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SOCIAL LCA IN PROGRESS

A historical perspective on the engineering ideologies of sustainability: the case of SLCA

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Abstract

Purpose The 1990s produced two distinct engineering ideologies of sustainability—one emphasizing engineering innovation and the other emphasizing socio-cultural change. The technological change ideology of sustainability refers to *engineering reform* controlled and directed by engineers themselves—in other words, technological practices can be improved through the application of expertise. The technopolitics' ideology of sustainability is about *engineering challenge*; it places more emphasis on the devolution of expertise from the existing model of engineering and society, and it questions the dominant values of engineering practice. In this article, I present a historico-philosophical perspective on the development of social life cycle assessment (SLCA) to highlight how the dialectic between sustainability and engineering has been defined largely by the ideology of technological change.

Methods I provide original historical evidence regarding the roles of key actors and institutions in fitting the life cycle perspective and corporate social responsibility (CSR) into sustainable development. Primary data for this chapter is based on archival materials as well as on 30, in depth, semi-structured interviews with North American and European LCA and SLCA experts. Other primary data were collected from participant observation in SLCA webinars and workshops.

Results and discussion Technology is at the heart of SLCA—it is a shared faith in technology as the solution. At the same time, there is growing appreciation amongst SLCA proponents that such technology must be construed more critically. Although it remains a subaltern current within LCA, SLCA is evidence of how technological change and technopolitics are starting to converge and influence each other—a probe toward a more reflective form of engineering discourse and toward the formation of a new hybrid sustainability ideology.

Conclusions SLCA, I argue in this article, is an ideological hybrid where there are many spots of dissent and disagreement but also some surprising fundamental alignments between those who see engineering as techniques and those who believe that engineering needs to be socially and politically contextualized. Yet, even as the concepts of sustainable development, CSR, and LCA provide the intellectual and institutional mold within which SLCA becomes conceivable, these concepts may also obscure the historicity of sustainability engineering.

Keywords Engineering · History · Ideology · LCA · SLCA · Social · Sustainability

1 Introduction

The 1990s produced two distinct engineering ideologies of sustainability—one emphasizing engineering innovation and the other emphasizing socio-cultural change.

Here I conceptualize ideology in terms of the historical and normative bases of what contemporary engineers consider to be the embodiment of sustainability: life cycle assessment (LCA). This conceptualization of ideology explores the interplay amongst engineering discourse, industrial systems/processes, and how engineering cultures

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foster sustainability by adopting normative assumptions and problem-solving practices—particularly LCA—as part of their professional identities. The historical/discursive element of engineering ideology accounts for how ideologies inform narratives of technological progress and thus how engineers are involved in the social and political shaping of technological futures. Engineering ideologies of sustainability not only affect how professionals imagine LCA as a medium of technological and environmental transformation, but also how they conceptualize sustainability as a vehicle to renegotiate engineering knowledge and identity in addressing some of the most pressing existential dilemmas facing their discipline.

The first ideology, based on creativity, resembles an *ideology of technological change*, as characterized by engineering historian Matt Wisnioski in his analysis of American engineering in the 1960s. The technological change ideology of sustainability refers to *engineering reform* controlled and directed by engineers themselves—in other words, technological practices can be improved through the application of expertise. In this article, I am building on Wisnioski's analysis adding to it another dimension for the twenty-first century: I present the case study of the development of social life cycle assessment (SLCA) to highlight how the dialectic between sustainability and engineering has been defined largely by the ideology of technological change (Wisnioski 2012).

The ideology of technological change serves as the counter-paradigm to an ideology of *technopolitics* while positing that technology is neither good, nor bad, nor is it neutral. Since the 1970s, the solution that engineers have favored for the dilemmas of technology and social progress has been that "[t]hrough rational management,… technology's unintended consequences could be minimized and its positive capacities maximized" (Wisnioski 2009: 410).

The second and less influential ideology of engineering sustainability, with its emphasis on socio-cultural change, stems from a minority of practitioners and academics during the 1980s and 1990s who self-identified with the conceptual framework of social responsibility. Engineers associated with organizations like Engineers for Social Responsibility (ESR), the subaltern US group of American Engineers for Social Responsibility (AESR), and later the International Network of Engineers and Scientists for Global Responsibility (INES) mindfully suggested a more culturally and politically sensitive vision for engineering sustainability. The technopolitics' ideology of sustainability is about *engineering challenge*: it places more emphasis on the devolution of expertise from the existing model of engineering and society, and it questions the dominant values of engineering practice.

1.1 The rationalities of engineering ideologies of sustainability

Despite their shared concerns with systemic interdependence, the technological change view of sustainability thrives on the assumption that it is both rational and objective, while the technopolitics' view is based on challenging such claims to objectivity and questioning the value of sustainability's political ends. And whatever their differences, for the most part, both ideologies of sustainability assume a certain level of engineer autonomy in the operation of sustainable technology.[1] The typology in Table 1 classifies the rational bases of the engineering community's ideologies of sustainability by listing them under three headings: (a) premises, (b) core assumption, and (c) operating principle.

