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Sustainability-oriented Innovation: A Systematic Review

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This paper is intended as a contribution to the ongoing conceptual development of sustainability-oriented innovation (SOI) and provides initial guidance on becoming and being sustainable. The authors organize and integrate the diverse body of empirical literature relating to SOI and, in doing so, develop a synthesized conceptual framework onto which SOI practices and processes can be mapped. Sustainability-oriented innovation involves making intentional changes to an organization's philosophy and values, as well as to its products, processes or practices to serve the specific purpose of creating and realizing social and environmental value in addition to economic returns. A critical reading of previous literature relating to environmental management and sustainability reveals how little attention has been paid to SOI, and what exists is only partial. In a review of 100 scholarly articles and 27 grey sources drawn from the period of the three Earth Summits (1992, 2002 and 2012), the authors address four specific deficiencies that have given rise to these limitations: the meaning of SOI; how it has been conceptualized; its treatment as a dichotomous phenomenon; and a general failure to reflect more contemporary practices. The authors adopt a framework synthesis approach involving first constructing an initial architecture of the landscape grounded in previous studies, which is subsequently iteratively tested, shaped, refined and reinforced into a model of SOI with data drawn from included studies: so advancing theoretical development in the field of SOI.

Introduction

Growing concern about resource over-consumption, environmental degradation and social inequity have resulted in calls for a transition toward a more sustainable society and economy. The first mass-readership environmental book detailing the scale of damage wrought on nature by humanity was Fairfield Osborne's (1948) classic, *Our Plundered Planet*. Other more, or less, apocalyptic studies followed (e.g. Carson 1962; Cole *et al.* 1973; Meadows *et al.* 1972), their fears and ideas echoed in institutional environmental initiatives such as The International Union for the Conservation of Nature and Natural Resources (IUCN, founded 1956), The United Nations Environment Programme (UNEP, founded 1972) and the launch of the World Conservation Strategy in 1980, the product of a collaboration between IUCN, UNEP and the World Wildlife Fund (WWF 1980). The latter document showed, for the first time, that economic development and conservation are not incompatible.

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It was in the subsequent work of the World Commission on Environment and Development's Brundtland report (Brundtland 1987) that the idea of sustainable development – 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' – became more mainstream. Elkington (1997) popularized the notion of sustainable development in terms of the Triple Bottom Line (TBL), in which businesses are exhorted to adopt a responsible approach and give equivalence to environmental, social and economic dimensions in decision-making.

Markets and economic agents have been identified as either part of the problem, thus requiring changes to the dominant economic paradigm (Mittelstaedt and Kilbourne 2008), or part of the solution, positioned to effect positive change in the direction of sustainability (Mittelstaedt and Kilbourne 2008; UN 1999; Desrochers and Hoffbauer 2009; Simanis and Hart 2009). Either way, business has been encouraged to find means of achieving sustainable economic growth, and so the role of innovation in helping businesses transition to sustainability has received considerable interest from academics, managers and policy-makers (EYGM 2012; Hall 2002; OECD 2010a, UNDP 2010). Sustainability-oriented innovation (SOI) involves making intentional changes to an organization's philosophy and values, as well as to its products, processes or practices, to serve the specific purpose of creating and realizing social and environmental value in addition to economic returns. A critical reading of previous literature relating to environmental management, sustainability and innovation reveals how little attention has been paid to SOI (Doherty *et al.* 2014), and what exists is often deficient in four respects.

First, within the existing literature it remains uncertain precisely what sustainability means or how it can be achieved. A variety of conceptualizations exist (Blättel-Mink 1998; Blowfield *et al.* 2007; Bos-Brouwers 2010; Elkington 1994; Fussler and James 1996; George *et al.* 2012; Gladwin *et al.* 1995) and a confusing array of labels applied to (aspects of) the phenomenon, including, but not exhaustively: corporate social responsibility; green-, eco- or ecological innovation; social environmental management; and responsible innovation (Carroll and Shabana 2010; Owen *et al.* 2013; Seebode *et al.* 2012). Second, previous work tends to treat sustainability dichotomously (sustainable/not sustainable), rather than embedding SOI as a dynamic, unfolding process that is achieved over time. Third, with some notable exceptions (e.g. Klewitz and Hansen 2013), previous work often overlooks the social dimension (Schiederig *et al.* 2012) of SOI. Fourth, many reviews of environmental management and sustainability exclude contemporary grey evidence and are thus prone to time lag and incompleteness of search.

The purpose of this paper is to present the evidence on SOI through identifying, analysing and synthesizing firm-level SOI practices and processes, and to provide guidance on becoming and being sustainable. In so doing, we attempt to address the deficiencies highlighted above. To achieve this, we employ a novel review approach involving three stages:

(1) *Stage 1: Developing an initial 'architecture' for reviewing SOI.* Drawing on theories of environmental management and of innovation in fields cognate to sustainability, we sketch the basic building blocks of an initial conceptual framework of SOI, its underlying assumptions and key dimensions.
(2) *Stage 2: Systematic review of SOI.* We systematically review (Tranfield *et al.* 2003) the literature on SOI published between 1992 and 2012. We chose these dates as they mark an era when business began seriously to engage in the sustainable development debate, highlighted by their role in the three Earth Summits 1992, 2002 and 2012.[1]
(3) *Stage 3: Framework synthesis.* We adopt a framework synthesis methodology for our systematic review, in which the initial framework from stage 1 is iteratively developed as it is tested, shaped, reinforced and refined by findings from included studies (Barnett-Page and Thomas 2009; Dixon-Woods 2011; Thomas *et al.* 2013).

We propose a model of SOI that commences as a response to regulatory stimuli with incremental change at the firm level and culminates with radical change at the large-scale systems level. We argue that to move through the framework requires a step-change in philosophy, values and behaviour, and that this is reflected in the firm's innovation activity. The paper concludes with a discussion of the implications of findings for scholarship, policy and practice, and identifies opportunities for further research.

[1] See, for example: http://www.uncsd2012.org/ (accessed 25 November 2014).

Stage 1: Developing an initial 'architecture' for reviewing SOI

The importance of innovation in refreshing products and services, renewing the organization, even ensuring its survival is seldom disputed. Innovation is also mobilized to pursue environmental and social objectives. One key sustainability question is: 'What are the innovation activities firms engage in to become sustainable?' The question implies organizational change over time, a dynamic process with different models of activity playing a dominant role in each (Hargrave and Van de Ven 2006). Sustainability is not about either/or: rather, sustainability is about becoming, an idea usefully captured by the journey metaphor (Mohrman and Worley 2010).

To address this question, we first construct an 'initial architecture' by drawing on and integrating two theoretical perspectives from cognate fields: the innovation activities of firms (e.g. D'Este *et al.* 2012), to give 'Dimensions of SOI' and theories of environmental management (e.g. Kolk and Mauser 2002), to give a temporal aspect, or 'Contexts of SOI' (see Figure 1). This architecture provides the starting point for our evidence synthesis, which follows the framework synthetic approach (Barnett-Page and Thomas 2009; Dixon-Woods 2011; Thomas *et al.* 2013), and we build on these bodies of literature to take better account of the wide range of innovation activity, dynamic and contextual possibilities (e.g. Schiederig *et al.* 2012) to provide a more complete picture of SOI.

Dimensions of SOI

The mainstream study of innovation for environmental and social benefit is young, yet its relatively rapid growth has already prompted a number of reviews. Research to date reveals important dimensions of SOIs, but has focused excessively on a limited range of innovation types (products and technologies) predominantly in the realm of environmental challenges.

Table 1 summarises previous reviews in fields cognate to sustainability, and is organized according to the innovation area of focus with which each study is predominantly concerned: product innovation; product and process innovation; and product, process and organizational innovation. This organization reveals the field's rather narrow, product-centric origins and subsequent evolution to include more diverse innovations implemented and impacting in different contexts.

We draw on these studies to provide dimensions of SOIs in our conceptual framework. Three dimensions emerge: technical/people; stand-alone/integrated; and insular/systemic. These dimensions are discussed below and are illustrated in Figure 1.

