

The Greening of IT:

How discourse informs IT sustainability innovation

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Abstract— We review three sociological theories of technology innovation and diffusion, which highlight the importance of discourses on the social shaping and trajectory of IT innovations. We consider how key concepts of each theory are applicable to understanding Green IT as an area of innovation. We highlight how these theories might inform action in this innovation movement to help guide the collective actions of participants in Green IT and areas of research on Green IT discourses that may prove beneficial.

Green IT, Computerization Movement, Organizing Vision, Innovation

I. INTRODUCTION

The Information Technology (IT) field (broadly defined) has become increasingly interested in how information technologies are impacted by and impact sustainability [7, 11, 18, 19, 23, 38]. The term “Green IT” is now a well-recognized buzzword [2] although what “green IT” actually entails is far from clear [4, 21]. Major IT producers have taken up the challenge of considering their own impact on sustainability and are positioning themselves to benefit from an association with Green IT through public good will and through offering service and product offerings [24, 29]. Academics, through research, conferences and publications, are rapidly joining this field [4, 7, 13, 21, 23, 28] as analysts, consultants and industry observers.

As Green IT becomes a widely heralded topic, are associated innovations likely to gain a significant following and to lead to meaningful improvements in economic and environmental sustainability? We suggest that understanding discursive processes that underlie the burgeoning movement for Green IT will help stakeholders who are engaged in developing or promoting innovations to plan and carry out effective actions. In this paper, we outline three areas of sociological theory (computerization movements, organizing visions, and collective action), which have developed through research on the interaction between

discourse and innovation. We consider how these theories are synergistic and highlight their relevance to Green IT innovations. We suggest research questions on the Green IT movement that these theories point to and discuss how such research might contribute to the development, promotion and implementation of effective Green IT innovations.

II. DISCOURSE AND IT INNOVATION

The theories we consider in this paper are part of a field of social science known as the *social construction of technology*, or SCOT [5]. A key assumption is that technology innovations cannot be fully understood without accounting for the social context of their development and use [25]. SCOT theories presume that technologies do not determine human action, but instead, they are designed artifacts of human agency and thus are shaped by (and shape) social, political and discursive processes. The theories we discuss here focus analytic attention on how discourses shape technologies, particularly in the early stages of innovation, as ideas about possible uses and consequences of a new technology are debated and shared understandings may emerge [20, 34].

A. Computerization Movements

Kling and Iacono [22, p. 228-9] define a computerization movement as “a kind of movement whose advocates focus on computer-based systems as instruments to bring about a new social order ... based upon collaborations of participants with diverse interests.” A computerization movement relies on broad claims about the social value of computerization, such as improved efficiencies, communication, and even democracy and generally is utopian regarding the inevitable positive outcomes of computerization [14, 43].

The concept of a computerization movement draws from theories on discursive processes in social movements. Benford [3, p. 615] explicates how adherents of a social movement “negotiate a shared understanding of some

problematic condition or situation they define as in need of change, make attributions regarding who or what is to blame, articulate an alternative set of arrangements, and urge others to act in concert to affect change.” Three types of *collective action frames* arise within social movements [3]: *diagnostic frames* focus attention on the societal problem(s), *prognostic frames* focus on possible courses of change and improvement, and *motivational frames* associate values with engagement in the social movement. The development and elaboration of collective action frames are typically contested processes, in which various actors attempt to shape the movement according to their own views and interests.

Extending their earlier work, Iacono and Kling [20, pg. 94] claim that computerization movements “are similar to other social movements such as the labor movement or the woman’s movement in the ways that they reject dominant cultural codes and package alternative beliefs, values and language for new, preferred forms of social life.” They define a *technological action frame* (a type of collective action frame) as a multi-level composite understanding, expressed and circulated in language. Technological action frames legitimize investments in an innovation (beyond IT vendors’ promotion) and posit how the technology innovation would work and how the future would be different with its widespread adoption. Public discourses that promote, interpret, and report success stories with a technology innovation are essential to a computerization movement. Over time, the beliefs and views of the movement may become incorporated into organizational practices, as firms adopt the innovation. Studies have been conducted to examine computerization movements in various fields [12], such as computerization in the mortgage processing industry [26], but questions remain about how to evaluate the “success” of computerization movements in fostering innovation diffusion.

