Leviathan and the hybrid network: Future Earth, co-production and the experimental life of a global institution

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In the opening words of *A Sociology of Monsters*, John Law caricatures a middle-class white male, middle-aged, non-disabled person's perspective on the history of sociology: 'We founded ourselves on class; then, at a much later date we learned a little about ethnicity; more recently we discovered gender; and more recently still we learned something ... about age and disability' (Law, 1991: 1). Thus, the hypothetical sociologist's gradual realisation that 'his' sociology had never spoken for "us": that all along the sociological "we" was a Leviathan that had achieved its (sense of) order by usurping or silencing the other voices' (Law, 1991: 1). In acknowledging the struggles – the 'pain' – of sociology's gradually expanding and more inclusive scope, Law signals the (potential) monstrosity of discipline and exclusivity in the formation and perpetuation of academic knowledge and communities.

Whether or not one subscribes to this view of sociology as monstrous, science and technology studies (STS) is replete with monsters. From Haraway's cyborg (1991) to Latour's appeal for us to love and care for our technologies rather than abandon them as Frankenstein did his creation (Latour, 2011), the central preoccupations of this field concern the (blurred) categories of and relations between nature; culture; the human, non-human or more-than-human; the scientific; technological; social; material; epistemic and the political: the construction, maintenance and disturbance of our 'natural' and 'social' orders and kinds. Whether leviathan in the sense of biblical sea monster, monolithic and powerful organisation, or Hobbes's body politic ruled by the sovereign head of state – or whether ambiguous hybrid – the monster

is a useful metaphor and heuristic for exploring and describing disruptions to order and control; the unusual, unfamiliar or potentially threatening; and our anticipation, fears and hopes.

With this in mind, might disciplines, research communities and knowledge domains be usefully characterised as leviathans, giant structures composed of many individuals governed by one singular centralised agency policing their boundaries? Or are they best seen as hybrid networks, configurations or assemblages of the scientific and the political, the material and the epistemic, the social and the natural? Or perhaps it is more productive to consider our epistemic apparatus not as a monster itself, but as facing monsters in the process of its continuous (re)formulation, (re)definition and (re)structuring.

This chapter explores efforts to bring about transformations in global environmental change (GEC) research institutions, communities and cultures. In particular, it focuses on the reconfiguration of several existing international GEC research programmes into one initiative: Future Earth (henceforth FE), an international research initiative on GEC and sustainability that was launched in 2012 and became fully operational in 2015. This reorganisation is accompanied (and in part motivated) by ambitions for a ‘new type of science’ (FE, 2014: 2) and ‘a new “social contract” between science and society’ (FE, 2013: 11). To achieve these aims, FE is unique in explicitly adopting co-design and co-production of knowledge as a strategic agenda for the governance, coordination and production of research from global to local levels.

Here, co-design and co-production (and transdisciplinarity) can be understood as the opening up of science (or research more broadly) and its governance to the participation of a wider range of stakeholders, with the goal of transforming the ways it is done and used, as well as its efficacy and impact. However, we do not yet know how this transformation might be enacted in practice in a concrete programme. Given this, what are constructive ways of understanding this initiative and others like it? Are there monsters lurking in the uncharted territories of the deliberate co-production of new research at a global scale? And what is FE – a powerful leviathanesque organisation, a hybrid network, a combination of the two or something else entirely? This chapter, written in early 2016, explores the answers to these

questions at a particular moment in FE's development, drawing on data from a qualitative case study of FE conducted between 2013 and 2015. FE has since evolved (and will continue to evolve for its duration), but may still face many of the questions and tensions considered here.

The following section provides background on transformations in research systems and cultures, changing science–society relations, and a brief introduction to the concepts of co-design, co-production and transdisciplinarity.

Changing research systems, cultures and science–society relations

Since the 1980s and 1990s, scholars of research policy and STS have explored changes in research systems, institutions, philosophies, cultures and practices. The various conceptualisations of transformations in the dynamics between research and society include post-normal science (Funtowicz and Ravetz, 1993), mode 2 knowledge production (Gibbons et al., 1994) and post-academic science (Ziman, 2000), amongst many others. While such concepts are diverse, they all describe, theorise or advocate a shift from the disciplinary organisation of research within the academy towards a greater recognition of socio-economic priorities and involvement of broader communities – particularly non-academic actors – in the governance and production of research, whether at a local, national, regional or global scale (Hessels and Van Lente, 2008). These ideas and accounts are not uncontested, but some of them have also taken on a performative role, both suggesting that a new organisation of knowledge production should take place (or is taking place) and simultaneously participating in its realisation (Godin, 1998).