Technical/people. The literature to date has been dominated by a technically focused, product-oriented view of innovation, promoting incremental adjustments in practice to attend to environmental challenges. For example, Winn and Roome (1993) conclude that R&D management and the environment is represented in the literature as a set of tools and techniques rather than a strategic management issue: Baumann *et al.* (2002) observe increased understanding within firms of 'tools' – any systematic means for dealing with environmental issues – in the product development process. Contrasting with this is a more recent focus on people-centred innovation, in which sustainability is treated as a socio-technical challenge affecting a cluster of elements including, for example, technology, regulation, user practices and markets, cultural meaning, infrastructure and supply networks (Geels 2005). The technical responses that characterize early SOI literature have become supplemented or supplanted by fundamental transformations at

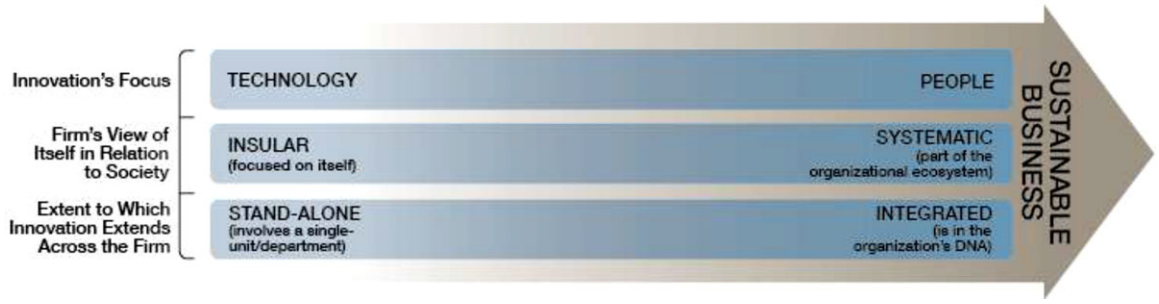

Figure 1. SOI dimensions

Table 1. Previous reviews of innovation in fields cognate to sustainability

Area of focus	Findings (Studies)	SOI dimension (example)
Product innovation or NPD	• Environmental NPD an emergent phenomenon, principally regarded as a set of tools, techniques and hardware • SMEs' environmental innovation predominantly technological, internally focused and incremental • Firms lack, but require, a strategic orientation to NPD and environmental challenges • NPD taking place in isolation from its context • Environmental NPD seldom linked to other processes inside the company or to processes outside the company • Need for functional departments (R&D, marketing, operations) to act together in an integrated way with external stakeholders for successful environmentally related NPD (Winn and Roome (1993); Baumann *et al.* (2002); Johansson (2002); del Brío and Junquera (2003))	• Technical (tools, techniques and hardware) • Insular (internal-focus) • Integrated (linking across functions) • Stand-alone (isolated NPD)
Product and process innovation	• Innovations focus mostly on technological development but are facilitated by non-technological changes • Practices are evolving from 'end-of-pipe' solutions to integrated environmental strategies • External stakeholders within firm's value chain becoming involved • More challenging sustainability goals require multiple targets to be addressed, by wide range of mechanisms in different contexts • Eco-innovation can be strategically and competitively advantageous, not simply a cost to the business (OECD (2009); Pereira and Vence (2012))	• People (non-technological change) • Stand-alone (end-of-pipe technologies) • Systemic (external stakeholders) • Integrated (strategically and competitively advantageous)
Product, process and organizational innovation	• Interaction with external actors increases as sustainability behaviour becomes more strategic and market oriented • Firms adopt different response modes to sustainability challenge • The most active exponents of SOI interact extensively with external actors and effecting transformations on a systemic level • Many SMEs engage mostly in incremental innovation • Business model innovation emerges as enabler of radically changing processes, products, and organizational forms in order to more successfully integrate sustainability into core business (Schiederig *et al.* (2012), Klewitz and Hansen (2013))	• Systemic (external actors and wider systems) • Integrated (strategic and market orientation) • People (business model innovation)

different levels of socio-technical systems. Some 'advanced players', OECD (2009) report, innovate in domains beyond the technical, such as adopting new business models or replacing products with services that represent alternatives, or additions, to primarily technological solutions, suggesting that the focus is not just technological, but also on how innovations are used, who they involve, and how they impact behaviour change (Geels 2004).

Stand-alone/integrated. This dimension is internal to the firm and describes the extent to which SOI thinking extends across the firm: whether or not SOIs 'stand alone' as increments to the dominant design (Abernathy and Utterback 1978) associated, typically, with individual departments, functions or products, or are integrated widely through the firm. OECD (2009) provides evidence of a shift to a more strategically oriented practice. They note how innovation for sustainable manufacturing has moved on from end-of-pipe, 'stand-alone' solutions to modes of practice that require sustainability to be more deeply embedded in the culture of the firm: for example, through the effective adoption of product lifecycle thinking, integrated environmental strategies and environmental management systems. That is, SOI moves from being an 'add-on' activity to diffusing and suffusing throughout the organization as strategic sustainability behaviour (del Brío and Junquera 2003; Klewitz and Hansen 2013; Schiederig *et al.* 2012).

Insular/systemic. The insular/systemic dimension reflects the firm's view of itself in relation to wider society. It is about whether or not innovations are internally oriented, addressing internal issues, or are designed and targeted to impact a wider socio-economic

system beyond the firm's immediate boundaries and stakeholders. Baumann *et al.* (2002) observe that firms' environmental product development processes are seldom linked to other processes outside the company. More progressive SOI firms are described as looking beyond their boundaries, engaging with and facilitating change in wider systems and engaging with diverse actors, possibly including forming coalitions with stakeholders such as NGOs, lobby groups and governments (OECD 2009; Pereira and Vence 2012; Schiederig *et al.* 2012).

Contexts of SOI

Kolk and Mauser (2002) reviewed 50 firm-level, stage/phase models and typologies of environmental management published between 1987 and 2000. In the period following, more models have been proposed, reflecting a continuing desire for better understanding and clearer insight into how organizations become sustainable.

These models have evolved from simple linear representations to more elaborate taxonomies reflecting context and activity. However, they remain limited by their relatively static view of the world: a general failure to recognize that, over time, firms may look to extend the levels and nature of their response (Kolk and Mauser 2002). Furthermore, they tend to be limited either by their largely conceptual or anecdotal origins or, in the case of empirical studies, methodological quality. Typically, this means that models directly or indirectly suggest categorizations unique to each individual study. So, for example, models are inconsistent with respect to the point of departure, number of stages, stage duration, transitions through stages and end point. These characteristics limit generalizability and make cumulative and comparative work difficult. Nevertheless, from these models, which typically consist of between three and five categories, we are able inductively to derive three distinct contexts of activity as described below.

Mostly, models adopt an intra-firm perspective in which a firm's sustainability orientation is passive, reactive and incremental or proactive in integrating and embedding sustainability into strategy. For example, Hart (1995) describes a three-category model. Initially, the focus is on Pollution Prevention, focusing on end-of-pipe methods of continuous improvement to reduce emissions; next is Product Stewardship in which the use of tools (e.g. Life-cycle Analysis) is integrated into the firm's product-development process; the final category is Sustainable Development, in which a strong sense of social–environmental purpose provides the backdrop for the firm's corporate and competitive strategies. More recently, Baya and Gruman (2011) described a Sustainability Maturity Path, a four-part journey in which sustainable practices are adopted along a trajectory mapped from Compliance through Obligation and Efficiency to Leadership. However, even in Leadership, in which sustainability is embedded in every part of the business, and economic, environmental and social impacts are equally and intelligently weighed, activity remains internally focused.

In the more recent models, sustainability is seen as a systems-level problem in which some of the challenges are simply too great for any single organization to tackle alone (Lamming *et al.* 1999). In this sense, SOI ultimately must address and have an impact on a diverse set of external issues, collaborators and stakeholders (Florida 1996). A small number of models include this ultra-firm perspective. Berry and Rondinelli (1998) describe three categories, Non-Compliance, Compliance and Beyond Compliance: Beyond Compliance is characterized as a new industrial revolution reflecting changes in the perceptions of legislators, government regulatory officials, business leaders and environmental interest groups of their own and of each other's roles. Tukker and Butter (2007) describe a three-category model commencing with System Optimization (e.g. fuel efficiency, low-emission technologies) and Singular Innovations (changing elements of the production/consumption chain) culminating with Systems Level innovations, which focus on societal needs or functions and the systems that determine how these are fulfilled (e.g. spatial planning and transport infrastructure).

Based on this analysis, we propose three initial contexts of SOI activity, initially labelled 'Reactive', 'Embedding' and 'Systems Change'. Integrating these with the dimensions of SOI generates our initial architecture of the field. It is initial in the sense that it provides an a priori framework onto which we map innovation activity data from studies identified for this review.

Initially, the model was conceived as presented in Figure 2 but, as we accumulated SOI activities, and consistent with the framework synthetic method (Barnett-Page and Thomas 2009; Dixon-Woods 2011), it was iteratively developed, applying the data to the framework and the framework to the data in a process of model refinement, enrichment and validation to produce our final model (see Figure 3).

