



Accounting and sustainable development: An exploration



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ABSTRACT

As the social and environmental impacts of human activity have become more evident, the role of sustainable development as an organising principle in a variety of policy contexts and over multiple scales has become central. There are, at least, two implications that emerge from this observation. First, morally infused problems that need to be addressed have become more intractable, requiring innovation in our modes of thinking. Second, new spaces have emerged where the academy might explore how knowledge is created, validated and translated (or not) alongside policy and practice settings. One outcome of these trends has been the emergence of a stream of work (sustainability science) which investigates how disciplines might develop knowledge that progresses sustainable development. The aim of this paper, in line with the focus of the special issue, is to explore what possibilities emerge for accounting in light of a sustainability science approach. To achieve this end the paper starts with an exploration of the frustrations expressed in the literature over the perceived lack of progress made by social and environmental accounting towards addressing sustainable development. The paper then introduces sustainability science with the aim of imagining how an accounting for sustainable development might emerge. The paper closes with two illustrations of how a sustainability science approach to accounting could develop.

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Introduction

Since the 1970s, and most influentially within the pages of *Accounting, Organizations and Society*, our understanding of accounting has been enriched by drawing on new intellectual agendas and approaches. This paper seeks to contribute in a small way to this history by exploring possible links between the sustainable development literature and accounting. The accounting literature¹ has not been

silent on the issue of sustainable development and during the last decade (Gray, 2002) started to describe itself as 'accounting for sustainable development' to cope with an interest, both in theory and praxis, in organizational accounts that encompass global social and environmental issues, beyond the previous concern with local stakeholders and the immediate organisational context (Gray, 2010; Hopwood, Unerman, & Fries, 2010; Schaltegger, Bennett, & Burritt, 2006; Unerman, Bebbington, & O'Dwyer, 2007). Attempts to develop accounting practice in this area, however, has turned out not to be straightforward.

In particular, scholars note that it is difficult to define what sustainable development might mean in an organizational context (Gray & Milne, 2004) along with a lack of credible sustainable development accounts in practice. Two specific concerns focus our attention here. First, reviews of external reporting (sometimes described as sustainable development reporting) have found that this form of reporting has little to do with sustainable development

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¹ The terminology used in the paper warrants a mention. When we use the phrase accounting we will be referring to the entire discipline of accounting. Social and environmental accounting refers to a sub-set of this discipline that focused more closely on the social and environmental impacts of organisational activities. In line with others (notably Thomson, 2007 and Buhr, 2007) we will argue that accounting for sustainable development is likely to be distinctive compared to social and environmental accounting and accounting itself, while having a connection to both those arenas of scholarship.

(Gray, 2010). This has led some to suggest that these accounts should be conceived of as narratives decoupled from underlying organizational realities, intended (at best) to construct a plurality of discourses about sustainable development and among which it is impossible to adjudicate. This perspective is reflected in studies that examine the construction of corporate discourses about sustainable development (see, for example, Bebbington, Larrinaga, & Moneva, 2008; Buhr & Reiter, 2006; Ferguson, 2007; Laine, 2009; Llewellyn & Milne, 2007; Spence, 2007). The merit of the narrative turn in this stream of research is that it has provided a healthy scepticism about claims found in these accounts that organizations operate in accordance with the demands of sustainable development.

Our second focus is on how accounting has sought to engage with sustainable development principles through full cost accounting (Antheaume, 2004; Atkinson, 2000; Bebbington, 2007; Bebbington, Brown, & Frame, 2007; Bebbington & Gray, 2001; Bebbington, Gray, Hibbit, & Kirk, 2001; Bent, 2006; Frame & Cavanagh, 2009; Fraser, 2012; Herbohn, 2005; Xing, Horner, El-Haram, & Bebbington, 2009). Of the various accounting techniques that have attempted to better expose social, environmental and economic externalities (at the root of unsustainable development), full cost accounting was seen as the most promising as it moves beyond the entity to identify externalities. However, despite some experimentation in this area, how one might create a defensible account of (un)sustainability² remains elusive.

These two sets of observations have created something of a conundrum. We seem unable to observe in practice, or realise in academic experimentation, robust accounts of organisational (un)sustainability. At the same time, the challenges that face human society in social, environmental and economic terms (and issues emerging from the interplay of these factors) remain non-trivial. In addition, sustainable development remains the overarching concept under which an array of research and praxis takes place and as such remains central to an articulation of these various challenges. Drawing these points together, this paper is motivated by a desire to keep open the possibility that the discipline of accounting might, under certain conditions, allow organisations to address sustainable development challenges. In order to achieve this, however, we suggest that the intellectual roots of any accounting for sustainable development might have to be (re)envisaged.

In particular, it is our contention that attempts to account for sustainable development have drawn too closely on accounting and too little on sustainable development thinking. Indeed, Gray (2010, p. 47) suggests the same,

stating that the “baggage associated with conventional accounting is no longer apposite when seeking to account for sustainability”. We agree with this and would suggest that accounting for sustainable development, as a distinctive research area, is yet to fully emerge and that its realisation requires a re-connection with wider discussions about sustainable development (in a variety of disciplines) to identify research questions that are of broader relevance and research approaches that might be valuable. To achieve this aim, this paper draws on the area of sustainability science to develop propositions for accounting.

The paper is structured as follows. Section two reflects on the disappointment expressed in social and environmental accounting concerning its attempt to address sustainable development. We argue that environmental accounting in the nineties connected with broader environmental debates and generated a new approach in the accounting literature which has subsequently been lost with the literature now focusing on accounting and management research questions. Recovering this connection to social and ecological concerns might, therefore, be valuable for accounting for sustainable development.

Section three refocuses attention on the links between sustainable development and accounting for two reasons. First, much of the accounting literature reproduces the *Brundtland Report* definition but does not explore more contemporary sustainable development work. There are some underlying elements of sustainable development that, if not recognized, might lead to accounting scholarship being decoupled from sustainable development concerns. Second, we argue that social and/or environmental accounting must be distinguished from accounting for sustainable development and this is attempted at the close of this section.

In section four the focus moves to an extended introduction to sustainability science (drawing on material that has been published over the last fifteen). We have framed our discussion in two ways: first, by describing the motifs of this area and, second, by addressing the issue of how to judge the merits of work in this area.

Section five brings the analysis undertaken to date together and seeks a consilience between accounting and sustainability science by way of two case studies. The first takes an existing area of accounting (that of full cost accounting) and explores how a sustainability science approach might influence the practice and evaluation of this work. The second case examines what we might learn if we start from a sustainable development perspective and identify a problem area where accounting might play an important role, but on which it has remained mostly silent, despite its importance. This example relates to sustainable consumption and production (an overarching theme of the United Nations' sustainable development agenda) where institutions have developed around the creation of certification processes (often reflected in certification labels). Certification seeks to identify more socially, environmentally and economically sound production processes and through this to shape consumption choices. We will argue that there is a role for the accounting academy to contribute to an evaluation of the possibilities for and outcomes from certification. Both cases are used to demonstrate

² As reflected in the call for papers, discussions of the pursuit of sustainable development sometimes note that what we are in fact doing is seeking to move away from being unsustainable due to the problems with defining a singular point of sustainable development. Likewise, sustainable development, sustainability and organisational sustainability are terms that are often used without clear articulation of the differences between them. For the purposes of this paper we use the phrase sustainable development for the overarching concept; sustainability as the end point of achieving sustainable development; and organisational sustainability to indicate actions that organisations might undertake in accordance with the principles of sustainable development.

how a sustainable science inspired accounting investigation might develop.

To close, section six provides some concluding comments. Taken together, we hope that this paper might cause scholars to think differently about accounting investigations that are linked to sustainable development ideals as well as have more practical hope (Orr, 2002) of addressing sustainable development via the discipline of accounting (in concert with other disciplines). Before we reach that point, however, an examination of social and environmental accounting (as the place where sustainable development issues have most frequently been considered) is undertaken.

Social and environmental accounting³

Many putative accounts for sustainable development (however incompletely they have been realized) emerged from environmental accounting, which itself was an extension of work in social accounting (see Gray & Laughlin, 2012). Before the eighties environmental accounting was not articulated as a distinct research subject. During this decade, however, there was pressure for companies to disclose environmental liabilities (often emerging from litigation) and this led to studies that tried to explain environmental disclosures in terms of corporate characteristics (see, for example, Trotman & Bradley, 1981). The focus of these studies was the disclosure of environmental issues that were essentially local in nature and which could have a material impact on corporate accounts. By the end of the 1980s, however, various developments, perhaps most influentially the publication of the *Brundtland Report* (UNWCED, 1987), created the impetus for an identifiable area of research in this area: environmental accounting. The *Brundtland Report* reflected a concern about the scale of human impact on the global environment as well as the possibilities for equality in human flourishing and used the concept of sustainable development to describe the outcome sought (socially just and ecologically sound development). The *Brundtland Report* motivated the UK Department of the Environment to commission economist David Pearce to write a report on environmental economics ultimately giving rise to the influential *Blueprint for a Green Economy* (Pearce, Markandya, & Barbier, 1989). In turn, the Chartered Association of Certified Accountants commissioned Rob Gray to describe how accounting might contribute in the wake of Pearce et al. (1989). This resulted in the publication of *The Greening of Accountancy. The Profession After Pearce* (Gray, 1990). This report, alongside special issues of *Accounting, Auditing and Accountability Journal* and *Accounting, Organizations and Society* in 1991 and in 1992 (volume 4, issue 3 and volume 17, issue 5, respectively) created arguably the base from which environmental accounting emerged as a distinctive sphere of inquiry.