2 The formation of SLCA: toward a hybrid sustainability ideology in engineering

I assert that technology is at the heart of SLCA—it is a shared faith in technology as the solution. At the same time, there is growing appreciation amongst SLCA proponents that such technology must be construed more critically. Although it remains a subaltern current within LCA, SLCA is evidence of how technological change and technopolitics are starting to converge and influence each other—a probe toward a more reflective form of engineering discourse and toward the formation of a new hybrid sustainability ideology.[2] SLCA, I argue in this article, is an ideological hybrid where there are many spots of dissent and disagreement but also some surprising fundamental alignments between those who see engineering as techniques and those who believe that engineering needs to be socially and politically contextualized. My primary data for this paper is based on 30, in depth, semi-structured

[1] For example, a conference entitled "Preparing for a Sustainable Society," co-sponsored by the IEEE Society on Social Implications of Technology and IEEE Toronto Section, took place in Canada (Ryerson Polytechnical Institute, Toronto, Ontario, Canada, June 21–22, 1991). The conference's Call for Papers read: What is a sustainable society? How will the relationship between technology and society change if a strategy of sustainable development is adopted? Can society control and redirect the technological system it has created or is this system now controlling society? (Burkhardt and Vanderburg 1991: 6–8).

[2] As one European engineer and SLCA practitioner put it, "I know… [that in 2014] several companies…are working on SLCA; trying to define suitable indicators to assess social aspects along…[product] life cycle[s]…to apply the SLCA guidelines…[and] to integrate [SLCA] into existing sustainability reporting." Groupe AGÉCO, a Canadian consulting group, reported in 2013 that it has conducted 15 SLCAs, while LCA pioneer PRé Consultants—serving 80 % private companies and 20 % government services in 60 countries around the world—explained that more and more clients express interest in SLCAs. Interview data; webinar on "Combined Environmental and Social Life Cycle Assessment in the Food, Beverage and Agricultural Products Sector." Webinar offered by New Earth on June 26, 2013.

Table 1 Rational bases and operating principles for engineering ideologies of sustainability

Engineering ideologies of sustainability	Premises	Core assumption	Operating principle
Technological change	Engineering creates prosperity—yet engineers have unintentionally contributed to environmental problems "Sustainable" means "environmentally sustainable" Environmental problems can be eliminated by technological means without a sacrifice of prosperity	The reorientation of environmental technology is autonomous, thus, the exploitation of natural resources should neither be decreased nor increased, but ought to be effectively managed	Engineering activity must account for its own environmental costs in the context of a free-market economy. Sustainability is an engineering problem
Technopolitics	The design and social integration of engineered systems reflects normative—yet not readily recognizable—assumptions and values; therefore, development has equivalent effects on the social order as any other form of political act Engineering and science play a supportive—not central role—in the quest for sustainability The logic of competitive productivism must be reconsidered	Provided that technology is autonomous, the pressing question in sustainability engineering is re-conceptualizing and redirecting the democratic control of technological means and technological expertise	Engineering activity must continually challenge the adequacy of sustainability metrics as well as the very processes by which their objectivity is established. Sustainability is a political problem: assessing social and environmental impacts of a project or a product requires equal involvement on the part of technological experts and non-engineering "stakeholders," such as local communities or users

interviews with North American and European LCA and SLCA experts and also on unpublished memoirs and other archival material. Other primary data were collected from participant observation in SLCA webinars and workshops. Although there are, particularly in Europe, other strands of social sustainability from a life cycle perspective, in this paper, I deal primarily with the mainstream of SLCA as it pertains to United Nations Environment Program (UNEP). Covering the period up to the first half of 2015, the paper does not consider the most recent developments in SLCA.

SLCA began emerging when sustainable businesses—companies that take into account their own "corporate responsibility"—perceived a lack of transparency in their supply chains, preventing awareness of and reactions to corporate exposure to risks such as forced or child labor, prohibition on freedom of association, etc. SLCA, then, is based on the combined support of two of sustainability engineering's most fundamental conceptual roots: first, the ontological assumption that the world is a system comprised of interlocking processes which produce global unintended impacts or "footprints"; second, the methodological supposition that footprints become meaningful—namely, their awareness can help researchers inform decisions—when measured in life cycles, after these global processes have been modeled by input–output data.

LCA practitioners tend to be comfortable with their practices within the realm of techniques, whereas in SLCA, this no longer holds true. Yet, regardless of the fact that the translation of quantitative data into engineering decisions is no less problematic in LCA than in SLCA, most engineers view LCAs as more robust and technically sound. SLCA is then an attempt by sustainability practitioners to make *social impacts* more "sound" in engineering cultures.

