Information Systems in Environmental Sustainability: Of Cannibals and Forks

Dirk S. Hovorka, Elaine Labajo, and Nancy Auerbach

Abstract That individuals, communities, and organizations need to change patterns of behavior and interactions to create a sustainable future for the biosphere has become a widely accepted concept in both organizational practice and sustainability research from multiple disciplinary perspectives. Information systems and the organizational, community and individual actions they support have the potential to alter the current trajectory of resource consumption, negative environmental impacts, and ecosystem degradation. Although the Information Systems discipline has begun to address the problem of environmental sustainability, current models adhere to a technologic-managerial mindset which supports the organizational status quo. By critiquing the assumptions of the established Triple Bottom Line framework, this research proposes that Information Systems research can be expanded in three directions: addressing collective rather than individual actions, creating, measuring and monitoring a broad range of environmental impact measures, and designing organizational learning systems that enable adaptive management practices in the face of unpredictable and nonlinear environmental changes. Recognition of these additional research avenues will emphasize the difficulty of the problem domain and support transformational research thinking.

> "Below was a welcoming planet. There, contained in the thin, moving, incredibly fragile shell of the biosphere is everything that is dear to you, all the human drama and comedy. That is where life is; that's where all the good stuff is."
>
> Loren Acton, astronaut

D.S. Hovorka (✉)
Information Systems, Bond University, Gold Coast, QLD, Australia
e-mail: dhovorka@bond.edu.au

E. Labajo
Bond University
e-mail: elaine.labajo@gmail.com

N. Auerbach
School of Sustainable Development, Bond University, Gold Coast, QLD, Australia
e-mail: nancy_auerbach@bond.edu.au

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1 Introduction

That individuals, communities, and organizations need to change patterns of behavior and interactions to create a sustainable future for the biosphere has become a widely accepted concept in both organizational practice and sustainability research from multiple disciplinary perspectives. The call for a paradigm shift towards a sustainable economy (Senge, Smith, Schley, Laur, & Kruschwitz, 2008) is being heeded, as reflected by the increasing interest of the Information Systems (IS) community in the role of socio-technical systems in creating environmental sustainability.

A paradigm shift (Kuhn, 1977), by definition, requires a new way of conceptualizing fundamental beliefs about the world in which new problem domains are identified, new methods created, and new exemplars identified. In this case, what Senge at al. (2008) challenges is the creation of the future, by reflection on the past, in an evaluation of ourselves as individuals, as families, as communities, as organizational actors, as to our place within the natural world of the future. The difficulty is that such a shift requires alteration of the fundamental beliefs people have about the world and of the assumptions that are held about what sustainability of the natural world means. Furthermore, there must be a determination of both the role of a market-based economic system, and the role of organizations in relationship to environmental sustainability.

Dourish (2010) notes that although there exists a wide range of sustainability studies performed by researchers in Human Computer Interaction (HCI), the dominant emphasis is on the role of information systems as a persuasive force for behavioral changes at the individual level. Recent research has expanded this view to encompass the "role that IS can play in shaping beliefs about the environment, in enabling and transforming sustainable processes and practices in organizations, and in improving environmental and economic performance" (Melville, 2010). The reference perspectives of these recent research contributions are largely drawn from organizational management approaches, and include value chain and competitive activities, the development of sustainability portfolios, and "eco" goals (i.e. equity, efficiency and effectiveness). The exemplar research problems are identified as application of information technologies to reduce system flows such as transportation costs and energy consumption, to monitor emissions and waste, and to modify consumer behavior (Malhotra, Melville, & Watson, 2011).

Thus the foci of recent IS research frameworks is on managing the interface between organizations and something quite distinct and separate called "the environment." These approaches are well aligned with the precepts of techno-corporate Ecological Modernization Theory (Mol & Janicke, 2009), which assume that environmental sustainability is a managerial or technologically determinant problem which can be solved through technological modernization and without radical changes to current free market economics (York, Rosa, & Dietz, 2003). These assumptions also underlie the widely adopted concept of the Triple Bottom Line

(TBL) (Elkington, 1997) in which overall sustainability is an aggregate of three separate components: financial, environmental, and societal sustainability.

In contrast, other theorists view the current economic patterns of production and consumption as constituting a Treadmill of Production (Gould, Pellow, & Schnaiberg, 2004), such that even efficient organizations utilizing state-of-the-art environmental practices and technologies, grow to serve higher consumption demands, and ultimately increase their total ecological footprint.