B. Organizing visions

A theoretic approach that also emphasizes the importance of discourse in IT innovations is the organizing vision framework articulated by Swanson and Ramiller [34, p. 460]: “An organizing vision is a focal community idea of the application of information technology in organizations ... a vision for organizing in a way that embeds and utilizes information technology in organizational structures and processes.” An organizing vision draws together ideas about how organizational practices could be altered, given the adoption of a core set of technologies, in terms of organizational roles, responsibilities, relationships, lines of authority, control mechanisms, work processes, and so on.

An organizing vision develops early in the emergence of an innovation and may persist through the initial stages of its diffusion, as vendors, customers, users, and other innovation participants attempt to understand what the innovation actually *is* or *could be* [34, pg. 461-3]. The development of an organizing vision is generally marked by

“buzzwords” and metaphors around which the vision takes shape. For example, the metaphor of “data warehousing” suggests how database and network technologies could be used to alter how business reporting is accomplished in organizations [9]. An organizing vision provides a social account of an innovation’s usefulness and application, making it easier for decision makers to decide whether or not to participate. It legitimizes the innovation in relation to broader discourses in the organizational context, such as the pursuit of greater efficiency, customer service, or improved decision-making. Importantly, the organizing vision helps mobilize the market place, as various participants create forums to discuss and develop ideas about the innovation, such as trade shows [40] or mass media outlets [41].

In contrast to the societal-level focus of the computerization movement framework, the organizing vision framework adheres more closely to the organizational field that develops around the production, diffusion and use of an IT innovation. Wang and Swanson [40] highlight the importance of institutional entrepreneurs, who help legitimize an innovation and mobilize the resources needed to bring an innovation from concept into widespread use. Wang and Ramiller [42] assess how the discourse related to an innovation evolves, from interpretations of what the innovation actually is, to “knowing how” the innovation may be implemented and used, for example, through case reports of user experiences and consultants’ commentary.

The organizing vision framework highlights the trajectory, or “career” of an organizing vision, noting that the vision may rise or sink depending on the progression of related organizing visions and the success (or failure) stories that become part of the discourse, as organizational experiences with the innovation are publicized. The viability of an organizing vision to promote the diffusion of an innovation may be characterized by its interpretability, plausibility, importance (in terms of business benefit, acceptance, market interest) and discontinuity (conceptual and structural) [32].

C. Collective action and institutional innovation

An innovation is, by definition, new and different. Yet, in contrast with invention, innovation typically results from the collective actions of many individuals and organizations [1]. Collective action is required when individuals, groups, or firms do not have the resources, power, or legitimacy to develop or mobilize an innovation on their own [17]. Technological innovations develop through a political process in which actors contributed to a larger solution by recombining their practices and technologies, while addressing each actor’s self-interested goals.

Collective actions surrounding significant innovations are often associated with institutional changes, ranging from micro-level interactions (individual level) to macro-level structures (e.g., field or societal level). Combining insights from the social movements and technological change management literatures, Hargrave and Van de Ven [17, p. 877] articulate a collective action model of institutional

innovation “based on a dialectical theory of change in which opposing actors in the organizational field frame issues, mobilize collective actions, and engage in contested processes in order to achieve material improvement, be it technical or social.” This model emphasizes the importance of conflict, power, and politics in explaining institutional innovation.

The term *collective action* has several implications when applied in theory. A collective action occurs when two or more individuals work to produce a *public good*. A *public good* is one whose use cannot be restricted to only those who act to produce it; use of the public good, while perhaps requiring regulation, does not diminish and may even enhance the public good [6]. A common example is a public park. Though some individuals work to create the park, all users may take advantage of it, and its value is not diminished through this use (assuming responsible behavior and some regulation on utilization). In the domain of IT innovation, technology standards result from collective action among networks of self-interested but cooperative actors [26, 27]. While standards become a public good and widespread use has been viewed as positive for development of a marketplace, their negotiation is characterized by political and economic contention [17].