Alongside the emergence of these ideas there have been increasing calls within national and international research (funding) communities for multi-, inter- and transdisciplinarity; public and stakeholder engagement; and RRI – often to address grand societal challenges such as global environmental change, health or sustainability (Felt and Wynne, 2007). In this context, co-design and co-production have been advocated as research and/or governance approaches – for example, by UK research councils and academics (Campbell and Vanderhoven, 2016), as well as in wider public policy contexts (Durose and Richardson, 2015).

However, while these initiatives aim to move beyond the traditional disciplinary organisation of research and open up research and policy processes to a wider range of actors, the concepts underpinning them retain a high degree of interpretive flexibility (Ribeiro et al., 2016), sometimes serving as ‘buzzwords’ that mobilise people and resources (Bensaude Vincent, 2014), or as ‘boundary objects’ that enable diverse parties with different perspectives to work together (Star and Griesemer, 1989). In particular, co-production and related concepts such as co-design and transdisciplinarity have various meanings in different theory and practice contexts, including STS, public policy, environmental and sustainability research, health, community and development studies, and the arts and humanities. In general, these terms refer to the participation or collaboration of non-academic actors in research (whether defining questions, gathering or analysing data, or engagement in other aspects of the research process) (e.g. Pohl et al., 2010), or the involvement of communities and/or other non-governmental actors in policy processes or public service provision (Bovaird, 2007). Co-production is also employed as an analytical idiom by Sheila Jasanoff and other scholars in STS to signify the co-constitution of science (knowledge) and social (political) order (Jasanoff, 2004).

While the language of STS and cognate fields (e.g. ‘participation’, ‘engagement’, ‘co-production’) is adopted in research governance, practice and broader policy contexts, the motivations for using these approaches in these contexts do not always follow the original logics espoused by scholars, and implementing the concepts can be challenging (Irwin, 2006; Pohl et al., 2010; Stirling, 2008). The reasons for proposing and adopting these approaches to reconfiguring epistemic practices, knowledge domains, and science–society relations are at least as diverse as the range of interpretations of the concepts themselves. STS scholars continue to argue for social agency, for opening up or democratising science and governance, and ensuring accountability of science/scientists and policy makers to broader society. But they also suggest that, despite the proliferation of the language of STS, deficit and linear models persist that assume one-way relationships between experts and other stakeholders, and between knowledge and socially beneficial outcomes via policy, failing to acknowledge the uncertainties and limits of knowledge and governance (Jasanoff, 2003; Stirling, 2008; and see chapter 12).

In the case of the co-production of research, even within STS there are varying rationales for advocating co-production practices, driven by different logics (Löwbrand, 2011, following Barry et al., 2008). One rationale is underpinned by a 'logic of ontology' that hopes to challenge the broad questions of collective purpose and ontological assumptions inherent in particular world views or issue framings. Another is a 'logic of accountability' that calls for the alignment of research portfolios with societal need. In the context of a research project on EU climate policy, these different rationales seemed incompatible. Broadly speaking, policy makers in the co-production exercise wanted knowledge that would be 'useful' within a predefined framework, while social scientists wanted to challenge the policy framework.

Other initiatives to implement or study co-production have tended to focus on the intentional pursuit of co-production at local, national or regional levels and in individual projects and organisations (e.g. Robinson and Tansey, 2006), or the broader (often much less explicit) processes of the co-constitution of science and social order in national and international contexts (e.g. Beck and Forsyth, 2015). However, only a few studies have examined the adoption of co-design and co-production as principles for the governance and production of new research at a global scale (Lahsen, 2016; van der Hel, 2016). This chapter addresses that gap by exploring how co-production is understood – and how it relates to broader questions of institutional identity and function – in the case of FE.