Environmental accounting in the early nineties was strongly inspired by ideas imported from both the science and the economics of sustainable development, creating a fertile ground for experimentation and for the emergence

of a new literature (Gray & Laughlin, 2012). This new literature was concerned, for example, with the interplay between accounting and environmental valuation (Hines, 1991; Milne, 1991; Power, 1992; Rubenstein, 1992). As environmental accounting became institutionalized within accounting departments its focus reoriented to core accounting concerns including management accounting, financial auditing, financial accounting, and annual report analysis as well as emerging practices of environmental audit and stand-alone reporting (see Thomson, 2007 for an overview). Once this occurred, this earlier interdisciplinary focus was largely lost. Some social and methodological reasons could explain this focus.

The dominance of corporate reporting orientated research has resulted from a tendency of scholars to take on board the pre-occupations of accounting itself (that is explaining managerial behavior as well as examining financial and non-financial indicators) and to use the theories and methods that are readily available and encouraged by academic departments and journals in this area. As Gray and Laughlin put it, “[m]uch of this research has been routine descriptions of disclosure practices and/or attempts to link disclosure to theoretical explanations” (2012, p. 238). This research has been dominated by explanations drawing from voluntary disclosure (Healy & Palepu, 2001), resource dependence (Dowling & Pfeffer, 1975) and legitimacy theory (Deegan, 2002; Patten, 1992). A focus on narratives has been pivotal in constructing what could be labeled as a “sociology of preparers” (see Christenson, 1983).⁴ This focus also creates methodological preferences. In particular, with a sociology of preparers perspective the object of research is defined as being a narrative (Czarniawska, 2004) about environmental (and to a lesser extent social) sustainable development found in corporate reports. The reports themselves are decoupled “from the factual organizational actions” (Laine, 2009, p. 1047) which from a sustainable development perspective are unsustainable. Further, the difficulty of translating sustainable development to an organizational level (Gray, 2010; Gray & Milne, 2004) is left unaddressed along with an assessment of the unsustainability of organisations in and of themselves. Understanding organisations in a sustainable development context is hence not developed within this literature/framing.

These preoccupations are comprehensible if one takes accounting and its modes and rationales as given. We would argue, therefore, that a similar process to that which initiated environmental accounting has to happen so that accounting of sustainable development can emerge. Specifically, we argue in section three (and seek to demonstrate by example in section four) that accounting for sustainable development implies a research approach that is distinctively different from that of accounting, environmental

³ Debates around the efficacy of social and environmental accounting are lively and ongoing – see, for example, most recently the thematic issue of *Critical Perspectives on Accounting* journal in 2013 (Vol. 24, No. 6).

⁴ Taken together this literature has uncovered a lack of correspondence between reporting and any conception of social and environmental ‘reality’ (Hopwood, 2009) and an overarching bias toward the disclosure of good news. Further, research suggests that accounting and reporting discourses are intended to align public perception with institutional demands (Buhr, 1998; Buhr & Reiter, 2006; Laine, 2009) derived from the interests of the most powerful stakeholders (Neu, Warsame, & Pedwell, 1998), notably the providers of financial resources (Bebbington et al., 2008).

accounting and social accounting and which might address the problems noted above.

Indeed, there are hints of similar suggestions in the environmental accounting literature itself (Owen, 2008; Parker, 2005, 2011) with scholars suggesting that colleagues in mainstream accounting and other fields could be making contributions to environmental accounting by avoiding a purely narrative focus. One example is provided by critical sociologists who focus on detailed accounting issues in the area of carbon accounting and who argue accounts are both contestable and provisional (which is different than saying that it is impossible to adjudicate between them). Indeed, sociologists have focused on the more modest (from an accounting perspective) role of carbon accounting in the everyday operation and institutionalization of carbon markets. In this arena accounting technologies have been 'black-boxed', thereby allowing the carbon market to operate (Callon, 2009; Lohmann, 2009; MacKenzie, 2009). In contrast with, for example, Gray (2010), critical sociologists thus foresee a potential in environmental accounting when they argue that we need to understand in detail accounting and other technologies if we wish to influence the basis for praxis and policy making. As MacKenzie (2009, p. 453) puts it "making carbon markets more effective is crucial, and the esoteric nature of their subpolitics means that researchers have a particularly salient role to play in bringing to light matters of apparent detail [by which he means the accounting] that in fact play critical roles in this respect."

In summary, we have argued in this section that a similar process to that which initiated environmental accounting might be needed for an accounting for sustainable development to emerge. In order to create this possibility we believe that we need to renew our understanding of sustainable development so that the focus on accounting problems might be replaced with a more contextual appreciation of the issues at stake. Likewise, we will argue that accounting for sustainable development requires a particular research approach that allows this broader context to emerge. Taken together we hope that this material might point towards research investigations that will respond to the frustrations expressed in environmental accounting about the achievements of that field in the context of sustainable development.

Accounting and sustainable development

This section seeks to point towards what accounting for sustainable development might entail by way of a two stage investigation. First, a description of the issues that fall under the ambit of sustainable development is attempted. Second, a translation of these concerns into an accounting context is undertaken drawing from and building on section two. The aim of this approach is to distinguish social and/or environmental accounting more clearly from any putative accounting for sustainable development.

Defining sustainable development

Sustainable development is most frequently characterised as "development that meets the needs of the present without compromising the ability of future generations

to meet their own needs" (UNWCED, 1987, p. 8). While this definition is familiar to many, its radical nature can only be appreciated in the context of the time it was first promulgated. For example, Cohen, Demeritt, Robinson, and Rothman (1998, p. 351, emphasis added) note that in

"adopting the term 'sustainable development', the [Brundtland] Commission argued that problems of human development (poverty, inequity, basic human needs) could not be separated from, indeed were *causally* connected with environmental problems of resource depletion, biodiversity, pollution and life support systems... [and that] the explicit linkage of the population and development 'problem' in developing countries with the 'consumption' problem in industrialized countries meant that SD was inherently a global concept."

As a consequence, they argue that sustainable development "is not a scientific concept but a contested term in an essentially political discourse about human activities and behaviour" (Cohen et al., 1998, p. 52). At the same time, however, elements of environmental evaluation, for example, can be scientifically based (see, for example, Rockstrom et al., 2009). This reasoning raises both ontological and epistemological questions.

From an ontological perspective, it is argued that a distinction in conceptualization exists between natural and social systems. Although there is uncertainty about the natural system aspects of sustainable development, this uncertainty is of a different kind than that which exists when it comes to examining social systems aspect of sustainable development (see also Frame & O'Connor, 2011). For example, the politics involved in the definition of notions of opportunity costs or hypothetical baselines (Lohmann, 2009) make carbon accounting the subject of deep controversy. Carbon emissions and the science of climate change, however, resist a purely narrative approach that would reduce them solely to social constructions that can be deconstructed (Dunlap, 2010; Herbohn, 2005; Redclift, 1999) with the purpose of underplaying climate change and the processes by which physical measurement is sought. At its most extreme, the physical phenomena could be dismissed as being 'unreal' by virtue of a focus on the narratives that surround it. As Latour (2004, p. 231) put it, referring to the science of climate change:

"[m]y argument is that a certain form of critical spirit has sent us down the wrong path, encouraging us to fight the wrong enemies and, worst of all, to be considered as friends by the wrong sort of allies... The question was never to get away from facts but closer to them, not fighting empiricism but, on the contrary, renewing empiricism."⁵

⁵ Relatedly, Gray (2010, pp. 52–55) suggests that one might place accounting for sustainable development beyond modernity (and in so doing, draws on post-modernity references). This is in contrast to the premise of sustainability science which emerged (at least in part) as a reaction to postmodernity (see also Dunlap, 2010 and Redclift, 1999). As will become apparent later in the paper, sustainability science retains its attachment to modern ways of thinking (albeit that these are reconceptualised). For example, Fadeeva and Mochizuki (2010) allude to the idea of reflexive modernity (drawing from Beck) and liquid modernity (drawing from Baumann) in their exploration of sustainability science.

In conclusion, although it has to be recognized that environmental problems have an (uncertain) physical substance, accounting for sustainable development needs to be based on a distinction between the incomplete knowledge of phenomena in the natural system (Brugnach, Dewulf, Pahl-Wostl, & Taillieu, 2008; Walker et al., 2003) and the inherent contestability and multiple framings of the 'social', as an object of knowledge.

This ontological position gives rise to epistemological implications. For example, it is noted that the introduction of the concept of sustainable development pointed towards a desire for "a more integrated approach in tackling deeply intertwined global environmental problems and development issues" (Goeminne, 2011, p. 627). Implicit within such an integrated approach is a re-examination of how knowledge is produced, including the relative level of interaction between disciplines and the movement through multi, inter and trans-disciplinarily approaches.⁶ The point that may have been lost with the passage of time (and with the frequent repetition of the bare bones of the *Brundtland Report* definition with little or no subsequent discussion) is that sustainable development requires not only a new approach on the ground, but new ways of reflecting upon and shaping practices. In particular, investigations that focus on an issue of concern (rather than a discipline framed starting point for problem identification) might more readily allow subjective and objective dimensions of issues to be appreciated together rather than either perspective being assumed to provide unique access to truth. In addition, a plurality of perspectives (including those who are affected by the problem) can be brought together in such an inquiry. Indeed, the issues of concern that are widely accepted to fall within the ambit of sustainable development (Clark & Dickson, 2003, p. 8059) are sometimes called the "WEHAB... targets of water, energy, health, agriculture and biodiversity". What is relevant to note is that these areas do not neatly map onto disciplinary fields. Rather, they are arenas which can only be understood through multiple lenses: in short they require, at least, inter-disciplinary approaches for their investigation.