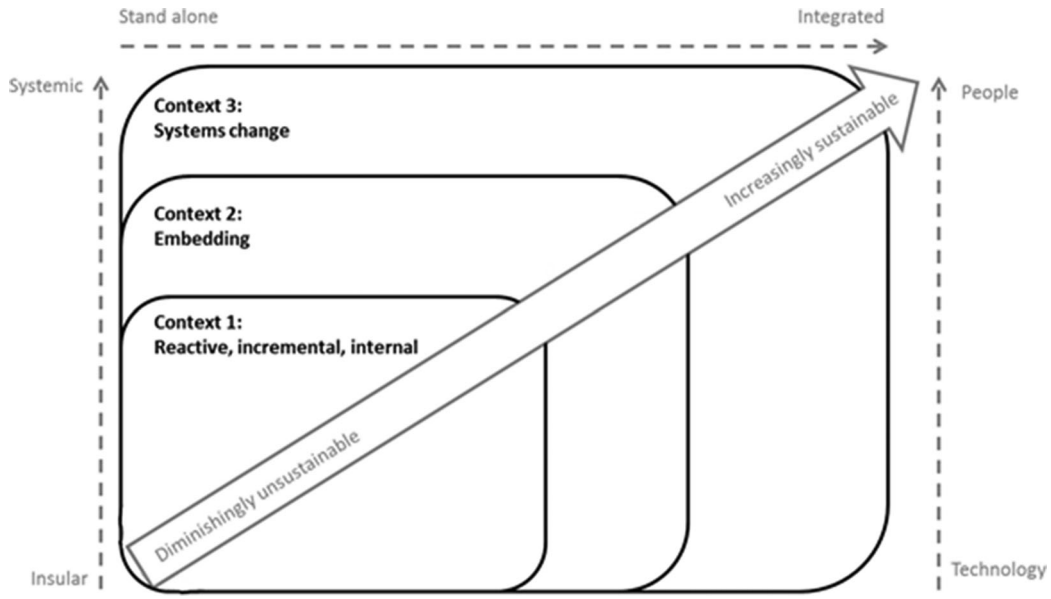

Figure 2. Initial model of SOI

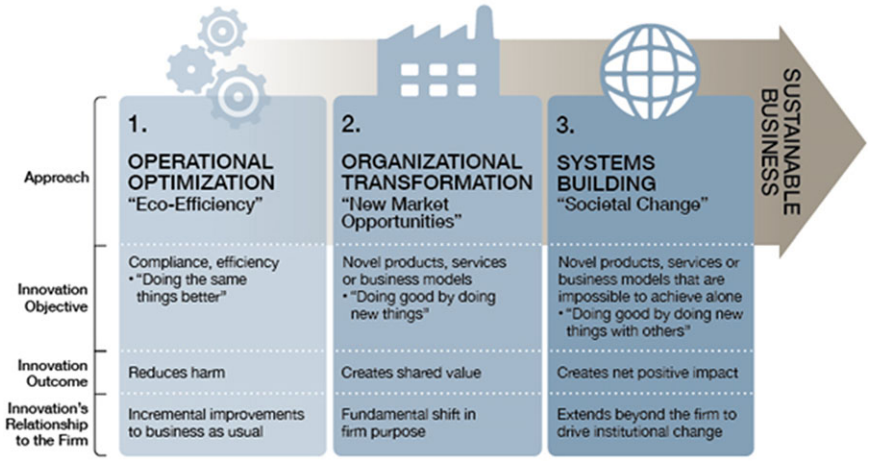

Figure 3. Final model of SOI

Stage 2: Systematic review of SOI

Denyer and Tranfield (2009) describe five steps in producing a systematic review: Question formulation; Locating studies; Study selection/evaluation; Analysis/synthesis; and Reporting/using results. Focusing on the first four, our review approach was as follows.

Question formulation

Research scope, question and inclusion/exclusion criteria and protocol were established in dialogue between the research team and a guidance committee consisting of academic and industry experts. Following discussion, the research question was settled as 'What are the innovation activities firms engage in to become sustainable?'

Locating studies

Our search strategy (Figure 4) consisted of looking for relevant studies in the scientific and grey literature. An initial literature scoping helped to identify keywords and search strings relating to innovation and sustainability which, with guidance committee support, was developed and refined over a number of

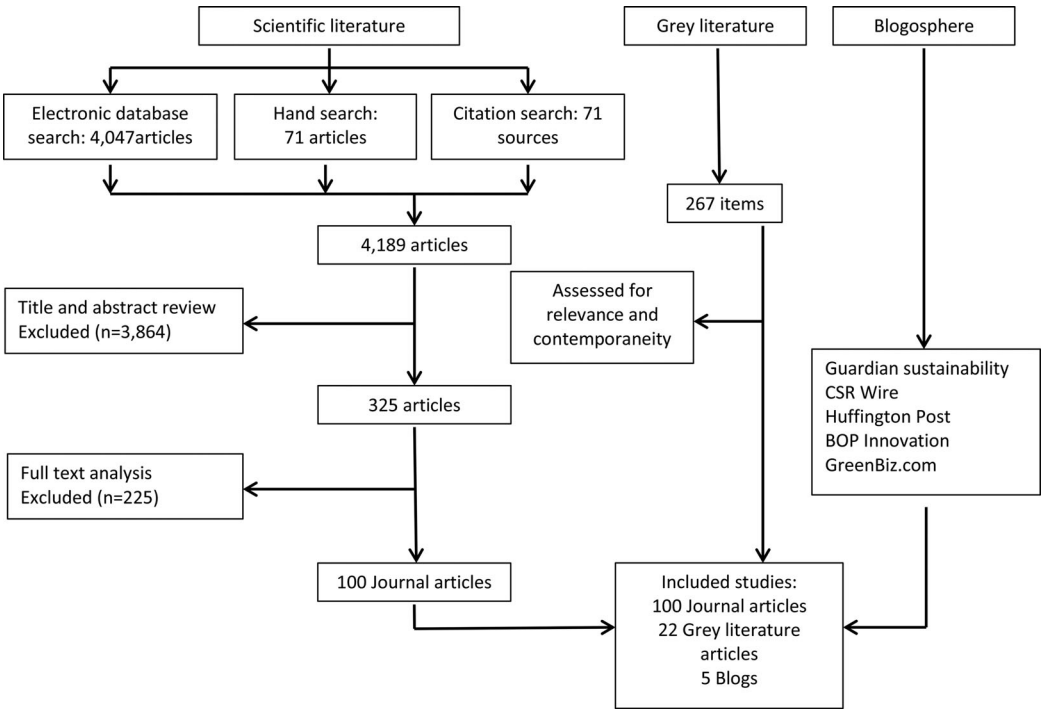

Figure 4. Search strategy

iterations. A range of electronic databases including EBSCO Business Source Complete, IBSS, ISI Web of Knowledge and JSTOR were searched.

A supplementary, multi-layered strategy was adopted to search the grey literature, including hand-searching, seeking expert recommendations, snowballing, cross-referencing, technical and specialist online databases selected on the basis of reputation, currency and authority as well as search functionality (e.g. United Nations; WWF; European Commission; World Business Council for Sustainable Development (WBCSD); Global Reporting Initiative) as well as five blogs, again using authority and reputation as the yardstick for inclusion.

Study selection/evaluation

Evaluation is not simply a mechanism for excluding evidence on the basis of its quality, but is about appraising and reporting what is included to allow conclusions to be drawn about the reliability of findings (Denyer and Tranfield 2009).

We bound our study in the period 1992–2012, book-ended by the Rio Earth Summits. During this period, the foundations of sustainable business practice began to be laid, reflected in the establishment and/or growth of many influential platforms and initiatives, including: the WBCSD (founded 1991); The Global Reporting Initiative (founded 1997); business and consumer certification systems, e.g. the Forest Stewardship Council (founded 1993); the United Nations Global Compact (founded 2000); international environmental and social standards for business, e.g. the ISO 14000 (1990s) and 26000 series (2010); and various sustainable business think-tanks, strategy and consultancy groups, e.g. Volans (founded 2008), and blog sites, e.g. the Guardian Sustainable Business Blog (founded 2010).

For the two types of source material (academic and grey), a dual and pragmatic approach to selection and evaluation was adopted. No studies were excluded on the basis of quality; rather, relevance – that the innovation described directly addresses at least one of the three components of the Triple Bottom Line (Elkington 1997), people, planet profit, but not profit alone – was the important inclusion criterion. This approach is consistent with the notion of fit-for-purpose evidence (Boaz and Ashby 2003; Briner *et al.* 2009; Gough 2007) in which quality appraisal can be subordinate to the objective of a review: the important consideration is the contribution of the evidence to synthesis and understanding (Pawson 2006; Pawson *et al.* 2004; van Aken and Romme 2009).

To establish generalizability and reliability of findings (Denyer and Tranfield 2009; Gough 2007), and using journal ranking as proxy indicator of quality and Reay *et al.*'s (2009) hierarchy to assess strength of evidence, studies were evaluated after selection.

For various reasons, some researchers have been reluctant to include grey literature in systematic reviews: the process can be resource intensive (Benzies *et al.* 2006) and concerns over quality can distract from scholarly ambitions (Goduscheit and Jørgensen 2013; Müller-Seitz 2012). However, including the grey literature can bring benefits (Hopewell *et al.* 2007), including addressing the problems of time lag to provide more contemporary, relevant and contextually important findings as well as providing evidence for 'the wisdom of practice', which may not be reflected in the scientific literature (Benzies *et al.* 2006; Winn and Roome 1993). Thus, our rationale for including the grey literature is twofold: it is grounded, first, in having the utility for practice of our findings in mind; and second, from the observation that, of the scholarly studies included, the average lag from study to publication was four years, thus raising the real possibility that many contemporary practices (as our guidance committee pointed out) were not included in the scholarly literature.

The selection process largely followed that outlined in Barroso *et al.* (2003), including scanning all citations identified from the various databases and web searches and within-team review to validate selections.