Future Earth background

FE, a major international research initiative on global environmental change (GEC) for sustainability, was officially launched by the Science and Technology Alliance for Global Sustainability in June 2012, during the UN Conference on Sustainable Development (Rio+20).¹ Its unique ambition is to provide a global framework and international coordination of new research on GEC and sustainability (as opposed to the

1 The Alliance (formed in 2010) comprises the International Council for Science (ICSU); the International Social Science Council; the Belmont Forum of global change research funders; the United Nations Educational, Scientific and Cultural Organization (UNESCO); the United Nations Environment Programme; the United Nations University; and the World Meteorological Organization (see www.stalliance.org/).

large-scale synthesis of existing research in assessments undertaken by the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)). It aims to become 'a major international research platform providing the knowledge and support to accelerate our transformations to a sustainable world' and 'a platform for international engagement to ensure that knowledge is generated in partnership with society and users of science', merging several existing international GEC research programmes (FE, n.d. a).

These programmes aimed to coordinate and promote international interdisciplinary research on GEC, set research agendas, and make links between research and policy (FE, 2013: 13). Between 2006 and 2009 the International Council for Science (ICSU) reviewed some of the programmes, concluding that there was a 'need to implement a single strategic framework for Earth system research in the near future' because the research landscape was 'complex, confusing, and often [led] to inefficient use of human, institutional, and financial resources' (ICSU, 2009: 2). In 2009 ICSU and the other co-sponsors began a visioning process to rethink the future of the programmes (which converged with the development of the 'Belmont Challenge', a funders' vision for GEC research (Belmont Forum, 2011)), and later established a transition team to design a new ten-year initiative to succeed them. FE was launched in June 2012, and became fully operational in 2015 through the change from an interim to a permanent secretariat. Key features planned for the fully operational phase of FE included:

- an emphasis on integrated research across disciplines spanning natural and social science, the humanities, and engineering
- the co-design and co-production of research with stakeholder groups including funders, policymakers, civil society and business
- the initiative's global scope, encompassing all regions, and bottom-up input from the research community and other stakeholders
- the accelerated delivery of solutions-oriented, policy-relevant research (FE, 2013; ICSU, n.d.).

The co-design and co-production of relevant knowledge in particular are billed as 'one of the most innovative aspects' of the initiative (FE,

n.d. b). FE thus exemplifies calls for transformations in research systems and knowledge-making communities towards engagement with non-academic stakeholders. But what do co-design and co-production mean in FE, and why have they been adopted as core features of the initiative? And how can we make sense of this type of programme?

Jasanoff and Wynne (1998: 58–59) note that two potential avenues for development were mooted for one of FE's precursors, the International Geosphere–Biosphere Programme (IGBP), in the mid-1990s (Barron, 1994). Firstly, the 'rich tapestry' model, in which diverse (sometimes pre-existing) national and individual contributions or initiatives would have been grouped under the broad umbrella of the IGBP. Here, IGBP's role would have been to facilitate communication and collaboration, but its identity, visibility and ability to attract funding may have been weakened. The second model was that of the 'flagship', where effort would have been focused on 'task-oriented activity' (such as major field experiments or modelling activities) with closer integration, greater harmonisation and stricter dirigisme, reinforcing IGBP's status as an autonomous international programme at the cost of its inclusivity and diversity. In terms of the metaphorical monsters described at the start of this chapter, these models respectively align with the notion of a knowledge community as a hybrid science–society network, and as a monstrous leviathan.

FE faces similar dilemmas in relation to its structure and role. Might it become – or is it best viewed as – a loose hybrid network of the scientific–political, the material–epistemic and the social–natural, in which there may always be ambiguity around what type of organisation it is? Or is it better viewed as a leviathan, a giant monolithic structure composed of many individuals governed by one centralised agency aiming to coordinate, prescribe, direct, harmonise and standardise knowledge production, potentially to the detriment or exclusion of some voices? Or is it both – or neither? And what role might co-design and co-production play in these various scenarios?

Emerging tensions and ambiguities

Drawing on a qualitative case study of FE conducted between 2013 and 2015, this section firstly explores the diverse designations and roles imagined for FE, noting that ambiguities between them – and

in the ambitious remit of FE – were seen as potentially problematic by some FE and external actors. Six specific tensions and ambiguities arise from these diverse visions and are likely to proliferate as FE is extended and replicated at different scales and in different contexts. Ambiguities in co-design and co-production in FE are then identified, starting with the predominant rationale for this approach (co-production for utility) before detailing two further views (co-production for democratisation, and co-production as a threat). The necessity of resolving these ambiguities is questioned, and their relation to the flagship/leviathan and rich-tapestry/hybrid-network models is discussed.