While the WEHAB targets emerged from a policy context, collectives of influential scientists (see Rockstrom et al., 2009) also focus on the threat to human wellbeing presented by climate change (see *Intergovernmental Panel on Climate Change*, 2007, 2013; Stern, 2006) along with concerns about the integrity of ecosystems through modification of the nitrogen cycle or through declining biodiversity⁷ (*Millennium Ecosystem Assessment*, 2005;

United Nations Environment Programme, 2007, 2012). These concerns about human modification of the planet's life support systems focus, in the main, on the threats to human wellbeing that arise from these trends through the loss of ecosystem services,⁸ albeit that all species will be affected by global environmental climate change (for a significant publication on the implications of these trends see *The Economics of Ecosystems and Biodiversity*, 2010). Indeed, it is widely believed that we are now living in the anthropocene, which is described as an era in which "human actions have become the main driver of global environmental change" (Rockstrom et al., 2009, p. 472).

While ecological concerns focus on future threats to human flourishing, there are also contemporary challenges to wellbeing. Development, however conceptualised (see Sen, 1999, for an influential conceptualisation of development as freedom) around the globe is highly unequal with some experiencing grinding poverty while others are starting to experience the 'diseases of affluence' (for example, obesity, heart disease and psychological ill health). Concern about unequal development manifests itself in global equity debates (as expressed in the Millennium Development Goals, see <http://www.un.org/millenniumgoals/> along with annual updates published by the United Nation's Department of Economic and Social Affairs) but equity within countries remains a major policy concern and drives, to greater or lesser extent, all national government policy agendas (Wilkinson & Pickett, 2009). Indeed, the nature and drivers of wellbeing of human populations has re-emerged as an area of active debate and experimentation in many countries (see Jackson, 2009; Stiglitz, Sen, & Fitoussi, 2009; Victor, 2008), drawing on earlier work in this area (Ayres, 1998; Daly, 1996).

It is, therefore, possible to point to an array of issues that sustainable development concerns itself with, without coming to a formal definition that would encompass all possible activities that might arise within its ambit (see also Quental, Lourenço, & da Silva, 2011 for a synthesis of characteristics and scientific roots of sustainable development). Of course, this characterisation (as opposed to a definition of sustainable development) poses problems if the usual mode of inquiry in a discipline is to draw from concepts and spheres of inquiry are relatively settled. Müller (2003, p. 24) explored just this point and notes that that "pronounced transdisciplinarity of mode-2 science does not support the development of any formalism⁹... [and further notes that a] lack of formalism and generally accepted definitions and ideas" makes such inquiries appear unusual from the point of view of more formalised fields. By way of clarification, Gibbons et al. (1994) distinguish mode-1 and

⁶ Max-Neef (2005, pp. 6–7), characterizes these distinctions as being on a continuum from single discipline work (which he calls "specialization in isolation") to trans-disciplinary. In brief, he sees multi discipline work as arising where disciplines examine a common area without creating co-operative practices or understandings. In contrast, inter discipline work involves some level of co-learning or co-ordination of efforts between disciplines. For him trans-disciplinary activity emerges where disciplines fully integrate their concerns with each other and share and/or develop values and concepts in common. Others characterise trans-disciplinary work as necessarily involving practice and practitioners in its knowledge production processes.

⁷ Indeed, there are suggestions that humankind is witnessing (and indeed driving) the seventh mass extinction that the planet has experienced (Carpenter & Bishop, 2009).

⁸ The previously mentioned *Millennium Ecosystem Assessment* (2005) describes how human wellbeing relies on services drawn from the natural environment. These services are frequently classified in terms of supporting services (such as photosynthesis, and nutrient and water cycling that allow ecosystems to function); provisioning services (that is, materials such as food, fibre, fresh water and genetic resources); regulating services (most notably the climate system); and cultural services (encompassing the non-material benefits from ecosystems including enjoyment, psychic and aesthetic benefits from being in nature).

⁹ Müller (2003, p. 24) notes that by 'formalism' he does "not mean a mathematical formulation of a theory but merely some rather robust and widely accepted framework to rely on in discussions."

mode-2 science in the following way. Mode-1 is used to describe a pattern of work that is motivated by academic concerns as presented by the academy (this is characterised as the usual mode of academic operation). In contrast, Mode-2 science takes a problem centred focus, shaped by concerns of practice and is likely to involve teams of researchers from different disciplines.

The lack of formalised definition of sustainable development also leads to accusations that the concept lacks meaning (from a mode-1 point of view). Cohen et al. (1998, p. 354) reject the suggestion that “the concept of...[sustainable development] is empty.”¹⁰ Indeed, it can be argued that it represents a potential breakthrough in thinking about the linkage between environmental and social issues. It allows, even requires, a recognition of the globally interconnected nature of environment and development questions.” As a result, the broad nature of the *Brundtland Report* definition of sustainable development has allowed a wide coalition to unite under its rhetoric while the implications that arise from its application in particular situations remain contested. Further, given the complex and interlocking nature of the issues identified above, discipline specific framing of research is unlikely to be sufficient to fully describe or remedy particular sustainable development problems. For example, a characterisation of rural poverty as arising from a lack of income would point towards an economic based solution (that of increasing income). This framing and remedy, however, would not necessarily bring to light issues of land tenure (a legal issue); agricultural practices (from technological studies) or gender inequity that might reinforce poverty. While many disciplines have much to bring the study (in this case of rural poverty) they each only shed light on some aspects of the issue.

Two modes of inquiry have emerged in light of this: discipline specific insights to sustainable development problems as well as studies that seek to use a problem area as the focus around which disciplines are assembled (the sustainability science approach). Before moving to consider this second approach, however, it is instructive to consider in more detail how the discipline of accounting has sought to engage with issues emerging from the sustainable development agenda.

Accounting and sustainable development

There are no clear demarcations consistently drawn in the literature between social and environmental accounting and accounting for sustainable development.¹¹ It is, however, crucial for the line of argument proposed in this paper to distinguish these two (undoubtedly linked) areas. There is, however, no existing literature that seeks to develop this distinction. As a result, we have used the framing found in a book that seeks to explore accounting and

accountability issues that emerge in the context of sustainable development as a way to start our line of thinking.¹² Specifically, Unerman et al. (2007) gathered together insights from colleagues who were likely to have a conception of possibilities for accounting for sustainable development. While many authors (due to their chapter scopes) did not directly address the difference between social and environmental accounting and accounting for sustainable development (and indeed often used these terms interchangeably), those that did fell into two categories. First, some noted that they considered activities that constitute social and environmental accounting could be seen to point towards a possible accounting for sustainable development while being unsure if the latter actually existed at the time they wrote their contribution. For example, Buhr (2007) noted that she was “not convinced that such a thing as sustainability reporting exists [and that she was therefore providing]...a chapter on the histories and rationales for something that is yet to be and, quite possibly may never be” (p. 57). The second set of responses (notably those drawing from Gray & Milne, 2004) asserted that there are step changes at the level of scale of analysis and the standard of attainment that is sought as one moves from social and environmental accounting to accounting for sustainable development. Indeed, the idea of a ‘step change’ lead to Thomson (2007) asking if “it is now time to enter into a meaningful discourse on whether sustainability accounting is a coherent cognate field of study in its own right” (p. 34). He also suggests that as presently constructed there is a danger that accounting for sustainable development could become “simply an interesting empirical site for accounting and finance researchers to focus their empirical and theoretical microscopes on” (Thomson, 2007, p. 34).

Taking these observations on board, two dimensions are explored below in an attempt to more clearly delineate social and environmental accounting from accounting for sustainable development, namely: who ‘counts’ in any investigation (that is, from whose point of view are questions framed), and how issues of concern emerge into the domain of accounting for sustainable development. In exploring these two aspects, we are not suggesting that we have the answers to what accounting for sustainable development should become. Rather, this analysis is by way of posing problems (a dialogic framing, see Thomson & Bebbington, 2004; Thomson & Bebbington, 2005) for existing accounting in order to point towards (as Thomson, 2007, hopes) what accounting for sustainable development might entail if it were to emerge as a coherent field of its own. Each aspect will be taken in turn, recognizing that each element co-evolves with each other. In addition, they in turn shape the sort of theorizing that might emerge in this context.

In seeking to identify ‘who counts’, social and environmental accounting has made a firm commitment to

¹⁰ See also Frame and O'Connor (2011) who consider these issues in terms of sustainability assessment and suggest that a non-bounded definition of sustainable development could become an open signifier.

¹¹ Gray (2010), for example, moves to talking about accounting for sustainable development on the basis that some for profit corporations use the term ‘sustainability’ in their corporate reporting practices. While this might be descriptively correct, it is not a particularly useful basis from which to define an academic field.

¹² Other potential syntheses of accounting and sustainable development was also examined. Schaltegger et al. (2006) focus on the sustainability of corporations in the face of challenges rather than on conceptualising sustainable development itself. Hopwood et al. (2010) was also reviewed and was starting to develop a conception of sustainable development that points towards the discussion in this paper. The nature of the book (the presentation of organisational centred cases), however, was not conducive to a theoretically informed discussion.

pluralism and it is, therefore, not surprising that information rights for stakeholders are a central issue to developing a more pluralistic setting. Defining stakeholders, however, requires a definition of an area of concern (or an entity) around which stakeholder's rights might be determined. In accounting, this is primarily determined by reference to an entity which is itself defined in some legal form (and which is the 'usual' entity of analysis for accountants).¹³ Likewise, how stakeholders make their impact felt and/or those stakeholders that require an organizational response is usually determined by relative power to affect the entity in question (see Mitchell, Agle, & Wood, 1997). This has, naturally, lead to the development of stakeholder theory as a way to determine 'who matters' as well as a focus on the extent to which the legitimacy of the entity in question is created and maintained.¹⁴

In contrast, the sustainable development literature points towards an interest in those who are adversely affected by current arrangements (such as the environment itself, future generations and the least well off of present generations).¹⁵ These could be seen as the stakeholders of the sustainable development project and as a result the question arises as to what entity (or combination of entities) creates the conditions that result in any harm. The answer to this is more complex because no one single entity creates and sustains these problems. Rather, a combination of institutions (including modes of organising) frames these outcomes. This would suggest that the entity in question in any account of sustainable development might be based in these socio-economic arrangements (embedded in a variety of historical, legal and cultural contexts). This includes large, listed for profit companies (the typical focus of accounting research) but also how they are affected by institutions that might cause them to behave in an unsustainable manner (such as providers of capital and capital markets). Moreover, a focus on the actions and accounts from those entities that are not bound to the rationales of profit making and listing markets (such as family owned business, social enterprises and the public sector) are likely to yield more insight about possibilities for change than focusing on the heavily constrained listed corporations.