Analysis/synthesis

We adopted a framework synthetic approach. Framework synthesis is similar to framework analysis (Pope *et al.* 2007), a matrix-based technique for data analysis in primary qualitative research involving the a priori construction of thematic categories into which data can be coded (Ritchie and Spencer 2002). Framework synthesis is an adaptation of this and has been used to conduct syntheses with similar a priori specification of a coding framework (Barnett-Page and Thomas 2009; Carroll *et al.* 2011). The approach is particularly suited to addressing questions related to the attributes of activities (Gough *et al.* 2012; Oliver *et al.* 2008).

Our initial framework is drawn from an extensive reading of the environmental management and innovating for social and environmental benefit literatures, lending it legitimacy (Dixon-Woods 2011). The studies informing the development of the initial framework were excluded from the subsequent systematic review, thus limiting potential for method variance (Chang *et al.* 2010).

Data were extracted to a specially designed spreadsheet pro-forma. The studies included were coded according to bibliographic characteristics, study design, quality, strength of evidence and innovation activities. Grey literature coding focused on innovation activities.

Using the Dimensions and Contexts of SOI as a guide, SOI activities were mapped onto the framework and simultaneously categorized according to established categories in the innovation management literature (e.g. Adams *et al.* 2006; Tidd and Bessant 2009), namely:

- strategy: organizational and management processes aligned to deliver sustainability
- innovation process: the organization of the innovation process to deliver sustainability, from searching for new ideas to converting them into products and services and capturing value from them
- learning: recognizing the value of new knowledge, assimilating and applying it to support sustainability
- linkages: internal and external linkages crafted as opportunities for learning and influencing around sustainability
- innovative organization: work organization arrangements that create the conditions within which SOI can take place (e.g. enabling structures, communications, training and development, leadership and, reward and recognition).

Disagreements were resolved by discussion.

Descriptive summary

We, like others (e.g. Baumann *et al.* 2002; Klewitz and Hansen 2013; Schiederig *et al.* 2012), find the scholarly literature to be widely distributed, of variable quality, immature and skewed.

Widely distributed. Of the academic literature, 100 articles selected from 55 separate journals are included.[2] Thirty-six journals provide one article each, and 18 journals provide two or more. Two journals, *Business Strategy and the Environment* and *Journal of Cleaner Production*, accounted for over one-quarter of the included scholarly studies.

[2]Full list available from corresponding author.

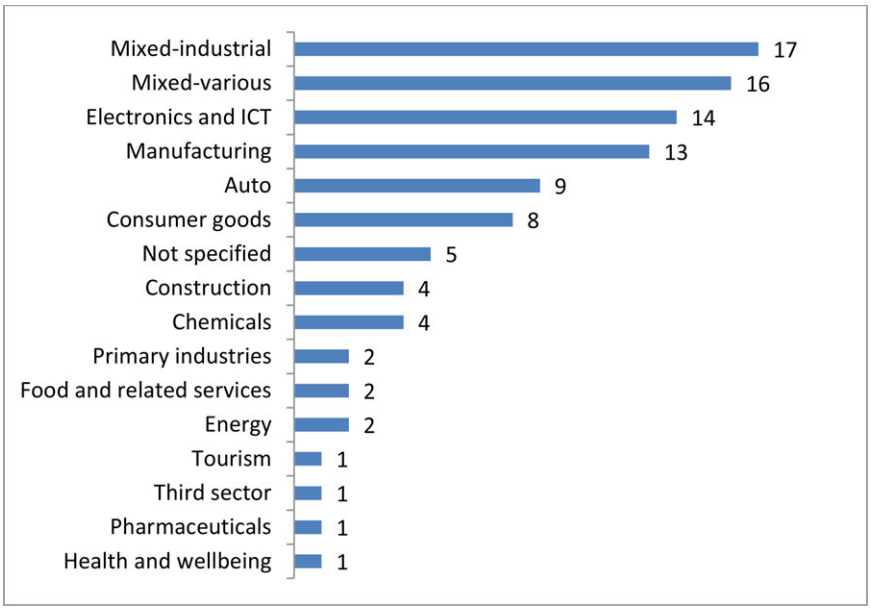

Figure 5. Selected studies by industry

Variable quality. Academic studies were evaluated using the Association of Business Schools (ABS) journal rankings[3] for 2010 as a proxy for quality and assessed against Reay *et al.*'s (2009) evidence hierarchy, and found to be of variable quality. Only seven studies came from journals rated 4 in the ABS rankings, 16 from journals rated 3, 27 from journals rated 2, and 8 from journals rated 1. The remaining 42 articles are derived from journals not included in the ABS rankings. Reay *et al.*'s (2009) evidence hierarchy consists of six levels, where 1 is the strongest level of evidence and 6 the weakest. Our sample of studies consists exclusively of evidence of levels 3 (Comparative, multisite case studies or large-sample quantitative studies: 32 studies), 4 (Small-sample, single-site qualitative or quantitative studies: 45 studies) and 5 (Descriptive studies and/or self-report stories: 23 studies).

Immature. Sixty-eight (of 100) studies are small sample or single case, largely focused on empirical discovery and description. Top quality journals provided only seven studies. These observations suggest an immature field lacking a coherent and cumulative body of literature and theoretical development (Burgess *et al.* 2006; Mäkinen and Seppänen 2007).

Skewed. Within our sample, the service and consumer goods sectors are under-represented and manufacturing and process industries over-represented (Figure 5). This reflects a focus on environmental considerations in the manufacturing context and on technical processes, with work done largely by scholars in science and engineering.

In terms of the grey literature, we uncovered a rich stream of evidence, including conference papers, reports, teaching- and consultancy-based case studies, histories, individual stories of SOI and prescriptions relating to innovative activity that seemingly were not represented in the scientific literature — at least not in a timely fashion. We identified a short list of 267 grey items, subsequently reduced to 27 (five books/chapters, one case study, three conference papers, 11 reports/practitioner press, one thesis and five sustainability blog posts).

Stage 3: Framework synthesis – final model of SOI

(1) Innovation activities of Operational Optimization

Operational Optimization reflects an internally oriented perspective on sustainability, referring to a 'doing the same things but better' approach directed

[3]Rated from 1 (described as 'modest standard journals within their field') to 4* (described as 'world elite journals'). Source: http://www.associationofbusinessschools.org/sites/default/files/abs_lightningwintro.pdf accessed January 2014.

toward reducing harm through reactive, incremental improvements driven by compliance or proactively pursuing efficiencies. These are activities characteristically technical, stand-alone and insular.

Strategy. The argument that adopting sustainable social and environmental policies is competitively disadvantageous to firms has been challenged by Porter and Van der Linde (1995) among others (e.g. Peloza 2009; Peloza and Shang 2011). Strategically, the focus of innovation activity in Operational Optimization lies within the firm's boundaries: the targets for change are internal. Principal drivers include responding to regulatory requirements (compliance) and the pursuit of efficiency gains through new practice adoption. Sustainability-oriented innovation becomes more proactive when reactive innovation becomes uneconomic, e.g. when add-on solutions incur costs greater than the cost of process redesign (Alston and Roberts 1999). The sustainability outcome is a reduction in harm per unit of production, which is achieved through using existing innovation processes and without compromise to existing business models.

Process. The innovation process focuses on incremental improvements, oriented to a single issue and related to 'technical-fixes' as the way to reduce impacts while maintaining business as usual. Examples include: reducing the intensity of resource use, better waste management or pollution capture/control, recycling (Alston and Roberts 1999; Bossink 2002; Chen *et al.* 2012; Dangelico and Pujari 2010); (re)designing product content and packaging (Alston and Roberts 1999; Clark *et al.* 2009; Shrivastava and Hart 1995); product miniaturization (Chen and Subramian 2010); and using decision tools and aids to integrate environmental thinking into NPD, such as through dematerialization or eco-design (De Marchi 2012; Maxwell and van de Vorst 2003; Simon *et al.* 2000). The application of tools, of which there are many and which range in purpose, complexity and ease of use, enables users to evaluate sustainable materials and sustainable design alternatives and relate them to financial incentives, environmental regulations or the demands of clients (Bossink 2002).

Learning. Sustainability-oriented innovation is rendered uniquely complex by the requirement to integrate diverse knowledge relating to economic, social and environmental considerations: this makes SOI an information and learning challenge, making new knowledge and knowledge management essential. Firms with effective knowledge management processes can exploit these to support SOI (Ayuso *et al.* 2011), and focus on: exploiting existing knowledge management capabilities to identify and access relevant knowledge; unlearning existing knowledge that contradicts sustainability principles (Bossink 2007; Magnusson *et al.* 2003); filling competence gaps through training, targeted recruitment or importing expertise (Geffen and Rothenberg 2000; Petruzzelli *et al.* 2011); and integrating diverse elements of sustainability by issuing guidelines and monitoring compliance (Zwetsloot 2001).

Linkages. The necessary linkages in the context of Operational Optimization are those that connect line workers and managers with the necessary knowledge to effect the changes appropriate to comply with legislation and regulation. Typically, such knowledge does not exist within the firm, especially in regard to sustainability tools, and external knowledge experts may be required to help navigate and implement these (Conway and Steward 1998; Lee 2009).