During the study, FE was still very much an organisation in the making; many aspects of its design and implementation were still ambiguous and yet to be determined. Data collection for this study was concluded before the transition from the interim to the permanent secretariat in 2015. FE has since evolved and will continue to evolve for its duration.

Visions of Future Earth and the negotiation of ambiguities

During the period of study, visions of FE – of what it is supposed to be and what roles and functions it is supposed to have – were diverse, ambitious and, sometimes, ambiguous. In official and internal documents and webpages (produced between 2010 and early 2015), as well as in interviews and focus groups conducted as part of this study,² FE has been conceptualised in a range of ways. Some of these visions evoke a leviathanesque ‘flagship’, for example: ‘a consolidated and comprehensive effort, a flagship initiative on Earth System Research for Global Sustainability’ (ICSU, 2011); ‘the global research platform providing the knowledge and support to accelerate our transformations to a sustainable world’ (FE, n.d. a).³ Others are more suggestive of the ‘rich tapestry’ of a hybrid network, for example: ‘at its core a

2 Interview and focus group participants comprised members of the Future Earth Science Committee, Interim Engagement Committee, Interim Secretariat, Alliance/Governing Council, and other actors involved in or aware of FE’s development and implementation.

3 This has since been changed on the website to ‘a major international research platform’ – perhaps as an acknowledgement that there may be other such platforms.

“federation” of projects and other initiatives related to Global Environmental Change’ (FE, n.d. c); an umbrella, tent, arena, network, and hub (e.g. interviews 7 and 8;⁴ FE, n.d. d). Others still might fall into either, both or neither category, for example: ‘first and foremost a community’ (FE, n.d. e); part of a global innovation system (interview 9); amongst others.

Across the data, FE’s imagined roles and functions are as diverse as its definitions and designations. They include (but are not limited to): integrating the existing GEC programmes; creating interdisciplinary, integrated, authoritative knowledge on the key challenges of GEC and sustainability (including climate change, biodiversity loss, and socio-economic change); informing policy, decision making and action in the UN system (such as the Sustainable Development Goals, the IPCC and the Framework Convention on Climate Change) and at other levels; raising, redirecting and coordinating research funds, activity and capacity; bringing about a change in the culture or practice of scientific research; involving existing and new communities of researchers, particularly from the social sciences, and engaging stakeholders; bringing together GEC and sustainability research communities and refocusing GEC research on sustainability challenges; all at local, national, regional, and/or international levels.

This wide-ranging diversity in defining what FE is and what its remit entails is acknowledged in passing in two early Q&A posts on the FE blog. In posing questions to the Chair of the FE Science Committee and to the Interim Director of FE, ICSU communications staff noted respectively that ‘Future Earth seems to mean different things to different people’ (Mengel, 2013) and ‘Future Earth may seem like all things to all people’ (Young, 2013). These statements reflect the roots of FE’s plural definitions and purposes: on the one hand, many people have been involved (and have a stake) in its development, giving rise to a broad range of visions and interpretations; and on the other, the ambitions for its remit and scope are extremely broad even within single narratives of the initiative, incorporating a wide range of actors, knowledges, practices, phenomena, and scales.

4 In an effort to maintain anonymity, interview numbers (one per interview) have been attributed at random and do not reflect the order in which the interviews were conducted.

Although diverse understandings of what FE is and might do emerged from the interviews, there were varying degrees of awareness of and concern about these differences, with some interviewees retaining a strong sense of FE's purpose (from their perspective), and others viewing a lack of clarity around its identity, objectives and activities as potentially problematic. In mid-May 2014, one Interim Engagement Committee member argued for more specificity about FE's intended achievements, stating that 'Future Earth needs to really, really improve the definition of who and what it is and what its exact purpose is; I still think it's a bit too vague' (interview 10).

