Plurality in understandings of innovation, sociotechnical progress and sustainable development: analysis of OECD expert narratives

Savaget, Paulo[1]; Acero, Liliana[2]

[1] *University of Cambridge, Cambridge*
[2] *Federal University of Rio de Janeiro*

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Abstract
Deterministic theory and discourse on sociotechnical progress ignores the existence of multiple and equally-viable pathways towards progress, obscures socioeconomic and environmental conflicting interests and values, and overshadows socially-inclusive deliberative choices about policy strategies. Demystifying techno-determinism, by incorporating a plurality of understandings to policy appraisal, becomes not only a matter of democratic accountability but also of analytical rigour. This article analyses the normative and ontological understandings on scientific and technological pathways among a group of experts interviewed at one key Directorate of the Organisation for Economic Cooperation and Development (OECD), using Q-methodology. The three main framings detected do not correspond exclusively to any single innovation and development theoretical framework – namely Innovation Systems, Learning Systems, Catch-Up models or the STS approach. Each narrative organizes an array of policy understandings based upon different theories and practices. As these forms of discourse highly influence global policy recommendations, their plurality should be made explicit, negotiated and integrated into policymaking.

Keywords: Sociotechnical progress, OECD, Q-methodology, public understanding of science, policymaking, sustainable development, innovation.

1. Introduction

Sociotechnical progress is usually portrayed by technocratic policy discourses and by the main theoretical approaches on science, technology and innovation policy as the unfolding of a self-evident and previously ordained technological pathway (Stirling, 2009). These discourses do not accommodate diversity of understandings on the concept of progress, nor aspirations on what the future should hold (Acero, 2010). The plurality

of normative and ontological understandings of progress is usually obscured by technocratic discourses, under the pretence of a unique technological pathway, in which their economic impact is regarded as the main determinant of progress in a certain field (Stirling, 2007a). Technocratic discourses hinder reflexivity about whose interests are met by the sociotechnical goals being pursued and also lack social accountability of the institutional forms of control and patronage of scientific evidence on which policy decisions are based or justified (Wynne, 1992a; Irwin, 2001).

Our study presents selected results of a wider empirical study carried out at an intergovernmental organisation: The Directorate for Science, Technology and Industry (DSTI) of the Organisation for Economic Cooperation and Development (OECD). The main aim of the aforementioned research was to analyse contemporary understandings of sociotechnical progress. The OECD is key in the setting and promotion of global policy goals towards socioeconomic development and the Directory chosen specializes in designing policy recommendations on science, technology and industry.

This article focuses on the ontological and normative perspectives within narratives of a group of OECD employees in relation to different pathways towards progress, as well as on their underlying values, priorities, goals and assumptions. An analysis of plural understandings might contribute towards showing the diversity of factors that influence human agency, including those related to wider social perspectives and aspirations in policymaking.

We first offer a brief conceptual critique of the main techno-deterministic theoretical frameworks on innovation and development based on a science, technology and society (STS) theoretical approach to plural policy appraisal. Subsequently, we will present our methodological approach for discourse analysis: Q-methodology, which presents formulated statements to interviewees in order to compare their interpretations and reactions towards each of them. We then examine how it was applied to collect, classify and analyse narratives on innovation at the OECD. This is followed by an in-depth analysis of the three main narratives found among the interviewees, of their zones of convergence and divergence, and of variations within them. The article concludes with a brief remark on the benefits of accommodating a plurality of views into policymaking.

2. Techno-deterministic theories on science, technology and innovation

Though largely relegated to the periphery of mainstream economic theory, an essential aspect of economic development is devoted to the analysis of the dynamics of innovation. While neoclassical theories characterized innovations merely as exogenous events and understood them as spontaneous and sporadic discoveries resulting from embodied creativity and geniality (Solow, 1956), in evolutionary economics, the in-depth study of innovation – and its creative destruction – plays a central theoretical and practical role. Innovation is regarded as a systemic process, mainly driven by firms, including development, implementation and diffusion of technologies (Lundvall, 1992).

When the study of innovation processes began to be anchored in the historical trajectories of firms, sectors and nations (Freeman and Soete, 1997), two main interrelated theoretical frameworks were developed: Innovation System and Catching-

Up approaches. These two analytic frameworks have highly influenced the shaping of contemporary narratives on science, technology and innovation policy.

The Innovation System approach theorizes on the main forms of intersection between knowledge and technologies, actors and networks, as well as institutions (Malerba, 2004). A system's propensity to innovate is considered largely the result of a complex interaction between multiple interrelated factors, such as corporate behavioural patterns, the role played by research centres and universities, as well as the specific strategies followed in science and technology design and policy making (Lundvall, 1992).

The conceptual framework that describes the unfolding of Learning Systems was developed from within the theory on system innovation, to explain processes of technical change among latecomers (Viotti, 2002), i.e. in countries that develop mostly through the diffusion, adaptation and improvement of foreign technologies to local realities. This approach holds similarities with the premises of Catching-Up insights. These emphasize that absorption or imitation of foreign technologies can drive growth in underdeveloped economies, due to their higher marginal productivity rates. Technologically backward countries were considered in this approach to be able to build technological capabilities similar to those of developed economies, by maximizing absorption and/or imitation of external technologies (Fagerberg, 1994). Only then, latecomers would be able to shift to new innovation pathways, local firms becoming increasingly capable of generating their own proprietary and radical innovations (Perez, 2012). Hence, a predetermined set of stages of innovation, unfolding in a linear fashion, is usually prescribed in this approach as desirable for development promotion.

The Catching-Up approach (Abramovitz, 1986; Fagerberg, 1994) – and, by extension, its assumptions on Innovation Learning Systems (e.g. Viotti, 2002) – has been strongly criticized based on the analysis of substantive historical and empirical evidence on recurrent learning patterns in technologically backward countries (Perez, 2012). Field studies carried out in latecomer countries have often shown that learning processes develop differently than the main stages described by the Learning Systems and Catching-Up approaches. For example, public investment on infrastructure, policies on research and development (R&D) and education, as well as the implementation of training programmes for capacity and capability building, have proven to be crucial in fostering innovative behaviour and subsequent growth among latecomers (Amsden, 2001; Chang, 2012).