Collective action is essentially communicative in nature [6, pg. 374]: “Three basic functions are requisite to all collective action: (a) a means of identifying people with relevant, potential interests in the public good; (b) a means of communicating messages commonly perceivable among them; and (c) a means of coordinating, integrating, or synchronizing their contributions.” Use of new media may facilitate organizing collective actions, with less need for formal organization. Flanigan et al. [15, pg. 34] describe a “collective action space” as having two dimensions. One is the *mode of interaction*, or how individuals interact with each other to engage in collective action. At one end of the continuum is *personal, direct interaction* where members are known to each other and close relationships exist. At the other end, *impersonal interaction* “involves no personal, direct interaction with known others. Consequently, individuals remain largely unknown to each other in spite of their shared affiliation.” Collective action may also vary in *mode of engagement among participants* [15, p. 37]. In entrepreneurial engagement, participants have a high degree of autonomy and conduct collective action in ways that are not controlled by a central authority or bounded by the constraints or rules of action associated with an organization or group. At the other end of the continuum is institutional engagement, characterized by formal bureaucracies, which develop policies and standards and in which members follow the rules of the leaders or center.

D. Commonalities and key concepts

These sociological theories are descriptive and explanatory. That is, they provide an array of concepts and associations that inform our understanding and can guide research to

help explain social and technological outcomes. These social constructivist theories are not predictive, but, by highlighting how actions may influence outcomes, they do suggest how action might be guided to achieve particular, desirable outcomes.

There are notable overlaps and synergies among the three sociological theories of innovation outlined above. First, each theory emphasizes the *heterogeneous communities* that participate in an IT innovation and related discourse, and in the *mix of cooperation and competition*, even contention, that are likely to result, as self-interested entrepreneurs, IT vendors, service providers, customers and so on attempt to shape the direction of the innovation in ways that are most favorable to their own efforts. The computerization movement literature characterizes dissent in terms of counter-movements [20, 22] whereas the organizing vision framework suggests conflicting goals are inherent in innovation communities. Similarly, the collective action model of institutional innovation focuses on *issues of power and conflict* among the network of actors who engage in creating or revising an innovation and in the institutional arrangements that develop to support an innovation [17].

Second, each theory draws attention to *discourse* [30] and *communication* in the *social shaping of IT innovations*. The computerization movement framework focuses on *broad public discourses* that promote computerization generally. The organizing vision framework explicates how discourses develop from but also shape innovation communities in *organizational fields*. Recent theorizing about collective action [6, 15] highlights the ways in which *new media* may facilitate communication within *social movements* associated with an innovation through various *strategies* for engagement in the innovation.

III. HOW DISCOURSE INFORMS GREEN IT INNOVATION

Discourses reflect social and technological change, but they also help shape these changes [30]. Discourses related to Green IT are growing rapidly, and a variety of actors are engaged in it, including IT vendors, consultants, customer firms, academic researchers, and commentators of various types. “Green IT” represents an emerging field at the intersection of the environmental sustainability movement and the proliferation of modern information technologies. Broadly speaking, the term “Green IT” has at least two meanings. On the one hand, numerous opportunities exist to use IT to address environmental issues. On the other hand, significant efforts have been taken to make the development and use of IT more environmentally sustainable. Taking these two aspects of Green IT together, if we consider IT as one of the many sectors of our society, then it is proper to say that “Greening of IT” is a *subset* of “Greening through IT,” because the potential environmental benefits enabled by IT may be realized in both IT and other sectors.