The purpose of this chapter is twofold: to critique the current modality of environmental sustainability research being adopted in IS research as providing reasonable initial steps but needing more depth and weightiness to be truly transformative, and then to move from critique to constructive engagement by offering new entry points for IS research. This research suggests three areas into which IS research can be expanded:

- Matters of the scale of the phenomenon and the societal level of response,
- The measurement of impacts of organizational practice, and
- Designing adaptive management systems which enable organizations to learn from, and respond to, management responses to emerging threats to the environment and to better respond to the dynamic nature of environmental sustainability challenges.

IS researchers must avoid unreflectively adopting concepts from other disciplines and simply recreating the paradigmatic status quo of "business as usual." Instead we must "carefully and critically examine the conceptual foundations upon which our system and our reasoning are based" (Dourish, 2010, p. 8). We argue that the dominant approach to IS research in environmental sustainability is inherently self-limiting, because it has not challenged the dominance of productivity, cost reduction, profitability, and economic efficiency (Watson, Boudreau, & Chen, 2010) as the ultimate goals of human activity, and it provides a narrow scope with which researchers can engage the domain. As poet Stanislaw Lec asked, "Is it progress. . .if a cannibal uses a fork?" (Elkington, 1997, p. vii).

2 IS Sustainability Research

Although there is a wide range of "Green IS/IT" research in the IS discipline, a thematic survey of the role of HCI and sustainable development (DiSalvo, Sengers, & Brynjarsdottir, 2010) reveals a focus on information technologies as a mechanism of persuasion which can alter individual action, rather than a means of coordinating collective, political or regulatory activities. Recent IS literature has expanded this focus to encompass organizational strategies focused on the TBL framework, and defines IS for environmental sustainability as "IS-enabled organizational practices and processes that improve environmental and economic performance" (Melville, 2010, p. 2) or sees an opportunity for IS "to tackle sustainable development while improving productivity, reducing costs, and enhancing

profitability" (Watson et al., 2010). Other research at the organizational level of analysis includes a framework of IT-enabled business transformation (Elliot, 2011), the conceptualization of organizational sustainability portfolios (Hart, 1997), or creation of a set of eco-goals (DeSimone & Popoff, 1997; Gray & Bebbington, 2000). In examining these approaches, we agree with Dourish (2010) that there is a dearth of research that conceives of sustainability as a trans-disciplinary problem at different scales which goes beyond current practice or inspires changes to the traditional business orientation of much IS research.

For the purpose of critique, we subsume all the approaches to IS research on sustainability mentioned above under the TBL framework, as they all either implicitly or explicitly align with it. The framing imposed by the TBL which these studies adopt was first articulated as a method for organizations to assess their impact in three dimensions: environmentally, socially, and economically (Gibson, 2006). For many organizations, the TBL approach has become a synonym for "sustainability" or "sustainable development" and represents an ideal framework with which to contribute to the sustainability challenge. But rather than fulfilling Elkington's (1997) original desire that the TBL be a Trojan Horse which would lead to a broad understanding and vision of sustainability, the TBL is frequently a strategic logic for organizations, and is used primarily to enhance shareholder value, while attending to limited engagement with social benefits and perhaps a reduction in negative environmental impacts (Figge & Hahn, 2004; Hart & Milstein, 2003). This is fundamentally a financial orientation which prioritizes organizational economic well-being and assumes that environmental and social well-being are amenable to the same type of utility measures as economic success.

But as argued by Winsor (2001), the predominant discourse around sustainability constructs the relationship between financial, societal, and environmental values based on *organizational interests*. Vanclay (2004) further argues many organizations have succumbed to the use of the TBL as an accounting procedure which forgoes any deeper initiative to address the fundamentals of environmental sustainability. Second, he suggests that the measures of TBL are a naive and simplistic view of social and environmental impacts which obscure the true consequences of organizational activities on society and the environment.

Although an organization's performance is often measured in terms of profitability, an organization's impact on society and the environment are often temporally or spatially displaced. The dramatic focus on ever-increasing shareholder value and the frequent lack of immediacy of observed consequences make the undesired effects of organizational activity easy to ignore.