The construction of a life cycle social impact assessment method calls for moving away from the non-contextual, yet tangible—e.g., CO2 emissions—to measure contextual intangibles, e.g., human dignity. In the mid-2000s, a small international engineering community argued that the collision of value systems inevitable in the development of sustainable technology requires a new technological remedy, one that incorporates traditional engineering techniques with non-traditional engineering data.[3] In developing such a remedy, SLCA champions extended the standardized LCA concept of "Areas of Protection" (AoP)—which includes "human health," "natural environment," "natural resources," and "man-made environment"—to "human wellbeing", thus allowing extra-

[3] "Generally," argued the UNEP Guidelines, "practitioners of S-LCA will need to incorporate a large share of qualitative data, since numeric information will be less capable of addressing the issues at hand..." (Life Cycle Initiative 2009: 9). For example, "bypassing data on worker impressions in favor of more 'objective' data (such as variability in observed worker arrival times, or other attempted proxies for perceived degree of control) would introduce greater uncertainty in the results, not less" (Life Cycle Initiative 2009: 40).

engineering values to enter into engineering discourse and practice. By explicitly accepting that value systems are inherently contained within social impact assessment—“not a deficiency of SLCA but…[a characteristic of] its very nature… necessitat[ing] an honest…approach” (Reitinger et al. 2001: 382)—SLCA advocates offered sustainability engineering a new venue to envision technology as a medium of social transformation and an opportunity to reflect openly upon engineering assumptions, cultures, and professional identities.

Optimism about SLCA is fueled by faith in engineering progress, ideologically rooted as it is in the integration of engineering ideologies of sustainability and oftentimes depicted as an “instrument of renewal” (Spillemaeckers 2007). Yet the ideology of technological change, while important, is only one of the drivers of SLCA. As SLCA researchers are celebrating sustainability through fair trade and smart corporate management, they also show greater willingness to open the “black box” of their technique. Like the technopolitics’ ideologues of sustainability, SLCA pioneers claim that their engineering knowledge’s justification lies in its explicitly value-laden nature.

Interestingly, while contextualizing their assumptions, however, practitioners communicate their developing perspectives on SLCA by *decontextualizing* sustainability engineering discourse—by taking metaphors like “holism” or “feedback” for granted—hence furthering the discursive integration of technological change and technopolitics. Thus, blurring the ideological boundaries of sustainability, engineering was manifested; for example, in a 2013 article published in the *International Journal of Life Cycle Assessment*, which surmised that because life cycle methods are inherently value-laden, they render technological egalitarianism credible (Sala et al. 2013).

The most recent sustainability engineering vocalizations, this article illustrates, have shifted over time along the continuum of technological change and technopolitics. Merging these two ideologies in SLCA mobilizes engineering cultures in support of qualitative social impact assessment; as these issues *become a legitimate part of engineering knowledge*, and as they are addressed by professionals in everyday practice, convergence gradually expands the boundaries of engineering cultures themselves.

3 Targeting the social risks: fitting the life cycle perspective into corporate social responsibility

Over the 2000s, sustainability engineering continued undergoing two important historical transformations. First was the concept of the so-called “triple bottom line,” coined in 1994 by sustainability leader John Elkington and adopted in the title of the 1997 business report put out by the Anglo-Dutch oil company Shell, which had become a key element of the engineering discourse on sustainable development (Elkington 2004). In 2002, *Walking the Talk* was co-written by DuPont’s Charles (Chad) Holliday and Swiss corporate titan Stephan Schmidheiny, with the authors maintaining that sustainable development was “partly about social justice” (Holliday et al. 2002: 13). Representing a “small but growing number [of corporations that] are moving towards sustainability reports…” Holliday challenged fellow engineers to embrace the “social side of sustainable development” (Holliday et al. 2002: 163 and 106). In response to such challenges, the SLCA community—heavily represented by individuals with engineering backgrounds—was officially launched in 2004 to expand the LCA methodology to a triple bottom line tool (Benoît et al. 2010).

The second historical transformation to promote sustainability in industry was the development of “corporate social responsibility” (CSR). Adhering to the central idea that external values challenge the engineering profession, Technical University of Denmark’s management engineer Louise Camila Dreyer, in the first Ph.D. to cover SLCA in 2009, contextualized her subject matter as helping companies meet “society’s expectations…[as regards]…a wider responsibility for the social impacts of their business activities” (Dreyer 2009: 104). These two closely related transformations grew in large part out of development-oriented institutions, corporate engineers, and LCA practitioners’ growing engagement with elements of a technopolitics’ vision of sustainability.