How can the sociological theories outlined above, which focus research attention on discourses of innovation, help individuals or groups to engage more effectively with Green

IT? In the following discussion, we highlight how these theories and related concepts may inform our understanding of how Green IT is developing as an area of innovation, and we suggest areas where research in the Green IT field, focused on discourse, might provide useful guidance to innovators and promoters of Green IT innovations.

A. *Green IT as Computerization Movement*

Green IT is part of the broad social movement focused on environmental sustainability. In this movement, technology developments (so-called “green technologies”) are often promoted as solutions to environmental constraints. Green IT may be characterized as a computerization movement (CM), which advocates widespread investments in IT to address sustainability [2, 18, 24]. IT use can be seen as well as contributing to environmental problems, for example, hardware electricity use and consumption of natural resources to produce consumer electronics, which rapidly become obsolete and are disposed of [18]. *Green IT* is theorized as a solution to some of these IT-related problems, for example, energy-efficient server technology [13]. Moreover, increased use of IT is theorized to reduce environmental resource consumption generally, such as paper for printing and gasoline use by telecommuters [2, 38].

Although we can recognize such arguments readily as they circulate in public discourses, analyzing the technological action frames of the Green IT computerization movement explicitly could highlight opportunities for guiding or promoting Green IT. Such analysis would not be purely academic exercises and would delve deeper than marketing and public relations promotions. For example, what are the prevailing arguments for Green IT evident in diagnostic frames? Are sustainability problems defined narrowly as the need to reduce power consumption or more broadly, such as reducing, reducing, and recycling all forms of IT? What types of actors promote different framings of the problems, and what contests and conflicts do various framings suggest? Do IT hardware vendors promote replacement of hardware with more energy-efficient models (prognostic framing), without consideration of the “carbon footprint” that such replacements might entail (alternative prognostic framing)? Energy efficiencies can easily be linked to firm-level cost reductions (motivational framing) whereas consideration of the carbon footprint of new IT acquisitions may call for a different level of social accountability of both customers and IT vendors (alternative motivational framing) and may question whether increased spending on information technologies is necessarily a social good (alternative diagnostic and prognostic framing).

Examining the diagnostic, prognostic and motivational frames of the Green IT CM can help surface conflicting values and interests among various actors and the specific Green IT solutions they promote. Doing so may require surfacing deeply embedded assumptions and challenging some widely-held values, for example, the extent to which for-profit firms should be held accountable for the long-term societal and ecological costs of their actions. Diverse diagnostic and prognostic frames in the Green IT CM may need to be re-framed and addressed through public policy or

educational program. For proponents of the Green IT computerization movement, frame analysis may point to opportunities for innovations in technology or technology use practices that could help bridge diverse frames or to the need for collective actions to promote a broader, shared motivational frame to bridge diverse interests.

B. *Organizing Visions for Green IT*

An organizing vision forms around a core set of technologies and their possible integration with organizational practices to address acknowledged business problems. What, however, are the “core technologies” of Green IT? What are the organizational practices that are implicated, and what organizational problems are addressed? Does the buzz word Green IT present one diffuse organizing vision, ranging from efficient computer servers to e-waste recycling programs or even telework? Or, is Green IT simply a legitimizing buzzword that diverse organizing visions, such as server virtualization or cloud computing, have latched on to? Examining the dynamics of the discourse around various Green IT organizing visions may highlight potential problems with sustained adoption of an innovation as well as opportunities for better positioning specific innovations.

Energy-efficient servers and software for server virtualization are core technologies clearly linked to a vision of Green IT [13, 18]. In this narrow organizing vision, energy efficiency and cost reduction are the business problematic to be addressed, primarily through new technology. However, a narrow organizing vision may limit the potential impact of Green IT. Organizational decision-makers may be satisfied with achieving the “low hanging fruit” of power savings, and lose motivation to pursue more extensive innovation, which may be harder to justify in simple economic terms. Too narrow a vision may fail to motivate engagement with the innovation at all, if potential adopters find the Green IT organizing vision insufficiently distinctive or motivating to pursue, given other investment opportunities that have similar cost-benefits at the firm level [39]. A consequence for Green IT innovation is that technology and organizational support structures may fail to develop and market interest may wane [35].

