



Center for  
Higher Education  
Policy Studies

# The construction of new scientific norms for solving grand challenges.

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Reflections from the Norwegian Idélab research programme

**CHEPS WORKING PAPER 07/2017**

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## **Table of Contents**

Abstract .....	3
1. Introduction .....	4
2. Understanding challenge-led research as a social learning problem.....	5
2.1 Multidisciplinary research and the grand challenges.....	5
2.2 The turn to practice in science studies.....	6
2.3 Understanding collective social learning: a community of practice approach .....	7
3. Operationalising scientific social learning in Communities of Practice .....	8
4. Case study & method – an introduction to Idélab.....	10
5. Idélab creating virtual communities of practice? .....	12
5.1 The language of collaboration and multidisciplinary research .....	12
5.2 Project practices embodying social learning practices .....	13
5.3 ‘Antisocial learning’: compliance practices in Idélab.....	15
6. Steering scientists towards multidisciplinary social learning practices.....	16
6.1 A first-cut analysis of the underlying tensions .....	16
6.2 Social learning practices within Idélab project partnerships.....	18
7. Discussion and conclusion .....	21
Acknowledgements .....	24
Bibliography .....	25

## **Abstract**

There is an increasing recognition that there are a class of problems which society must solve urgently in the 21st century if humanity is to survive into the 22nd, the so-called Grand Challenges. Science policy makers have been active in recognising these challenges and the attendant need to develop new multidisciplinary ways of working. But embracing multidisciplinary is not a straightforward choice for scientists, who individually are strongly steered by norms and values inculcated through their past scientific experiences. In this paper, therefore, we ask whether new funding approaches can contribute to creating new ways of working by scientists towards challenge-driven research, specifically by changing scientists' expectations and beliefs. We address this research question with reference to a single new experimental method, the 'research sandpit', implemented experimentally in a single national science system, Norway. We conclude that the sandpit approach appeared to shift research perceptions of individual scientists, particularly around long-term belief structures.

**Keywords:** grand challenges; research impact; multidisciplinary research; research policy; academic motivation; academic behaviour.

## **1. Introduction**

There is an increasing recognition that there are a class of problems which society must solve urgently in the 21st century if humanity is to survive into the 22nd, the so-called Grand Challenges. These include diverse issues from climate change and resource scarcity to urban inclusion and security and human rights, but all are quintessentially what Ackoff (1999: 99–101) calls multidisciplinary ‘messes’, demanding novel multidisciplinary knowledge to produce concerted, coordinated social change in the face of often strong resistance from vested interests. Public administration has recognised the urgency of these problems by seeking to prioritise creating new knowledge to solve them, developing a range of policy instruments to coordinate change efforts oriented towards new ways of working.

Science policy makers have been active in recognising these challenges and the attendant need to develop new multidisciplinary ways of working. Science funders are increasingly adopting ‘challenge driven’ approaches to research funding (Amanatidou, 2016). The European Commission’s Flagship Horizon 2020 funding scheme directs funds to challenges via work programmes that specifically encourage large multidisciplinary/ multisectoral consortia to collectively create excellent, useful knowledge. Reacting to the grand challenges in other words envisages both changes to science funding but also in scientific behaviours, towards multidisciplinary, challenge-driven approaches. A number of new instruments have emerged to encourage these – such as research ‘sandpits’ – that seek to reward scientists who embrace these changes and create multidisciplinary knowledge (May & Perry, 2013).

But embracing multidisciplinary is not a straightforward choice for scientists, who individually are strongly steered by norms and values inculcated through their past scientific experiences (Knorr-Cettina, 1981). Science at an individual level involves distinguishing between good and bad choices whilst undertaking scientific activities, including determining research questions, argumentation, data gathering, interpretation, and reflection (Olmos Peñuela et al, 2015). Scientists take these choices as individuals – in their offices and laboratories, in archives, in the field – but do so anticipating how their wider peer community will later judge their choices. This leads to a collective coordination of the overall process of scientific advance towards goals shared between individuals within wider disciplinary communities (Gläser, 2012). And so with their expectations based on past experiences within these communities, it is not a trivial matter to create new ways of working for scientists.

In this paper, therefore, we ask whether new funding approaches can contribute to creating new ways of working by scientists towards challenge-driven research, specifically by changing scientists’ expectations and beliefs. We problematize the issue as one of social learning between scientists active within different academic communities with distinct norms and expectations; if experiences occur in which social

learning creates understandings of good multidisciplinary, we posit that these new approaches may be able to succeed. We address this research question with reference to a single new experimental method, the 'research sandpit', implemented experimentally in a single national science system, Norway. We explore whether the multidisciplinary teams that were created at the same time evolved new collective ways of working that might help legitimate future multidisciplinary behaviour as a reasonable research practice. We conclude that the sandpit approach appeared to shift research perceptions of individual scientists, particularly around long-term belief structures. This is a challenge because of the potential disconnect between a desirable practice and the visible behaviours making it harder for individual scientists to regard their practices as being multidisciplinary.

## **2. Understanding challenge-led research as a social learning problem**

### **2.1 Multidisciplinary research and the grand challenges**

The centrality of multidisciplinary research to solving the grand challenges of the 21st century is evident in a number of developments in theory and practice. Following Ackoff there is a theoretical argument that the multifaceted nature of grand challenges demands a range of knowledge inputs in creative ways to produce solutions. An alternative argument highlights how these grand challenges have emerged as the unintended consequences of the complex systems within which late capitalism is organised, which means that many problems have multiple causes for which a mono-disciplinary cause-effect-solution approach no longer makes sense. We regard rising interest in 'responsible research and innovation' as a different response to the same pressure: how to control research that through its complexity has become increasingly opaque and remote from societal control (Stilgoe et al, 2014).