3.1 Social sustainability tinkerers

From an engineering expert’s perspective, the first effort to tinker with social, environmental, and economic dimensions of sustainability was a method developed in 1987 by Germany’s Öko-Institut. In the succeeding years, the method was modified by the German chemical company Hoechst AG and became known as Product Sustainability Assessment (PROSA; Öko-Institut 1987). Starting in the late 1990s, another German chemical company, BASF, would collaborate with Öko-Institut and Karlsruhe University to articulate SEEbalance®, the first SLCA method developed explicitly for industrial product comparative assessment and application. BASF offered a corporate engineering vision based on the World Bank’s “four capital approach,” according to which companies were supposed to strike a balance between providing for their social networks, caring for their workers’ productive capacities and for the natural environment, and being efficient regarding their produced capital (Schmidt et al. 2004).

In parallel to but independent of Öko-Institut’s sustainability assessment, SETAC in 1993 published its “Conceptual Framework for Life Cycle Impact Assessment,” which proposed the consideration of a “social welfare impact category” (SETAC 1993). The same perspective was built into the 1992

Nordic guidelines for product LCA and was embraced in the scholarship of a small group of Swedish and Danish researchers in the 1990s (Nordic Council of Ministers 1992; Andersson et al. 1998; Wenzel et al. 1997; Hauschild and Wenzel 1998).[4] Most such independent projects appeared in engineering settings, like Patrick Hoffsteter's 1998 dissertation, which built on Mary Douglas' cultural theory to integrate the "value sphere" in LCA—but they were not followed up by other researchers until very recently (Hofstetter 1998). For example, a 1995 study in the *Journal of Cleaner Production* proposed a combination of quantitative and qualitative impact categories for assessing occupational hazards and argued that "the best solution for the external environment is not always the best solution for the work environment and vice versa…" (Antonsson and Carlsson 1995: 215). That same tension would characterize much of the SLCA literature and the social sustainability movement as a whole during the succeeding decades.

From the mid-1990s on, the importance of social issues in consideration of sustainable development grew substantially, as did the range of constituencies involved in defining social sustainability metrics. If the challenge of a shrinking environment that put the engineering profession on the mission to sustainable development in the first place were the result of a short-term, profit-focused industry, then business performance standards that incorporated environmental and social metrics would achieve industrial sustainability integration. To accomplish this goal, companies would need the support of engineering practitioners and their professional organizations.

In November 2002, the American Institute of Chemical Engineers (AIChE) issued a statement which read: "[The Sustainable Engineering Forum] SEF will do its part to add some scientific rigor to analyzing sustainability and to use appropriate metrics to determine comparative merits of [industrial product] alternatives" (AIChE 2002). AIChE's SEF was not chartered until 2003, so the first engineering "sustainability metrics," intended for the chemical processing industry, were coauthored in 2002 by the UK's Institution of Chemical Engineers (IChemE) Roland Clift, who had also coauthored the first article ever on "Social and Environmental Life Cycle Assessment" 6 years earlier (O'Brien et al. 1996). The IChemE "Sustainable Development Progress Metrics" were conceived as an amalgam of engineering practicality and supply chain systems thinking. IChemE's sustainability leadership cast the Metrics in accordance with the triple bottom line—i.e., "the impact of industry in sustainability…summarized"—and saw themselves as initiating a relationship between companies developing performance standards for internal benchmarking on the one hand and engineering practitioners implementing and interpreting those standards on the other. IChemE was also interested in developing "social indicators" by looking at two major social themes—namely "employment situation" and "health and safety at work"—while also discussing the broad category "Society" for which inventory data such as "Number of meetings [per year] with external stakeholders concerning company operations" were suggested. The introduction to the Metrics, echoing AIChE's 2002 statement, explained that the concept of sustainability required practitioners to reflect on their identity as technical workers (IChemE 2002).

In the same year that Roland Clift collaborated with his colleagues at IChemE's Sustainable Development Working Group to develop the Metrics, he published an *Engineering Management Journal* article entitled "Engineering with a human face." Similar to their predecessors, the "heroic materialists" of Watt and Brunel's caliber, sustainability engineers drew on the insights gleaned from tinkering with the interface of natural and technological environments, taking pride in carving social progress while having "fun of the impossible." But unlike their predecessors, the sustainability engineer "has emotions," and was likely to be female. In "Engineering with a human face," Clift expressed the view that the addition of social concepts into engineering methodology was a means to simultaneously enhance engineering practice's technical sophistication and to mirror the holistic principles of the profession. Clift recorded not only the changes in engineering science ("does my project recognize that science is uncertain?"), but also the transformation that sustainability brings into the relationship between the engineer and her public audiences. He went on to describe the shift in engineering thinking presently manifested in the development of SLCA: "…management of the product started by eliminating risks to the workers who manufactured it, and to the customers. Over time this has grown to address risks to suppliers and distributors, and to encompass 'design for the environment'" (Clift and Morris 2002: 226–230).