Both conceptual approaches to innovation described previously largely blur the contours of conceptual distinctions between technical progress, growth and development. Their largely techno-deterministic narratives tend to support the notion that scientific and technological progress implies the pursuit of an unavoidable pathway towards accumulation of wealth, which, in turn, has resulted in a differentiation of countries according to stages of development (Leach et al., 2007a). Countries are usually described as being in a similar endless technological race, boosted by technical advances and motivated only by economic growth. Society is portrayed as passive and largely unable to stop progress, and technical knowledge as unitary and conflict-free (Collins and Evans, 2002).

Embedded in this rather deterministic notion of progress, modern policy-making appears based on perfectly sound evidence and as thoroughly accountable. It also frequently deals with people as mere "wheels in the giant machine of technocratic and bureaucratic rationality" (Beck, 2000:222). Knowledge is often considered completely reliable and its contents presented as a unique, homogeneous and harmonious version of nature. Interests, values, assumptions, subjectivities and priorities framing knowledge generation and innovation diffusion are hardly acknowledged.

3. Plurality in innovation theory and policy appraisal

Theories based upon the assumptions discussed previously tend to uphold that whatever emerges in scientific and technological progress will necessarily serve the public good (Jasanoff, 2009). However, the introduction of novelties often exacerbates social and environmental vulnerabilities. Detrimental impacts of many technological trajectories upon natural resources and social well-being have also raised questions about whether present prosperity trends can be expanded in the future (Clark et al., 2005). For example, the concept of sustainability has been conceived to expose the disadvantages of past approaches to development, as well as to contribute in the design and evaluation of alternative pathways (WCED, 1987). Policy-agendas of international organisations, such as the OECD, the World Bank and the United Nations, have been increasingly expanding their institutional framings of development to include dimensions beyond economic growth, such as poverty alleviation, gender equity, wealth redistribution and environmental conservation. As public scepticism towards utilitarian economic frameworks increased, more light is shed on the relevance of sustainable innovations for development, as they are capable of jointly generating better outcomes for economic performance, human welfare and environmental stewardship.

Moreover, the coexistence of multiple (often contending) viable pathways towards sociotechnical progress is ignored by techno-deterministic approaches. The possibility of making deliberate choices between different or even alternative technological pathways also tends to be denied (Leach et al., 2007b). Those mainstream perspectives do not question who innovates, who benefits, the cost and the means required (Jasanoff, 2009). In multiple ways, technocratic narratives obscure social interests (Acero, 2011), as well as the essentially normative character of human intentionality in the direction of progress and development (Sen, 2001).

Technological policy decisions that have generated extreme unintended consequences (e.g. the Chernobyl nuclear plant accident) or which are currently facing public opposition (e.g. genetically modified organisms) are often reconstructed by policymakers so as to confirm their blamelessness or impartiality "whilst attempting to manufacture public trust and legitimation" (Wynne, 1996: 51). Embedded in a unitary notion of progress, contemporary policymaking often tries to convey an appearance of full accountability, transparency and scientific rigour, and frequently labels policy-decisions as evidence-based or scientifically-sound (Leach et al., 2007b). However, many politically-driven decisions taken under such labels obscure disciplinary tensions between interested parties, different understandings of nature and institutional

patronage – such as controversies on radioactive waste (Mackerron and Berkhout, 2009) and on the MMR vaccination process in the United Kingdom (Savaget, 2011).

Technocratic narratives are based on assumptions that also overlook the socially constructed nature of knowledge. They understate the interests, values and priorities that frame both knowledge generation and the related exercise of power. Knowledge is treated as a faithful representation of reality. While denying choices on desired development paths, they overlook the uncertain, open-ended and socially constructed nature of knowledge (Jasanoff, 2009). For instance, uncertainty of causes and outcomes is frequently dealt as risk, whereas other dimensions, such as ambiguity (known unknowns) and ignorance (unknown unknowns), are absent from mainstream policy discourse (Wynne, 1992b).

Knowledge and technologies are also inextricably intertwined with sociotechnical imaginaries (Jasanoff and Kim, 2009). These are involved in generating attainable futures for the public good, as a background for policy goals and investment legitimation.

Definitions of progress refer to change, to the transition from one state to another. However, social perceptions of the current state of affairs, as well as expectations about the future are essentially plural. There are multiple public understandings about how changes can and should be carried out. As a consequence, democratic appraisal towards the inclusion of a variety of potential pathways for sociotechnical progress is not merely desirable, but also reflects with greater accuracy the multilevel and multifaceted character of reality (Irwin, 2001). In this respect, democratic and deliberative policymaking acknowledges plurality within human intentionality and also becomes a key pillar for rigorous evaluation and accountability of the pathways chosen.

4. Research design and methodology

This article examines a plurality of narratives on sociotechnical progress held by fourteen policy experts within the Directorate for Science, Technology and Industry (DSTI) of the Organisation for Economic Cooperation and Development (OECD). It presents selected results of a wider research project on this theme carried out during 2012 from a qualitative exploratory approach (Savaget, 2012).

This institution was chosen due to its crucial role in shaping international development policies. Its studies and recommendations highly influence the design of public policies in different contexts, including in countries that are not members of the OECD. The Directorate on which the study has focused is the section responsible for empirical analysis and general policy-recommendations on science, technology and innovation trends.

The following main interrelated research questions were explored:

1. What are the most salient understandings of sociotechnical progress in an intergovernmental organisation?

2. How plural are these understandings? What main patterns can be observed at their intersection?

The study was conducted applying Q-methodology technique for discourse analysis, which is particularly useful to aid in "revealing a range of interwoven complexity of beliefs and attitudes, many of which may have been previously unrecognized or submerged within generalizations" (Addams and Proops, 2000:11). Q-methodology contributed to systematically identify of what Stephenson called 'operant subjectivity' within the OECD, including members' framing assumptions on the chosen topic, their opinions, beliefs, values, and expectations (Brown, 1993). Divergences in subjective viewpoints were used to build robust systematic typologies that reflect different understandings of a theme. An advantage of Q-Methodology for content analysis resides in its capacity for in-depth qualitative analysis of formulated statements, unravelling the meanings and saliency attributed to each of them by interviewees. Answers can be quantitatively and qualitatively compared, as they react to the same statements. Then, though mainly a qualitative methodology for content analysis, eventually this tool uses quantitative factor analysis and narrative processing (Webler et al, 2009).