Lack of clarity or focus in FE's mandate has also been flagged as problematic by external stakeholders. In late May 2014, Ian Thornton, deputy director of the UK Collaborative on Development Sciences, blogged about FE, having attended an ICSU workshop. He suggests that despite considerable awareness of FE among UK stakeholders, there is confusion about 'what Future Earth will do, its value-add, and whether UK funders should engage more closely' (Thornton, 2014). He attributes this confusion to the challenges inherent in articulating what coordination of research can achieve, particularly in the context of an evolving organisational mandate, arguing that FE should pare back its goals and clarify what the secretariat will do: 'Is it mainly coordination? Or, evidence synthesis and policy influence? Or being a hub for debate?' (Thornton, 2014). Indeed, during the period of study, FE documents and actors suggested that the initiative (if not specifically the secretariat) is intended to take all three roles identified by Thornton, and more.

Overall, the analysis of the data suggests (at least) six linked points of tension or dilemmas between different visions and ambitions for FE, at times echoing the leviathan and hybrid-network models. Firstly, related to Thornton's point above, there is a potential conflict between visions of FE as a hub or arena for debate, dialogue and deliberation, and that of FE as a platform to deliver solutions-oriented, policy-relevant knowledge and innovation outputs. The ability to achieve both within the same institutional and conceptual framework has been questioned by scholars outside the initiative (Löfbrand et al., 2015).

This is closely linked to the second and third tensions. The second is between consensus and plurality, or between the desire to integrate

knowledge (and also to create an integrated, authoritative, singular organisation, programme, or brand) and the inevitable multiplicity of a multi-scalar, multidisciplinary, multi-stakeholder international initiative and its forms of knowledge (Klenk and Meehan, 2015). The third tension is between the ambition to bring about new ways of doing science while also promoting and ensuring continued authority for existing ways. Here we might loosely align debate and plurality with the hybrid-network model, and solutions and singularity with leviathan (with caution, as STS has alerted us to the reductionism of binaries), but the new versus existing ways do not align as neatly with the models. Perhaps a hybrid network is more amenable to innovation or novelty, and the (authority of the) status quo more easily maintained and elevated by a leviathan.

One participant discussed FE's role as a forum for debate, highlighting tensions between new and old:

To me, what's exciting about Future Earth is that it is pioneering a new approach to thinking about and doing science, which is integrated, interdisciplinary, co-produced, and it also should be a forum for encouraging debate and encouraging this approach but in a critically reflective way. [...] But I do think it faces real tensions because at the same time it's trying to give more prominence to some fairly standard ways of doing science.

The participant then identified a challenge:

But the threat is that integrating everything becomes a kind of lowest common denominator and you lose, as it were, the cutting edge nature of that science – and I think both can happen there but I think we need to work very actively with those tensions and be aware of them and push on both fronts. (Interview 7)

The tension between singularity and multiplicity is perhaps heightened by the authority-building and fundraising aspirations for the initiative, particularly for those imagining its place in the UN system. One participant suggested that FE is 'not trying to be totalising', but that the ambition is to be 'the main place' and 'the natural platform' with which the UN, the European Commission and other international organisations wish to partner (interview 8).

Relating to authority building, there is a fourth tension between FE's ambition to be inclusive (of both existing and new research and

stakeholder communities) versus upholding standards and setting limits on what counts as FE knowledge or approaches. On the one hand, interviewees spoke about working towards making FE 'a growing tangible concern that people understand and that they want to be part of' (interview 8), and opening up FE not only to the core projects of the existing GEC programmes but also to other science communities, including 'the mass of environmental social science across the world that by definition until now has been excluded from this dominant global environmental change community' (interview 7). However, they also spoke about the need to 'regulate the arena' (e.g. through peer review, critique and allowing the most robust claims to survive), whether because scholars and/or stakeholders are not 'fully aligned' with FE, or 'committed enough to the codes', or might 'clutter up the arena with false claims or with unfounded claims' (interview 8). Processes for affiliation with FE and ways of including other communities were being discussed and designed by the committees during the period these interviews were conducted, with varying ideas about the appropriate level of bureaucracy, who should be included and how.

Linked to this ambiguity around openness to participation or affiliation, there is a fifth tension between the directive action of establishing an initiative from the top (global and centralised) level down and the ambition to be responsive to the needs of society and to include bottom-up input from the scientific community. One participant argued that FE is 'a directive programme' and is not intended to do 'purely responsive science', that it needs to set 'broad strategic directions through the [strategic research agenda] process', but that there should be 'wide engagement' in putting those agendas together, and the research community should be given 'wide freedoms' to design research to meet them, without it being 'a completely blue skies programme' (interview 3).