Taken together this would also create an argument for a sustained examination of the setting within which organisations operate. For example, if we wished for 'better' sustainable development reporting we need to understand

how performance and/or reporting guidelines are developed (see, for example, O'Sullivan & O'Dwyer, 2009). In addition, looking at particular points of change (for example, the passage of key pieces of legislation/regulation or physical shocks) that might be necessary (but insufficient) for less unsustainable operations is possible. Likewise, considering possibilities for change at country or sector levels (Figge & Hahn, 2004; Frame & Bebbington, 2012; Russell & Thomson, 2009) and how this might cascade to individual organisations would be relevant insights to have. Finally, examining the work of the public sector (as a shaping and guiding process in society and in and of itself) is likely to be fruitful (see Ball & Bebbington, 2008, for a summary). Such approaches would reduce a focus on those entities (listed for profit entities) for which pursuing sustainable development is more problematic, at least until institutions around them are reformed.

The second point of distinction relates to how issues of concern present themselves to researchers. As noted before, in social and environmental accounting issues considered are those that are most closely related to operational concerns of large for profit entities. This has dictated the focus on reporting activities previously noted as well as some organisational operational activities such as environmental costing routines, performance management, translation of strategy and supply chain analysis. Likewise, the impact of operation of new markets (for example social responsible investment) has created a substantive focus on the impacts of these markets and their intersection with existing investment/governance issues. Of the various concerns from the sustainable development agenda (framed as WE-HAB) recently water and carbon accounting (notably special issues on carbon have been published in *Accounting, Auditing and Accountability Journal* and the *Journal of Cleaner Production* in 2011 and 2012 respectively) have most consistently captured researchers' attention, not least because markets have been developed to translate these concerns to the entity level. There are, however, some aspects missing as a result of this framing (Bebbington & Larrinaga, 2008).

If we return to the literature on sustainable development then the two planetary processes that are most beyond boundary limits are biodiversity loss and the nitrogen cycle (see Rockstrom et al., 2009). While there is an emerging literature on biodiversity (Jones, 1996; Jones, 2003; Lamberton, 2000 and a special issue of *Accounting, Auditing and Accountability Journal* in 2013), the implications of the nitrogen cycle has yet to be translated into organisational research. The area where one would make the connection (in operational terms) is in the farming industry (or via food as the focus of research). We would suggest that these research gaps arise because accounting researchers have insufficient exposure to the ecological concerns that emerge from the sustainable development field. A similar picture emerges in the social arena where, except some work in fair trade and human rights (see McPhail & McKernan, 2011 and the rest of articles published in the 2011 special issue of *Critical Perspectives on Accounting*), accounting has not been systematically and actively considering social equity concerns. Our argument here is that if one took sustainable development as the point of departure then a wider array of relevant topics

¹³ This might be compared with other possible entities (some of which make more ecological and social sense) such as: cities, communities, regions, ecosystems or sectors. While these entities are likely to be more familiar as fields of analysis for geographers or economists they remain legitimate possible units of account for accounting scholars as well.

¹⁴ Stakeholder analysis and a focus on organisational legitimacy have been dominant conceptual foci of the corporate social responsibility (and social and environmental accounting) literature and have also been subject to lively ongoing debate. Historical entry points to this substantive body of work include (for stakeholder theorising) Freeman (1984); (its application to accounting) Roberts (1992) while Deegan (2002) provides an important summary of legitimacy theory informed work.

¹⁵ Driscoll and Starik (2004) consider the environment as an organisational stakeholder while in 1972 Stone seminally considered the potential legal standing of trees (see Stone, 2010). In the area of philosophy Mulgan (2006) has produced a relatively accessible introduction to the philosophical issues of treating future people seriously.

might be researched, drawing on pockets of work in accounting that already address these various issues of concern.

Likewise, if a different research agenda was pursued, it might be that a different set of theories would provide a touchstone for researchers. In particular, the usefulness of theories that provide a sense of how longer cycles of change behaviour (and associated rationalities) are likely to emerge. One area that has been used to inform many areas of work (including some in accounting) is that of governmentality (Bebbington & Thomson, 2007; Frame & Bebbington, 2012; Gouldson & Bebbington, 2007; Spence & Rinaldi, 2014). This theoretical framing widens the scope of what might be examined beyond particular techniques and practices (such as accounting) to their place in constellations of governing activities (and the impacts of these shaping contexts). Theories that explain how organisational practices become more similar to each other as well as how moments of change arise are also likely to be valuable (and are applicable to institutions themselves). Moreover, if one puts sectors and countries at the heart of problem posing, one might identify contexts where countries have substantial natural resources (such as, but not limited to, those in the Pacific) but relatively weak capacity to effectively govern activities of private corporations. In these settings, a possibility for oversight and disciplining of corporate activities might be those opportunities provided by private regulatory means (for example, sector based self-regulation, problematic though that is also likely to be – see, for example, Bebbington, Kirk, & Larrinaga, 2012). Lessons from private regulatory processes (such as the United Nations Principles of Responsible Investment and/or the Global Compact) might provide a basis from which Governments could control (at least to some extent) the likely impacts of these corporations. To the best of our knowledge there has not been a systematic attempt to use these existing regulatory contexts to enforce some accountability on corporations whose impacts are viewed as problematic from a sustainable development perspective. This is not to say that these are the only possible avenues forward, but these sorts of framing device do tend to shift the focus onto the context which shape entities behaviours rather than a focus on entity accounts.¹⁶

In addition to considering specific theories that might contribute to understanding and answering research questions, a literature has been developing that addresses methodological questions about how we might address sustainability development issues. This approach is termed sustainability science. This approach does not mean that there is any less need for excellence within discipline knowledge.¹⁷ Indeed, this is viewed as a pre-requisite for

bringing knowledge to a more sustainability science orientated exploration. Rather, proponents of sustainability science argue that unless we develop additional modes of intellectual investigation it will be impossible to engage effectively with the complex, interlocking and ethically imbued problem set that we are facing. Hallmarks of this approach are introduced in more depth in the next section and will infuse the rest of the paper.

Sustainability science¹⁸

The purpose of this section is to provide a bridge between earlier concerns about how one might research sustainable development issues and an appreciation of the complexity of the real world contexts in which these issues emerge and evolve. We have argued that additional modes of knowledge production (in conjunction to discipline based investigation) are required for this task and that this has been attempted by an emerging field of inquiry termed sustainability science. In particular, sustainability science is a description applied to a particular approach to knowledge production that seeks to point “the way towards a sustainable society” (Komiya & Takeuchi, 2006, p. 2; see also Kajikawa, 2008; Kastenhofer, Bechtold, & Wilfing, 2011). The term is most frequently credited to Kates et al. (2001), although it draws extensively on previous discussions of wicked problems (Beilin & Bender, 2011; Rittel & Webber, 1973) and post normal science¹⁹ (Funtowicz & Ravetz, 1993) with clear links to notions of ‘mode 2’ knowledge production (Gibbons et al., 1994; Müller, 2003), addressing ‘divergent problems’ (Orr, 2002), and/or seeking consilience (the ‘jumping together’ of knowledge, see Wilson, 1998).²⁰

Motifs of sustainability science

Various motifs that characterise a sustainability science approach have been outlined in the literature, namely its: domain of concern (inter-disciplinary understandings of nature–society interactions); how it defines its research focus (on sustainable development problem sets); how it decides what knowledge ‘counts’ (reflecting participatory and democratic desires); and its recognition that normativity is inherent in the problem set. Each characteristic is outlined in more depth in the following paragraphs.²¹

Sustainability science is concerned with the “fundamental character of interactions between nature and soci-

¹⁸ In this context, science is used to describe the generic process of systematically developing knowledge.

¹⁹ Wicked problems are described as problems that defy resolution. Brown, Harris, and Russell (2010, p. 4) paraphrase these as resisting “complete definition, for which there can be no final solution, since any resolution generates further issues, and where the solutions are not true or false or good or bad, but the best that can be done at the time”. Post-normal science is the approach one has to take with wicked problems, with sustainability science being an example of a post-normal approach.

²⁰ Material in this area is found in journals such as *Futures* and *Ecological Economics* which are journals in which accounting scholars sometimes publish and which sometimes inform accounting work. There are also sustainable development journals, such as *Sustainability Science* and *International Journal of Sustainable Development*.

²¹ These motifs have been developed on the basis of an extensive review and synthesis of the sustainable science literature.

¹⁶ We don’t believe that it is helpful to the flow of the paper to fully develop these propositions. Rather, they are offered in order to ground our suggestions in more particular terms as a way to encourage a move beyond focusing on corporate produced narratives as a way to regulate organisational behaviour.