Bibliometrics provides more empirical evidence in charting how multidisciplinary norms and behaviours are emerging (Wallance & Rafols 2016). Bugge et al (2016) chart the rise of the concept of the bioeconomy in multiple science fields in parallel, highlighting how each field makes their own definitions and conceptualisations, whilst simultaneously oriented towards producing common solutions. Lawton et al (2016) highlight that although cognate disciplines may be able to interact effectively, there can be epistemic differences that preclude effective collaboration between disciplines. There is a risk in incorporating disciplines with different epistemic bases, if one epistemic base dominates the partnership, thereby framing, shaping, reducing, and potentially excluding the contributions from other disciplinary fields.

And indeed, these observations are also visible within policies oriented towards solving the grand challenges. Arguably the most visible of these is the European Commission's Horizon 2020 programme which marked a radical change from its four predecessor

programmes in not having specifically disciplinary orientations for its research programmes. Instead, H2020 has seven 'Grand Challenges' under which all its funded activities fall, with the intention being that this will encourage the formation of multidisciplinary consortia to bid against particular call topics, leaving basic science research as the responsibility of the European Research Council and national funding agencies (Benneworth et al, 2016). This has also been seen in other European funding streams, such as in Joint Programming Initiatives and the COST actions (Cooperation in Science and Technology).

But there is a concern within certain disciplines, most notably the social sciences and particularly the humanities, that early experiences have seen more technological disciplines dominate funding streams and conceptual discussions, with the humanities being almost entirely marginalized (Else, 2013; Greenhalgh, 2013; Lee, 2013). As the Science Europe thinktank observed in 2014, 'We conclude that the actual role of the humanities in the 2014–2015 [Horizon 2020] Work Programme is marginal in quantity as well as quality' (p. 7). Humanities was relegated to understanding human responses to new technological interventions; little attempt was made to use humanities to shape which technological choices were made. This constrained those researchers' possibilities to identify and work on research questions that were deemed as important within their own fields, reducing the potential disciplinary impact of that research in those fields.

## **2.2 The turn to practice in science studies**

We contend that a real policy challenge for multidisciplinary working remains in ensuring that when consortia of non-cognate researchers work together there is not a domination by some epistemic bases (notably the technological disciplines) of others (social sciences and humanities). And despite increasing policy interest, achieving effective multidisciplinary research is more complex than might initially appear evident, primarily for practical reasons. We trace this to a particular epistemological hierarchy that exists within science in terms of the extent to which disciplines conform or deviate from an ideal-type version of science operating within logical, transparent, reproducible, and replicable paradigms (Biagioli, 2009). Olmos Peñuela et al. (2013) highlight a number of ways in which humanities, and to a certain degree social sciences, systematically deviate more from these norms than more technological sciences in terms of being hermeneutic rather than experimental, providing understanding rather than allowing predictions, and being intensive and unique rather than extensive and comparable.

If researchers working in multidisciplinary teams experience that multidisciplinary working is imposing exogenous epistemological norms upon their individual practices, this in turn might act as a disincentive for future multidisciplinaryity and drive further disciplinary purity (following Knorr-Cetina's path impregnation property; 1981). As this

would undermine the policymaker goal of stimulating multidisciplinary research to solve the grand challenges, these policymakers face a difficult balancing act. They must encourage the formation of consortia who are willing to promise to undertake future multidisciplinary work, whilst at the same time ensuring that the experience is not negative for those who may find themselves on the epistemic periphery of those activities.

We therefore argue that for multidisciplinary research to be successfully produced through new multi-epistemic science practices, it must be valid within the different epistemic communities that contribute to that research. In this we use Benneworth & Olmos Peñuela's (2017) criteria for cognateness between researchers, which comes about when meaningful use is made of the knowledge of one partner by the other. This builds on the progressive nature of research as a knowledge-creation activity and the epistemological framing of newly created knowledge being shaped by its antecedent knowledge base. We therefore argue that successful multidisciplinary research must be grounded upon a mutual interdependence between partners upon each other's knowledge.

### **2.3 Understanding collective social learning: a community of practice approach**

Understanding how individuals use others' knowledge in their own research processes involves understanding what Amin & Roberts (2008) call 'knowing in action'. They propose a typology of knowledge exchange processes for different kinds of social learning approaches that reflect the fact that many kinds of knowledge cannot simply be transferred but are encoded in behaviours (tacit rather than codified knowledge) (Nonaka 1994; Nonaka & Krogh, 2009). Roberts (2014) distinguishes four kinds of 'knowing in action', highlighting how each kind of knowledge becomes encoded into different kinds of collective acts (whether creating craft products, conferring professional status, creating particular quality standards, or co-developing virtual products). Accessing the knowledge requires participating in those acts, and in turn is dependent upon securing the legitimacy to access to those collective acts a determining factor. This may be within localised settings (communities of practice), within professional practice groups (networks of practice, Brenner et al 2003), or wider imagined epistemic communities (Haas, 1994) (Haselsberger & Benneworth, 2010). Our contention is that it is possible to explore whether genuinely multidisciplinary research teams are being formed by exploring the extent to which these kinds of collective practices of knowing in action can be observed by participants within these activities.

One example of the application of this kind of approach was with Gertner et al (2011), who used the communities of practice (CoP) approach to explore how the UK's Knowledge Transfer Partnership scheme operated. The scheme sought to encourage academic-business knowledge exchange through the use of 'associates' organisationally

positioned between the two knowledge teams. Gertner et al suggested that the associates began at the peripheries of both organisations, but over time each partnership evolved into a new 'team' crystallising with the associate at the core through which knowledge flowed between university and firm. We would therefore expect that if multidisciplinary instruments are creating multidisciplinary communities then we would see these researchers connected within these communities of 'learning in action'. By observing practices associated with these communities of learning in action, we would then be able to understand whether social learning processes were being engendered across epistemic boundaries (as a first step towards genuinely multidisciplinary knowledge creation).