Also important is that an organizing vision helps to mobilize a variety of participants in the innovation. A narrow vision of Green IT may fail to recruit innovators or users to the marketplace or may dismiss promising innovations. For example, videoconferencing facilities have long been associated with expectations of reduced costs due to travel. As personal videoconferencing on mobile devices such as cell phones and tablet PCs rapidly diffuses, should the CIO be promoting firm support for these technologies and practices as part of a grander vision for Green IT?

On the other hand, overuse of a buzzword like Green IT can discredit the organizing vision as implausible or too great a discontinuity with current technologies and organization practices [32]. The organizing vision for “cloud computing” [16, 37] has been linked with the legitimizing claims of Green IT, yet, thus far, there is no clear evidence that cloud computing is environmentally friendly, due to the likelihood that consumption of computing may skyrocket

with ease of access, despite reduced energy consumption per transaction [8, 36]. If cloud computing (or various instances of it) are shown to be environmentally unfriendly, claims about sustainability of both organizing visions may be discredited.

For individuals and groups interested in Green IT, the organizing vision framework highlights possible avenues for engagement in the discourse surrounding this innovation. For example, some may focus on the ways in which the Green IT organizing vision is interpreted, challenging overly narrow [33, 35] or overly broad claims [8, 36]. Experiential reports and case studies help diffuse “how to” knowledge [18, 28, 42]. Assessments of how potential adopters perceive the organizing vision [32] can help to identify public relation strategies to address misperceptions or encourage new perceptions. Clarifying the boundaries and overlaps among the many IT organizing visions that clamber for attention can also help innovation community participants to adjust their own activities, claims and position, so that Green IT ventures are themselves sustainable.

C. Collective action, institutional innovation and Green IT

Substantial and sustained technological innovation involves a community of actors [1, 17]. A number of sub-communities are forming within the Green IT movement, with varied goals and participants. For instance, some Green IT sub-communities are composed primarily of IT vendors and associated service providers, who “package” and deliver technologies and services for customers [29, 31]. Other sub-communities focus on articulating and promoting Green IT concepts and practices generally and on providing educational resources and outlets [18, 19, 28, 38]. Still others are engaged in Green IT primarily as pundits, for example, the bloggers, pundits, trade press and other industry watchers, who report on developments among vendors and their customers [2, 8, 10, 35, 36]. Individuals and organizations may be involved in multiple communities, whose goals and roles may overlap and which may be complementary or competitive.

The collective action space concept [15] is useful to categorize Green IT sub-communities and their collective action strategies. We briefly consider the possible space for collective actions among academic and industry researchers as an example of the types of analyses that might be done for other Green IT sub-communities. Table 1 illustrates these categories and suggests examples.

First, individuals or organizations may act *entrepreneurially* to establish programs or projects that promote the use of Green IT or which educate students and community members. Such activities tend to draw together individuals who share common values and who can work closely together, for example, members of a department or a faculty member and student club. Personal networks may be extended and become more formally organized, for example, in the formation of special interest groups within an academic community. Such groups then become *formal organizations and bureaucracies* that communicate and coordinate among participants. The First International Workshop on Green Enterprise and Commerce

(<http://intelligent.pe.kr/GreenCom11/>) and the research track on Green IT and Green Supply Chains at the 13th IEEE Conference on Commerce and Enterprise Computing’s (<http://www.tudor.lu/cec2011>) are examples of this “space.” Recent work on collective action theory suggests that individuals (or groups) also can act *entrepreneurially* but also impersonally, that is, beyond their personal networks to others interested in (or potentially recruited to) the Green IT movement. In these instances, personal interaction is not required for collective action to occur. Pundits and commentators engage in these types of strategies, for instance, publishing “how to” books” [2, 38] and maintaining blogs focused on Green IT [8, 35]. As these activities are formalized and brought under the control of formal organizations and bureaucracies (such as journals or mass media outlets), contributions to collective actions become less entrepreneurial, and may still require little personal interaction. Examples might be public forums held to educate and inform practitioners about Green IT.