¹⁷ We will return to this point later in the paper. Being open to other disciplinary focuses in the context of a sustainability science orientated investigation is not about ‘anything goes’. Likewise, a desire to be interdisciplinary does not imply a rejection of disciplines as useful ways to understand and act in the world.

ety" (Kates et al., 2001, p. 641; Clark & Dickson, 2003; Quental et al., 2011). Understanding such interactions requires both an understanding of the particular systems in question as well as the interactions that emerge at their intersection and at different scales (Holling, 2001). For example, Jerneck et al. (2011, p. 72) describe natural systems as being "driven by a set of fundamental natural principles, such as gravity, thermodynamics and natural selection, while social systems are driven by... dynamics, such as demography, ideology, inequality and power struggles, as well as rationalisation, specialisation, institutionalisation, competition, capital accumulation, efficiency and technological change".²² Table 1 outlines the questions that Kates et al. (2001) identified as needing to be addressed.²³

Crucially, sustainability science emerged at a time when science was being asked to engage in policy domains which were characterised by high levels of complexity and uncertainty.²⁴ At this time it also became apparent that "laypersons (e.g. judges, journalists, scientists from another field, or just citizens) could master enough of the methodology to become effective participants in the dialogue" (Funtowicz & Ravetz, 1994, p. 204). Moreover, Funtowicz and Ravetz (1994, p. 204) note that since "no particular expertise can deliver certainty for policy decisions, no expertise can claim a monopoly of wisdom and competence." Confidence in the ability of a single discipline (and/or 'scientifically' derived knowledge) was challenged at this time after a period where 'science' had enjoyed (and then lost) the confidence of many.

As a result, sustainability science adopts an interdisciplinary approach to problem definition and analysis (Clark & Dickson, 2003; Jerneck et al., 2011). This arises because it is believed that we are facing problems that are different in both scale (they are global in expression, see Allen, Fontaine, Pope, & Garmestani, 2011), as well as complexity (in that there are possibilities for irreversible outcomes as well as the potential for discontinuities/tipping points in these systems – see Jerneck et al., 2011; Quental et al., 2011; and especially Scheffer, Carpenter, Foley, Folke, & Walker, 2001). Indeed, Jerneck et al. (2011, p. 70) suggest that taken together "anthropogenic influences on global life support systems have reached a magnitude unprecedented in human history, levels that now jeopardise the well-being of humanity" with emergent properties arising from systems interactions (Clark & Dickson, 2003). To further complicate matters, many of the problems that

are faced are in need of urgent resolution (Cohen et al., 1998). Taken together, these characteristics are often described as being 'wicked' (Rittel & Webber, 1973), and sustainability science suggests that wicked problems can only be addressed through a post-normal approach (Funtowicz & Ravetz, 1993).

The second motif of sustainability science is that it is problem focused along with being applied in nature. This focus is required if one believes that problems emerge from complex interactions between systems. Further, if it is assumed that problems are driven by a particular confluence of aspects in particular settings then this is a robust approach to knowledge production. A particular focus sits in contrast to a trend in knowledge production towards generalizability (Cohen et al., 1998 discuss this in the context of global climate change). In this vein, Clark and Dickson (2003, p.8060) caution against a focus on the specific leading to a presumption that sustainability science does not address fundamental questions – indeed the questions posed by Kates et al. (2001), among others, are fundamental in nature, albeit that their investigation may be particular in execution.

The focus on the particular also creates the opportunity for a more nuanced appreciation of individuals' experience of the particular problem set. Specifically, there is a greater potential for individual narratives about subjective experience of sustainable development problems to be heard (and voiced) if one focuses on specific times and places. Given this 'closer' view, there is a belief that sustainability science is more likely to expose the position of the most vulnerable and hence might engage researchers more directly with moral judgements (which is itself linked to the fourth characteristic of sustainability science described below).

One critical question arising from a focus on the particular is how, if at all, knowledge from one study may be connected to knowledge from another study. This question is usually addressed in two ways. First, the nature of learning within a sustainability science approach is characterised as social learning. Social learning has two aspects to it. The first is that learning is best achieved through "learning together to manage together ... by doing" (Cummins & McKenna, 2010, p. 799). This characteristic is implied by a post-normal approach where the knowledge to action nexus emerges through "refined interplay between iterative practice and planning" (Cummins & McKenna, 2010, p. 799). A second aspect of social learning is that through working closely with others (both other disciplines and with practitioners), "new relational capacities" (Pahl-Wostl, Mostert, & Fabara, 2008, p. 24) are created. Learning how to collaborate, how to listen and when (and how) to challenge is, therefore, core to a sustainability science based interaction.

The third motif of sustainability science (linked to the previous point) is that it tends to be more participatory in nature than traditional science: that is, knowledge is coproduced, (see Clark & Dickson, 2003; and Cortner, 2000, who describe this as 'civic science'). The reasoning for this is as follows: if one seeks to understand complex problems and their expression in a particular context then those who are directly affected by those problems are

²² This observation speaks to earlier suggestions that sustainable development has both objective and subjective bases for understanding.

²³ In this characterisation of sustainability science, the humanities (which can be seen as reflecting on the "values implied in human aspirations and projects", Gibbons et al., 1994, p. 7) is relatively under explored. One could argue that a focus on social systems also encompasses issues that the humanities can and do shed light on. Equally, the natural science background of the main proponents of sustainable development is likely to lead to an undervaluing of humanities research.

²⁴ Brown et al. (2010) and Pielke (2007) provide examples of various issues that fall into this category including: persistent organic pollutants; genetically modified organism; trans boundary diffuse pollution and the bioethics of cloning. Likewise, Bjørn Lomborg's *The Skeptical Environmentalist* (and the controversy that followed this publication) is an example of this situation.

Table 1

Core questions of sustainability science (from Kates et al., 2001, p. 642).

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- How can the dynamic interactions between nature and society—including lags and inertia—be better incorporated into emerging models and conceptualizations that integrate the Earth system, human development, and sustainability?
 - How are long-term trends in environment and development, including consumption and population, reshaping nature–society interactions in ways relevant to sustainability?
 - What determines the vulnerability or resilience of the nature–society system in particular kinds of places and for particular types of ecosystems and human livelihoods?
 - Can scientifically meaningful “limits” or “boundaries” be defined that would provide effective warning of conditions beyond which the nature–society systems incur a significantly increased risk of serious degradation?
 - What systems of incentive structures—including markets, rules, norms, and scientific information—can most effectively improve social capacity to guide interactions between nature and society toward more sustainable trajectories?
 - How can today’s operational systems for monitoring and reporting on environmental and social conditions be integrated or extended to provide more useful guidance for efforts to navigate a transition toward sustainability?
 - How can today’s relatively independent activities of research planning, monitoring, assessment, and decision support be better integrated into systems for adaptive management and societal learning?
-

likely to have insight into how they have been created, how they are sustained and what might be done to address them (Cohen et al., 1998; Jasanoff, 2007). Further, the distinction between experts and laypersons is becoming blurred in contemporary controversies and hence there is a wider group who might have insights to offer in any problem area. At the same time, a realisation that individuals and communities not usually thought to be ‘knowledgeable’ (such as indigenous peoples or, in general, those affected by problems) might have relevant knowledge has reinforced this more open attitude to who might ‘know’. As a result, a more participative approach to knowledge generation is at the core of the post normal approach, especially in its use of extended peer communities (Funtowicz & Ravetz, 1993) to assess the robustness of knowledge generated.

What is more, many actions that are sought in the name of addressing sustainable development will require individuals, communities and institutions to change and may involve difficult trade-offs to be negotiated (see de Vries & Petersen, 2009, for a description of how the Netherlands has attempted this). If the resolution of a problem cannot be achieved by resorting to ‘facts’, a collectively agreed course of action has to be sought. Likewise, the wicked nature of sustainable development problems means that solutions are never permanent. Rather, ‘solutions’ require continual reworking as actions taken often create other manifestations of problems. The active and on-going participation of those who are affected by (and who affect) a sustainable development problem situation is therefore necessary. Indeed, this point speaks to another characteristic of wicked problems. That is, “scientific exploration and practical application must occur simultaneously ... [and hence] influence and become entangled with each other” (Kates et al., 2001, p. 642).

The fourth motif of sustainability science concerns its explicit recognition of normative and politically infused nature of sustainable development arenas (Cohen et al., 1998; Spangenberg, 2011). There is some debate if this is a clearly distinguishing feature of sustainability science with, for example, Cohen et al. (1998, p.366) arguing that science “is political in non-trivial ways” and has always been normative (Cortner, 2000; Goeminne, 2011). It would appear, however, that even while many have accepted the value driven nature of science, not all have and hence the

usefulness of explicit recognition of this aspect of sustainability science.

Sustainability science, therefore, points towards a different sort of investigation for the academy. Differences include: (i) a focus on a broader class of problems than that usually present within a discipline based investigation; (ii) an assumption that it is necessary to adopt inter-disciplinary framings of problems in order to understand them; (iii) an assumption that there needs to be a deep and reciprocal engagement between practice and the academy; and (iv) a recognition that action is likely to precede full understanding, with all the attendant risks that this brings. Arenas that are starting to demonstrate these characteristics include: industrial ecology, ecological economics, human ecology, social ecology transition theory, resilience theory, cultural theory, world systems analysis and earth system governance (see Pretty, 2011 for other examples).

Moreover, sustainability science emphasises that learning from feedback obtained from experiments in action are necessary to address sustainable development issues. Indeed, Allen et al. (2011, p. 1339) characterise sustainability science as being “based on the philosophy that knowledge is incomplete and much of what we think we know is actually wrong, but despite uncertainty managers and policy makers must act”. As a result, we need continually to imagine and shape a sustainable trajectory (Kates et al., 2001). Sustainability science, therefore, implies a break from models of knowledge production that assumes that a ‘right’ answer can be found with the application of discipline specific methods and foci. While this has and likely will continue to be ideal for some topics, these approaches are not viewed as being sufficiently robust for the sustainable development problem set.