Gertner et al used the CoP approach, first proposed by Wenger (1990, 1998) as a way of understanding how operatives taking routine but complicated decisions (in an insurance office) dealt with the many uncertainties generated by having to follow complicated insurer rule sets (see also Lave & Wenger, 1991). Individual clerks were observed to build knowledge on dealing with difficult cases through an ongoing process of negotiation with other nearby clerks. These negotiations and interactions were embedded within social activities that were not entirely based around problem-solving. Team members would socialise together and tell stories about their work which encoded the ways they made these judgments, but they did not tell these stories in social settings with the aim of transferring that knowledge; it was a purely social act. Nevertheless, the community's collective knowledge was at least partly dependent on the telling and retelling of these stories. These were not fixed communities, but defined by participation in both the functional task, making insurance judgments, but also the social tasks, with the life of the community, and position within the community, and the centrality to the collective knowledge resources dependent on the performance of both those activities.

### **3. Operationalising scientific social learning in Communities of Practice**

Multidisciplinary research (taken in this paper following Ackoff as an antecedent for producing useful knowledge to solve grand challenges) poses considerable uncertainty for scientific judgment-making, the process by which scientific communities collectively decide what constitutes good behaviour and which ideas and concepts to support. Although scientific judgment-making is ultimately an attempt to make individual decisions conform with community norms, these two elements – the individual and the disciplinary – are interrelated. There is considerable internalisation of those norms through the academic training process (e.g. the Ph.D.), giving what Knorr-Cetina calls 'path impregnation' (1981). For scientists this is bound up with paradigms as ways of thinking and channelling judgments collectively (Kuhn, 1962). The tension of multidisciplinary research emerges for individuals when decisions with which they are



comfortable within their paradigms are regarded as being illegitimate by others operating in other paradigms. At an individual level, cooperating scientists must negotiate this and find legitimate practices that all can live with if they are to undertake genuinely multidisciplinary research together. Our contention is that by following these trans-paradigmatic negotiation processes as social learning processes it is possible to reflect upon the extent to which knowledges are being combined between the paradigms, or whether it remains in individual paradigmatic silos, administratively together but socially apart.

Following Gertner et al, we explore the extent to which social learning practices associated with these communities of practice can be observed within deliberately multidisciplinary research consortia. Wenger (1998) highlights that communities of practice are characterised by three features: mutual engagement, joint enterprise, and shared repertoires (see also Bucholski & Benneworth 2017). Mutual engagement refers to the existence of opportunities for individuals to interact with other individuals in their efforts to solve a problem, such as the clerks being able to ask other clerks how to process particular individual claims. Joint enterprise exists where there is a common functional goal in the process to which all participants are working, which may be to successfully adjudicate on claims in ways that best serve the company's interest. Shared repertoires are the practices and activities into which meaning and knowledge is encoded but which also have an independent social life, such as the telling of stories about how a difficult claim was resolved during an employee lunch break. All three of these characteristics are micro-scale processes that emerge through individuals interacting.

It is possible to create a heuristic for the kinds of things that might characterise a multidisciplinary community of practice based around a single research project. The mutual engagement would be characterised by regular contacts between the project partners in which they attempted to exercise collective influence to integrate the activities of the individual research teams. The joint enterprise would be an attempt to run an integrated scientific project which was regarded as legitimate within the various scientific paradigms in which the individual researcher teams operated. In terms of shared repertoires, one might expect for a kind of narrative case history to emerge around the way scientific judgments are taken, so that as collaborations become longer in their duration, the discussions about what is legitimate or desirable make less reference to abstract arguments and judgments, and more reference to what has been regarded as legitimate in past discussions. One would expect to see these value judgments become encoded and internalised within the project tools and technologies, and talked about unselfconsciously in a more abstract way.

#### **4. Case study & method – an introduction to Idélab**

In this paper we ask the research question of whether new funding approaches can change the expectations and beliefs of participating scientific communities as an antecedent step to creating new ways of working by scientists towards challenge-driven research. To address that question, we explore the extent to which one new funding experiment, the idélab in Norway, has resulted in projects in which there is multidisciplinary social learning between participants, specifically exploring whether the three elements of communities of practice can be identified within the project teams. From both their webpages and the interview, it is clear that the Research Council of Norway chose the idélab format – based on the ‘sandpit’ – as a way of creating change within research practices, therefore making it a suitable case for this research:

Recent evaluations of the Research Council have challenged us to play a greater role in promoting activities that generate more groundbreaking research. The Idélab method will cultivate radical projects that cross disciplines and subject areas in new ways. (Forskningsrådet 2013)

We had started thinking about finding new ways of addressing social challenges. Then we were informed about the sandpit approach from the ESRC. One of the roles of the Research Council [of Norway] is to be an agent of change. The inspiration was: how do we change practices with funding research with this change-agent role in mind? So we decided to try the sandpit method. [RCN Interviewee]

In this section, we firstly set out the background and introduce the idélab funding scheme, and then set out our methodology for how we sought to identify these collective social learning practices within the five research projects funded following the first idélab. We then set out how we gathered information on the research projects, and we stress that in reporting it we have produced stylised analyses that highlight tensions without necessarily claiming that things failed or were problematic.