A study anchored on Q-methodology involves the following consecutive procedures: creating a set of broadly relevant statements that describe the topic; choosing participants; performing the Q-sorting process - where participants evaluate and rank statements along a continuum; carrying out a multivariate statistical analysis of this ranking; and, finally, identifying dis(similarities), (dis)agreements, controversies and ambiguities in understandings.

First, a selection of 196 relevant phrases on sociotechnical progress was made. These were partly chosen from a wider array of statements from a key official document: *the OECD Innovation Strategy* (OECD, 2010) and partly, extracted from publications based on the techno-deterministic innovation and development theories previously discussed. This first selection of statements was aimed to illustrate the main type of contents within "the flow of communicability" of a diverse range of narratives on sociotechnical progress (Brown, 1993:94). Sentences should preferably be short and 'stand-alone' and contain "excess meaning", i.e. presenting ideas, words and expressions with potential for significantly different interpretation by each participant (Webler et al, 2009).

This initial broad range of statements underwent a two-stage selection process. First, they were allocated into four previously established categories of classification, as shown in Table 1, reflecting distinct functional areas of concern of specific narratives (Addams and Proops, 2000). Then, they were selected according to statement relevance and diversity (Brown, 1993). A total of 44 representative statements (11 for each of the four categories), formed the final sample. The most relevant of these statements to each of the narratives found among the participants - as listed in Table 2, 3 and 4 - are discussed in the next section.

Table 1: Classification categories

CONSTITUENCIES OF PROGRESS	TYPES OF CLAIM	
	ONTOLOGICAL	NORMATIVE
Embedded Interests	What interests are prioritised	What interests should be prioritised
Pathways Pursuit	How pathways are pursued	How pathways should be pursued

Face-to-face individual interviews were conducted between May and July of 2012 at the OECD with 14 employees from different hierarchies, professional backgrounds, nationalities, selected to potentially offer a wide array of perspectives on the themes of interest. A pack composed of 44 statement cards was assigned to each interviewee to be read as a whole, in order to first develop an overall impression of the range of potential opinions. Participants then had to sort and rank those 44 cards in an 11-point scale score sheet, ranging from -5 (least like how I think) to +5 (most like how I think) and place each of them over the blank spaces in a quasi-normal ranking sheet. They were also asked to justify their loadings, i.e. to explain how they understood each statement and the main reasons for attributing saliency (or lack of saliency). The qualitative information obtained in this way was taped, transcribed and further processed.

Data analysis entailed two different stages, both performed with the software PCQ. First, the card distribution data was used for correlation and by-person factor analysis – i.e. statistical analysis is not performed by variable or statement, but rather by person. People correlate to others with similar opinions based on the loadings they attributed to each statement. Second, the resulting correlation matrix was subjected to factor analysis to create clusters of participants with similar opinions. Weighted averaging revealed the level of (dis)agreement that each statement received within each of the identified opinion clusters. This process showed three clearly differentiated clusters. Five participants had to be excluded from the analysis because the factor analysis revealed that they were either statistically confounded – i.e. loading significantly on more than one factor – or because they were not strongly associated to a particular narrative.

Finally, the qualitative information provided by the interviewees and for each saliently ranked sentence were grouped according to the narratives with which the interviewees were associated. This process allows contrast of meaning attributed by each interviewee to each sentence, unravelling the (dis)similarities within each narrative, described and compared in the following sections.

5. The Narratives

Three different types of discourse, showing the (dis)similarities in the rankings for each statement, were identified: Socially Conscious, Pluralistic and Pragmatic narratives.

This section describes each narrative, highlighting their most prominent ontological and normative understandings, based upon the data provided by only nine

of the fourteen participants interviewed. The participants are hereby anonymously identified, with numbers randomly assigned (e.g. as P1, P2…) to ensure confidentiality.

5.1.The Socially Conscious narrative

This narrative groups together those understandings that attribute a central or significantly important role to the social dimension of progress within innovation. Table 2 shows only the most salient statement rankings found.

Table 2: Socially Conscious statement ranking

*Darker colours represent the most salient rankings (+/- 5). Lighter colours identify the second most salient rankings (+/- 4)

The understandings of two of the research participants converge in this narrative category. Policy interventions are regarded in this form of speech as needing to be value-neutral, accountable and evidence-based; characteristics understood as "not having a set ideology in mind" (P2), or "not benefiting just one party" (P5). For P5, the term evidence-based describes the need to "measure, compare and assess" public interventions. Instead, for P2 it implies that, "you have a good set of data as a basis for public interventions, so you actually know what you are doing".

P2 and P5 share one main normative concern: to integrate social perspectives into policymaking, but they vary in relation to how to reach social consensus. While P5 focuses on pursuing an ideal –reaching consensus among different social groups –P2 highly values building common ground considered as a substantively democratic policy driver.

The Socially Conscious strongly oppose those understandings that hold that policies and other management interventions are essentially experiments. For both interviewees mentioned, policymaking is based on past experience and anchored in scientific evidence though they understand the term 'experiment' in different ways. One interviewee focuses on describing policies as evidence-based, while the other emphasizes flexibility in policymaking and design of long-term policy strategies.

Both participants disagree that innovation should be considered as a main priority in developed countries *vis-à-vis* technical learning in developing countries, though the basis for this disagreement is framed differently. While P2 stated that developing countries should "not only focus on learning, but also innovate on their own", P5 criticized the passivity attributed to developing countries in that normative statement.

The Socially Conscious narrative also contests the approach that holds that "the sustainability agenda should prioritise innovation rather than changes in social behaviour". Both interviewees considered that social behaviour should not be taken just as a secondary concern within innovation processes. However, while P2 expresses the need for "working equally on both [innovation and social behaviour]", P5 argues that a "sustainability-agenda should definitely rely on social behaviour, on changes in peoples' mind, in their ways of thinking, rather than solely upon massive innovation".