In the context of industrial transformations, like the development of CSR, engineers began to tinker with social sustainability. Insofar as it had already been dealing with voluntary efforts since the early 1980s in the US at least, the chemical industry was leading the way in defining social sustainability indicators. Importantly, as the work of engineers like Clift illustrates, whatever their proponents' self-understanding, the life cycle thinking and social impact improvement corporate discourses *combined* helped SLCA appeal to both technological change and technopolitics' proponents of sustainability. In combination, the next section will discuss the historical development of these discourses—influenced by European cultures of environmental responsibility—reverberated and promoted a new engineering identity, one that embraced a social element in engineering knowledge per se and an identity operationalized along product life cycles.

[4] The method outlined in Andersson et al. (1998) fills a gap between traditional LCA and so-called "Socio-Ecological Principles."

3.2 Sustainable development, corporate social responsibility, and life cycle assessment

SLCA stands at the crossroads between sustainable development, CSR, and LCA. The official birth of the tripartite relationship between sustainable development, LCA, and CSR can be attributed to the creation of the Business Council for Sustainable Development (BCSD), founded by Stephan Schmidheiny in 1991.

"After Rio, there was a sense of OK, what's next?" Schmidheiny is quoted to have asked: The answer was corporate efforts to define extension of his ideas around the concept of "eco-efficiency". Another answer was BCSD's initiative—under the leadership of Swiss company Anova Holding AG's Frank W. Bosshardt—to reach out to ISO regarding the development of international environment standard ISO 14000. ISO worked closely with the International Electrotechnical Commission (IEC) through an ISO/IEC Strategic Advisory Group on Environment (SAGE), which culminated in the creation of the TC 207 technical committee that started to develop the standard for LCA in February 1993. In 1995, the BCSD merged with the World Industry Council on the Environment (WICE) to open the WBCSD secretariat in Geneva, Switzerland. Sustainability, in the lexicon of the corporate engineer, was translated into taking responsibility for industrial products throughout their life cycles (Timberlake 2006: 21; Piper et al. 2003; Garcia-Johnson 2000).

These sustainability initiatives,[5] and the standardized knowledge they propagated facilitated the application of LCA across various business contexts. In the early 1990s, 150 companies, including some major US corporations, adopted the "Business Charter for Sustainable Development," which was based on 16 principles developed by the International Chamber of Commerce (ICC). The Charter was launched during the Second World Industry Conference on Environmental Management (April 10–12, 1991, Rotterdam, The Netherlands; Ember 1991). In the mid to late-1990s, the ICC—an organization which engineer-founders of the WEPSD considered essential for the Partnership's future—worked together with UNEP and FIDIC to develop the so-called Environmental Management System (EMS) Training Resource Kits based on the ISO 14001 and the European Environmental Management and Audit Scheme (EMAS; Coates 1993).

SPOLD, created in 1992 by a variety of multinationals interested in the promotion of LCA as a corporate management tool for sustainability, offered a vision of CSR as exemplified in the social value of LCA and linked by inventory data, methods to exchange such data (SPOLD format), and other environmental assessment techniques such as material flow analysis. After SPOLD's dissolution in 2001, its mission was continued by the, again European-based—UNEP/SETAC Life Cycle Initiative, which was created a year later (2.0 LCA Consultants, undated).

This section explained that whereas the US had fostered technocratic LCA, European engineers and practitioners seem much more politically attuned and willing to tackle social complications reflecting different engineering traditions and broader cultural concerns arising from European country contexts.[6] Under the aegis of SPOLD, European scientists and engineers asserted in a technopolitics fashion in 1996 that the barriers between LCA practitioners and society at large needed to be broken down so that both "LCA results be presented in a [socially] meaningful way…[and] societal priorities…be expressed in terms that enable LCA 'technological experts' to produce an answer" (Unknown 1996: 65). In other words, as sustainability engineers become more diverse in who they are and where they come from, they bring different values compared to the economistic Americans. The integration of technological change and technopolitics as SLCA may thus also be a story about how American-centered engineering cultures are facing challenges.

3.3 Social auditing pioneers and the global reporting initiative (GRI)

One of the first "full range" reporting standards for industry that "walked the talk" of the triple bottom line was AA1000, developed in 1999 primarily by Simon Zadek, the AccountAbility founder, self-proclaimed "Buddhist economist," and until recently, non-resident Senior Fellow at Harvard University. The purpose of AA1000, according to Zadek, was to fuse elements of ethical and socially responsible behavior in the twenty first century corporate management and business operations (Institute of Social and Ethical AccountAbility 1999).