The first idélab to be organised by the Research Council of Norway (RCN) was held in January 2014, and was entitled ‘Towards a Zero-Emissions Society’. The impetus for the idélab initiative came from a review of the Research Council of Norway, after which it sought to be more innovative in its funding methods. The ‘sandpit’ method had been tried and tested by the ESRC in the UK, and it was a UK-based team that led the first idélab with an international team of mentors (led by Prof. James Wilsdon, now at the University of Sheffield). Potential delegates applied to attend, completing a short online application form (in English, the language of the idélab). A diverse array of expert backgrounds was encouraged – the natural sciences, technology, the social sciences and humanities. The Research Council of Norway invited 30 selected participants to stay a week (although individual institutions had to pay travel costs). RCN told participants

that they had had over 200 applicants of which 155 were eligible, something that had pleasantly surprised the research council, and that it was a careful selection process.<sup>1</sup>

The call for applications announced NOK30m to be awarded for those projects selected by the mentors and Research Council at the end of the event, and ‘the researchers responsible for the project ideas selected are guaranteed funding from the Research Council provided they submit a full application by the deadline and there is nothing else that dictates otherwise’ (Norges Forskningsråd 2013). Funds were provided by three of RCN’s funding streams: one in biotechnology, one in nanotechnology, and one in ICT, with a fourth funding stream (food and bio-based industry) willing to contribute funds to projects that fell under its purview. While it may seem obvious in hindsight that the provision of resources from this rather small pool (when considered alongside RCN’s high number of funding streams) would have a profound effect on the kind of projects that were to be funded, this was not the evident until rather late in the first idélab.<sup>2</sup>

The event took a complete working week, with delegates arriving and mingling on a Sunday evening at a carbon-neutral conference venue outside Oslo, with the event finishing at lunchtime on the following Friday. The first two days were spent brainstorming and thinking around and outside the theme, and on days three and four these ideas were gradually shaped into projects. These were submitted in written form to the mentors late in the evening on day four, and presented orally on day five. At the end of the event, the mentors announced which projects had been selected to receive funding. There were four principal projects funded – the pot having grown to NOK40m during the week – together with a fifth, smaller, project which would follow the other four projects and reflect on their multidisciplinary nature for the three years of their funding.<sup>3</sup>

Both in the run-up to the first idélab and at the event itself, the Research Council of Norway was candid that this was an experiment that participants had agreed to, but which had not been previously been implemented in Norway. This case study explores how this novel idea was implemented in Norway in terms of building new kinds of research practice through an exploratory approach seeking to identify particular kinds of micro-research practice as indicative of social learning practices. We draw on a series of twelve structured conversations (henceforth referred to as interviews) with delegates from the first idélab who had gone on to work on funded projects, along with two project researchers who had not been at idélab, and one RCN representative who has been involved with idélab from the beginning. Five of the project interviewees are from one project (here referred to as project A). This project serves as our principal case

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<sup>1</sup> indeed, this was hammered home to such an extent that we jokingly referred to ourselves as ‘the chosen few

<sup>2</sup> This is a situation that has been clarified in subsequent idélabs. To date there have been four, with the latter two being more industry-focused and lasting only three days. For more details see Norges Forskningsråd 2017.

<sup>3</sup> This article is one of the outcomes of the fifth project.

study, with which the others can be compared. All transcripts were anonymised, and where names were given they were changed. The transcripts were analysed using textual analysis methods: first, the flagging of key concepts; second, the drawing out of statements and implications. Because one of the authors of this paper was themselves an idéalab participant, these ten interviews were with an interviewer who had a shared experience of the idéalab. The familiarity of this shared background was essential for our purposes of exploring the *community* created by the idéalab and to what extent it was fostered during the projects.

## 5. Idéalab creating virtual communities of practice?

### 5.1 The language of collaboration and multidisciplinary research

All idéalab projects shared the common characteristic in that they were multi-epistemic, not just with regards to, say, chemists working with biologists, but rather with technology-focused projects including active engagement with researchers from the social sciences. Most of the projects were divided into work packages, which tended to be mono-disciplinary, with full project meetings taking place regularly in which the different work packages reported their progress. One of the biggest obstacles all the projects needed to overcome was therefore one of scientific communication: the issue of how the results – particularly interim or incomplete results, and failures – could be presented to project members in a way that everyone could understand.

For most the projects, this involved individual researchers avoiding the discipline-specific details of their work when reporting to the group, and instead focusing on what was essential to the whole project. Some, however, went further:

If we go into the details other people just stop listening. [...] People won't understand. *But if I do basic storytelling*, or more interesting or more general things, then people can follow what I'm saying. But too many details and they will just be lost. [Researcher A3, emphasis added.]

I maybe don't use terms for things that we have [in my scientific community], I use some kind of layman description. Even though you can describe something with only two words, if they are words they [other project members] have never heard of it's easier not to. [...] *I have to think in advance: 'Is this the way I want to explain it?'* [Researcher A5, emphasis added.]

These examples show two different strategies applied independently by two individual researchers in project A. The first is one of storytelling where a scientist presents results as a narrative, with that week's findings presented in the context of the whole project's unfolding, making it easier for everyone in the group to grasp, regardless of disciplinary background. The second strategy is that of forward-thinking, with the researcher in

question, being very conscious of the language employed when talking to the group, taking care to think before speaking.

Another project approached the problem of group communication somewhat differently:

We have had an emphasis in the project that we try to communicate simply to each other; a multidisciplinary project will always have these challenges, there will always be some jargon and you have to learn each others' way of speaking. [...] We had a very low threshold for stopping each other to define words, or explain underlying mechanisms behind phenomena or whatever, and I think that has worked pretty well, even if you have to do that several times before it sticks. [...] So we have some common language and get familiar with some of the technical terms, but we also had to define a solution base. We wanted to implement the technology, and we had a choice between different scale levels. *So we kind of created a jargon that we are all familiar with that is maybe unusual to someone from the outside. We defined the size of it and don't have to repeat that much any more. We have also created our own jargon in a way, to explore different situations.* [Researcher B1, emphasis added.]

