on how to proceed. Many responses to the implications of constitutive reflexivity have indeed centred on how to improve conventional criteria, decision rules and models—to develop better schemes for observation, the coding of data, rigorous analyses but, nevertheless, to use 'reflexive accounting' which acknowledges introspectively the shortcomings

of both quantitative and qualitative methods (e.g. Denzin and Lincoln, 2000; Atkinson et al, 2001). In other words, achieving stability in what can be said about knowledge-making practices requires measured efforts to overcome reflexivity. Mainstream sociology does not accept that *no* principle will sort out conflicts. To abandon the theoretical leverage provided by an idealisation of the social scientific observer seems unthinkable.

Other approaches however, have suggested that reflexivity is a progressive way forward, for example, to explore literary expressions that can keep constitutive reflexivity at bay while simultaneously allowing it a central position. Latour would argue that, in spite of the overarching emphasis on mapping the material-semiotic constituents of actor-networks, we are after all simply telling stories which points to some sort of infra-reflexivity. Also, since text is thought to operate at a different level from the world *about* which it reports, one recommendation has been to find ways to recover and sustain the kinds of uncertainties that only exist in the early stages of enquiry, i.e., before the construction of the text has solidified the concepts and categories used in the reporting. The literary experiments in the late 1980s and early 90s, representing one or another form of so-called meta-reflexivity, play on such uncertainties and the early works were often very artistic. They include playwriting, fiction, performance art, co-authored dialogues, and collages of mixed media (e.g. Ashmore, Mulkay & Pinch, 1989; Pinch and Pinch, 1988). But, one can argue that these literary experiments have also shifted the reflexive project around full circle, back towards benign introspection and reflection. The authors produce conventional analyses about scientific claims and technical expertise through alternative media and forms of representation, and in ways which aim at being taken seriously as analysts among peers even if the literary experiments as such deny them a positioning as *scientists*. To what extent these developments can be considered progressive we leave unanswered. They appear to primarily suggest new forms of introspection and reflection. There is in fact little in the way of embracing constitutive and immediate reflexivity in research, as substantively-observably evident but unproblematic, apart from studies in ethnomethodology (see Button, 1991).

Summary and its implications for interdisciplinarity and integration in innovation assessment

We started by suggesting that research traditions in sociology have faced significant complications in justifying their methods and reasoning—complications that provide important examples of enablers, constraints, risks and vulnerabilities in orienting to, approaching and practising expertise. The critiques sociologists have faced, with respect to disciplinary favouritism, boundary work and reflexivity, have been posed to a large extent as epistemological

challenges but also as recommendations, both of which are strongly suggestive of the kinds of disciplinary issues to consider in attempts to achieve interdisciplinarity and integration in innovation assessment. There are significant challenges to keep in mind, if only to moderate disciplinary or methodological privileging, and remind the partners of how problem-identification, propositions and decision criteria concerning the interpretive pairing we have been considering, are all practice-specific achievements which, taken together, form an *ecology of practices* (Stengers, 2005).

The task for such case studies is twofold. Each partner is committed to evaluating the claims and the practices of scientists and innovators of the epistemic networks associated with an innovation domain and its assessment. The partners are also committed to one another in exploring and better understanding the respective roles of their methodological and ideological approaches, as members of epistemic networks themselves. But, before addressing further specific implications for the case studies, we shall first continue summarising our notes on studies of practice and the reflexive thesis.

To first address our treatment of scholarly interests in practice, it is a noteworthy example how sociologists have positioned themselves as legislators who identify and codify the norms, rules and regularities in the actions of others. Not only does this positioning signal self-declared disciplinary privilege, but a bulk of the critique of sociological reasoning centres on its commitment to structures, systems and unifying explanatory principles. Some practice theorists concur in a different view, that knowledge, meaning, action and language are not determined in reference to abstract structures or systems. There are no hidden structures that can explain the phenomena of practice. Accordingly, it is also the case that the phenomena of practice are not explained in reference to individuals and their intentions and mental states. Practices are not reducible in that way.

One way of responding here is to argue that practices are situated somewhere 'in-between' macro and micro referents, which is in keeping with relatively recent developments in social theory. For example, Giddens deliberately avoids privileging one over the other of the structure-agency or system-actor pairs (e.g. Giddens, 1986). According to the theory of structuration, individual actors can draw upon pre-existing sets of rules and resources which are contextually resident within an existing structure in a particular domain. i.e., there are always sets of rules and resources available to individual actors in the practices that reproduce social systems. Another way of responding here is to consider more carefully Wittgenstein's influence on the studies of practice, including studies of technical work and ethnomethodology, to say that all talk of 'levels'

is entirely unnecessary for it does not add anything to the observable-reportable situatedness of actual practice. In other words, a 'theory' or a heuristic of articulating what a practice consists of, concerns the visible and what practitioners themselves have to say and show for what the know and do.