In his early articles (1993–1999), Zadek extended the accountability, transparency, and sustainable production notions that pervade current SLCA discourse, linked them to Schumpeterian economics and appropriate technology, and

[5] For example, as a result of discussion within Working Groups of the December 2003 meeting of UNEP/SETAC members in Lausanne, Switzerland, it was decided that a new "Task Force" be created to focus on the inclusion of social issues in LCA. In 2003, an LCA leader wrote that "[t]here seems to be a consensus about these three pillars, but not about the relative weights of these aspects" (Klöpffer 2003: 157–159). Another early instance where SLCA and sustainability were cast in the context of the triple bottom line is the paper by Udo de Haes et al. (2004).

[6] Latin American engineers may also be more socially and politically minded: "Social and economic benefits are not normally considered in a life cycle assessment, but these are significant aspects in the context of developing countries toward sustainable development," members of the Chilean Research Center for Mining and Metallurgy wrote in a 2011 SLCA study (Rada et al. 2011).

employed them as analytical tools to operationalize social change at the structural and individual levels. A 1997 article concluded: "This [Buddhist Economics] vision was (and is) largely consistent with a number of historical and contemporary calls for an approach to economics that embodies principles of self-realization, social justice, harmony and creativity, and an appreciation in practice of one's role in the cycles of nature" (Zadek 1997).

Zadek made explicit connections between appreciating the nature of being human and overcoming the "deep lethargy of the democratic project." Such a link also resonated with technopolitics' ideologues of sustainability, who postulated that market capitalism's hegemony had to be challenged, if not overthrown, if environmental sustainability and social justice were to inform both the means and the ends of engineering knowledge and practice. Read in the context of SLCA's contemporary development as an engineering technique that is seeking transparency in the valuation of social impacts, Zadek's assumptions represent another level of integrated technopolitics' ideology—particularly, the idea of professional and methodological reflexivity—in mainstream sustainability discourse (Ibid).

In the same year, Zadek advanced his version of Buddhist economics; individuals from the Coalition for Environmentally Responsible Economies (CERES) and the Tellus Institute began co-founding the Global Reporting Initiative (GRI) with the support of a $3.75-million grant from UNEP—the largest donation of its kind in the history of non-governmental organizations (NGOs).[7] Considered by management scholars and SLCA researchers alike as the cutting edge of sustainability reporting, the GRI has exerted substantial influence on business sustainability as a multi-stakeholder procedure for designing and communicating reporting guidelines. In the absence of legitimate social metrics of sustainability, SLCA studies would have been even harder to imagine, let alone to execute. Thanks in large part to the vision of GRI founding members Robert Kinloch (Bob) Massie IV, Allen L. White, and Paul Raskin, I argue the SLCA community has found an institutional reference point and a methodological standard in the face of constantly shifting expectations about the purpose of sustainability engineering practice (Szejnwald Brown et al. 2007; Levy et al. 2010; Labuschagne et al. 2005). Massie, White, and Raskin's involvement with indicators of sustainability was key in promoting techopolitics ideas and tools of corporate transparency as well as stakeholder participation to affect sustainable social change.

A risk analysis and total cost assessment (TCA) expert, Allen L. White, proposed new premises for socially responsible companies to reposition their role in society. A pioneer in designing methods for social and environmental assessment—such as the PoleStar software, which simulates socio-ecological systems—Paul Raskin helped bridge the relationship (often conceptualized as a gap) between sustainability rhetoric and situated, meaningful, practice. And an early champion of the CSR movement—he served as executive director of CERES from 1996 to 2003—Bob Massie promoted integrated reporting in places where it was resisted most: multinational engineering corporations.

Allen White is what Halina Szejnwald Brown and coauthors have termed as an "institutional entrepreneur" (Szejnwald Brown et al. 2007). Such individuals are promoting ideas and tools of corporate transparency and stakeholder participation to affect sustainable social change. Along with Bob Massie, White was involved with CERES and the development of its environmental reporting standard since the early years of the organization. He currently serves at the board of directors of Greg Norris and Catherine Benoît-Norris' New Earth, which in 2009 launched the SHDB, the only currently available database explicitly designed to make the UNEP Guidelines SLCA framework operational.

The complementary interests in life cycle, risk analysis, approaches to pollution prevention, and TCA that White developed during his tenure at the Tellus Institute in the early 1990s would later become the backbone of his strategies of institutional entrepreneurship. In 1993, White was directing Tellus Institute's risk analysis group and pioneering Total Cost Assessment (White et al. 1993). Six years later, he published an *IEEE* article entitled "Life Cycle Design Practices at Three Multi-National Companies" with Tellus Institute colleague Karen G. Shapiro in which they argued that LCAs should not be identified with measuring environmental performance only. Shapiro and White wrote that LCA was evolving into a pragmatic methodology that struck an engineering balance between societal expectations and corporate reality (Shapiro and White 1999). More than a decade later, in the wake of the Occupy Movement, White linked business accountability with the question of a "Version 2.0" social contract: "[W]hich version of the social contract will prevail?" he questioned. Will it be that of "unfettered markets…[and] gradual undoing of the concept of collective good…or [that which] rewards business leaders who respect…the historical citizen-government covenant" (White, undated manuscript). In White's view, the sustainable corporation and society at large are not separate entities. By identifying positive social

[7] The GRI was founded between 1997 and 1999.

impacts in industrial supply chains, SLCA boundaries are also shifting the boundaries of the social contract between business and society.