But the techno-managerial approach risks being "hobbled by an unflappable sense of technological optimism" (Hannigan, 2006, p. 26). The assumption that a transition from the polluting industrialization of the past can be based on a silicon-chip revolution that is ecologically neutral is by no means warranted. IS research must begin to address two significant issues:

- The logic by which "large scale phenomenon can be reduced to the aggregated effects of rational actors through self-interest" (Dourish, 2010, p. 2) privileges economic prosperity ahead of environmental sustainability or social justice, and reduces consideration of government regulation or collective action. The only stakeholders considered are the organization (and its investors) and the consumer. Nowhere is the environment considered a stakeholder in its own right.
- The linear mindset of designing IS to manage specific input–output processes without consideration of the dynamic and non-linear characteristics of the environmental systems that need to be sustained represents "current-next" thinking. This thinking assumes that the processes embedded in the system to achieve environmental goals are currently adequate and will continue to be adequate in the future. On the contrary, both environmental and social domains are changing with a range of anthropogenically induced environmental transformations already occurring. Although reduction of carbon footprints, energy consumption, and waste production are all critical, much deeper analysis of organizational impact on environmental factors such as biodiversity (Wilson, 1994), ecosystem services (Daily, 1997) and the influence of ecosystem economics (Hanley, Shogren, & White, 2007) must be included.

3 Defining Sustainability

As IS research moves into the realm of environmental sustainability, it is critical to recognize the multidisciplinary history and the variety of perspectives brought to the domain of inquiry. In this discussion, we focus on the concept of maintenance and stability of the natural environmental such that humans can live comfortably, and that plants, animals and ecosystems are not at risk from human activities. The term *sustainability,* and the notion of *sustainable development,* are claimed by many different actors who use the terms in many different social, political, environmental, and developmental contexts (Norton, 2005). The ambiguity of the term sustainability has become a major barrier in the organizational transition towards a society which exists within the means of the environment. For example the term "sustainable growth" is a term widely adopted by extraction industries and in land development. However if "sustainable growth" implies increasing resource consumption through usage of more land, more water, more food, and production of more "things" for more people, then the term itself is an oxymoron (Bartlett, 1994). When the term "sustainability" is used, it is necessary to be cognizant of what is being sustained and what the boundaries of the system are.

As in any scientific inquiry, it is important to avoid vague and ambiguous use of language. For system models of sustainability to have any legitimacy, it is critical to bound what is being sustained (the organization? the environment? the current global population?); how long it is to be sustained (decades or centuries?); and in what state the system is being sustained (continued organizational profitability? current rate of species extinction? current level of poverty and global health?).

Current organizational practices are sustainable if we are willing to accept the current rate of climate disruption, species extinction, and habitat destruction. It is a very different problem for techno-managerial perspectives like the TBL if the goal is sustainability for the billions of the world's poor people, much less the projected population increase, or a reduction in the current rate of habitat destruction and consequent loss of ecosystem services.[1] A system dynamic view reveals that it is clear that a reduction in the rate at which non-renewable resources are consumed will extend their lifespan, but at current rates of increasing use, the timeframe for many resources, such as oil, is in decades, rather than centuries.

A widely adopted definition of sustainability, drawn from the Brundtland Report (1987), states that sustainability is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." This form of *weak sustainability* assumes natural and man-made capital are substitutable with one another (Pearce, 1993) and asserts that sustainability can be achieved within a 'growth economy' while ignoring the dynamic that growth is intimately linked to environmental degradation.

In contrast, *strong sustainability* (Milne, Ball, & Gray, 2008), defines sustainability as a concept that entails a comfortable standard of living within the capacity of nature and that "sustainability implies that nature's capital should be used no more rapidly than it can be replenished" (Wackernagel & Rees, 1996, p. 34). In this paper, we adopt this concept of strong sustainability which emphasizes maintaining intact natural capital and recognizes that ecosystem services, such as clean water supplies, fisheries, CO_2 uptake by vegetation, and agriculturally productive soils, are non-substitutable and essential for the welfare of human beings (Pearce, 1993).

Advocates of the TBL model argue that it captures the essence of sustainability (Savitz & Weber, 2006) and is an effective framework in helping organizations to incorporate sustainability concerns into organizational accountability (McDonough & Braungart, 2002). This perspective suggests that the TBL is seen as a model that helps an organization to be "sustainable." Thus, when used in these parameters, sustainability refers to the ability of an organization to continue their operations in perpetuity or to "sustain" profits in the long term.