Evaluation and sustainability science

An area of substantive debate within sustainability science is how one might judge the outcomes of an investigation and/or policy intervention. In particular, the traditional role of science in delivering valid and reliable knowledge to society becomes problematic in sustainability science (Farrell, 2011) for several reasons. Specifically (and as is apparent from the previous characterisation of sustainability science) it is impossible to say that a problem is ‘solved’ or to say what an ‘ideal’ outcome might

be, or even to define in a unique manner the problem to be subject to investigation. Whereas more mainstream knowledge systems use the standards of scientific peer review structures with a method-oriented quality control (Farrell, 2011), we would argue that this approach is not sufficiently robust for addressing sustainable development. Instead, the principle of 'quality' is suggested in post-normal and sustainability science as an alternative criteria against which an evaluation might be undertaken for the production of usable information for decision makers and the public. Interrogating what quality means in this context is necessary.

Aslaksen and Ingeborg Myhr (2007, p. 489) state that when "science no longer is imagined as delivering "truth" irrespective of context, science receives a new organizing principle, that of quality" (see also Farrell, 2011; Funtowicz & Ravetz, 1994; Spangenberg, 2011). Quality is characterised as being information of a quality solid enough to guide decision makers and the public at large (Spangenberg, 2011) and which will reduce unsustainability (Baumgartner, 2011). This characterisation of the standard against which to judge a sustainability science investigation is likely to cause discomfort for discipline based scholars as 'quality' is defined by reference to an outcome (that of guiding a decision) without providing any evidence as to whether the decision is the 'right' one. This is, however, the heart of the issue with wicked problems – there is no straightforward way in which to know if a decision is or will be 'right'. Sustainability science, therefore, seeks to honour the nature of the problem set and to try (as far as possible) to 'proof' a decision by involving as many people as it is appropriate in the construction of and review of courses of action.

Indeed, Funtowicz and Ravetz (1993) coined the notion of "extended peer communities" to refer to the idea that "an ever-growing set of legitimate participants [are included] in the process of quality assurance of scientific inputs" (p. 752), reflecting a "wider set of criteria" (Gibbons et al., 1994, p.8) for the evaluation of science. This approach is consistent with the third motif of sustainability science (investigations are participatory) with extended peer communities being indispensable in situations where judgements are no longer about validity or reliability alone. Rather, in these settings judgements are also political (Cohen et al., 1998; Goeminne, 2011; Spangenberg, 2011), involving negotiations or judgements about whether enough knowledge exists to guide action. Facts or conclusions about the solution are unavailable in such context. Rather, the pursuit of requisite quality is likely to be an on-going task. Careful and deliberate use of extended peer communities to examine research findings are, therefore, the key mechanism used to make judgements on the quality of the work.

This depiction of 'quality' as the way to evaluate sustainability science will seem insufficient from a normal science perspective. As Funtowicz and Ravetz (1993) put it, however, extended peer review is not new to science but is an emergent phenomenon and an existing empirical reality. For example, they describe how AIDS research has operated "in the full glare of publicity involving sufferers, carers, journalists, ethicists, activists and

self-help groups, as well as traditional institutions for funding, regulation and commercial application...[in such a way that t]he researchers' choice of problems and evaluations of solutions are equally subjected to critical scrutiny" (see also Farrell, 2011).

In summary, Funtowicz and Ravetz (1994, p. 205) propose that "unity in post-normal science derives not primarily from a shared knowledge base, but from a common commitment to certain sorts of approaches for resolving complex policy issues". The heuristic of extended peer communities is offered as a way to ensure that the quality of problem description and proposed actions are the best they can be given the inherent complexity of the problem sets. Farrell (2011, p. 339) notes, extended peer communities do not resolve a "host of contentious issues...[Rather, they offer] a conceptual frame within which the character and dynamics of these situations can be placed and through which the complexity of their dynamics can be better understood and constructively managed".

In summary, Clark and Dickson (2003, p. 8060) note that sustainability science "is not yet an autonomous field or discipline, but rather a vibrant arena that is bringing together scholarship and practice, global and local perspectives from north and south, and disciplines across the natural and social sciences, engineering, and medicine" in a structured manner. The approach has some support and it is believed that it may provide a methodological basis for addressing sustainable development problems (but not resolving them as they are, by nature, irresolvable). Indeed, Baumgartner (2011, p. 785, emphasis added) noted that given "sustainability problems are concerned with many different disciplines, the interactions of which are of high complexity...sustainability science must be both integrated *into* traditional disciplines as well as be integrated within multi, inter and transdisciplinary research programs." This brings us to consider how a link may be made between sustainability science and the discipline of accounting.

Accounting and sustainability science investigations

The thesis explored in this paper is that if a sustainability science approach is taken accounting's interaction with sustainable development would develop in new ways. This penultimate section seeks to further build this case by reference to two areas of study, both of which are non-exhaustive examples of how work might develop within accounting. First, we take an area of accounting investigation (that of full cost accounting) which is connected to sustainable development concerns (namely the description of externalities) and suggest how this area might develop if it were more formally infused with sustainability science thinking. The second investigation takes a theme of importance to sustainable development (that of sustainable consumption and production) and demonstrates the relevance of accounting expertise to this arena of investigation, and specifically in the context of certification schemes. This second topic was selected because a substantive research literature exists in this area to which accounting has not

contributed and is an area that has not been addressed by accounting (but see Elad, 2001; and Francis, 2011 who hints at the possibilities for research in this area). Taken together, this section seeks to ground the preceding conceptual discussions into more concrete propositions concerning accounting research agendas. Both areas of study embrace the characteristics of sustainability science outlined earlier, namely: exploring areas of significant ecological–societal interaction by focusing on a particular problem set that requires the participation of multiple parties (as well as disciplines) in seeking a more socially just and ecologically sound outcomes.

Sustainability science and full cost accounting

Interest in full cost accounting was inspired by practice and research on cost benefit analysis/externalities valuation²⁵ and encouraged by the impetus provided by the introduction of the ‘polluter pays principle’ in policymaking (European Union, 1992; United Nations, 1992). Drawing from the tenets of the polluter pays principle, proponents of full cost accounting (see below) suggest that identifying more sustainable ways for obtaining goods and services requires shedding light on the (un)sustainability of current activities by assigning a value to the use of otherwise free environmental (and social) services. The rationale underlying full cost accounting is that implicit valuations are already present in decision making and a zero value is likely to be attached to impacts that are not internalized (Bebbington et al., 2001; Canadian Institute of Chartered Accountants, 1997; Costanza et al., 1997). Academic focus on full cost accounting has spread in the last decade (Antheaume, 2004; Atkinson, 2000; Bebbington & Gray, 2001; Bebbington et al., 2001; Bent, 2006; Herbohn, 2005; Lamberton, 2000), with variants such as the Sustainability Assessment Model also emerging (Bebbington, 2007; Bebbington et al., 2007; Frame & Cavanagh, 2009; Fraser, 2012; Xing et al., 2009).

In accounting terms, financial accounting is enabled by, and constitutes, the boundary between an organization and its environment. This framing of the organization, based in the ‘entity concept’, dictates that accounting should be only interested in some costs (that is, those borne by the entity) even though this obscures social and ecological impacts that arise at a wider scale. By ignoring these wider impacts, financial accounting contributes to the construction and maintenance of a bounded organization that ignores its full character (Lohmann, 2009).

In contrast, external costs are central to full cost accounting and hence it is an approach that addresses the interlinkages between sustainable development problems and an entity. Although full cost accounting shows potential, it also inherited the limitations of cost benefit analysis (discussions of which prompted discussions on foundational aspects of post normal science and ecological economics). These limitations revolve around the extent to which externalities can be defined in multiple ways and are often not easily amenable to ecological, social or eco-

nomic modeling. For example, planetary ecological processes which require protection “react in a nonlinear, often abrupt, way, and are particularly sensitive around thresholds levels of certain key variables” (Rockstrom et al., 2009, p. 472). The consideration of the socio-economic subsystems whereby these ecological processes are affected creates further complexity, as do the values that might be used to translate physical aspects to the economic measures that can then be used in a full cost account (Niemeyer & Spash, 2001; Spash, 2007; Söderholm & Sundqvist, 2003). Taken together, these issues make any full cost accounting exercise inherently contestable. Drawing on the previous discussion about sustainability science, we contend that the contestability of an account is not a limitation. Rather, it is a reality with which any account must work.

Full cost accounting has a direct link to the sustainability science literature in that ecological valuation was the focus of the seminal work of Funtowicz and Ravetz (1993), Funtowicz and Ravetz (1994). Further, full cost accounting sheds light onto the “complex dynamic that arises from the interaction between human and environmental systems” (Spangenberg, 2011, p. 278) and, more specifically, the systems for monitoring the sustainability performance of institutions (Spangenberg, 2011). A sustainability science infused conception of full cost accounting is also reflected in Bebbington (2007), Bebbington (2009), Bebbington et al. (2007), Frame and Brown (2008), Frame and Cavanagh (2009), and Frame and O’Connor (2011). In contrast to this literature, we would argue that a lack of appreciation of a post-normal approach held Herbohn (2005) and her research collaborators back from moving to a fully monetized full cost account (noting that a reluctance to monetize is not necessarily a good/bad thing).