Paul Raskin, White's colleague and founder of the 1976 Tellus Institute of Boston, also exemplifies the concept of institutional entrepreneurship. The models he designed—the Long-range Energy Alternatives Planning (LEAP) system, the Water Evaluation and Planning (WEAP) system, and the PoleStar System—are all examples of integrated approaches to managing resources and to exploring future socio-economic and environmental scenarios.[8]

In late September 1997, only a year out of Harvard's Divinity School, where he served as Director of the Project on Business Values and the Economy, Massie was, and still is, well versed in engineers' identity politics (personal communication). But as attested to by the reason behind his visit to Detroit's Renaissance Center—General Motors' (GM's) 1994 decision to endorse the CERES Principles—a new era of public accountability was thought to be on the rise. "Will we find a way to build a Global Reporting Initiative, so that international trade does not lead to an increase in secrecy and a decrease of environmental and labor standards?" Massie asked the GM engineers at the climax of the CSR movement in the late 1990s (Massie 1997).

Just 1 year after Massie's speech to GM engineers, Zadek, whose career encapsulates the evolution of the field of SLCA as a whole, had joined the GRI. The 1998 GRI "Sustainability Working Group," chaired by Zadek, remarked that "…[sustainability reporting] is complementary to the existing financial reporting, i.e., by addressing the non-financial aspects of business and the intangible business assets and values…." (Global Reporting Initiative 2013: 80).[9] Due to the convergence of institutional, ideological, and technological developments, the assessment of social impacts of corporate behavior and industrial operations in life cycles soon became a central feature of the definition of both sustainability and CSR.

4 Discussion and conclusions

4.1 What is "natural"?

Enough evidence exists to argue that the historical development of sustainability engineering overlaps considerably with "sustainable development," largely defined by global institutions; "corporate social responsibility," largely run by multinational corporations; and "Life Cycle Analysis," increasingly integrated within both development and CSR discourses. Yet, even as the concepts of sustainable development, CSR, and LCA provide the intellectual and institutional mold within which SLCA becomes conceivable, these concepts may also obscure the historicity of sustainability engineering.

A common formulation amongst SLCA champions is that sustainable development is an overarching concept at the policy level; social responsibility is the business application or framework of a broader policy mandate; and SLCA is a technique that "stakeholders" may use to assess social conditions in product supply chains throughout their life cycles (interview data). The same narrative also recognizes the influence of institutions such as the GRI in initiating within the CSR movement a focus on due diligence in supply chains, without which the life cycle perspective would be lacking an area of application (interview data). This narrative, however, tends to confuse two different elements: one is the concepts of sustainability engineering ideologies, which are symbolically portrayed and discursively tested. The other is the actors through which concepts are put into practice. Failure to recognize this distinction implies that concepts assume a life of their own or that engineering practices are devoid of ideologies. So what is interesting about such distinctions? They enable movement from a historical analysis of ideas and the institutions that have contributed to shaping them, toward an appreciation of

[8] Like the philosopher Paul Feyerabend, Raskin had no doubts about the limitations of scientific materialism—namely, the idea that a materialistic cosmology could provide an accurate account of human nature. But unlike his mentor at Berkeley, Raskin associated self-understanding, the key in mediating between human and non-human nature, with the world of business. The year he founded the Tellus Institute, he published an essay on the "Ecology of Scientific Consciousness" that appeared in *Telos*, a critical theory journal, following a piece by Theodore Adorno that debated the historical process of understanding the meaning of human existence in the context of Beethoven's Missa solemnis (Bernow and Raskin 1976). In 2002, Raskin had found an appropriate name for that historical process: Great Transition. His 2002 book featuring that title is an excursion into future global socio-technological scenarios. "New values" have taken root, wrote Raskin, leaving their mark on the global business landscape. Unlike the "unfettered market" (a phrase used also by White), which can only deliver the goods of efficiency, "[e]nvironment, equity and development goals are supra-market issues...." Instead of collapsing social sustainability into the corporate bottom line, the accountability movement is characterized by "forward-looking corporations [that] seize the new reality as a business opportunity and a matter of social responsibility." In addition, corporate operationalization of transparency would be marked by the "establish[ment] [of] tough standards for sustainable businesses and innovative practices to meet them" (Raskin et al. 2012: 19, 29, 51).

[9] By 2007, there was already many sources of social performance indicators including company CSR rating schemes. Good Guide, for example, founded in 2007 by UC Berkeley professor Dara O′ Rourke had initiated a process of aggregating between different data sources.

the ideologies that have sustained those distinctions and conferred them legitimacy.