The dilemmas between strategy/directiveness versus responsiveness, and between blue-sky research versus useful research, link to a sixth tension, which itself links back to new versus existing ways. This is the tension between a utilitarian focus on demand-driven science and the more traditional curiosity-driven model. Again, we might loosely align inclusivity and responsiveness with the hybrid-network

model, and setting standards and strategy or direction with that of the leviathan. But, similar to the tension between new versus existing modes of science, utility versus demand and curiosity versus supply do not map neatly onto the models.

While thinking in terms of dilemmas might suggest mutual exclusivity, these tensions are not necessarily dichotomous. However, they are issues that those involved in FE were negotiating and navigating at the time of this study, and will probably continue to face as the initiative further develops. While this type of ambiguity can perhaps be expected in the early stages of a new initiative as its identity and remit are still in flux, it could be argued that some stabilisation may occur through the social order of recognised practices, structures and identities, particularly as the multiple roles and functions imagined for FE inform design decisions made about its governance, operations and activities.

For example, certain aspects may find some sort of stability in FE's organisational structure or its infrastructural architecture. In March 2016 the headline of the 'Get Involved' page on the FE website was changed from 'Future Earth is first and foremost a community' to 'Future Earth is first and foremost an open network committed to global sustainability.' This change was implemented in conjunction with the launch of the FE 'Open Network', an online networking tool to which anyone can sign up: (potentially) a concrete mechanism of openness and bottom-up input.⁵ (Of course, the extent to which such mechanisms will be used or will enable collaboration on equal footing remains to be seen.)

Despite these points of stabilisation, as FE further develops and is rolled out and taken up at regional and national levels (whether through its regional hubs or centres and national committees, and/or by other initiatives affiliating, or in multiple other possible ways), the same and further ambiguities are bound to emerge. As the FE network extends and becomes more complex, the FE model is also extended, adapted and interpreted in a diverse range of contexts.

5 These developments were at least partly driven by personnel changes between the interim and permanent secretariat in 2015, and the associated shifts in perspectives and approaches.

Ambiguities in co-design and co-production

In addition to the tensions and ambiguities that emerge when thinking through and talking about FE's identity and functions, there is ambiguity around the concepts and roles of co-design, co-production and transdisciplinarity in FE. This ambiguity has also been regarded as problematic by some. As noted by science writer Jon Turney in an FE blog post (Turney, 2014), the *Design Report* (FE, 2013) and the 'Impact' section of the website (FE, n.d. b) perhaps prompt more questions than provide answers about these concepts. On the one hand, it is suggested that co-design and co-production require 'an active involvement of researchers and stakeholders during the entire research process' (FE, 2013: 22), but on the other, it seems that less active involvement of stakeholders may be preferred at some stages:

Co-design and co-production of knowledge include various steps where both researchers and other stakeholders are involved but to different extents and with different responsibilities [...] Whilst researchers are responsible for the scientific methodologies, the definition of the research questions and the dissemination of results are done jointly. [...] It is also recognised that the focus for this way of working should be on where the research and stakeholder community feel that it will bring the greatest benefits. (FE, 2013: 23)

The website and *Design Report* do not address how to reconcile continuous engagement with the described division of responsibilities, nor how it should be decided where co-design and co-production bring the greatest benefits (and to whom). There are additional uncertainties on the roles of participants and stakeholders in co-design and co-production, the scale at which these endeavours should happen, and the anticipated outputs and outcomes, stemming in part from the differing rationales for undertaking such processes (and more broadly from differing imaginaries of science, society and the relationship between them) (Hadley Kershaw, forthcoming).

The predominant vision of co-design, co-production and transdisciplinarity in FE (in the documents and among many of the key actors) is that collaboration between researchers and stakeholders will ensure that the 'right' research questions are asked and therefore relevant or useful knowledge (and solutions) will be produced, and will be more likely to have impact as users have been involved in its production.

This utilitarian view corresponds to the logic of accountability as discussed on p. 111: redirecting research portfolios towards societal need (Lövbrand, 2011: 227), with an additional emphasis on impact of research. This type of rationale has been criticised for its normative assumption that co-produced and transdisciplinary research leads unproblematically to beneficial social solutions (Polk, 2014), and for restricting plurality, deliberation and social-science involvement (Lövbrand et al., 2015).