It follows from here – to summarise our treatment of the reflexive thesis – how one reading of Wittgenstein after all supports a theory of a universal truth and a general explanatory principle, i.e., *sociality* and *the social*, whereas a very different reading of his *Philosophical Investigations* does not support anything of the kind (see debate in Bloor 1992 and Lynch 1992a, b; also discussion in Lynch, 1993: 75-76). The relationships that can be drawn up within these incommensurable readings are:

1. Wittgenstein's treatment of *use*, *practice*, *form of life*, is deliberately used to crack an assumed mystery in the face of constitutive reflexivity which is seen as a serious philosophical and practical problem (e.g. Winch, 1990[1958]; Bloor, 1976). First, the relativising project threatens to render any philosophical realism impossible. Secondly, when doubting there are such things as straightforward interpretations, philosophical scepticism dictates that one is confronted with countless questions about the very task of interpreting, and the interpretative flexibility goes along with uncertainty about where one can stop asking the questions.

2. Wittgenstein's treatment of *use*, *practice*, *form of life*, suggests there is no mystery to crack about rule-following and other interpretative tasks, however, with radical anti-causalist and anti-epistemological implications (e.g. Sharrock and Button, 1999). Constitutive reflexivity is not a problem, rather, it points to sites of practice in which phenomena and that which can be said about them and done with them, is (re)negotiated and (re)established over time in a reflexively accountable manner. Interpretive flexibility is not a problem either, nor is uncertainty, for the very immediacy of reflexivity swiftly uncovers the relevancy constraints of any meaningful action or claim.

The immediate relevance of the explorations we have outlined here would be to suggest reflexivity of the introspective and reflective kind—to recommend that each partner *let their hair down*, so to speak, and confront *their own* orientations, approach and practice of expertise, their orientations to explanatory principles and universal theory, their relationship with the development of social theory in particular, and of a long history of socially, ethically, legally, and policy-relevant studies of science, technology and innovation. Another immediate relevance, concerns the fact that all partners in the consortium have some disciplinary overlap with sociological research directed at science, technology and innovation. The partners already recognise disciplinary distinctions and similarities among themselves which are further clarified in and through the work on each case study, i.e., what the disciplinary range is, including the wider network of innovation practitioners and policy makers, and what the implication are for

approaching and orienting to *others*.

At this juncture, the concept of an 'ecology of practices' can help tying the question of what constitutes one practice to a question of its co-existence in an environment of other practices (Stengers, 2005, 2006). In such an ecology, no practice is ever just a social practice or a social construction or a technical enterprise. Rather, the specific ways in which practices diverge over time is crucial for their co-existence. In this vain, approaching innovation practices as they diverge, is to feel their boundaries by way of experimenting with the relevancy constraints of questioning and probing practitioners, albeit, in a manner that systematically avoids mobilizing them in defence against attack (Stengers, 2005, p. 184). Ideally, this approach should be multi-directional whereby each practice is addressed in terms of the obligations that visibly engage practitioners in achieving their work satisfactorily, in serving and answering to the requirements of their trade. In that case, the relevancy constraints emerge in the course of solving specific problems *together* in some shape or form.

Although one can argue that very few disciplines are neatly bounded or siloed, misalignments are still prone to emerge when practitioners recognisably cross the disciplinary boundaries of their practice. There are no guarantees that one practitioner can take the place of another solely on the basis of some overlap in orientation to problem-finding and problem solution. Furthermore, in situations where boundary work or boundary negotiations pose a significant challenge (on boundary work, see also Lee, 2005; Wynne and Dressel, 2001; Shackley and Wynne, 1996; Bloomfield and Vurdubakis, 1994), there are no 'extra-territorial' methods ready-to-hand for defining what matters to the parties involved. Each party has different constraints, risks and vulnerabilities to consider. Each working relationship should be considered a significant practical achievement. It is achieved in and through new articulations produced between the parties involved in response to common interests and problems. Each party can then produce their 'local' disciplinary versions of what is the case and what is at stake if they need to. In other words, the art of establishing working relations rests on a kind of diplomacy that mixes shared representations with certain degree of 'abandonment'. Common interest in some issue, a problem definition and problem solution, is produced not because these are *the same* or even similar across disciplines, but because their alignment is approximated through selective and pragmatic learning.

We can say for sure about our observations of the case studies in innovation assessment that underpin this paper, that an adequate approach to the work of assessing the four innovation domains to-date does not only consist of descriptions of different tools and concepts, but also of

clarifying the constraints and enablers with which the work is judged by peers and institutional arrangements. Paradoxically, in bringing different practices together, these elements can only be well understood in and through actual disciplinary approximations. The establishment of relations between different assessment practices has to be invented to provide specific solutions to concrete issues that are identified in the course of doing this work. In this sense, the case studies provide a good basis for experimenting with the question of how obligations and requirements *can* be connected in some way. The results of the case studies will then have themselves become enabling of a framework for better balanced evaluations. Finally, it is worth considering how bounded each of the partners are to disciplinary identity and practice—how there is a recognisable *home practice* or a disciplinary group of which the partner is a representative. Considering the history of Science and Technology Studies, for instance, the answer is *yes* and *no*, suggesting that each of the partners will need to consider their place among peers and the implications for the boundaries of their practice when committing like diplomats to a project they share with *others*. This potential double-bind differentiates, on the one hand, practitioners who are mutually constrained by the project in which they are working towards a common goal (*have you fulfilled the terms and objectives of the project contract and arrived at some kind of integration?*). On the other hand, it differentiates the binding constraints of a representative who *returns with results* (*what space have you created for 'us' in the integration you have been working towards?*).

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