In this project's early stages, the group focused specifically on communication, to the extent that they created their own 'common language' and 'solution base', allowing them to all employ certain common jargon within meetings, knowing that they would be understood by the others. This approach (the community itself forged its own common terminology) was very *community*-focused, rather than relying on the efforts of *individual* researchers. As Researcher B1 acknowledges, such internal jargon is not necessarily understandable to others outside of the group setting and therefore the *use* of the common terminology makes two clear statements. Firstly, it indicates who belongs to the community and who doesn't; secondly it shows whether a researcher is communicating with fellow community members or with those outside the group (for example in marketing the product, or publishing the results).

## 5.2 Project practices embodying social learning practices

One of the reasons project A stands as our principal case study here is because this project saw, in the first year of work, a major change of direction that came about as a direct result of its multidisciplinary nature. The project group decided to curtail one work package's activities, following input from the work package that was investigating the societal impact of the project. This was a decision that was reached in a manner that involved social interactions and which had consequences for all group participants. The process was recollected in one of the interviews:

I didn't have any opinion on it when we started. I didn't know enough about it. I never really opined anything firm on the issue. So the conclusion came as a result

of the process, and it did not come as a result of somebody shouting and screaming. It was a good experience, and probably the right decision. But if you had asked me before, about two years ago, maybe I would have said something like, 'well it can't hurt to do research so that we generate knowledge and then maybe it will be useful in the future', something like that. But now we concluded to stop researching that area, and now I think I see it more as the right decision to not waste resources on something for which the actual usefulness is questionable, without actually concluding that it is probably not useful, but it is so questionable and I cannot resolve the question, I can only note that it is debated and probably the majority would conclude that it is not useful so let's not waste resources. This is my view now and it is different from when I started, for I did not have strong opinions. I see it as a good thing, and there are probably other projects for which similar processes would be useful.

This particular work package not only brought up things about law and what the public would think about such large-scale operations, but also to my (small) surprise that it isn't sure at all whether if you still went ahead with it, it would remove carbon from the cycle as intended. So it revealed a lot of different parties there. That was illuminating. [Researcher A1.]

This quotation reveals several learning practices, involving the public, collective governance, individual reflection and the impact of this for the technological research. First, there research involving the general public revealed the public perception of the work undertaken. Secondly, there was the group decision to stop work on one area: this was indeed a group decision, taken only after all those involved had given their input. Thirdly, the researcher's individual reflection acknowledged a distinct change of personal stance on the issue. Whereas before, they had no particular opinion except that 'it can't hurt to do research', following the input regarding the societal impact of the proposed work, they swung around to a perspective that weighed the societal usefulness of the research against the resources they would have expended on it. Finally, the researcher here expressed some surprise that the research into societal impact also cast doubt on the technological nature of the research – that had this work package continued, the overall goal of the project (and of the first idéalab, that of lowering carbon emissions) might have been compromised. Here, then, is a researcher in one discipline (one of the natural sciences), reflecting with unreserved admiration on what they had learnt from how work in a different discipline (the social sciences) directly affected work in still another discipline (another natural science).

An example from another project shows how multidisciplinary communication within the project directly resulted in increased reflection and 'trust':

It turned out that we would have a couple of hours each month to talk about ethics and the future impact of the project and how we do science. And what we

found is that this has been a great strength in the project all the time. It has forced us to really think about this all the time, and these are things we wouldn't have thought about otherwise. It builds a lot of trust between people, it makes it easier to ask questions, with these people who clearly don't know physics and chemistry makes us make sure that everyone understands. Very often you cannot understand what others are doing and you have to trust that they are making the right decisions towards a very well-defined common goal. So even if we are not experts in each others' fields we can trust that we are heading in the same direction. [Researcher E1]

These projects witnessed similar patterns of social learning experience, resulting to a greater or lesser extent from interaction with partners outside of the actual project group. While the results of one had a greater influence on the project's final outcomes than the other, what they have in common is the result of increased reflection and integration of societal concerns into the scientific practice of individual project members. This, as we shall see more fully in sections 6 and 7 below, is of primary importance not only for holding multidisciplinary project teams together, but also for developing and continuing changing research practices both on the level of the individual researcher, and on national (and international) policy levels.

### **5.3 'Antisocial learning': compliance practices in Idélab**

Both the idélab and the individual projects experienced problems and tensions derived from the activities' trans-paradigmatic nature. One of the earliest hiccoughs, with lasting repercussions, occurred in the idélab when relatively late in the week, some of the groups formed to work on project proposals were told they had no chance of receiving funding because their ideas did not align to the three participating funding streams within idélab. One researcher recalls it thus:

With [another delegate] I was developing an idea, [...] it was a really cool project. But as time passed I realised it wasn't what the mentors wanted; they wanted more stuff related to the themes of the idélab, as far as I understood. And that was a bummer because we had invested quite a lot of time into it. So we had to think of something else and there was no time to start on something new so we joined in with an existing idea. [...] I sort of became pushed into this group by the mentors there, and I got the feeling that the leaders of that project initially thought that it was unnecessary for me to be part of it. [...] I always felt from the start that my part was on the side, not a full member. [...] So I was a bit disappointed. [Researcher A2]

Even at the idélab itself the Research Council acknowledged and apologised for this lack of clarity regarding the requirements, and backed up their apology by providing the

NOK10m extra funding.<sup>4</sup> Nevertheless, as an event recalled in interviews by four of the ten researchers present at the idéalab, even three years down the line it was seen as an important stage in the genesis of the projects.<sup>5</sup> In effect, what took place – regardless of the initial clarity of the funding requirements – was a forced compliance with the goals of a small number of Research Council funding streams, despite idéalab purporting to emphasise creativity and an openness to moving beyond disciplinary boundaries, and on individual researchers stepping out of their comfort zones. This form of restriction, whether explicit or implicit, works against the goals of collaboration and openness that are associated with fostering a community of practice among researchers collaborating on multidisciplinary projects. Indeed, researcher A2 learnt from the experience that, in the idéalab as with any funding call, before you can use your expertise to work together with other researchers to save the world, you first have to ‘look for the money’:

If I ever take part in another idéalab I will be less open-minded, and more targeted towards what the funders actually want, which is unfortunate, but that’s how it is unless the Research Council become more open-minded themselves. That remains to be seen. The goals should have been communicated more clearly from the start. I feel like I wasted two days there on a project that was a no-goer, and got punished double because not only can you not continue with what you wanted to do, you cannot start something new. You have to jump into an existing project and then you get down-prioritised. [Researcher A2]

## **6. Steering scientists towards multidisciplinary social learning practices**

### **6.1 A first-cut analysis of the underlying tensions**

At the end of the week of the idéalab, delegates from the five funded projects departed with high hopes for the future; after three years, the projects can be loosely divided into two groups. Three projects were at least as (if not more) successful as could realistically have been hoped on that snowy January Friday in 2014, achieving their goals, producing scientifically useful work and forming meaningful multidisciplinary collaborations. Two projects were less successful, and comparing these two groups provides an insight into the tensions inhibiting forming new behaviours.

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<sup>4</sup> In addition, this kind of misunderstanding has not recurred at subsequent idéalabs, which have made the requirements for receiving funding clearer from a much earlier stage.

<sup>5</sup> In addition, as this study focuses only on funded projects, and those delegates who did not receive funding were even more directly affected by this misunderstanding, we can presume that a significant number must recall the idéalab in this light.



One tension more easily overcome in some projects than in others was recruiting and maintaining the project team regardless of events in individual researchers' professional and personal lives. In a three year project with a team of, say, ten researchers from various career stages, there are always going to be some who change jobs, some who take temporary leave, some who decide to leave permanently. Whilst the idéalab delegates were from a wide range of disciplines, it would have been impossible to have every possible skillset for every possible project represented, so a certain amount of recruitment was not only inevitable, but desirable. Therefore, flexibility worked into a project's design was necessary, alongside strong leadership. Both researchers interviewed from project C strongly suggested that the project's leadership was at least partly responsible for their lack of success; one expressed it as follows:

But with [leader] as a project leader it just did not succeed. I proposed reducing the amount that [leader] did... Three postdocs plus reviews, but [leader] was the coordinator, the most important part. This was not what was suggested in the beginning, with four equal parts. And [leader] was mad about that.. [...] I'm not sure how it was organised. [Leader]'s postdocs were part-time, so [leader] still has money left to do something. The plan was to have one postdoc each and have them collaborate with each other. But that didn't work out. It was not a good group altogether. That's how it worked out. [Researcher C2]

This also highlights that these multidisciplinary teams did experience an expected issue in multi-paradigmatic working, namely minds just not quite meeting, or not communicating well within the group. This can be seen in researcher C2's not understanding the motives of the project leader, and of the leader's reaction to the proposition to reduce their role. This can be compared, for example, to project A, which, as we have seen, was in fact strengthened by the thorough discussion and resolution of a problem which, to this observer, seemed much more threatening to the whole project than problems with recruiting and keeping postdoctoral researchers.

When discussing communication problems, researcher D1 put it like this: 'I feel that within my project our different backgrounds made communication a bit difficult. It took way too long for me to understand those barriers.' Later in the interview, they added the following:

I'm – hopefully – much more sceptical about collaborating with people I don't know. In general I've become more of a sceptic. [Interviewer: Of what?] Of working with different fields, different people. I used to be much more happy-go-lucky. But in the last three years I've experienced lots of other stuff. I'm three years older, I'm less adventurous. I've become much more focused on co-operating with the right people. I will... think more thoroughly before entering into any [future] project. That might also be age!

This can be usefully compared with the following statement from researcher C2:

The four groups worked separately. [Interviewer: Is that how you would normally work?] I wish I had more experience with this! I guess it's often the way it works. We know now what to expect. [...] We wanted the postdocs to meet once a month, but we didn't have enough postdocs. We met twice a year as a group and that was interesting. And we always planned what to do together in the project experiment – but now I think there will be no project experiment. I believe that we could have been closer together, and more committed.

These two quotations provide some additional insights into the scientists' reactions to multidisciplinary working environments. First, it can be seen from the short sentences and pauses, and the interviewer's interjections, that the researchers had some trouble finding the right words. They were, of course, aware that their words were being transcribed for the purposes of this study; in addition, both were being interviewed in a second language. Both attempted to lighten somewhat what they were saying with hints of good-humoured self-depreciation, either with regards to experience or with growing older. Reading beyond this, it is clear there were communication problems in both: 'groups worked separately' (C2), or there were 'barriers' (D1). As we shall see more fully in the following section, the Research Council were realistic about the limited expectations of the idéalab experiment, regarding partial success as success. However, it is hard to comment on the long-term behaviour-changing effects of those two less successful projects in terms of whether they also help impregnate researcher paths towards more multidisciplinary outcomes.