They also believe that "the reduction of current global levels of hunger and poverty should be a top priority in the design of a global policy agenda". This priority was regarded either as an incontestable goal (P2), or else, one to be tackled mainly through innovation (P5). Both believe progress should address social, economic and environmental challenges equally and tackle each dimension differently and according to country specificity. However, it is acknowledged that most socio-political systems have so far predominantly emphasized the economic dimension of progress.

The interviewees within this framing were also against the statement that "social injustice is preferable to total environmental ruin". However, they voiced quite different perspectives. The implicit trade-off between environmental and social features was seen as problematic by P2, who argued that trade-offs are not necessarily an imperative and, if they were, it would be difficult to prioritise either one of these dimensions. P5's discontent lies in that statement´s attribution of a secondary role to the social aspect: "It's really hard to distinguish, but in my opinion social injustice has more

importance than environmental ruin". The Socially Conscious also believe that the notions of 'progress', 'prosperity' and 'development' refer to different types of processes. But they also agree that these concepts tend to be unclearly defined.

5.2.The Pluralistic narrative

This narrative is characterized by strong emphasis on the existence of multiple goals, interpretations, values, solutions and pathways towards technical progress. It focuses on underpinning the values and interests underlying policymaking rather than on the pursuit of an ideal pathway towards progress. Table 3 presents the most salient statements grouped in this form of narrative.

Table 3: Pluralistic statement ranking

*Darker colours represent the most salient rankings (+/- 5). Lighter colours identify the second most salient rankings (+/- 4)

Three study participants share this narrative (P1, P6 and P9). They all strongly agree that policy priorities should be better tailored to different contexts and settings, as well as to multiple actors and levels. P1 indicated that the "various capacities that actors may have, different cultural practices and alike (...) need to be taken into account when choosing priorities and designing policy measures". P6 commented that "obviously, it is difficult to imagine people agreeing with an opposite approach". P9 related the absence of a 'one size fits all' policy, to the statement that all policy interventions are to be considered as experiments. He declared: "although you try [policies] on the basis of evidence, they are still experiments and that's why you try to prioritize some in specific contexts" (P9).

Framing policy interventions as experiments was further qualified in relation to their lack of result predictability, as well as the difficulty of developing a sound and rational interpretation of policymaking processes and designing rigorous control procedure for policy implementation.

Two participants largely converged on their understanding of the statement that "not all human problems can be addressed by technical solutions". P1 suggested that "we should not take a techno-deterministic route, [as] technical solutions can be part of the solution but they are not enough". P9 forwarded examples on the type of choices faced by humankind, which frequently influence policymaking: "basic human dilemmas that we always find ourselves in, such as love, happiness and making choices".

Strong value judgements permeated interviewees' narratives regarding "the reduction of current global levels of hunger and poverty as a top policy priority", as well as on providing support for the socially vulnerable and contributing to environmental resilience. P6 mentioned: "social vulnerability is related to the fragility of entitlements", and emphasized the importance of developing a robust socio-environmental system less vulnerable to "shocks and external accidents". P9 stated: "if we live in a society which is a caring society, then we try to reduce social vulnerabilities and protect those who need to be protected", describing environmental resilience as follows:

> "there are tipping points in all ecosystems beyond which you cannot go without disintegration and decay. And we have to respect what these limits are. So, to respect environmental resilience means not to push things so far that we push ourselves into catastrophic situations; climate change would be the obvious example" (P9).

These participants also strong disagreed with the deterministic framing that considers progress as a 'one-track race to the future' and describes the main challenge of a country to be 'keeping-up' with this race. P1 emphatically refuted that view: "the way things have been framed for the last 30 years or so suggests that there is [only] one-track", but history "shows us that that was in fact never true". Similarly, P6 suggested: "there are many important pathways at any point in time, with [different] choices to be made". And P9 said: "there are multiple pathways and we can follow one that can lead us in many different directions, and [there are] many different visions of progress".

Regarding the statement that, "policy decisions in some countries are unfortunately not made by experts", pluralists questioned the word 'unfortunately'. Either they argued that this happened "for a good reason" (P1) or that governments should engage experts, but that however, "experts shouldn't rule a country" (P6). They also declared that, "there's always room for experts, as inputs into the decision-making process (…) but that there are other things you need to take into account in democratic societies" (P9). They explained that a balanced view between different types of social perspectives should inform policymaking, one which includes the understanding of experts but which is not restricted solely to them. P1, for example, emphasized that "especially in developing countries, (...) decisions should not be taken by experts or just by outside experts, like the World Bank or the IMF [International Monetary Fund]".

There was significant dissatisfaction among participants with the statement: “the sustainability agenda should prioritize massive innovation, instead of changes in social behaviour”. Pluralists questioned the 'instead of' within that statement from three different standpoints. They expressed either that “innovation always implies changes in social behaviour to some extent” (P6); or that this positioning showed a “narrow understanding of technological innovation” (P1); or else that innovation depended on context as, “in some settings, you will need a much greater emphasis on innovation than you previously had and this usually requires changes in social behaviour” (P9).