Innovative organization. Operational Optimization is achievable through mobilizing existing innovation capabilities. Any already developed innovation capability can be an important antecedent of SOI capability (Ayuso *et al.* 2011). Innovation activities directed in this way can be a stepping-stone toward increasing firm-level sustainability, e.g. by contributing to the beginnings of an empowering SOI culture throughout the firm (Peloza 2009). This can be enhanced if internal communications are reframed to focus on sustainability, such as by incorporating the sustainability message (Reed 2002), establishing clear goals at the product level (Petala *et al.* 2010) and securing the involvement (Florida *et al.* 2001) and motivation of line workers (Sandström and Tingström 2008).

Shrivastava and Hart (1995) note that many companies have embraced the practices of environmental management in the sense of Operational Optimization, but fewer have seriously engaged the wider implications of sustainability thinking. Moving beyond Operational Optimization requires a more radical approach that renders innovation more complex and ambiguous.

(2) Innovation activities of Organizational Transformation

Innovation activity for Organizational Transformation represents a fundamental shift in mindset and

purpose from 'doing less harm' to creating shared value and delivering wider benefits for society: 'doing good by doing new things'. The context is characterized by a redefinition of internal and external relationships that increasingly are conceived in terms of environmental and social impacts. Returning to the three dimensions of the SOI framework, activities are characteristically more people oriented, more deeply integrate sustainability within the organization and are less insular. It remains largely internally oriented, suffusing and diffusing sustainability throughout the organization, but extends to immediate stakeholders too.

Strategy. In this context innovation and sustainability are deliberately orchestrated within the firm, implying a growing SOI culture in which sustainability is no longer regarded as an add-on, but rather is/becomes embedded as a cultural and strategic norm. The strategic shift towards 'doing good' offers opportunities for innovation in business concepts and practices, constituting a shaping logic that goes beyond an internal, operational focus on 'greening' to a more external and strategic focus on sustainable development (Hart 1997).

A clearly articulated sustainability strategy can act as a trigger for innovation (Ayuso *et al.* 2011; Huang and Wu 2010). For example, Bendigo Bank's strategy is to improve the prospects of its customers and communities first, on the basis that doing the right thing by customers and communities results in strong community support for the bank, and therefore sustainable growth in shareholder value (Stubbs and Cocklin 2008).

Our review also reveals that the social dimension of sustainability emerges more strongly in the Organizational Transformation context. This is realized predominantly by organizations serving new markets with novel, sustainable products and also making products and services available to communities disadvantaged or isolated for reasons of geography, infrastructure or income (Carrillo-Hermosilla *et al.* 2010; Prahalad 2012; Ray and Ray 2011; Viswanathan and Sridharan 2012). This observation is drawn from studies focused on sustainable innovation in developing economies, often related to bottom-of-the-pyramid innovation (e.g. Hart and Christensen 2002; Prahalad 2010).

Process. Where Operational Optimizers may successfully leverage existing innovation processes, this may not be a useful approach for Organizational Transformers, where more radical innovation may be required (Sandström and Tingström 2008). Here, the innovation process is often driven by the personal values and aspirations of concerned business leaders themselves (Dyllick and Hockerts 2002); this can have a profound impact on organizational values and culture, as documented by Anderson and White (2009) in the case of Interface.

The innovation process can be enhanced for SOI through the adoption of new platforms and new knowledge sources. To stimulate more radical innovations, firms are drawing inspiration from a range of new sources, including: biomimicry (Benyus 1997), a design science approach meaning 'to imitate life'. For example InterfaceFLOR looked to nature for design inspiration for their 'Entropy' range, which resulted in significantly reduced waste going to landfill, and increased company revenues (Anderson and White 2009). Backcasting (Nattrass and Altomare 1999) involves envisaging a desired end state and working backwards from that to discover and design the necessary intermediate steps to reach that point. Other techniques include systematically looking to identify, explore and integrate the views of stakeholders from the 'fringes' (Hart and Sharma 2004), specifically including community action groups, social entrepreneurs and activists (Mulgan *et al.* 2007). Firms need to be alert to, pick up and use such weak signals (Aschehoug *et al.* 2012; Holmes and Smart 2009; Joshi 2010) by investing in absorptive capacity (Cohen and Levinthal 1990), reaching out and bridging to new communities of stakeholders (Hollander 2003).

Innovation practice in bottom-of-the-pyramid markets has seen the emergence of new innovation platforms such as reverse innovation, jugaad innovation and resource constrained innovation. Reverse innovation describes a trickle-up effect, where innovations are first used in developing countries and then applied in developed countries (Govindarajan 2012; Immelt *et al.* 2009). Frugal or resource-constrained innovation occurs where resource inputs are minimized with the purpose of reducing the end product's cost without loss of quality (Zeschky *et al.* 2011). Similar to this is jugaad innovation, from a Hindi word that translates roughly as 'an innovation fix', referring to harnessing ingenuity to locate opportunities and improvise simple solutions (Radjou *et al.* 2012).

Learning. Organizational Transformers recognize the importance of leadership and of the external knowledge that resides in value chains: interactions with both suppliers and customers can

contribute to successful SOI (Conway and Steward 1998). Sustainability-oriented innovation driven by regulation may not result in added value, but engaging with key stakeholders of the firm can positively affect a firm's SOI (Ayuso *et al.* 2011). In the case of the automotive industry, for instance, Geffen and Rothenberg (2000) demonstrated the importance of developing partnering arrangements to allow suppliers and assembly plant to work together effectively to exploit and implement complementary skills and competencies to improve the environmental performance of assembly plants. Bringing customers' input to the process, such as through sales force proximity, market research, extensive charting and in-depth analysis of customer needs (Milliman *et al.* 2012), provides another mechanism for identifying where the value added from environmental innovation can be found (Foster and Green 2002).

Linkages. The emphasis in the literature is on how firms develop and exploit external linkages in pursuit of sustainability objectives. These linkages include developing new networks into their wider value chains and stakeholder networks and, in particular, into supply chains, to develop long-term collaborative approaches with external partners. Whereas technological innovations reduce or eliminate impacts at a product level, in the long-term a collaborative approach is necessary to make the whole supply chain sustainable (Stubbs and Cocklin 2008).

Compared with other innovations developed by the same firm, SOI activity is characterized by higher levels of both inter- and intra-organizational collaboration (Petruzzelli *et al.* 2011). New relationships up and down value chains promoting collaborations for adapting processes to respond to sustainability are evident (Baya and Gruman 2011). In contrast to Operational Optimization, the focus shifts from local activity to activity among the firm's immediate stakeholders, including: exploring new opportunities at inter-sectoral interfaces (Lettice and Parekh 2010; Mirata and Emtairah 2005) and developing sustainable supply chains (Stubbs and Cocklin 2008).

Considerable attention has been paid to Sustainable Supply Chain Management (SSCM), and we found evidence of organizations extending sustainability principles into their supply chains (e.g. Birkin *et al.* 2009; Carrillo-Hermosilla *et al.* 2010; Huber 2008; Zhu *et al.* 2010). To achieve effective SSCM, long-term collaborations with external partners appear critical. Specific activities can include sourcing sustainable materials from alternative suppliers or working with existing suppliers to provide sustainable materials; developing sustainability standards for the supply chain and then operationalizing them through a supplier code of conduct; providing environmental design specification to suppliers; performing environmental audits for suppliers' internal management; requiring suppliers' ISO 14000/ ISO 26000 certification; and cooperating with customers on environmental objectives (Pujari *et al.* 2003; Zhu *et al.* 2011). Firms wanting to achieve the greatest sustainability impact may choose to target upstream supply chain initiatives, where the greatest damage occurs in the extractive and primary processing industries (Huber 2008). At InterfaceFLOR,[4] for example, more than two-thirds of the overall environmental impact of a carpet tile is related to raw materials. Virgin nylon yarn alone makes up about half a carpet's greenhouse gas emissions: reducing the amount used is fundamental to InterfaceFLOR's strategy of creating a more sustainable product (Arratia 2010).

Innovative organization. Innovative activity around internal and external communications helps to embed sustainability. The literature particularly emphasizes the importance of top management support and line manager commitment for sustainability: explicit, clearly defined sustainability policies intertwined with overall firm strategy; communication of values and goals of sustainability that reach beyond operational and eco-efficiencies (Huang and Wu 2010; Lee 2009; Pujari *et al.* 2003; Reed 2002). The call for action, communications between departments, clarity of long-term goals and strategies and the importance of the sustainability agenda in the context of the business purpose distinguish this context from the reactive mode of Operational Optimization (Reed 2002; Moors *et al.* 2005; Polonsky and Ottman 1998).