TABLE I. THE COLLECTIVE ACTION SPACE FOR GREEN IT

Mode of Interaction	Mode of Engagement	
	<i>Entrepreneurial/ individual autonomy, little or no central control</i>	<i>Institutional/ formal organizations and bureaucracies</i>
<i>Personal/ direct interaction</i>	<ul style="list-style-type: none"> • Individuals’ effort to develop Green IT curriculum • Localized Green IT programs/projects 	<ul style="list-style-type: none"> • Networks and special interest groups • Collaborative research project • Green IT conferences and workshops
<i>Impersonal/ little direct interaction</i>	<ul style="list-style-type: none"> • Green IT blogs • Publications such as “how to” books 	<ul style="list-style-type: none"> • Journal special issues on Green IT • Public service announcements on Green IT

Table 1 depicts collective action groups and strategies placed discretely in a “box,” but the concept of collective action “spaces” [15] allows that each form of collective action, that is, each strategy, may draw from, depend on, and support other forms of collective action. For example, writing “how to books” for Green IT depends on an audience to consume the book (if the authors hope to be financially compensated). Educational courses and programs are one potential audience, and the individuals who organize new programs can take advantage of these materials in curriculum. Importantly for academic researchers, the emergence of organizational forums and institutional channels for Green IT research publications will help legitimate this sub-field and mobilize others to participate in Green IT research and innovations. Finally, we anticipate that collective actions around Green IT will cycle through personal to impersonal modes of interaction and back, as small groups form and undertake localized actions, these actions are leveraged and extended to wider communities, which then spawn new localized activities.

We developed this example for one segment of the Green IT community. Sub-communities are developing globally across industries and fields of practice. This type of analysis

could be conducted for other sub-communities, for example, among vendors and their customers generally, in specific industries, and in different national settings. Doing so might help Green IT innovators to recognize “empty spaces” within and across sub-communities, where different forms and forums for collective action, utilizing a variety of communications channels and media, might be beneficial. As sub-communities take shape and develop, they tend to drift apart, as each commits to different technological solutions or institution innovations [17]. It is possible that Green IT sub-communities will drift apart and barriers to communications between them will develop – or that various local efforts will never realize opportunities for coordination – limiting the prospects for synergistic collective actions. For collective actions to occur, there must be a means of identifying interested participants, communicating among them, and coordinating and synchronizing contributions [6]. This is true within a collective action group and also across groups. In addition to formal organizations, Web 2.0 and social media are widely heralded to foster communications in just these ways, suggesting that Green IT innovators and communities will need to move beyond traditional and accepted formal forums to build communication in these new media channels.

IV. CONCLUDING REMARKS

In this paper, we reviewed three sociological theories within the tradition of the social construction of technology domain, each of which points to the importance of discourse on the emergence, development and sustainability of technology innovations. Each theory outlines theoretic concepts and areas of possible research to aid the community of scholars who are interested in this area to better understand Green IT as a social and technical arena of innovation. We have suggested that these sociological theories would be valuable to researchers studying Green IT as a socio-technical phenomenon, as well as to researchers and others involved in the important work of Green IT innovation promotion and diffusion.

Understanding Green IT as a computerization movement, in which various organizing visions are taking shape, can help us to articulate our understanding of the social and institutional contexts, which will largely determine the trajectory and impact of this field of innovation. Such analyses would highlight the social values and business incentives for sustained Green IT innovation, as well as the communities and networks of innovations, working in collaboration or competition, to do so. Bringing to the foreground the collective action strategies through which Green IT will be implemented (or not) by various sub-communities can help us to organize and leverage strategies for action, as well as to assess which strategies are effective and how various strategies might work synergistically. We hope that this paper contributes to a common ground to articulate strategies to help bridge the communities of organizational, information systems, and computer scientists who are engaging with Green IT.

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