2012

Applying King et al.'s taxonomy to frame the IS discipline's engagement in green IS discourse

Craig M. Parker
School of Information Systems, Deakin University, craig.parker@deakin.edu.au

Rens Scheepers
School of Information Systems, Deakin University, rens.scheepers@deakin.edu.au

Applying King et al.'s taxonomy to frame the IS discipline's engagement in green IS discourse

Craig M. Parker
Rens Scheepers
School of Information Systems
Deakin University
Melbourne, Country
Email: craig.parker@deakin.edu.au, rens.scheepers@deakin.edu.au

Abstract

This paper considers how the IS discipline can engage with discourse on the institutions and their interventions which influence and regulate green IS innovation. To consider possible responses, we apply King et al.'s (1994) taxonomy, based on Institutional Theory, to frame a research agenda to guide future exploration and debate on the interventions to facilitate green IS innovation. Through the application of the taxonomy, we derive several pertinent questions for the discipline to consider as part of this debate. We conclude that the IS discipline can, and indeed should, play a more prominent role both through traditional responses (e.g., descriptive studies of green IS methodologies, organisational best practice, maturity models, etc.), but also through more active engagement in the form of participation and advocacy in shaping future green policy and regulation.

Keywords

Green information systems, institutional interventions, innovation, environmental sustainability

INTRODUCTION

There have been calls by leading scholars (e.g. Elliot 2011; Melville 2010) for the IS discipline to research the nexus of IS, organisations and the environment because humans and our (business) activities have a negative environmental impact. They advocate exploring: 1) how organisations can reduce the negative impact of their IS infrastructure; and 2) how organisations can use IS to reduce their (and/or encourage their stakeholders such as consumers to reduce their) impact. We use Watson et al.'s term "green IS" because it encompasses both and define it as the *"… integrated and cooperating set of people, processes, software and IT to support individual, organisational, or societal goals…"* (Watson et al. 2010, p 24) of achieving net environmental improvement.

Green IS innovation has already occurred judging from emerging scholarly publications (see review in Bengtsson and Agerfalk 2011). We define IS innovation as ideas (e.g. IS strategies, business-IS strategic alignment and business models), practices (e.g. systems development methodologies and IS management approaches) and objects (e.g. IS artefacts and modules) used in a novel way by IS academic or practitioner communities (adapted from Lyytinen and Rose 2003; Rogers 2003). For example, scholars are exploring how organisations can: green their IS infrastructure (e.g. Molla et al. 2011); use IS to achieve green objectives (Molla and Abareshi 2012), comply with green regulations (Butler and McGovern 2012); and communicate green reputations to stakeholders via websites (Parker et al. 2010). Our discipline is exploring the challenges with and methods for designing green IS given the stakeholder complexities and inconsistencies between their knowledge domains (Fernandez et al. 2009). While not an exhaustive list, these highly diverse examples raise the question of whether interventions are needed to facilitate the emergence of green IS innovation. For example, does the IS community have the needed knowledge for effective green IS innovation? If not, what interventions ares needed to facilitate this knowledge building and which stakeholders should initiate the interventions? How, if at all, should IS scholars contribute to debates around the development of interventions which directly or indirectly facilitate green IS innovation?

The major contribution of this paper is to apply King et al.'s (1994) taxonomy, based on Institutional Theory, to determine its suitability as a lens for framing a future IS research agenda to guide exploration of institutional interventions to facilitate green IS innovation. In particular we explore whether the taxonomy can be applied to frame questions for our discipline around the debates and nature of future research relating to interventions to facilitate green IS innovation. Other IS scholars have developed frameworks to guide future green IS research but their valuable work focuses on research questions or propositions associated with organisational (e.g. Bose and Luo 2011; Chen et al. 2008; Elliot 2011) and supply chain level green IS innovation (Dao et al. 2011; Watson et al. 2010). Like Melville (2010) we instead look at future research directions for the IS discipline (including academics and practitioners) as a whole relating to green IS innovation. The unique contribution of

this paper therefore is to examine the suitability of King et al.'s taxonomy to frame questions around the scholarly debates and research which is needed concerning green IS innovation.