The prevailing neoliberal economic paradigm privileges profit maximization as the critical value dimension in firms' business models. Among Organizational Transformers, an emergent paradigm is evident: a business that ascribes value to social and environmental as well as economic considerations (Bertens and Statema 2011; Dyllick and Hockerts 2002; Esslinger 2011; Stubbs and Cocklin 2008). The precise nature of the sustainable business model remains unclear and, for Birkin *et al.* (2009) at least,

[4]InterfaceFLOR, designer and maker of carpet tiles, see http://www.interface.com/ (accessed 25 November 2014).

no business claims to be fully realizing one. Nevertheless, a number of emergent types, such as social entrepreneurship (OECD 2010b), and characteristics, such as treating nature as a stakeholder (Laine 2010; Stubbs and Cocklin 2008), have been identified.

Less radical business model innovation can mean changing the nature of the deliverable. This can be done in several ways: for example, by designing 'green' from the outset of the product development process (Sandström and Tingström 2008) to focusing less on creating products and more on delivering services: this is a process of servitization, where a tangible product is replaced with a service, and reflects one response to re-thinking how to meet needs while sustaining growth without costly social and environmental impacts (Hansen *et al.* 2009; Tukker 2004).

For sustainability to be strategically embedded, reward systems and incentives need to reflect its centrality: linking individual and group reward systems to sustainability goals reflects corporate commitment and can help in shifting sustainability from a programmatic phenomenon to a corporate mindset (Baya and Gruman 2011; Blake 2006; Lent and Wells 1992). Sustainability cultures can be built from the top-down — e.g. by embedding sustainability goals and objectives in strategic and operational plans — and from the bottom up — e.g. by being alert and responsive to and rewarding employees' SOI ideas and initiatives (Florida *et al.* 2001; Haanes *et al.* 2011).

Embedding sustainability metrics with financial reporting integrates sustainability as a core concern through the organization and can lead to better sustainability performance (Sardinha *et al.* 2011; Shrivastava and Hart 1995). A globally accepted standard for peer-to-peer and industry benchmarking remains elusive, and so organizations adopt new reporting mechanisms either of their own design (Kaval 2011), or by signing up to one or more of the initiatives striving to make sustainability reporting standard practice.[5] Alongside new performance metrics (Lent and Wells 1992), new structures and new lines of communication are instituted, supported by CEO backing and cross-functional management committees (Haanes *et al.* 2012).

The German sportswear company Puma is a leader in transparency and disclosure of its external costs to society. It measures, evaluates and publishes data on its carbon emissions, freshwater usage, pollution and waste. The unique aspect of this exercise is that Puma has measured and monetized these impacts, calculating them along its entire supply chain. It effectively created the world's first environmental profit-and-loss statement. Although Puma disclosed an estimated €145m (US$182m) in such externalities for 2010, the revelation was far from the public relations disaster that some had predicted. The firm now uses what it learned to engage its raw materials and manufacturing supply chain (which is where almost 95% of these externalities arise) to improve its environmental performance (Sukhdev 2012).

(3) The innovation activities of Systems Building

Systems Building requires another radical shift in philosophy to thinking beyond the firm and reframing the purpose of business in society: 'doing good by doing new things with others'. A key feature is that sustainability cannot logically be thought of as an attribute of a single firm, but can only properly be applied at the global level (Lamming *et al.* 1999); this puts linkages at the heart of SOI activity, as is reflected in the limited evidence that we found.

The context is characterized by a shift toward networks of relations in which sustainability value is created collaboratively rather than individually (del Río *et al.* 2010) and firms shift from existing in isolation and in competition to integrated collaborations, with the potential to bring systems-shaping innovations (Gulbrandsen 2005; Taylor 2005): 'interconnected set[s] of innovations, where each influences the other, with innovation both in the parts of the system and in the ways in which they interconnect' involving many actors and institutions (Mulgan and Leadbeater 2013, p. 4). In terms of sustainability, it can be seen as the 'set of actions that shift a system – a city, a sector, an economy – onto a more sustainable path' (Draper 2013, p. 11).

Because the concept of Systems Building reflects an unconventional economic paradigm, relatively few organizations or industries appear currently to occupy this space: at least, this is the impression given from the limited number of empirical scholarly papers we were able to identify (Loorbach *et al.* 2010; Seebode *et al.* 2012). Consistent with our objective of informing practice, we found it helpful to turn to the grey literature to provide instances of activities.

[5] Multiple schemes have sought to establish common frameworks for reporting sustainability progress. These include the Global Reporting Initiative (www.globalreporting.org), the International Integrated Reporting Committee (http://www.theiirc.org/), the Carbon Disclosure Project (https://www.cdproject.net) and the Dow Jones Sustainability Index (www.sustainability-index.com).

Strategy. Being a Systems Builder means leaving behind the prevailing economic paradigm to reframe the purpose of the firm in society: a part of society, not apart from it. This moves beyond efficiency to effectiveness (McDonough and Braungart 2002a). The perspective underpins a logic of wide collaborations and investing in systems solutions to derive new, shared value propositions from the entire socio-technical and ecosystem network to make a positive impact.

Because the ultimate objectives of sustainability lie beyond the individual capacity of firms to achieve, the role of Systems Builders becomes one of initiating, mobilizing, inspiring and leading change: business is uniquely placed, more than government or civil society, to lead on this (Hart 2010). There is evidence of intimate, interdependent collaborations between perhaps previously unconnected actors, such as NGOs, industry associations and economic development organizations, emerging as a response (UN Global Compact and Accenture 2013; Wagner 2009). Such radical shift in philosophy and behaviour can present a considerable challenge for incumbent firms. The macro-level dynamics of the context constitute a socio-technical landscape, an exogenous environment beyond the direct control of organizations (Geels 2005), but within their sphere of influence. Changes at the landscape level usually take place slowly, in the order of decades.

Process. We found few scholarly studies reporting the innovation process among systems builders, and this remains a gap in the literature. The sorts of wide collaborations described above, though rare, involve developing workable relationships between a wide range of private, public and civil society partners (McDonough and Braungart 2002a, UNDP 2010). Where the sustainability challenges are of such scale that there is no single 'owner' of the problem, and there is a need to implement transformations aligned with the requirements of a more environmentally sustainable development, diverse collaborations usefully collectively define the problem and search for solutions (Mirata and Emtairah 2005).

Firms are working in new platforms with collaborators. Examples include: Nike's LAUNCH open innovation platform, involving working with industry representatives, material scientists, governments, investors and consumer groups on sustainable materials; Unilever's Sustainable Living Plan, involving working with governments and NGOs on broader system transformation to tackle food, energy and health issues; and Sony's initiative with Forum for the Future, bringing together technical experts, futurologists, designers, sustainability experts, writers and the public to explore how technologies might redefine lifestyles in 2025 (Bent 2012; Draper 2013). Collaborations such as these broaden a firm's search activities and knowledge base, particularly in relation to picking up weak signals, to deliver innovations and also enhance social legitimacy (Holmes and Smart 2009).

Learning. Novel collaborations are important for systems builders for the dialogues they inspire, the legitimacy they endow, the opportunities for new knowledge acquisition and the creative and responsive solutions they stimulate. Shared value, in which the causes of eco- and social-systems are advanced as equivalents to economic returns are being addressed through these novel collaborations (Porter and Kramer 2011). But these opportunities may fail to be realized if firms lack the internal knowledge management processes to convert these into innovation (Ayuso *et al.* 2011).

Exploring the limitations of existing models of innovation in the context of working across and beyond traditional boundaries to realize new value configurations, Seebode *et al.* (2012) reflect on the case of Philips, the Dutch multinational. They find that more radical SOI projects follow novel pathways, involve external partners and new configurations of knowledge, and that learning to work with new partners raises issues around 'finding, forming and performing' within new innovation systems.

In Loorbach *et al.*'s (2010) study of inter-firm relations among Dutch industrial collaborators, the concept of ambidexterity (Turner *et al.* 2012) is a helpful guide to understanding how firms successfully experimented with and learned from multiple new approaches to sustainability in a 'shadow track'. While simultaneously maintaining existing business models, the collaborators: redefined products and services; restructured practices and organization to break away from technological and paradigmatic lock-in; and developed a management approach integrating foresight and broader stakeholder collaboration. In these activities, they saw themselves as coevolving actors within a wider societal system pursuing radical innovation leading to increased sustainability.

Linkages. Systems Building locates firms in an industrial ecology characterized by mutually affecting interactions between multiple stakeholders embedded in networks, community, collaborations and

partnerships (del Río *et al.* 2010). Industrial ecology calls for a radical shift from firms existing in isolation and in competition to integrated collaborations, new frameworks for working together with the potential to bring game-changing systemic innovation to sustainability challenges (Berry and Rondinelli 1998).

For example, some of the most significant sustainable supply systems for natural resources, such as the Forest Stewardship Council and the Marine Stewardship Council, developed as a result of partnerships of industry groups, social and environmental NGOs and the public (Gulbrandsen 2005; Taylor 2005). We also note the coming together of previously implacable protagonists such as Greenpeace and Foron, to develop and market an ozone- and climate-safe refrigerant (Stafford and Hartman 2001), or between WWF and Lafarge that led, among other things, to the latter's decision not to pursue plans to build the UK's biggest super quarry on an unspoiled Scottish island (Seitanidi 2007). In a Swedish multi-sectoral initiative, the Landskrona industrial symbiosis programme brought together more than 20 firms and three public organizations to find novel solutions to sustainability challenges (Mirata and Emtairah 2005).