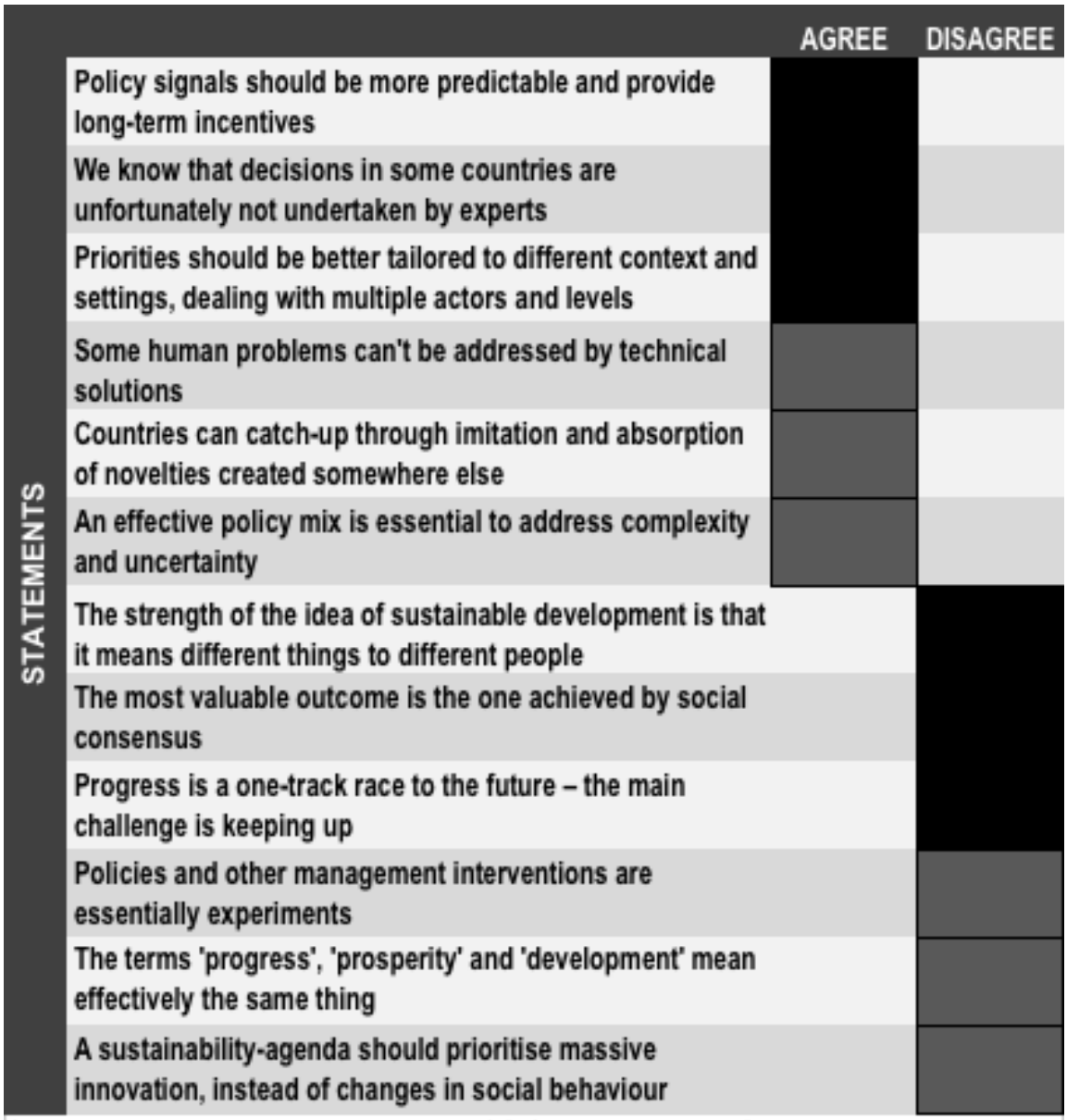
The Pluralistic narrative also holds that there are multiple potential forms of governance within sustainable development. Participants supported the need to gear society towards more sustainable pathways, bring intentionality into policymaking and recognize that there are multiple solutions to social problems, “and not just only one that relies exclusively on markets” (P1).

This narrative is also characterized by a significantly different attribution of meaning to and a wide variation of understandings of the terms: 'progress', 'prosperity' and 'development' than the other two narratives under discussion. For example, P6 considers those concepts as "multifaceted [terms] in themselves” and regards mainstream views on progress as "rather linear”. For P1, progress describes a broad process of change and one related to “social justice, [the] environmental dimension and so on”. Meanwhile, P9 defines progress from a relativistic standpoint: “progress for me means different things, depending on what I am thinking and considering at that particular time".

5.3.The Pragmatic narrative

The Pragmatic narrative interconnects understandings that support a practical approach towards policymaking. Its main concern is to define ways to make policies more predictable, effective and long-term oriented, instead of focusing on how policy choices are made. The understandings grouped within it deal more with the design of effective pathways towards progress than with the social interests and human values underlying decision-making processes. Table 4 presents the most salient statements grouped as part of this narrative.

Table 4: Pragmatic statement ranking



*Darker colours represent the most salient rankings (+/- 5). Lighter colours identify the second most salient rankings (+/- 4)

Four participants (P3, P4, P7 and P8) share this narrative. They emphatically agree that policy signals should be more predictable and support long-term initiatives. They also emphasize the policy problems that arise from short-term political mandates and strongly believe that policies should be better tailored to different contexts and settings and deal with multiple actors and levels. Hence, they oppose the 'one size fits all' policy approach.

P3 summarized the many difficulties involved in developing policy recommendations at the OECD for its 34 member countries, while trying to match their different priorities and contextual settings. P4 explained the need to better tailor policies to localities due to the unfolding of multiple global constraints, "ranging from tsunamis

to financial crisis". P7 stated that one policy problem frequently faced by their institution was that of the adaptation of policies to the needs of different regions.

According to these participants, the most valuable outcome is, ideally, one achieved by social consensus, as it would be the most democratically accountable result possible, but they express reservations: "the statement would only be true in an ideal world" (P3) and "there is too much of a utopian and politically correct vision within this statement" (P8). P7 and P8 mentioned that generating social consensus might not necessarily produce the most valuable outcomes; P7 described problems faced when trying to attain social consensus, observing:

> "we can have social consensus in this generation; one that says that we should consume what we can, destroy the planet, which probably would reflect certain social agreement. But probably it wouldn't be the most valuable [outcome] with respect to future generations".

Interviewees associated with this narrative disagree that policies and other management interventions are 'essentially experiments'. But their understandings reflect a variety and ambiguity in the different meanings attributed to the term 'experiment'. These framings mostly describe policies as being somewhat more sophisticated than experiments.

The Pragmatic narrative strongly opposes the notion that, "progress is a one-track race to the future". Pragmatists criticized the portrayal of progress as a linear path. P4 elaborated that linearity "could have been true in the past (...) but now there is a multi-way towards development". P8 considered that linearity has the in-built implication that the "future is progress [while] progress *per se* is not the future".

However, the participants' understandings converged in relation to the statement, "developing countries can catch-up through imitation and absorption of innovations created somewhere else". This framing was qualified to emphasize the central role played by learning throughout the catching-up innovation process.