However, the interviews and focus groups conducted for this research revealed a broader range of understandings of co-design and co-production in FE. Some participants saw them as deliberative or reflexive processes in which multiple perspectives, commitments and knowledges are brought together, discussed and socially constructed:

I would see the sort of co-construction agenda as about people, all these people, whether they're users, whether they're different scientists from different disciplines, coming to a situation bringing their own social commitments and drivers and understandings and assumptions about the world, and bringing those together and reflecting on them reflexively, realising that everybody's got a set of partial perspectives so those need to be deliberated on and debated out throughout the process, throughout the design, throughout the doing, throughout the communication. (Interview 7)

This view is more closely linked to visions of FE as an arena for deliberation, rather than as a platform for solutions, aligning with the logic of ontology described by Lövbrand (2011; following Barry et al., 2008) in which dominant frameworks and world views can be challenged, and ontological questions – including questions of common purpose – asked. That is not to say that participants voicing these opinions were not interested in finding solutions, having impact or 'making a difference'. However, this was more closely associated with extending agency and the rights of knowledge production or governance to non-academic actors, valuing their perspectives and knowledge, and democratising expertise:

[Co-production] is to recognise that scientific knowledge or scientists are not the only people who hold relevant knowledge. That knowledge of practitioners, decision-makers, local communities, et cetera, is valid knowledge. [...] That is why I like to call them knowledge partners,

because they are not just providers of additional data, they are not witnesses, they are active knowledge partners, their knowledge counts. (Interview 5)

A third view of co-design and co-production was also apparent: they were perceived by some as a threat. Many participants referred to the ideal of objective, pure science; either expressing concern about how to preserve it or noting that others in FE feel that it is challenged by co-design and/or co-production. Some of the most significant contestation arose around adherence or otherwise to this ideal, as well as around the notions of scientific independence and academic freedom. One participant suggested that the involvement of private-sector organisations (e.g. oil companies) in research could be dangerous, considering the elimination of conflicts of interest to be ‘the hallmark of science’:

For me, in the middle [of the research process] there should be a complete separation, I do not believe that stakeholders should ever be involved in the process of generating data, interpreting data or peer reviewing data. That, to me, provides egregious conflicts of interests that ... will ruin the integrity of science for society, in my opinion. (Interview 2)

However, this participant was not totally against the co-design of research questions and priorities, as long as there was still support for curiosity-driven science beyond FE. Other participants felt that perceived risks of bias or conflict of interest associated with involving societal stakeholders were legitimate but manageable concerns. For example, one participant suggested that accountability could be built into the research process by stipulating that projects address questions of inequality when co-designing and/or co-producing with business or other powerful actors (focus group 2); another proposed that political co-option could be avoided by ensuring that the academic peer-review process would be undertaken by rigorous and sceptical ‘top-rate’ scientists (interview 8).

Some committee members noted that the ambiguity between these different understandings of co-design and co-production (and the different levels of commitment to requiring them as mandatory elements of any affiliated project) was potentially problematic. Several participants suggested that it would be necessary to develop common understandings of these concepts and common ground rules, principles, processes

and practices in order to implement them and guard against conflict of interest and other threats. Others still stressed that there would probably always be multiple interpretations of these terms.

This latter view seems to strongly correlate with the hybrid-network/rich-tapestry model of FE, and raises the question of whether FE's institutional structure and accreditation/affiliation processes will be open and flexible enough to enable such multiple meanings and practices. Defined rules and shared understandings (temporary stabilisation) might be needed to avoid some of the tensions identified (such as conflict of interest, and ensuring that marginalised groups are considered when deciding with whom to co-produce) or to actually get something done (at least in a particular way, whether towards utility, democratisation, both or neither). However, any such rules or understandings may need to be settled and resettled as the initiative evolves – what one participant called an iterative 'learning process' (focus group 2).

So, where do these many differences, ambiguities and tensions leave us? Is FE best viewed as a leviathan, or a hybrid, or something else?