For some, the key to CSR is life cycle thinking, not sustainability. Former UNEP Executive Director Klaus Töpfer, for example, is quoted to have said that it is "[l]ife cycle thinking [which] implies that everyone in the whole chain of a product's life cycle…has a responsibility…" (Life Cycle Initiative 2009: 28). In fact, according to SLCA practitioner Evan Andrews and co-authors, the "awareness of managing upstream corporate social responsibility (CSR) issues has risen due to the growing popularity of LCA" (Andrews et al. 2009: 565). Chemical engineer Michael Z. Hauschild, who mentored the first two dissertations on SLCA, wrote in 2008 that in particular, the possibility to conduct LCAs "entails responsibility…" (Hauschild et al. 2008: 21). Others maintain that CSR drives the inclusion of social impacts in contemporary LCA studies: "the life cycle perspective is key…" a practitioner admitted in personal communication; yet, "the reccurring interest for [SLCA] was alerted from the CSR area" (Interview data). And, "in the academic community," adds an SLCA and engineering practitioner, "sustainable development is like a circle within the bigger circle of CSR and life cycle thinking is like vapors that permeate the whole thing" (interview data).

Some SLCA practitioners thus believe that within CSR, there is a need for a tool to harmonize views and standardize approaches (Weidema, undated manuscript). To view CSR in this way is to assume a certain ideal of engineering rationality—that of "holism" or "systems thinking"—and then critique it for falling short of that ideal. Correspondingly, although the assumption that SLCA would fill a CSR vacuum permeated Andreas Jørgensen's 2010 SLCA dissertation, he was shocked to realize that:

> SLCA was not so attractive as I thought. I made a series of interviews with a list of very CSR-engaged companies asking them about the possibility of using SLCA. Yet, all of [the representatives from the companies I approached] said, 'well, we don't really see the point of that [SLCA],' and basically they said, 'we are not really that interested in the kind of assessment it could provide…' Even though… we are talking about companies in the DOW Jones of sustainability here… And they also said, 'we don't have the resources you are asking; it's simply not possible for us…' (Personal communication).[10]

In a personal communication, one LCA consultant opined that neither CSR nor SLCA are able to provide the necessary "guidance" to social sustainability at the corporate level. They consider both CSR and SLCA as "approaches," each of which have advantages and disadvantages—for example, they claimed that SLCA typically does not include positive impacts occurring in the use phase of a product (interview data).[11]

The history of sustainability engineering may serve as a source to both contextualize and further explore the ideological underpinnings of SLCA, more than a "natural focus."[12] For example, the authors of a review article found it "surprising" that LCA was *missing* from the discourse at the intersections of engineering and sustainability (Sala et al. 2013: 1669).[13] Similarly, according to one practitioner, life cycle thinking is the elusive emblem of sustainable engineering: "I would always make the argument that life cycle thinking supports sustainable development, but I do not know…I do not know the history [of how sustainability and life cycle thinking became tied] that well…If I am doing a paper,… [I] go back to [the 1987] Brundtlandt [report] and you kind of go from there…" (interview data).

The "natural evolution" assumption expressed above by SLCA practitioners is ideologically rooted in the same technological change premise that sustainable technologies present opportunities to re-embrace the vision of engineering progress in light of challenges posed from outside the profession. This is not to argue that there are no conceptual or institutional links between SLCA, CSR, and sustainability. Quite the contrary. Rather, the "natural evolution" assumption fails to consider how the ideological visions of navigating the unintended consequences of development and of assessing socio-environmental impacts in life cycles have coalesced historically. This paper suggests that as "social impacts" become more sound in engineering cultures,

[10] Jørgensen also admitted that "this is a kind of snapshot of a situation…[meaning that] of course things can change and different companies may think differently in the future."

[11] One example of work that actually does address the positive impacts occurring in the use phase is Musaazi M.K. et al. (2013).

[12] The idea here is that corporate willingness to protect brands and profits has entailed a "natural focus on…CSR, and [has] broaden[ed] the focus to sustainability rather than just environment." This contention embeds the assumption that researching the social aspects of products in value chains is a "natural extension" or "natural next development" to linking life cycle thinking with the triple bottom line of sustainability; but it also assumes that corporate social responsibility is a single-dimensional concept (Hauschild et al. 2008; Andrews et al. 2009; Technical University of Denmark 2010).

[13] The authors note that in "an extensive literature review on sustainability and engineering, life cycle thinking and assessment are not even mentioned" (Sala et al. 2013: 1668). Yet, this assertion was based on reviewing only one article written by an author with an engineering background who himself neglects the—quite extensive—engineering-specific literature on sustainability.

sustainability engineering subject matter undergoes a fission between engineering and humanistic expertise.

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