Pragmatic-oriented experts recommended the design of effective policy mixes as a main step to address complexity and uncertainty in innovation for development. They shared a general understanding that technical solutions can contribute substantively to tackle human problems but also considered that they cannot deal with or solve them at their core. For example, the fact that in the case of cancer research, "despite all the money spent, it doesn't mean that they will find one [a cure]" (P3). Other concerns raised were the role of corruption (P4) and of religious conflicts (P7) as obstacles to implementing viable technical policy solutions.

Pragmatists strongly agree with the techno-deterministic perspective that proposes: "decisions in some countries are unfortunately not undertaken by experts", though participants held a range of different views on the notion of expertise. P4, for example, understands the role of experts in decision-making as "self-explanatory":

> "experts provide full-information about [the] possible consequences of a decision(...); policies may be biased, with decisions taken more in relation to their potential popularity than to real need, [and non-

experts] cannot evaluate properly because they have no expertise" (P4).

P3 holds a more sceptical view on this matter and argues that, "decisions can't always be taken based on evidence [produced] by experts, because it is difficult for experts to reach consensus". P3 says that, "even when most of the evidence is pointing towards a certain direction, for multiple reasons, it is still ignored". However, P8 expresses the only contrasting opinion: "fortunately they [decisions] are not undertaken by experts" and adds that "we can indeed improve where expert judgement comes into policymaking".

Divergent understandings were found in relation to the statement that, "the strength of the notion of sustainable development is that it means different things to different people", and these were based on multiple reasons. P3 believes that, "although not using the same terminology and vocabulary, people tend to share similar ideas about it [sustainable development]" and, as a consequence, the term cannot be flexibly interpreted. P7 and P8 think sustainable development cannot be considered at all as a strong concept.

Pragmatists were also against the statement that, "a sustainability-agenda should prioritize massive innovation instead of changes in social behaviour". Their arguments focused on providing descriptions of the changes in social behaviour and in technical solutions required to achieve sustainability.

Finally, the present narrative under discussion also finds important differences in definitions of 'progress', 'prosperity' and 'development'. P4 suggested that "these terms have very different meanings for the academia" and that each of them is "well-defined". However, he added: "in the public debate these three terms basically mean the same: the ultimate goal" (P4). P3 most clearly described that "progress is more economic, prosperity is probably more wealth and development is more about catching-up". Instead, P8 assigned a substantively different meaning to this statement than the rest stating that, "progress is the accumulation of change" while "development encompasses both the social and economic" aspects. For this last interviewee, prosperity has different meanings for different people and also often encompasses differential notions of liberty and freedom.

6. Selected comparisons between narratives

This section briefly presents selective comparisons between the different narratives and their (dis)similarities with theoretical approaches, largely on the main drivers of public policy on innovation. This aspect was prioritized because the DSTI specializes in innovation policy analysis and design of country specific policy recommendations. Other related issues were also analysed: the dynamics of scientific and technical progress; outcomes of technological competition; the role played by experts in policy design and the participants' alternative definitions on sustainable development.

Sociotechnical progress is often understood by most of the interviewees as closely dependent upon the unfolding of predetermined patterns and these are

characterized by a set of deterministically described traits. However, the Pluralistic narrative diverges from this overall understanding.

On the one hand, most of the narratives analysed disagreed with the academic and policy discourse that conceives scientific and technological progress as a 'one-track race to the future'. On the other hand, some of the understandings showed partial alignment with techno-deterministic theoretical approaches. For instance, this is the case of the characterization of linear stages towards development found among the upholders of the Pragmatic and Socially Conscious narratives as they endorsed aspects of the Catching-Up approach to explain innovation and progress in developing countries.

While the Pluralistic narrative strongly opposes the 'linear' description of innovation dynamics, the other two narratives have only slightly questioned such linearity. In the latter, pursuit of a linear pathway towards progress was only criticized when applied to describe the innovation trajectories of developing countries addressed within Catching-Up approaches.

The Socially Conscious narrative presents a normative approach to the generation and diffusion of innovations, instead of an ontological one. It highly values the role of overall social aspects in defining goals and implementing science and technology policies, apparently following the main premises upheld by the most critical authors within the Innovation System theoretical approach (e.g. Perez, 2012). However, this narrative suggests that attainment of social consensus becomes the most appropriate way to legitimize public policy. This type of discourse is embedded in some of the main assumptions of pluralistic policy appraisal as well as of academic thought that addresses the importance of the design of deliberative public engagement policies (e.g. Irwin, 2001; Stirling, 2009).

The most technically-laden perspective in relation to the definition of the main drivers of public policy is the Pragmatic narrative. This narrative considers knowledge as value-neutral and tends to view experts as the best suited social actors to make political decisions. It is thus most dissonant with the main theoretical assumptions within the science, technology and society (STS) approach, in which knowledge is overwhelmingly presented as intrinsically embedded in social interests and human values (Collins and Evans, 2002).

By contrast, the Pluralistic narrative is most consonant with the STS theoretical perspective. It holds that knowledge is not exempt from social interests, policies cannot be solely rationally implemented, and policy outcomes are not absolutely predictable and cannot be rigorously controlled. The integration of plural social perspectives is believed to be inherent throughout any policymaking process.

OECD employees' understandings diverged significantly with regard to the existence of a 'technological race' between countries. The Pluralistic and Pragmatic narratives share a similar understanding about the complexities embedded in science and technology. They also highlight broader dimensions of the uncertainties involved in scientific production and policymaking and address the need to simultaneously balance several different aims in order to attain progress. Furthermore, they emphasize that policy outcomes can never be fully predicted and show a certain level of scepticism about innovation results considering also that these are not always positive for society.

However, these two narratives diverge elsewhere. For instance, while Pragmatists want to obtain the best potentially-effective policy solution, pluralists believe that the best solution does not exist and regard policy solutions as path-dependent and partial because they tend to be intrinsically embedded in human values and interests.

The Pluralistic and the Socially Conscious narratives converge towards similar understandings on other key themes. First, they both acknowledge that not all human problems can be solved by technical solutions. Meanwhile, each narrative argues on the specific role played by science, technology and innovation in that matter from its own distinct standpoint. They also recognize the importance of promoting social, political and cultural changes concomitantly in order to attain progress and development.