In this way, Systems Builders are increasingly engaging in constructive dialogues with multiple stakeholders rather than simply acting on their own. They require the ability to build, manage or participate in complex coalitions over time (WBCSD 2010). They not only focus internally, but also look to lead and inspire change in the wider societal, economic, technical and environmental management systems through strong and visionary leadership and the mobilization of dynamic capabilities. Much of this, though, remains aspirational or at least empirically untested.

Innovative organization. At a conceptual level, the role of business in society has been reframed in a number of ways, and the scholarly and grey literature introduce novel rhetoric around this. Chang (2010), for example, suggests moving away from metaphors of war and competition, which can (inappropriately) inform leaders' decision-making, and instead use metaphors that describe businesses as part of a cooperative community based on relationships. In line with this, new business paradigms are emerging. The 'Benefit Corporation' or 'B Corp', emerging in the US in 2010, is one striking example of the role of business reframed. The B Corp has created a new legal form, allowing firms to go beyond benefiting shareholders to benefiting wider society and the environment. B Corps legislation 'helps return business to its proper role in society to create shared and durable prosperity' and certified B Corps are required to make decisions that have a positive material impact on society and the environment: 'not just to be the best in the world, but to be the best for the world' (B Corps 2013). A growing community of ≥1100 Certified B Corps from 37 countries and 121 industries now exists (B Corps 2013). Similar developments include ideas expressed by Conscious Capitalism and Corporation 2020, models of enterprise that explicitly take social and ecological considerations into account in their business strategies and purpose (Waddock and McIntosh 2011).

Other examples include, 'closed-loop production' (Abdallah *et al.* 2011) and 'circular economy' (The Ellen MacArthur Foundation 2013): restorative industrial models that move away from 'take, make and waste' to active recovery (e.g. waste, heat, water, energy or other resources) reuse and return of end-of-life products, at which point they can be disassembled and recycled into new products. Also emerging is the 'net positive contributor' model (McDonough and Braungart 2002b), which promotes adding greater value to society and the environment than is extracted.

Summary

A framework was devised for examining the activities of innovating for sustainability. The organizing logic for the framework was the context for innovation in which activities progressively shift from being internally oriented, incremental and efficiency-focused to being more radical and systemic. The framework provides structure for bringing together and understanding findings on innovation activities from a diverse literature. These are complex concepts becoming reified in corporate practice as new business models and new forms of value creation. They reflect new and extensive partnerships reaching deep and wide across social, institutional, regulatory and stakeholder strata, and wider cultural change beyond the capacity of enterprises to control but the development of which they can motivate, inspire and mobilise: these findings are summarized in Table 2.

Discussion

This review, organized around the idea of sustainability as a journey, presents a representation of contexts of that journey and its characteristic activities. The

Table 2. Activities of SOI

	Operational Optimization: doing more with less	Organizational Transformation: doing good by doing new things	Systems Building: doing good by doing new things with others
Strategy	• Comply with regulations or pursue efficiency gains	• Embed sustainability as a cultural and strategic norm in a shaping logic that goes beyond greening	• Logic of wide collaborations and investing in systems solutions to derive new, co-created value propositions
Process	• Focus on internal and incremental innovation facilitated by use of tools	• Adopt new values and platforms (e.g. reverse innovation) and new ideation practices (e.g. biomimicry)	• Adopt new collaborative process platforms with diverse stakeholders
Learning	• Exploit existing knowledge management capabilities to identify and access relevant knowledge	• Engage with key stakeholders of the firm – internal and external	• Develop ambidextrous skills enabling 'shadow tracking' and learning from experimentation with multiple new approaches
Linkages	• Recruit external domain experts for new knowledge	• Shift focus from intra-firm linkages to collaborations with immediate stakeholders	• Get the whole system in the room to diagnose problems, understand system complexity, build trust and identify levers for change
Innovative organization	• Exploit existing innovation capabilities	• Embed SOI culture through the organization	• Adopt new business paradigms (e.g. B-Corps)

focus is on practices that constitute day-to-day SOI activities. The literature does not allow us to conclude whether or not the journey is linear, or that firms cannot simultaneously pursue SOI activities that characterize more than one context. In that sense, we do not claim to offer a stages model, which requires categorical exclusivity, nor is it a typology, as typologies cannot account for change over time (Kolk and Mauser 2002).

Instead, we submit the model as a Scientific Model (Baden-Fuller and Morgan 2010, p. 168), a 'generic in-between kind[s]-of-description[s] that [is] neither general theory nor full empirical description': it submits a quasi-laboratory in which scholars can generate concepts and theories and investigate empirical domains and for managers to understand how their world works in a practical sense.

We have found the academic literature to exhibit characteristics indicative of a field at an early stage of theoretical development (Burgess *et al.* 2006; Mäkinen and Seppänen 2007): it is widely distributed, largely focused on empirical discovery and description and utilises a range of conceptual labels and definitions, many of which overlap, but around which there is limited consensus. In Whetten's (1989) terms, this is the 'What' phase of theory-building. Here, the variables, constructs and concepts logically to be considered part of the explanation of the phenomenon of interest emerge. The current study offers a theoretical contribution by moving knowledge beyond this state through the organization of disparate activities into a meaningful, dynamic framework more focused on 'How'.

At the outset, we proposed addressing four deficiencies in the existing research: its meaning, conceptualization, dichotomous treatment and failure to reflect more contemporary practices. Our focus has been on the literature published between 1992 and 2012, for reasons already explicated. However, it is valuable to reflect on how the literature has developed in the months following that cut-off and the extent to which it fits with or challenges our findings.

Consequently, we searched (March 2015) for the most recent literature on SOI, using EBSCOHost ('sustainab* AND innovation', Abstracts 2013–2015, Academic Journals). This returned, in total, 456 references. Using criteria established in the research protocol (i.e. language, focus on the substantive question, unit of analysis, empirical study), and following a review of abstracts, 19 were retained for further investigation. In light of these subsequent studies, the proposed SOI framework appears robust, but we make the following observations.

The articles published since the cut-off reinforce our original analysis that a diverse and skewed literature forms the basis of this review, from which three distinct contexts of SOI activity and practice are identified. However, a more coherent research and practice agenda that intertwines firm, societal and environmental priorities may be emerging in the most

recent contributions: in particular, around the themes of implementation, the systems perspective, business models and technological insufficiency.

Implementation. Increasing attention in the literature is being paid to the implementation of innovative solutions for sustainability. Hallstedt *et al.* (2013) propose a range of prescriptions for effectively embedding a strategic sustainability perspective in the product innovation process. Ceschin (2013) reflects on corporate, cultural and regulatory barriers that hinder the uptake of eco-efficient product–service system innovations finding, specifically, that implementation is influenced by a diversity of factors, not just by the technology itself. Silvestre and Silva Neto (2014) explore the impediments to the implementation of technological solutions in the Brazilian mining industry and, although noting the availability of technological solutions to these challenges, conclude that technology alone is insufficient. Instead, they report a largely passive and reactive industry, many of whose members lack the knowledge, motivation, education or will, and who operate in a context characterized by a lack of enforcement of environmental regulations.

On the basis of the proposed SOI model, and in the absence of empirical studies, we can speculate that start-up firms and spin-outs could select their point of entry to the framework and design their organizations accordingly, e.g. many social enterprises are founded specifically to support sustainable development and will launch as Organizational Transformers or Systems Builders. Incumbent firms, however, will probably face a stiffer task and may find it less disruptive to build from a basis of Operational Optimization. Keskin *et al.* (2013) provide some empirical support for our speculation. They describe start-ups attempting to take sustainable innovation beyond the traditional environmental focus to incorporate social aspects, as well as create awareness for sustainable behaviour through their products.

Systems Building. Beyond Operational Optimization and Organizational Transformation lies highly radical, game-changing systemic innovation that targets transforming established societal relationships and interactions between industry, consumer behaviour and lifestyles, institutional orientations, and even the very aims of business. The financial crisis of 2008, coupled with the challenges of climate change and growing social inequalities exposed major frailties of the prevailing economic system, prompting widespread debate on the need for systemic change as well as the need to develop new corporate approaches. As such, research, policy and practice agendas are coalescing around addressing long-standing problems caused by business having become disembedded from society (Polanyi 1944).

In the absence of managerial, policy and behavioural change within and beyond organizational boundaries, technological solutions are limited in what they can deliver. Our analysis highlights the importance of systems-level innovation, but we found little empirical work to populate this context. As a result, and consistent with the notions of fit-for-purpose evidence (Briner *et al.* 2009; Gough 2007) and pragmatic management research (Tranfield *et al.* 2003), this gap caused us to turn to the grey literature. Nike speak of 'getting the whole system in the room' in order to diagnose problems, understand system complexity, build trust, identify possible levers for change, and develop common thought processes (Draper 2013).