The paper is structured as follows. We first outline the key concepts underlying King et al.'s taxonomy (classifying IS innovations, institutions which can effect interventions, the types of institutional influences, and the types of interventions) and apply these for a green IS context. We then apply the four quadrants of King et al.'s taxonomy, and the associated interventions, for a green IS innovation context and pose examples of the IS discipline-wide questions which emerge. We next discuss the suitability of the taxonomy for framing a future research agenda relating to green IS innovation. We end the paper with some final concluding remarks.

KEY CONCEPTS UNDERPINNING KING ET AL.'S TAXONOMY

We chose King et al.'s (1994) taxonomy of institutional interventions in IT innovation for two reasons. First, Institutional Theory (from which King et al. derive their taxonomy) offers concepts for explaining the complex interrelationships among members of a social system (or institution) and the interventions which can change the behaviour of its members (Scott 2008) such as adoption of innovations. Further, Institutional Theory and King et al.'s work have been used by green IS researchers to investigate the institutional interventions facilitating adoption of green IS innovations by individual organisations (e.g. Chen et al. 2010; Chen et al. 2008) or by the IT manufacturing sector (Butler 2011). None of this prior work, however, has applied King et al.'s taxonomy in its entirety to frame a green IS research agenda. Second, we anticipated the taxonomy would offer a useful lens to frame questions for our discipline around the debates and nature of future research relating to interventions which can facilitate green IS innovation because of its similar use in other IS contexts (e.g. Brown and Thompson 2011). In the following sections we adapt to a green IS context the key concepts and terms which King et al. use and which form the basis of their taxonomy of institutional interventions facilitating IT innovation.

Green IS innovation

In this section we clarify the types of green IS innovations which institutional interventions could facilitate using Lyytinen and Rose's (2003; see also Swanson 1994) IS innovation categories: base innovations; systems development processes; and services. Ijab et al.'s (2010) green IS framework offers further insights into the latter two categories because they map ***where*** to inscribe green values in IS against the IS lifecycle: pre-use (systems development), use (services) and post-use (green outcomes). This gives rise to green IS innovations such as new IS (or modules) designed to achieve green outcomes, new uses of IS not originally designed for green outcomes but appropriated to achieve green outcomes, and uses of IS where both designers and users do not intend green outcomes but new green outcomes are achieved nonetheless. Table 1 lists examples of green IS innovations.

Table 1. Categories of green IS innovation

Category	Description / examples from the literature
Base green IS innovations	Innovations to hardware (e.g. DesAutels and Berthon 2011; Molla et al. 2011) and networks (Pernici et al. 2012) to reduce their environmental impact; to data processing, storage and visualisation methods due to difficulties (e.g.) with codifying, integrating diverse sources of and handling volumes of green information (Huang and Chang 2003; Shaft et al. 1997); and to hardware/software to enable environmental monitoring and green IS service innovations.
Green IS systems development innovations	Innovations to systems analysis-design (Zhang et al. 2011), programming (Capra et al. 2010; Huang 2009) and IS infrastructure sourcing, maintenance, deployment and governance methods (Molla et al. 2011) to reduce the environmental impact of IS infrastructure. New methods to: manage/monitor/measure IS infrastructure impact (Molla et al. 2011); manage diverse stakeholder needs and information interpretation during green IS analysis-design (Fernandez et al. 2009); and identify new green IS service innovations (or systems requirements).
Green IS services innovations	New (or changes to existing) IS to enable stakeholders to reduce the impact of their services/ products/processes (Ijab et al. 2010; Pitt et al. 2011) or to create new green products/ services; new uses and integrations of existing IS (Ijab et al. 2010) to achieve green outcomes; and new IS or uses of existing IS leading to new green knowledge. Novel alignments of business, green and IS strategies (Pernici et al. 2012).

Institutions influencing green IS innovation

Given the range of green IS innovation possible (see Table 1) we could expect there to be various institutions with a vested interest in introducing interventions which facilitate green IS innovation. King et al. provides a non-exhaustive list of potential institutions which can influence IT innovation. We use Scott's (2008) framework—the Three Pillars—to identify organisational institutions based on Institutional Theory and apply it to a green IS context (after Butler 2011) to identify examples of institutions which may influence green IS innovation. Institutions are social structures (e.g. governments, organisations, markets) which evolve,

have/reach stability and offer meaning to members through regulatory, normative and/or cultural-cognitive influences (Scott 2008).