While acknowledging that frameworks like the TBL provide organizations with initial engagement in the sustainability agenda, it is also worth recognizing that the TBL prioritizes financial goals, enhancing profitability and improving productivity, and is unlikely to be effective in the "improvement of the natural environment" (Melville, 2010, p. 1), although attempts may be made to improve a human-degraded environment, such as in revegetation of mine tailings. Frequently, the pursuit of the TBL may lead to greater levels of *un*-sustainability (Milne et al., 2008). As organizational activities become more cost effective and efficient, and organizational growth remains a primary economic focus, population growth and

[1] "Ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life" (Daily, 1997, p. 3).

increasing consumption will drive organizations onto the treadmill of production and increase their total environmental footprint. A reduction in the rate of increase of energy utilization and resource consumption is worth pursuing, but if the goal is *environmental sustainability,* such a reduction will only serve to slow environmental decline.

4 Environmental Sustainability

To achieve strong *environmental* sustainability requires a radical change in the positioning of humans and social organizations regarding the environment. Human activities depend on healthy functioning ecosystems, and humans refashion environments both materially, as consequences to their activities, and cognitively, as they apply differing value systems and definitions to what they deem the "environment" (Woodgate & Redclift, 1998). There is no single "environment" that lies distinctly and unproblematically discrete and separate from human affairs, and thus different actors will construct different views of their environments in relation to their specific interests, cultural norms, historical trajectories, and local knowledge (Dourish, 2010). One challenge for IS is to "find a research approach that consciously reflects the nature of [productive activities] as the coevolution between culture and environment, both in the past and the present" (Gliessman, 1990, p. 8).

Environmental sustainability is often used to refer to a small set of measureable goals for organizational input/output impacts such as the reduction of energy consumption, reduction or reuse of waste, and reduction of CO_2 contributions. However, the demands of the macro-economic system and reified organizational goals pressure organizations toward growth and an overall increase, albeit more efficient, use of resources (Meadows, 1998). More importantly, organizational impacts go far beyond the limited environmental measures currently identified under many TBL frameworks in which environmental impacts can be externalized or traded off (Kondoh, 2009).

For IS research to contribute to *environmental* sustainability, additional areas of concern must be identified and addressed. For example, the biodiversity of life at the genetic, species and ecosystem levels, as well as the environmental or ecosystem services humans depend upon, are increasingly at risk as human and global change pressures intensify (Daily, 1997). The ecosystem services provided to human activities are themselves dependent on biologically diverse ecosystems. As the environment become degraded, the costs for these services are shifted to the organizations (and people) who consume them (e.g. the increasing need for hydrocarbon-based fertilizer for large-scale agriculture). Yet the role and stakeholder status of the natural environment, and the ecosystems supported by it are not represented in recent IS sustainability research models.

In the dominant research perspective, the environment is viewed as external to the organization and as something that "just is" that can be managed as any other

capital. Because the environment and the organization are viewed as separate, researchers tend to restrict the role of IS to managing the inputs from, and the outputs to, the environment. Indeed, the conceptual model of Watson et al. (2010) bounds the system model at the organizational boundary rather than extending the consideration of organizational impacts into the environment or society. For example, in stating that *suppliers* provide energy, the model implies that energy (e.g. oil, natural gas, coal, solar) can be extracted at *no cost to the environment*. This is an unwarranted assumption given the impacts of oils spills, organizational activities in oil extraction areas such as the Niger Delta, and the reported effects on groundwater supplies from practices such as hydraulic fracking.

To transition from weak to strong sustainability entails acknowledging that the *natural environment* itself meets criteria of power, legitimacy, urgency and proximity and becomes a stakeholder (Driscoll & Starik, 2004), not merely something that can be managed separate from the organization. A coevolutionary perspective acknowledges that people's "activities modify the ecosystem and how the ecosystem's responses provide cause for subsequent individual action and social organization" (Woodgate & Redclift, 1998, p. 13). Organizations transform the environment to fulfill such human needs as living space, raw materials, and the assimilation of human waste. But simultaneously, the natural environment constrains the activities of organizations and the opportunities of future actors because there are limitations to the availability of natural resources and ecosystem services. As the chain of connections between organization and the environment becomes more complex, sustainability becomes a large scale policy goal against the backdrop of social choice and environmental constraints.

5 IS Environmental Sustainability Research

Although a coevolutionary perspective and a deeper comprehension of the meaning of sustainability will help in the necessary transformation of thinking, there are research areas in which IS can directly contribute. The following sections briefly outline how IS research can address issues of scale, the problems of measuring environmental impact, and how the design of adaptive management systems can enable organizational learning.