The grey literature also highlights a number of trailblazing Systems Building initiatives, not all of which are catalysed by the business community, but in which business plays a significant role. For example, NGOs such as the WBCSD and the WWF are helping bridge the science–business gap through innovative initiatives, recognizing that corporate sustainability must be rooted in ecological science, and that business has a key role in helping to reduce its impact and ensuring it stays within the limits of the planetary boundaries (Whiteman *et al.* 2013).

In the 2013–2015 literature, we observe a growing body of Systems Building empirical work. Gaziulusoy *et al.* (2013), for example, explore the use of the scenario method as a mechanism for firms to develop innovation pathways that require institutional, social/cultural, organizational and technological change. De Medeiros *et al.*'s (2014) review and empirical test highlight internal, inter-functional integration and wider, stakeholder integration as critical success factors for sustainable product innovation.

Business model. An increasing number of scholars are framing SOI as a business model challenge (e.g. Rohrbeck *et al.* 2013), reflecting the complexities of developing new value propositions and opportunities for new value creation and capture that a sustainability orientation poses. In an echo of the finding in the current review about the emergence of organizational reframing practices, Boons and Leudeke-Freund (2013) conclude that the search for business models for sustainable innovation equates to a search

for a business model that challenges the neoclassical economic worldview.

This may be more aspirational than actual, as many sustainability business models continue to exist within the neoliberal paradigm. Bocken *et al.* (2014) propose eight sustainable business model archetypes, a number of which are clearly rooted in the context of optimization. Their archetype maximizing resource productivity and energy efficiency emphasizes doing more with fewer resources and generating less waste, emissions and pollution.

The benefits to companies of this business model, such as cost reduction sustainability and competitive advantage, are increasingly clear (Aguado *et al.* 2013). The business model is articulated in terms of Operational Optimization, rooted in resource management – maximizing the productivity of resources, energy efficiency, minimizing waste – as, for example, Nair and Paulose (2014) describe in the case of the bio-fuel industry.

But Bocken *et al.*'s (2014) taxonomy extends beyond this: the remaining seven archetypes include two with a technological orientation: creating value from waste; and substituting non-renewables with renewables and natural processes. The logical extension of the latter leads away from the linear 'take–make–waste' industrial paradigm, to a systems-building orientation characterized by innovative business model configurations such as the circular economy (The Ellen MacArthur Foundation 2013).

Five archetypes are categorized as either socially or organizationally oriented and attend to behaviour change reflective of Organizational Transformation and Systems Building. Three archetypes have a social focus and describe business models that emphasise: 'sufficiency', solutions that actively seek to reduce consumption and production; 'functionality', services that satisfy users' needs without having to own physical products; and 'stewardship', proactively engaging with all stakeholders to ensure their long-term health and well-being.

The remaining two archetypes address the organizational domain. The first describes the repurposing of business in society, prioritizing delivery of social and environmental benefits through close integration between the firm, local communities and other stakeholder groups rather than pursuing only profit maximization. The second is about delivering sustainable solutions at a large scale to maximize benefits for society and the environment.

Technological insufficiency. The business model perspective integrates the business case with societal and environmental considerations and locates nexuses of sustainability value. The perspective also strongly indicates that sustainability is becoming less of a technical challenge than it is one of changing behaviour. To take advantage of new opportunities, societal actors and downstream entities need to be involved and invested in defining new value creation and what is sustainably valuable (e.g. performance advantages and environmental impact reduction) (Iles and Martin 2013).

Systems thinking and technological insufficiency come together at the macro level where, we note, two models have recently gained considerable academic, policy and practical traction: Planetary Boundaries (Rockström *et al.* 2009) and Doughnut Economics (Raworth 2012). The Rockström *et al.* (2009) framework of 'Planetary Boundaries' consists of nine Earth system processes which, to the extent that they are not crossed, define a 'safe operating space for humanity'. Crossing these boundaries, they argue, constitutes a risk of 'irreversible and abrupt environmental change', with potentially disastrous consequences for the biosphere and, by extension, humanity. Doughnut Economics brings planetary boundaries together with 11 social boundaries, dimensions of human deprivation developed from priorities outlined at Rio+20. Integrated in this fashion, planetary and social boundaries describe a safe and just people/planet space in which humanity can thrive.

Steffen *et al.* (2015) note that four of the nine planetary boundaries have already been crossed, with others in imminent danger. Raworth (2012), using UN data, shows that humanity is currently falling below each of the 11 social boundaries. The practical implication of occupying this space is the need for an interdisciplinary science of sustainability (Leach *et al.* 2013) promoting innovation in the use of natural resources and far greater efficiency in transforming those resources to meet human needs at a systems level (Whiteman *et al.* 2013).

These perspectives assert that economic activity is embedded in and dependent on complex, living, self-organizing natural and social systems with limits; and that a healthy economy is rooted in a healthy ecology and society: as encapsulated in the nested or 'strong' model of sustainable development (Giddings *et al.* 2002). Paraphrasing Lee (2008), this means incorporating and aligning business environmentally

and socially to take on responsibility to lead, through innovation, towards a sustainable world (Hart 2010).

However, while it is in the Systems Building context that the grey literature sheds the greatest supplementary and contextual light, it is for reasons of its presence that the conclusions here must be treated with greater caution. While we find some triangulation between the findings of the two bodies of literature (lending some validation to our framework), the paucity of empirical work highlights an immediate opportunity for further definitional and evaluative research in this context.

Indeed, the whole framework indicates important opportunities for future research. A significant opportunity exists at the transition points between the different contexts. Previous research has indicated that new knowledge (Phelps *et al.* 2007) and specific capabilities (Francis and Bessant 2005) are required at different stages of firm growth and change, raising questions about the specific knowledge and capabilities required to help firms move around contexts. The capability-based view originates in the work of a number of scholars, drawing on the resource-based view of the firm (Barney 1996; Penrose 1959). Amit and Schoemaker (1993) defined capabilities as the 'capacity to deploy resources, usually in combination, using organizational processes, to affect a desired end'. By extension, then, SOI capability can be conceived as the dynamic ability to adapt, integrate and reconfigure organizational skills, resources and functional competencies to respond to contemporary sustainability challenges (Assink 2006; Teece 2007). Research should focus on the further identification of specific resources and competencies of SOI that help firms move through the framework.

Furthermore, we have noted the challenge that managers face in knowing how to help their organizations become and be sustainable. The proposed framework offers a useful heuristic to help navigate this landscape and provides a set of indicative activities in each context. To give further practical value to the findings of this review, future research efforts should be directed towards both empirically testing the framework and operationalizing it in the form of a maturity model.

Research in this domain would be greatly enhanced by taking a longitudinal perspective, and we have been constrained from drawing conclusions about transitions between contexts by the cross-sectional nature of the studies included.

We also make two methodological contributions: first, by adopting a novel framework-synthetic approach – to the best of our knowledge, the first in a published systematic review in management and organizational studies. Our efforts to develop SOI theory are robust, given an approach grounded in the data of previous studies (Glaser and Strauss 2009; Yin 1994). Framework synthesis has been demonstrated as useful in other domains, and it has enabled us to build a richer, more refined model of SOI through a process of iteration between the initial model and data (Ratcliff 1994), and to provide a palette of practices from which practitioners might select. The framework, by plausibly accounting for the range of empirical observations provided by the studies included, delivers increased analytic generalizability (Locke 2001) compared against previous, isolated studies. In this sense, our synthesis, by moving to a higher level of abstraction, contributes to the development of knowledge (Tranfield *et al.* 2003). The use of a framework synthetic approach in this study should act as a stimulus for its continued use and for further exploratory use of other methods of synthesis in systematic reviews in the field.

The second methodological contribution is the inclusion of a wider range of the grey literature than in previous studies. By integrating the grey literature, we have been able to reflect more contemporary SOI activity than had we relied on the scholarly literature alone. In particular, we suggest that combining the two bodies of literature is particularly promising where research publications appear to lag contemporary practice and that opportunities should be taken, where appropriate, for the greater use of the grey literature in systematic reviews. Specifically, we have included the grey literature in this review to provide examples of practice to managers and others interested in making organizations more sustainable. In doing so, we push the boundaries of systematic review practice in management research into new territory. While this might be contentious, the approach finds support from Nutley *et al.* (2013), who argue that the processes of the review should reflect not only on what we want to know and why we want to know it, but also on how we envisage the knowledge product being used. With a clear practitioner purpose in mind, this review recalls the practice-oriented purpose of systematic reviews, but not at the cost of rigour (Tranfield *et al.* 2003). In doing so it raises questions about under what conditions more attention might be given to grey evidence in systematic reviews.

Conclusion

Roome (1992) argued that the conditions for sustainability cannot be met simply by compliance, and that managerially led action is required. The increasing presence of business representation over the course of the three Earth Summits suggests that some managers, at least, also subscribe to this view.

The pressing need to equip managers with the tools for innovative solutions to sustainability challenges coupled with the diversity and fragmentation of the academic literature have made this review necessary. Our inductively derived framework reflects and builds on the findings of previous studies and permits a synthesis of the innovation activities of becoming and being sustainable. We argue that, by understanding how organizations can become sustainable, pragmatically oriented SOI-related research has the potential positively to influence organizational behaviour: our model provides a strong basis for such influence.

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