Second, both narratives share a similar aversion towards social inequality. They consider that policy design should prioritize poverty reduction as a universal norm and promote equality. But while the Socially Conscious narrative emphasizes every country's autonomy in the design and implementation of policies to tackle social vulnerabilities, the Pluralistic one focuses on how policy-design processes could become more democratic.

Third, in both Pluralistic and Socially Conscious narratives, there is a substantive concern about an adequate definition of sustainable development. Participants representing both these views agreed that the social, economic and environmental dimensions are equally important, but also indicated they should not be equally treated. However, only the Pluralistic narrative ranked saliently the importance of taking environmental resilience and social vulnerability very seriously, as well as the need to value highly the understandings and priorities expressed by different social agents and integrate them into policy appraisal. In contrast, although the Socially Conscious narrative was substantively opposed to the understanding that holds that social injustice is preferable to environmental ruin, it also considered social aspects as more relevant in policymaking than environmental ones, or else, held that the existence of trade-offs between both dimensions are not necessarily true.

The Pluralistic and Socially Conscious narratives also show wide discrepancy regarding a key theme: the global campaign against world hunger and poverty. Though considered as a very important matter for Pluralists, it is not necessarily regarded as the top priority *per se*, as for them, development is less key to policymaking. The Socially Conscious narrative, based on the importance attributed to social inclusion, upholds that hunger and poverty are completely unacceptable.

Some of the understandings on policy design included within the Socially Conscious discourse are, to some extent, similar to those proposed by the Pragmatists. Both narratives hold that public policies must be undertaken by representatives instructed by experts and these are largely regarded as responsible for scientific and technological truth. But while the Pragmatic narrative highlights the central role played by experts in sound decision-making, the Socially Conscious portray experts as having to deal mainly with creation of common visions and pursuit of social consensus. On this matter, both perspectives hold views that substantively diverge from the Pluralists, who

suggest that political objectives should not be defined by experts but instead by different actors attempting to integrate plural social understandings into policymaking.

In general, the three narratives consider that there is an interpretative flexibility associated with the term 'sustainability'. However, the Pragmatic and the Socially Conscious narratives are more consonant on this subject than the Pluralistic one. They regard interpretative flexibility within sustainability-related theories as an inherent conceptual weakness that generates ambiguities in policy design and difficulties in policy implementation. In contrast, the Pluralistic narrative regards interpretative flexibility as a strength in the definition of sustainable development: the concept allows for multiple interpretations and thus can shed light on a plurality of understandings and goals towards development.

7. Final remarks

Very different understandings of development, innovation and policymaking co-exist among experts within the same Directorate of the OECD. The information analysed shows the richness and complexity present in the diversity of ontological and normative understandings of sociotechnical progress and its associated themes among a group of international experts from different backgrounds.

The three discourses analysed show aggregate plural understandings that cannot be fully represented by a single theoretical innovation construct or by the definition of the experts' specific institutional commitments to the OECD's overall goals. Instead, they reveal interconnected analytic interpretations raised by different theories of science, technology, innovation and sustainability as much as they reflect shared institutional and individual professional values.

The existence of a unique notion of progress among the interviewed experts is demystified by our study. The research illustrates diverse understandings, interests and values about different technological objectives and pathways. Accommodating plurality into policy appraisal becomes then not only a matter of democratic accountability but also of analytical rigour.

In the case of the OECD, observing plurality reinforces the importance of explicitly incorporating to its institutional goals, projects and reports, scenarios based on different perspectives about the aims and pathways of sociotechnical progress. In turn, this could contribute to create a variety of policy frameworks and incentives for development, broaden the scope of science and technology policy recommendations, and contribute to promoting socially inclusive governance. Such reframing could have a global impact, given the wide relevance of the policy interventions developed by its international specialists and the OECD's wider mandate.

It is apparent that early deterministic notions of sociotechnical progress are gradually losing momentum which, in turn, allows for more complex, dynamic pictures of change, knowledge and power to gain terrain. Undifferentiated pro-innovation discourses are increasingly being criticized by members of academia who recognize that governance faces an important challenge: one related to the inclusion of multiple coexisting pathways for sociotechnical progress mainly into theoretical thought and policy reflection. Therefore, these new perspectives show that direction and human

agency matter (Stirling, 2009). Institutional governance that acknowledges plurality and establishes a dynamic balance between multiple perspectives could contribute towards the recognition of and engagement with conflicting social understandings and interests. It could better address the promotion of democratic negotiation of differences and compromise between multiple understandings through open deliberation. When systematically undertaken, this type of initiative can contribute substantively to reduce political, scientific and technological biases in problem resolution and policy-design.

However, in the policymaking arena, deterministic and excluding notions of sociotechnical progress still dominate. But, as emphasized by Stirling (2007b), frameworks nurturing plural appraisal and wider social engagement in the governance of innovation are gaining ground. That includes, for example, approaches qualified as "discursive" (Dryzek 1990), "reflexive" (Rip, 2006) and "deliberative" (Leib 2005).

The study undertaken was exploratory and its results are not representative of the main potential narratives within other key science and technology international policy institutions. But some of the questions pursued in this research, the approach followed and the results reached may inform analysis of the background and foundational assumptions and premises in policymaking processes at similar institutions. The present analysis also intended to contribute toward comprehension of the more general conceptual and analytic relevance of recognizing, assessing and integrating plural understandings of sociotechnical progress within science, technology and innovation policies for sustainable (and democratic) development. Similar research exercises reproduced for other cases should be able to shed further light on the plurality of coexisting ontological and normative perceptions of sociotechnical progress as well as on how they influence social expectations on the multiple potentially viable innovation and development alternatives.

Undoubtedly, not all perspectives can or ought to be incorporated in all political decisions. However, even the process of exclusion of options can be made explicit and justified, if and when the starting point in that exercise were an open recognition of plurality in public practices. The identification of the multiple and coexisting objectives and pathways associated with each scientific and technological policy can (and should) be pursued through socially inclusive deliberation processes.

References

Abramovitz M (1986) Catching Up, Forging Ahead, and Falling Behind. *Journal of Economic History* 46, 385–40

Acero L (2010) Science, public policy and engagement: Debates on stem cell research in Brazil. *Genomics*, *Society and Policy* 6(3): 1–17.