Accordingly, if full cost accounting research and practice is to make a contribution to debates about sustainable development it needs to work with uncertain and contestable information deriving from the scale and complexity of the key ecological processes and diverse values imperfectly translated into economic/financial terms. Indeed, Funtowicz and Ravetz (1994) contended that uncertainty in input information must lead to uncertainty in conclusions, and to exhibit more certainty in the results than in the arguments on which they are based is a methodological flaw. The notion of quality as an alternative to validity (as discussed previously) becomes important in these circumstances and is explained here by way of contrasting full cost accounting examples.

The Spanish Railways (RENFE) disclosed in its 2010 annual report that during that calendar year its services ‘saved’ 2297 million euros in external costs that would have otherwise have arisen (due to the reductions in air pollution, carbon emission and noise that resulted from the use of this mode of transportation) if all rail traffic had moved by road. This single figure account of the value of externalities that could have been avoided can usefully be contrasted with Antheaume (2004) who reported that, depending on the different assumptions and bases used for the valuation of externalities, the external cost of an industrial process could range from 1.52 to 18838.28 thousands of euro per unit of product. This latter account could

²⁵ Full cost accounts at the organisational level (USEPA, 1996) could be argued to be equivalent to cost benefit analyses undertaken at the macro level (Epstein et al., 2011).

be characterised of being of a higher quality (in the sense used previously) than the Spanish railways exercise.

Quality in full cost accounting, therefore, means that uncertain and local data should not “be buried in a mass of hyper-precise arithmetical data, assisted by models involving advanced calculus” (Funtowicz & Ravetz, 1994, p. 203). Indeed, and drawing from Carl Friedrich Gauss, a “[l]ack of mathematical culture is revealed nowhere so conspicuously as in meaningless precision in numerical calculation” (Funtowicz & Ravetz, 1994, p. 201). Rather, a ‘good’ (see later) ‘quality’ process in full cost accounting terms would create context in which stakeholders have an opportunity to debate and discuss the construction of an account. This process (as illustrated by Frame & Cavanagh, 2009 and Fraser, 2012) is likely to bring to the fore the issues of whose interests are served by choices made. Choices over the boundary of investigation; externalities to be included (or not); valuations that might be used and who might be a part of these decisions will all impact on the full cost account itself. Details of this process and who such details are shared with would provide a base from which project and data quality could be evaluated.

Likewise, the nature of a ‘good’ full cost account could be suggested by drawing on sustainability science. For example, Bebbington (2007) sought to communicate all the steps that were taken from the raw data to an impacts profile within the Sustainability Assessment Model. In addition, the Sustainability Assessment Model self-consciously separated modeling of impacts (which involve a particular set of uncertainties and choices) from the evaluation of what the profile produced means. Separating these elements from each other created the chance for the values that are used in the evaluation process to be acknowledged and made visible. Finally, the decision within that research–practice collaborative team not to monetize aspects of impacts that could be seen as ‘game changers’ (such as species extinction) reflects greater awareness that monetization is not always appropriate (see also, Frame & O’Connor, 2011).

Indeed, a sustainability science framing suggests that the complexity of system processes, the instability of the boundaries between external and internal costs as well as the need to carry out full cost accounting experiments in particular contexts means that it would be likely for a range of externalities data to be produced that may well vary between groups and over time. Taken together, these observations imply that rather than focusing on the generalization of results, the validity of full cost accounting derives from the quality of information derived from experiments and the type of relations that are established between those involved in the problem context. More fundamentally, full cost accounting research needs to recognize that there is a diversity of perspectives about the suitability and feasibility of monetary evaluation, the procedures to be followed for monetary evaluation (if it is considered) and who has the authority for any decision making subsequent to calculations. Considering this diversity in perspectives, cost benefit analysis (Samiole, 2012) and full cost accounting unavoidably stand in contested terrain.

However, notwithstanding the contestability of cost benefit analysis (and the influence it gives rise to), a sus-

tainability science conception of the technique would stress the need to co-produce knowledge. In this respect, previous research has concluded that the implementation failures of full cost accounting exercises were due to the attachment of actors to different sets of values (Bebbington & Gray, 2001; Fraser, 2012; Herbohn, 2005). A sustainable science approach, however, would frame those results not as failures, but as the illustration of the importance and legitimacy of different value commitments and would explore the spectrum of rationalities and values represented. Such an approach would thus contend that since no particular expertise can deliver certainty in full cost accounts, praxis and research needs to be negotiated and mediated with different stakeholders with boundaries, baselines and values being constructed during the accounting process (Niemeyer & Spash, 2001). Full cost accounting, therefore, is an emergent field of investigation requiring deliberative approaches (Chilvers, 2008; Frame & O’Connor, 2011; Niemeyer & Spash, 2001; Spash, 2007) that would itself require the co-production of knowledge about detailed issues with stakeholders (who have a unique appreciation of the complexities of the situation and the decision stakes). A deliberative approach to full cost accounting is also at odds with any attempt to “squeeze all value dimensions into a single axiological scale” (Niemeyer & Spash, 2001, p. 573) and, therefore, is a fundamental redefinition of the conventional understanding of accounting.

This suggests four avenues for further research in terms of constructing an account. First, providing room for the participation of stakeholders in deliberative full cost accounting raises challenges such as, the representativeness of participants, inclusiveness, how to attain a fair deliberation or the access to resources to participate (Chilvers, 2008). Second, methods need to be devised to communicate the uncertainty (or even the ignorance) about different processes in the ecological and social subsystems (Funtowicz & Ravetz, 1993, p. 743). Third, methods need to be developed to allow the possibility of different forms of valuation, beyond monetary evaluation, including the possibility of refusing to put a value to a given process. Finally, full cost accounting research should explore whether it is reasonable to use the benefit transfer method (Brouwer & Spaninks, 1999) even in those cases in which stakeholders decide that a monetary measure is acceptable, because this method assumes a generalizability of values that is at odds with the foundations of deliberative full cost accounting.

The examination of full cost accounting from a sustainability science viewpoint could also help to provide insight into whether and how full cost accounting can “make the normative concept of sustainability operational” (Spangenberg, 2011, p. 276). This implies a focus on the politics of full cost accounting as these accounts could be seen as potential technologies of government that, through the problematization of particular challenges to sustainable development, suggest particular frames for their remediation (Miller & Rose, 2008). Full cost accounting, therefore, will construct narratives about sustainable development and the desirability of some economic activities, thereby mobilizing actors and resources in specific contexts. To link

back to the earlier example from the Spanish railways, it is relevant to note that the viability of this organization requires the mobilization of resources in the form of governmental subsidies and investments and an externalities account would certainly play into that negotiation. From this perspective, further research on full cost accounting could explore how issues of apparent detail such as the definition of baselines, boundaries or monetization methods could in reality be driven by different political stands, with important distributional and sustainable development consequences (see Samiolo, 2012).

It might also be useful to link full cost accounting experimentation in accounting to cost benefit analysis (Frame & Brown, 2008; Lohmann, 2009; Samiolo, 2012). Despite the controversies generated by valuation, cost benefit analysis is used to make and legitimate decisions even while it excludes from the analysis those issues that are not measured/measurable thereby illuminating some aspects and obscuring others (Espeland & Stevens, 2008; Funtowicz & Ravetz, 1994; Lohmann, 2009; Niemeyer & Spash, 2001; Porter, 1995). In contrast, the full cost accounting literature still focuses on experiments rather than drawing on a deep and wide set of practices that one might assume is taking place behind closed doors.²⁶ This suggests that there might be activity that is not being examined and also that full cost accounting could inform other areas of accounting. For example, carbon markets are essentially an attempt to internalize costs and identify externalities to inform decision making. To date, however, the carbon accounting literature seems not to have identified a connection with the earlier full cost accounting work. Regardless, we would argue that an appreciation of sustainability science motifs would be useful to any externalities account.

Accounting and sustainable consumption and production

While a sustainability science perspective has been used to reflect on existing accounting research and practices, it might also be used to explore areas where social and environmental accountants are absent but where they might make a contribution (noting that the mainstream of accounting researchers have dealt with issue of certification, but not in this particular policy context). Sustainable consumption and production is a cross cutting sustainable development theme (Spangenberg, 2011) that was first identified in the Rio Declaration and Rio Principles (United Nations, 1992) and which was then reinforced at the Johannesburg Plan of Implementation in 2002. In addition, it has been a key focus of the United Nation's Department for Economic and Social Affairs (see, <http://www.un.org/esa/desa/>) for at least a decade (see also <http://www.un.org/en/development/desa/climate-change/consumption.shtml>). This theme seeks to find a way to transform productive activities so that they might be less unsustainable

than they currently are (as a result consumption patterns might also become less unsustainable). The context of sustainable consumption and production often focuses on situations where producer and consumer communities are distant from each other in terms of geographic location as well as in terms of social and economic conditions. Most usually, producer communities are located in the global south while consumers are in the global north. Moreover, markets in which products are traded are viewed as having imperfections that will lead to either exploitation of the natural environment and/or impoverishment of producer communities. The idea behind sustainable consumption is that if demand can be stimulated for products that better support producers then sustainable development might be more possible. Certification schemes that focus on fair trade would be an example of sustainable consumption and production as well as ones that look at environmental credentials of production (such as dolphin 'friendly' or organic).

Sustainable consumption and production is a classic sustainable development issue in that it considers problems/solutions that emerge at society–environment interfaces where concerns about ecological integrity, social fairness and economic flourishing (for example, via fair exchange) are at the heart of the issue. Further, the nature of consumption and production means that many institutional players are involved, some with considerable economic incentives to perpetuate current consumption and production paradigms and others with incentives (but not necessarily power) to create new forms of activity. In the terms used previously in this paper this is a wicked problem that require urgent resolution and which involve complex moral and systems dynamics to be understood.