Living with ambiguity

The argument for FE as a leviathan might consider its emphasis on a new 'social contract' for science and society; the (potential) boundary building around what constitutes FE activities and knowledge; the singular nomenclature of 'Future Earth' (as opposed to, for example, 'Earth's Futures', or other plural alternatives); and the centralised, global coordination of the initiative. The argument for FE as a hybrid network might consider it as a boundary organisation (e.g. Miller, 2001) in its work to span science and politics; the (albeit initially imperfect (Padma, 2014)) regional distribution of the global secretariat hubs, regional centres, national committees and international projects, and the diversity of its global committee members; and its efforts towards inclusivity, such as the recent launch of the Open Network. Centralised documents and processes can be blunt instruments as they condense a broad range of views towards consensus or settlement, but perhaps it is unfair to look only at those instances of crystallisation in FE's development, when many other actors, knowledges, practices and phenomena operate within and around what some label 'Future Earth'.

For now it seems that there is something of both models in FE, depending on which lens is chosen, and perhaps it will continue to be an ambiguous double hybrid. However, analytically, it may be more useful to see FE as a continuously evolving network, assemblage or configuration – and part of bigger, broader networks – than as a rational, bounded entity (Pallett and Chilvers, 2015). It is then easier to take into account its multilayered development and iterations across different contexts, shaped by and shaping different actors, objects, cultures and practices; perhaps this view also opens up the possibility of taking a place within and/or shaping this initiative ourselves.

While FE faces many of the well-documented challenges of co-design, co-production and transdisciplinarity – and more, owing to the scale of its ambition – the various ambiguities that emerge in thinking, talking about and practicing FE, and what co-design and co-production might mean within it, are not necessarily problematic. They are inevitable and even necessary. They could keep FE, and especially co-production, alive.

Ambiguity can be seen as flexibility and openness, making space for conversation and the negotiation of meaning (Nerlich and Clarke, 2001). This is particularly the case when FE is imagined as an ongoing experiment, which may never reach a conclusion about how this type of work ‘should’ be done – indeed, in which such conclusions would be undesirable as they would close down the potential to adapt to new circumstances, contexts and actors. FE is part of broader systems, networks and ‘ecologies of participation’, rather than a dislocated, self-contained institution or event to be evaluated for its successes and failures against rigid pre-given standards or norms (Chilvers and Kearnes, 2016; Irwin, 2006). The notion that FE is stepping into the unknown and ‘feeling the way’, and that co-production is something that can only be worked out in practice (at ‘field level’) in specific projects and contexts, has been acknowledged by various FE actors, whether seeing co-production as a ‘messy social experiment’ (Turney, 2014), or thinking about a White Paper on engagement as ‘a testable hypothesis’ (interview 9).

From this perspective, FE should be treated with care and analytical generosity. Although its challenges and limitations should be acknowledged, it is also constructive to recognise that, during this study at least, FE had already introduced changes in comparison with the

existing GEC programmes. Simply starting conversations about why and how to co-produce research has the potential to introduce unfamiliar questions and perhaps reflexivity to existing projects, and institutional developments – such as the introduction of an engagement committee in addition to the standard scientific committee, and thematic rather than disciplinary organisation of research communities – have the potential to effect further change to well-established social and epistemic orders:

I mean, one really good thing is even having discussions about [power relations], because in somewhere like the IGBP Science Committee I can assure you the notion of talking about power would never have come up [laughs]. (Interview 9)

Perhaps it is productive to ask how FE can maintain experimentality while also putting policy and structures in place. How can it – and similar programmes – achieve a balance between bringing itself into being and allowing space for development, new and multiple perspectives, and bottom-up initiative? (How) can intangible processes and outcomes of research be valued in a culture of solutions orientation, policy relevance, and increasing quantification and audit (Strathern, 2000)? How can tensions between openness and closure be negotiated?

Other scholars have suggested that humility, institutional reflexivity and organisational learning are key to ensuring ongoing space for plurality, flexibility, diversity and capacity building (Beck et al., 2014; Felt and Wynne, 2007; Jasanoff, 2003; Pallett and Chilvers, 2015). There are indications that FE aspires to achieve this type of practice, whether through a reflexive form of co-production, through monitoring and evaluating its own processes and outcomes, or in acknowledging that FE is an ongoing learning process. Future research could (carefully and generously) explore to what extent – and how – FE is managing to achieve this within and beyond its ever-expanding and complex structure and networks.

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