5.1 A Matter of Scale

Building on sustainability research at the individual and organizational level, IS research can begin to explore the opportunities in problems of scale for information systems' support for networks of actors and environmental and political mobilization. The IS discipline provides a level of expertise in the creation, maintenance, and analysis of technical and social networks. As noted by Watson et al. (2010), the

scope of environmental sustainability is far beyond a single organization. Information networks can support the coordination and the interconnection of supply/demand networks. These same networks are invaluable in coordinating actions and in re-envisioning the scales at which people act upon, and in turn are acted upon, by the environment.

Social network research may continue to reveal how consumption choices can be altered and how collective actions by disparate groups can be supported. Dourish (2010) notes that alliances of groups with diverse concerns (e.g. recreational hunters working with wetlands conservationists; surfers aligning with water monitoring programs) can support similar strategic goals. Thus, in addition to supporting political persuasion, communication and coordination activities, IS networks could enable identification of interest alignment, thereby fostering large scale political mobilization. The ability to create and support networks of organizations will result in "significant changes in larger systems [that] requires building similar networks connecting many different organizations, and even different types of organizations" (Senge et al., 2008, p. 225). IS research into collaborative system-thinking and organizational learning for businesses and governments (i.e. Sustainability Consortium, World Business Council for Sustainable Development, Global Sustainable Food Lab) may enable systematic changes to core environmental problems (Senge et al.).

The application of spatial analysis and location-enabled data will be transformational in our understanding of how we, as a species, inhabit the world (Ellis & Ramankutty, 2008), and of our impacts on ecosystem services and environmental health. This may result in initiating changes in the social logic of consumerism and re-evaluating the definition of prosperity (Jackson, 2009). System dynamics perspectives on the interconnections among organizational activities and impacts will emphasize the need for recognizing limits, particularly the limits of environmental exploitation.

5.2 Measurements and Impacts

Although current exemplar problems posed for IS sustainability research are largely focused on energy consumption, resource and material usage, level of emissions, and waste management (Melville, 2010; Suggett & Goodsir, 2002; Watson et al., 2010) these are largely factors which pertain to *organizational sustainability*. Each organization is treated as an isolate with the view that if 1, or 100, companies reduce the rate at which their energy consumption is increasing, then environmental sustainability can be achieved. But this perspective ignores the dynamic nature of the natural world, changing ecosystems and environments, and the social world of increasing consumptive demands from a burgeoning population. Researchers must be careful to identify *ceterus parabus* assumptions and recognize that practices which may be sustainable for a global population of six billion people are unlikely to be sustainable for the mid-range prediction of 10.1 billion by 2100

(United Nations, 2011). Energy resources that are sustainable at a specified level of per capita consumption may not be sustainable as millions more people obtain cars, consumer electronics, and increase their material standard of living.

Although the TBL has been adopted by large organizations and business councils, environmentally meaningful implementation has proven problematic, because in many cases impact indicators have been oversimplified and watered down relative to assessment frameworks developed in the field of social impact assessment (Vanclay, 2004). IS research has significant expertise to offer in the domain of the development of measures and constructs, and the subsequent data collection, analysis and presentation. But the current business focus on sustainability does not leverage the considerable knowledge of state indicators from long standing research in social impact analysis, ecology, and the bio-geophysical disciplines. Thus with forward thinking, IS research approaches can become the nexus for reconciliation of impact assessment and the contributions to sustainability in a trans-disciplinary approach.

5.3 Designing Adaptive Management Systems

There is a marked need to monitor and learn from organizational sustainability initiatives. Environmental challenges are dynamic in nature, requiring management to respond accordingly. For example, the most important determinants in loss of ecosystem services and biological diversity involve land use change (habitat destruction) climate alteration, and biotic exchange or invasion (e.g. feral species) (Vitousek, Mooney, Lubchenco, & Melillo, 1997) all of which are occurring at increasing rates. Although global biodiversity challenges appear to be well-recognized, most indicators of the state of biodiversity show declines, even though responses in an attempt to reverse the trend are on the increase (Butchart et al., 2010). Individuals and groups of species operate within ecological structures and processes at different scales, and ecosystem behavior is non-linear in nature (Peterson, Allen, & Holling, 1998). Ecosystem management needs to be better understood, and knowledge of ecosystems better communicated for better recognition of their importance to society (Walker et al., 2002).