A subset of activity within the sustainable consumption and production arena relates to how certification schemes might provide a set of incentives to producers and signals to consumers concerning the sustainable development characteristics of products and processes. Certification schemes address aspects of activities including the way production impacts on natural resources in areas such as fisheries (see, for example, Constance & Bonanno, 2000), forests (comprising schemes such as Forestry Stewardship Council and Rainforest Alliance certification) and land resources, including 'organic' food production methods (Shreck, Getz, & Feenstra, 2006) and coffee production (Raynolds, Murray, & Heller, 2007). At the same time, a number of certification schemes focus on social or economic characteristics such as 'fair trade' (Gandenberger, Garrelts, & Wehlau, 2011). Still others cover processes or characteristics of services provided in areas such as tourism (Font, 2002) and buildings via 'green' and 'sustainable' building codes (Ding, 2008; Haapio & Viitaniemi, 2008).²⁷ The construction of standards for certification also need to be underpinned by ecological data on what constitutes sustainable production and/or by moral agreement as to what constitutes (for example) fair labour practices. These are substantive questions that require extensive discussion with

²⁶ As Atkinson (2000) points out, as soon as you have environmental impact data from corporate reporting (or from regulatory compliance reporting) you can construct an externalities account from readily available economic valuation data. This means that it is possible to create league tables of the impacts of corporations, independent of them taking part in such exercises. What we can note, however, is such accounts are not being routinely constructed (but see Figge & Hahn, 2004).

²⁷ Each of these areas have a substantial literature of its own, the review of which would unreasonably lengthen this paper while not contributing to the main line of argument being pursued.

extended peer communities as well as the input from a variety of disciplines (such as agriculture, philosophy and ethics).

Deeper questions also emerge from the examination of certification schemes, perhaps most interestingly in the area of regulation. Some argue that in a globalized economy the nation state has less ability to regulate (mainly) corporate activities (Constance & Bonanno, 2000) and hence certification schemes provide alternative governance mechanisms that can operate over national borders, often with the active involvement of non-governmental bodies with social and/or ecological concerns and credentials. Of course, this is a contested terrain and the ramifications of taking a certification approach rather than a regulatory one are the focus of literature in this area (see, for example, Constance & Bonanno, 2000; Lawson, 2011; Reynolds et al., 2007). Moreover, this approach has ramifications for how we might understand consumers and their role in shaping the behaviour of businesses (Eden, Bear, & Walker, 2008).²⁸

Within the context of certification schemes, the possibilities for developing, scrutinising and evolving auditing, assurance and/or certification techniques²⁹ come to the fore. It is therefore surprising that with a few exceptions (for example, Elad, 2001) social and environmental accounting has had little to say about this sort of certification.³⁰ There may be many reasons for this lack of literature including a lack of comfort with providing accounts and certification for research objects other than for profit entities (a point alluded to by Gray, 2010). Alternatively, a lack of knowledge among accounting researchers about the assumed importance of and nature of these schemes, their existence and/or their scale, scope and potential ramifications (from a governance perspective) may have inhibited an interest developing. Whatever the explanation, these schemes (if they are to be understood holistically) need the detailed input of the accounting discipline in terms of expertise around how to certify and the meanings associated with these actions.

In particular, an analysis of literature that addresses sustainable consumption and production demonstrates an absence of questions that would be expected if you had an auditing/assurance/accounting background (but see Francis, 2011). This is surprising as accounting, auditing and reporting activities are exactly those that allow for a “politics on reconnection” (Eden et al., 2008, p. 1044) and are essential to ensuring that knowledge intermediation happens. As such, examining sustainable consumption and production from the viewpoint of accounting is likely to be valuable for broader understand-

ings of sustainable consumption and production. The opposite also holds. Certification practices have the potential to illuminate accounting's understanding of itself and constitute a key cross over point where accounting might support sustainable development.

As a result, accountants might be involved in sustainability science investigations, working in partnership with disciplines as diverse as anthropology, philosophy, geography, agriculture, economics, health studies, consumption studies, politics and sociology. Extended peer communities that would have an interest in such a transdisciplinary inquiry would include individual producers, consolidators, exporters, certifier bodies, as well as consumers. Collectively, we might then be able to address the question that Reynolds et al. (2007, p. 148) pose as to “whether certification works to *hold the bar*, avoiding the erosion of social and environmental conditions, or to *raise the bar*, improving social and environmental standards” (emphasis in the original). If accountants are to contribute to the Kates et al. (2001) core question of “What systems of incentive structures—including markets, rules, norms, and scientific information—can most effectively improve social capacity to guide interactions between nature and society toward more sustainable trajectories?”, a consideration of social, environmental and sustainable development certification is an obvious site for engagement.

In summary, this section explored the contention that the tendency in the accounting literature to take on board the pre-occupations of its discipline has inhibited the emergence of accounting for sustainable development. It is likely that a focus on documenting (using content analysis) social and environmental related disclosures in Annual Reports or other media of a sub-set of economic entities (primarily for profit listed companies) is not fully in line with the demands that sustainability development places on the academy. This suggests that while pessimism about the actual and potential achievements of environmental accounting is warranted, there are possible solutions that do not require abandoning a commitment by accounting academics to being involved in sustainable development research. Rather, we would argue there is a case for getting closer to contemporary sustainable development debates in order to establish the utility of accounting to the study of sustainable development (and vice versa). We sought to illustrate this point using two examples, but many others will also exist.

Concluding comments

O’Riordan (2004) notes that sustainable development work is “energized by the failure to overcome complex and policy-linked problem arenas such as climate change, biodiversity management, social justice and entitlement to all people to steward essential planetary resources for permanent and workable livelihoods.” These outcomes are not presently realised in practice and hence continue to motivate researchers and practitioners. Indeed, the failure to achieve sustainable development has prompted the emergence of social and environmental accounting (a sub-discipline of accounting) which focuses on the impact

²⁸ In anything, reliance on certification suggests a belief in the power of consumers that might be unwarranted. At the same time, concerns arise if one assumes that human agency might be reduced to expressing oneself as a consumer in the absence of other forms of expression.

²⁹ These terms are rarely fully defined or distinguished in the existing non-accounting literature on certification.

³⁰ In contrast, the *Journal of Business Ethics* publishes many papers on this topic. The paper most closely associated with this topic, that we could find in the social accounting literature, was on the use of social accounting systems for fair trade organisations (Dey, 2007).

organisations have on society and the ecology. A wide array of disciplines also seek to address these concerns, drawing (as do accountants) from their own commitments, theories and modes of generating knowledge, doing what Spangenberg (2011) calls 'science for sustainability'. Spangenberg (2011) also calls for a 'science of sustainability', whereby the particular demands for knowledge that can be used in policy and other decision making domains in order to move human society towards sustainable forms of development are recognized and acted upon.

We have argued in this paper that this latter way of thinking (known as sustainability science, after Kates et al., 2001) has affected how disciplines come together to develop knowledge and define the subjects around which knowledge is to be generated as well as informing the development of disciplines themselves. Sustainability science has several characteristics including considering a problem area as being the object of research (rather than an organisation) as well as encouraging a trans-disciplinary approach to the research processes (that includes those that affect and are affected by the outcomes of the application of knowledge in practice settings and in policymaking). Taken together, this approach seeks to respond to the particular characteristics of sustainable development problems (that is, their wicked nature). We also sought to describe how such an approach might shape how accounting scholars approach research in this area.

The particular reason for seeking to reinvigorate accounting and sustainable development investigations is that there appears to be widespread pessimism (expressed most eloquently by Gray, 2010) that accounting can contribute to a more sustainable/less unsustainable society. It is our hope that by introducing a different approach to research (in methodological terms) we might work towards overcoming the limitations of our current accounting approaches to knowledge and its application. Of course, seeking to pursue sustainable development is problematic. First, its empirical base is a unique global experiment guided by partial scientific certainties and uncertainty about the dynamics of the whole system. Second, the translation of ecological limits and standards of social justice into policy and decision making is non-trivial. Third, the urgency to address sustainable development problems and lack of belief regarding the possibility of 'resolution' requires us to blur the conventional frontiers between the creation of knowledge and its application to actual policy and decision making. In adopting a sustainability science approach, however, we hope to make "our ignorance useful" (Funtowicz & Ravetz, 1993, p. 743). Sustainability science is a distinctive approach that has developed as a result of a belief that there are problems that are sufficiently different in nature that we need to experiment with new ways of knowing, including new forms of research engagement.

With that in mind, we believe that the time has come for accounting to self-consciously engage with the lessons of sustainability science to see how it might refocus its research activities as well as how it might engage more closely with other disciplines around problems of common interest. Jasanoff (2007, p. 33) frames the stakes thus:

"[we] need disciplined methods to accommodate the partiality of scientific knowledge and to act under irredeemable uncertainty. Let us call these the technologies of humility. These technologies compel us to reflect on the sources of ambiguity, indeterminacy and complexity. Humility instructs us to think harder about how to reframe problems so that their ethical dimensions are brought to light, which new facts to seek and when to resist asking science for clarification. Humility directs us to alleviate known causes of people's vulnerability to harm, to pay attention to the distribution of risks and benefits, and to reflect on the social factors that promote or discourage learning".

We believe (and have argued in this paper) that the discipline of accounting has a contribution to make in this area. In seeking to explore these themes in the context of accounting we have attempted to provide some pointers to how sustainability science framing might invigorate accounting scholarship. We offer these ideas in a problem posing mode. There are not recipes for how one gets accounting for sustainable development 'right'. Rather, we can only offer these suggestions (many of which can be empirically explored) as a starting point of a conversation. As with sustainability science, the standard of 'quality' as co-developed with you (our peer community) will ultimately be the judge of these propositions.

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