## **6.2 Social learning practices within Idéalab project partnerships**

The examples from projects A, B, and E highlight that the three features of communities of practice (mutual engagement, joint enterprise, and shared repertoires) can be seen: researchers in regular contact with each other and with partners, mutual legitimacy of the project's aims across the disciplines involved, and shared means of communication both inside and outside the projects. Despite the four-year time lag between the press release launching the scheme and the research interview with RCN for this study, their essential role remained the same: an agent of change. What is observable between the soundbite-ridden press announcement and the in-depth interview was the emphasis placed on who was driving that change. Where the announcement naturally focused on the delegates and the projects of the forthcoming idéalab, inviting potential applicants, the interviewee (equally naturally) placed a much greater emphasis on the Research Council's role in creating change. The importance of multidisciplinary and social learning was already implicit in the first presentation of the idéalab to the Norwegian public, and then foregrounded in the research interview:

A main feature of an Idéalab event is that the participants are challenged in an interactive process with researchers from subject areas with whom they would

not typically collaborate. The researchers are brought together in cross-disciplinary groups for a five-day workshop. During this period they will develop ideas into concrete project proposals with advice from highly qualified external mentors and a leader who has overall responsibility for the entire gathering. (Forskningsrådet 2013)

One of the very important impacts might be not only the projects funded, but also the new ways of networking. We know that people are working together afterwards, not only in directly funded projects, but also in planning future projects. So that may be an important outcome. [...] I realise that when you've got your funding, there is a danger that you more-or-less go back to your old practices, and earlier methodologies are not evolving into ways of reflecting differently about your research... In some ways it changes you, but it's maybe not dramatic. Maybe it takes more time to change practices – more than just one project, one practice. But the article [Røyne et al 2017] points out that it's not dramatically changing the way they work, but there are new ways of thinking about things, reflecting on ethics, crossing borders in new ways between technologists and social scientists, and the way of working from different perspectives. [RCN Interviewee]

This highlights the individual researcher(s) involvement in social learning practices and the progressive nature of research as a knowledge-creation activity. The 'new ways of thinking' might not be dramatic, but it is possible to perceive a ripple effect: taking part in an idélab and then a multidisciplinary project is an experience that stays with individuals, and one might expect those researchers to then pass the experience – or the fruits of the experience – to their students, postdocs, colleagues, and research partners. This effect is borne out in the interviews with the two, more junior, researchers recruited to project A after the idélab: among all the interviews, both their voices were among the most open and welcoming supporters of this kind of work. Indeed, the interviewee from the Research Council of Norway hinted that younger researchers may be the strongest drivers of the kind of change the Council envisages:

It's important to maybe start with using most energy on new, young researchers who are open for new understandings and doing things differently, rather than more experienced researchers whose mindsets can be difficult to change. Focusing on the younger generations is important. They are the future. [RCN Interviewee]

Nevertheless, while our interviews showed broad support for the idélab and the way of working it engendered, its strongest critic – indeed, the only interviewee who did not consider the process to be at the very least a successful experiment – was among the youngest. Likewise, the researchers who showed the most apparent and deep-rooted changes to their personal practices were those who were oldest. Therefore, while our

small sample of interviewees does not wholly support this division by age and/or experience, it does show, and strikingly, how the success or otherwise of projects involving multidisciplinary social learning practices is very much down to the individual researchers. This point was also brought up by the RCN interviewee, in the context of our discussion of the role of researchers from the social sciences and humanities in the idélab-funded projects:

It's all about mentality. They [researchers from the social sciences and/or humanities] have to learn the technology and understand it, that is way beyond their own disciplinary practices, and some are not interested at all. Some are trying to say that this is not the way to develop competencies in the social sciences and humanities, and in fact it drains them, because they have to take part in research questions that are far from them and are not the focus of the research. There are a lot of social science and humanities researchers who are quite sceptical of being involved in such projects. They want to do research within their own understandings of the discipline, which I can understand, but others are very keen to be pushed out of their comfort zone. Some like it, some don't. The same is true for other disciplines, sometimes they don't want to face the real world, or the interlinkages or complexities. But if you are going to address social science in tech research, then you have to go out of your comfort zones. [...] You're not going to solve big problems within disciplinary boundaries – you have to cross them. That is the intention behind idélab, to get people out of their comfort zones, and expand and use their competencies in different ways.  
[RCN Interviewee]

Change, therefore, depends on individuals, and this is as true for multidisciplinary research as it is for the addressing of the grand challenges themselves, but that change is rather slow, and the challenge for an instrument such as idélab is sustaining that change over the long term on the basis of relatively short – and in the context of RCN as a whole – rather marginal research projects. The interviewee showed that this is something of which the Research Council is well aware:

We are looking at how to make sure, after funding, that the projects are really staying in line with the aims of the idélab, and having the resources to follow up is critical. We can do much better when it comes to following up the projects than we do currently. It's very easy to fall back into old research practices when you are no longer at the idélab. It's difficult to be in that kind of mental change, pushing yourself to do things differently, when it comes to the actual practice afterwards. How do we help people stay out of their comfort zones? It's not easy to do things in different ways. When it's just one project trying to do things differently, and you have other things to do as well, there are not perhaps enough resources on just this one project to step out of your practices and change your

methodologies. That's really challenging for all the participants, to be able to change practices, not only for a short time, but changing your research on other projects too. Changing practices is not easy. [RCN Interviewee]

Indeed, it is not easy to deliberately introduce new practices especially in an academic environment where publications (and, metrics, and rankings...) are supremely important, mostly because they are easily quantifiable, as the leader of the first idélab, James Wilsdon, recently put it, 'we measure what we can measure, rather than what matters' (Campbell Collaboration 2017). Yet, as the citation below shows, the RCN interviewee – and, by inference, the organisation they represent – do believe that there are things more important than the measurable outcomes of a project:

What we are trying to do, and to some extent have succeeded in doing, is to focus more on the impact of research, and addressing social challenges. These are very complex, and we need research practices to change. We can't do it in the old ways. *It's not only quality that counts – quality in the academic sense – but re-defining how quality is understood when it comes to addressing and solving social challenges.* Being part of that initiative, to try to move research into new fields of understanding and working – that's important, and I'm quite proud to be one of the people in the Research Council who are challenging traditional practices. [RCN Interviewee, emphasis added]