In response, ecologists, land managers, and conservationists have implemented adaptive management perspectives which can incorporate natural variance and non-linearity in emerging environmental threats, management interventions, and outcomes (Salafsky, Margoluis, Redford, & Robinson, 2001). Sound process models are seen as a core element of adaptive management (Rumpff, Duncan, Vesk, Keith, & Wintle, 2011), such as in the case of managing the re-introduction of endangered species (Armstrong, Castro, & Griffiths, 2007). The principles of adaptive management are quite similar to the build/evaluate cycle of design science research (Hevner, March, Park, & Ram, 2004) in that the goal is not merely to create a functional artifact or management plan, but to learn from the activity.

This requires significant monitoring and evaluation of the impacts of sustainability initiatives at a collective scale, rather than at the level of individual organizations.

IS sustainability research can expand on initial research on business process technologies, regulatory audit systems, and energy informatics, to ensure that organizations can learn from sustainability initiatives. The conceptualization of monitoring systems that enable learning by networks of organizations and which can support learning organizations (Senge, 1990) for the purpose of cooperation, rather than competition, will be crucial to modifying the dynamics of the organizational-environmental system.

6 Discussion

Sustainability is a systems concept incorporating spatial and temporal dimensions which require the collaborative effort of various entities and associations at the individual, local, national and global level. Despite the genuine efforts of organizations, many of their environmental and social initiatives are executed in isolation and do not demonstrate any significant contribution towards long term sustainability of the environment. Even if the ecological footprints of some individual organizations are being reduced, the collective ecological footprint of organizations is still increasing (Gray & Milne, 2002; Kondoh, 2009).

In this chapter, we have argued that although recent entries into sustainability research by IS researchers provide much needed initiative, IS research constrains itself by adopting an instrumental approach to environmental sustainability. The research emphasizes the management of a technological response through technical systems or business process management, rather than recognizing the substantive problems in reconciling the needs of a growth economy with increasing consumption by a larger number of humans living in a closed and resource-finite system. Such an approach may serve to slow the rate of increase in resource consumption and ecosystem and environmental degradation. But a reframing of the problem will result in a deeper engagement with the potential contribution of IS to issues of sustaining the collective environment, not only the viability of the individual organization. We have suggested three ways in which the IS community is uniquely suited to contributing to ongoing efforts in IS environmental sustainability research that correspond to matters of scale, measurements and impacts, and designing adaptive management systems:

- IS research can create new entry points which consider the political and regulatory levels of analysis, in addition to individual consumers and individual organizations. The IS expertise in the creation, maintenance, and analysis of networks is critical in coordinating actions and in re-envisioning the scales at which people act and are acted upon. Similarly, the application of spatial analysis will be transformational in our understanding of how we as a species inhabit the world, and of our impacts on ecosystems and the natural environment. This may involve changing the social logic of consumerism and

re-evaluating the definition of prosperity. It is also necessary to start recognizing the need for limits, particularly the limits of environmental exploitation.

- In addition to design of the technological artifacts to collect, store, analyze, and present environmental information, IS research can serve as a trans-disciplinary nexus for development of impact measures and reconciliation of target measures for environmental sustainability. Spatial information from geographic information systems will enable a much greater comprehension of the extent and temporal characteristics of a wide range of environmental impacts and organizational relationships. Utilization of the coevolutionary interactions of the environment and related ecosystem services and organizations provide a backdrop to understand possibilities and constraints within regional and global systems over time.
- The design research expertise of IS research can be applied to the innovation of adaptive management systems which enable organizations to learn from the management outcomes of environmental initiatives and responses to emerging threats. Organizational, political and regulatory responses must react to the nature of environmental sustainability challenges rather than assume that a given set of innovations or business processes will remain effective in a dynamic environment. Combining the build/evaluate approach with environmental adaptive management principles will enable both business goals and environmental values to be open to revision in the face of increasing experience.

As IS research seeks to contribute to the challenges of environmental sustainability, it is important that we not merely export the concepts of IS into a trans-disciplinary domain without careful reflection and appreciation of context. Senge et al.'s (2008) challenge to ground paradigmatic change in new ways of thinking and perceiving requires that IS researchers not recapitulate the business status quo which, in part, created the current environmental problems. By explicitly recognizing that people's actions, the impacts of organizations, and the environment are intertwined in a complex and evolving system, IS research can expand and shape the ongoing debate and contribute to the changes in fundamental values, beliefs, and models that will be required for humans to achieve a sustainable society.

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