Acero L (2011) *Pesquisas e Terapias com Células-Tronco: Visões Sociais e o Debate no Brasil*. Rio de Janeiro: E-Papers.

Addams H and Proops JLR (2000) *Social Discourse and Environmental Policy: An Application of Q Methodology*. Edward Elgar Publishing Limited.

Amsden AH (2001) *The Rise of 'The Rest': Challenges to the West from Late-Industrializing Economies*. Oxford University Press.

Beck U (2000). Risk Society Revisited: Theory, Politics and Research Programmes, in U. Beck, B. Adam and J. Van Loon (eds.), *The Risk Society and Beyond*: Critical Issues for Social Theory, Sage, London: 211-229.

Brown SR (1993) A primer on Q methodology. *Operant subjectivity* 16(3/4): 91–138.

Chang H-J (2012) Kicking Away the Ladder: Neoliberalism and the 'Real' History of Capitalism. In: Kyung-Sup C, Fine B, and Weiss L (eds), *Developmental Politics in Transition: The Neoliberal Era and Beyond*, London: Palgrave Macmillan UK, pp. 43–50.

Clark W, Crutzen P and Schnellnhuber H (2004) Science for Global Sustainability: Toward a New Paradigm. In: *Earth Systems Analysis for Sustainability*, Cambridge, Massachusetts: MIT Press.

Collins HM and Evans R (2002) The Third Wave of Science Studies Studies of Expertise and Experience. *Social Studies of Science* 32(2): 235–296.

Dryzek J (1990). *Discursive democracy*: Politics, policy, and political science. Cambridge, UK: Cambridge University Press.

Ezrahi Y (1990) *The descent of Icarus: science and the transformation of contemporary democracy*. Harvard University Press.

Fagerberg J (1994) Technology and International Differences in Growth Rates. *Journal of Economic Literature* 32(3): 1147–1175.

Freeman C and Soete L (1997) *The economics of industrial innovation*. 3rd ed. Cambridge, Mass: MIT Press.

Irwin A (2001) Constructing the scientific citizen: Science and democracy in the biosciences. *Public Understanding of Science* 10(1): 1–18.

Jasanoff, S (2009) *Governing innovation*. Paper presented at Knowledge in Question: a symposium on interrogating knowledge and questioning science, May 2009. Available from: http://www.india-seminar.com/2009/597/597_sheila_jasanoff.htm

Jasanoff S and Kim S-H (2009) Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea. *Minerva* 47(2): 119–146.

Leach M, Scoones I, Stirling A (2007a) *Pathways to sustainability: an overview of the STEPS Centre approach*. STEPS Working Paper, Brighton, UK: STEPS Centre.

Leach M, Bloom G, Ely A, et al (2007b) *Understanding governance: pathways to sustainability*. STEPS Working Paper, Brighton, UK: STEPS Centre

Leib E (2005). *Deliberative democracy in America*: A proposal for a popular branch of government. University Park, PA: Pennsylvania State University Press.

Lundvall B-Å (ed.) (2009) *Handbook of Innovation Systems and developing countries: building domestic capabilities in a global setting*. Elgar original reference, Cheltenham, Glos, UK ;Northamption, MA, USA: Edward Elgar.

Lundvall B-Å (2010) *National systems of innovation: toward a theory of innovation and interactive learning*. This ed. 1. publ. The Anthem other canon series, London: Anthem Press.

Mackerron G, Berkhout, F (2009) Learning to listen: institutional change and legitimation in UK radioactive waste policy. *Journal of Risk Research*, 12, 37-41.

Malerba F (ed.) (2004) *Sectoral systems of innovation: concepts, issues and analyses of six major sectors in Europe*. New York, N.Y: Cambridge University Press.

OECD (ed.) (2010) *The OECD innovation strategy: getting a head start on tomorrow*. OECD innovation strategy, Paris: OECD.

Perez C (2012) *Innovation Systems and policy: Not only for the rich?* Working Papers in Technology Governance and Economic Dynamics, The Other Canon Foundation, Norway and Tallinn University of Technology.

Rip A (2006) Reflexive Governance for Sustainable Development, in Voss, J, Bauknecht, D., Kemp, R (eds), *Reflexive Governance for Sustainable Development*, Edward Elgar: 82-100.

Savaget, P (2011) Rethinking Diffusion of Vaccines: Giving Healthcare a Better Shot. *Desenvolvimento em Debate*, v.2(2): 51-71.

Savaget P (2012). *Dancing with Ananke: from Inevitability to Plurality in Policy-Appraisal*. MSc Thesis, Science Policy Research Unit, University of Sussex.

Sen A (2001) *Development as freedom*. 1. ed., 6th print. New York: Knopf.

Solow RM (1956) A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics* 70(1): 65–94.

Stirling A (2007a) Deliberate futures: precaution and progress in social choice of sustainable technology. *Sustainable Development* 15(5): 286–295.

Stirling A (2007b) Opening Up and Closing Down: Power, Participation and Pluralism in the Social Appraisal of Technology. *Science Technology and Human Values*, 33(2), 262–94.

Stirling A (2009) *Direction, Distribution and Diversity! Pluralising Progress in Innovation, Sustainability and Development*. STEPS Working Paper, Brighton, UK: STEPS Centre.

Viotti EB (2002) National Learning Systems: A new approach on technological change in late industrializing economies and evidences from the cases of Brazil and South Korea. *Technological Forecasting and Social Change*, Technology Policy and Innovation in the Globalized Learning Society 69(7): 653–680.

Webler, T., Danielson, S., & Tuler, S. (2009). *Using Q method to reveal social perspectives in environmental research*. Greenfield MA: Social and Environmental Research Institute.

World Commission on Environment and Development (ed.) (1987) *Our common future*. Oxford paperbacks, Oxford ; New York: Oxford University Press.

Wynne B (1992a) Misunderstood misunderstanding: social identities and public uptake of science. *Public Understanding of Science* 1(3): 281–304.

Wynne B (1992b) Uncertainty and environmental learning. *Global Environmental Change* 2(2): 111–127.