Although this is refreshing given contemporary emphasis on metrics and rankings, it must be stressed that the idélabs are only a small part of the Research Council of Norway's funding processes. Indeed, even if it is taking time (and do the grand challenges allow the luxury of that time?) it seems as if a move towards a pluralism in research funding is afoot in Norway:

I think we need a multitude of ways of funding research. But trying to see the interlinkages between different kinds of research, and getting people to work together, these are the way forward. Researchers need to focus more and more on understanding complexity. You have to develop multi- and trans-disciplinary practices all over the place. I think it's important that people can also focus on very narrow projects and that's important within disciplinary boundaries, but being only there is not the way forward. [RCN Interviewee]

## 7. Discussion and conclusion

In this paper we have sought to ask the question of whether new funding approaches can contribute to creating new ways of working by scientists towards challenge-driven research, specifically by changing scientists' expectations and beliefs. One striking outcome from our research is that those projects which best embraced their multidisciplinary nature were those where the members each felt that their research

was valued on an equal footing. This is most particularly visible in our primary case study of project A, where the results of the social science work package not only had a profound effect on the overall direction of the project, but also prompted personal reflection and change among individual project members. This perceived equality of disciplines among researchers working together on a project thus stands in stark contrast to the relegation observed by Science Europe in 2014. Where they observed that the marginalisation of one discipline led to its effective exclusion (which in turn undermined the very goals of the funding programme), our observations of the integration of social learning practices into multidisciplinary projects show that all disciplines can and should have an important role to play.

That this can occur even where resources are unequally distributed across disciplines or work packages shows not only the diligence of the individuals involved in the projects studied here, but also the potential for further success where social learning methods are encouraged and rewarded. Social learning practices such as those described here do not have to stem from equal distribution of finances, nor do they require that every discipline in every multidisciplinary project need be of equal importance. They do, however, necessitate an engagement and commitment to the potential for change brought about through social learning. This is exemplified in the following quotation, in which one of the most experienced researchers interviewed describes how their own personal view of working has been profoundly changed in ways that would have been unthinkable had they not taken part in the idéalab:

I'm now probably much more open in general to other combinations of competence if I'm thinking about future research directions, projects, not only in this setting but in general. I see more possibilities, anything is possible. It's more the long-term building of ideas and projects, the thinking around that is different. We all have our core expertise and that doesn't change so much, but being conscious about the fact that it can be combined with other people's expertise should be obvious, but many of us need a wake up call... I wouldn't have had it without this project. [Researcher A1]

In the context of our exploratory case study, it is clear that the projects that were the most successful were also those whose members were all willing and able to become mutually dependent on each others' varying knowledge and expertise, and that it was through this interdependence that the research processes generated provided new knowledge that was able to respond directly to the grand challenges. At the same time, we could identify in those projects all three features of communities of practice: mutual engagement in core activities such as defining research questions and problem solving; joint enterprise where all members saw themselves as working towards an agreed common goal that could be legitimate across all the disciplinary paradigms represented; and shared repertoires where the meaning and knowledge generated became encoded

and internalised in the individual researchers' working methods. We can therefore conclude that new funding approaches such as the idélab (or sandpit) can indeed go some way to changing the expectations and beliefs of participating scientific communities and thus help to create new ways of working on challenge-driven research.

There nevertheless remain some problems, not the least of which is the increased integration of the social sciences and humanities into the technological and natural science disciplines – and vice versa. We posit that one possible reason for this disparity is the 'antisocial' view of these disciplines as on the sidelines of scientific research. This view is prevalent in mainstream discourses both inside and outside of the mechanisms and institutions of research and research funding. As long as some disciplines are viewed – and view themselves – as outside of the funding game, they will not be incorporated as fully into research as a whole, and as a result all disciplines will suffer. While this problem is of course multifaceted, as long as there is a shortage of research funding in some areas which leads to the hoarding of these precious funds for monodisciplinary work that strengthens the discipline in question, the problem of marginalisation will remain. Yet, as the opening sections of this paper show, without multidisciplinary research the so-called Grand Challenges will remain unsolved.

We therefore highlight that on the basis of our research it is legitimate to argue that it is not just individual researchers and projects who need to adapt social learning practices for scientific research, but also funding agencies, on both the national and international level. The Norwegian idélab funding stream is only a small part of the country's overall funding strategy, but it is nevertheless one which can generate truly multidisciplinary work whose net effect stretches much more widely than the projects which have been funded. Indeed, publications in widely-read non-scientific journals (such as Røyne et al 2017), together with attention from high levels of government and the mainstream media (the current Norwegian minister for industry, Monica Mæland, opened the most recent idélab in June 2017, as reported in Blich Bakken 2017), are serving to generate interest in multidisciplinary work from various different angles.

It is to be hoped, therefore, that this new interest in multidisciplinary research will see an increase in social learning at the policy level as well as among the individual researchers. While we acknowledge the need for many ways of funding research, and for different types of research, we argue that the social learning practices we have outlined here among individual projects, researchers, and one national funding system are also required elsewhere. No amount of idélabs are ever going to solve the grand challenges on their own, nor is multidisciplinary research the only way forward. Nevertheless, an increased awareness of the fruitfulness of multidisciplinary working, together with an acknowledgement (financial as well as theoretical) of the equal importance of all disciplines in scientific process, might in time generate the kind of changes on a grander scale that as we have seen here are possible on the small scale. Whether or not this will

come in time to respond to the dangers facing our species and our world remains to be seen.

### **Acknowledgements**

The research into this article was funded by the Research Council of Norway, who have been unwaveringly helpful at every stage. Thanks are also due to co-conspirator Anders Gravir Imenes (University of Oslo), who has been a valued supporter of our efforts. Above all, thank you to the interviewees not only for their willingness to take part, but also for sharing personal insights and being extremely welcoming and open to us 'researching the researchers'.



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