The regulative pillar indicates that an institution can introduce rules, laws and other regulative mechanisms which exert coercive, legally sanctioned influence so that its membership behaves in a particular way (Scott 2008). Governments and global agencies are examples of institutions with this type of influence. Butler (2011) provides examples of various regulations which have influenced base green IS innovations. Organisations can also introduce rules (e.g. policies, procedures) which regulate the behaviour of staff (Chen et al. 2008) and trading partners (Dao et al. 2011), including the production and use of green IS innovation. Professional, trade and industry associations could also make membership contingent upon achieving/using green IS innovation.

The normative pillar indicates that an institution can introduce certifications, accreditations and other voluntary mechanisms to enable its members to demonstrate they are meeting the moral obligations and expectations of the social structure (Scott 2008). In addition, institutions can shame members which are not conforming to these conventions. The institutions mentioned earlier can use these mechanisms, but other institutions such as religious institutions and special interest groups (e.g. the St James Ethics Institute, Australia which administers the Global Reporting Initiative) can also introduce such voluntary mechanisms (see also Butler 2011). Educational institutions can also have a role in providing certifications and accreditations.

Finally, the cultural-cognitive pillar indicates that an institution (e.g. competitive market) can influence behaviour due to the shared beliefs and practices (e.g. best practice, traditional practices, market forces) which develop and are then mimicked by other members (Scott 2008). In the context of green IS Butler (2011) gives the example of social movements facilitated by organisations such as Greenpeace which raise consumer concerns about the environmental impacts of IT are encouraging base green IS innovation by IT manufacturers. Butler also explains that as more organisations (which King et al. call trend-setting firms) include green objectives in their business/IS strategies and/or green qualities in their products/services, others will mimic these new shared beliefs.

Dimensions influencing the role of institutions in green IS innovation

The three pillars, and King et al., suggest that the interventions which institutions can use to facilitate green IS innovation will depend on whether the institution wishes to: 1) **influence** or **regulate** (mandate) innovation. An institution can influence by using interventions underpinned by the normative and cultural-cognitive pillars, but it can alternatively (or in addition) regulate using interventions underpinned by the regulatory pillar of Scott's (2008) framework; and 2) increase the **supply-push** of or the **demand-pull** for IS innovation. *"Supply-push force for innovation comes from the production of the innovative product or process itself. Demand-pull force arises from the willingness of potential users to use the innovation… [B]oth are required for innovation…"* (King et al. 1994, p. 149). Table 2 below applies these two dimensions for the green IS context and shows that combining the dimensions results in four quadrants of institutional roles which can facilitate green IS innovation.

Table 2. Dimensions influencing institutional roles in green IS innovation

	Supply-push	Demand-pull
Influence	Quadrant I (Influence-supply-push) Interventions which (in)directly encourage the production of green IS innovations by IS producers.	Quadrant II (Influence-demand-pull) Interventions which (in)directly encourage stakeholders to seek green IS innovations. This creates demand for IS producers to produce green IS innovations.
Regulation	Quadrant III (Regulation-supply-push) Interventions which (in)directly mandate the production of green IS innovations by IS producers.	Quadrant IV (Regulation-demand-pull) Interventions which (in)directly mandate stakeholders to seek green IS innovations. This creates demand for IS producers to develop green IS innovations.

We explore specific green IS examples of the interventions in each quadrant later, but Table 2 implies two terms require distinction: "green IS producers" on the supply-push side; and "green IS users" on the demand-pull side. Table 1 suggests that green IS producers include IS academics and practitioners (e.g. developers, consultants, software houses, IS departments) who are not the end-users, while green IS users by contrast would be those individuals, organisations and communities which would adopt green IS innovations or appropriate existing IS to achieve green outcomes. Later in the paper we raise questions about this distinction.

In the next section we summarise the major types of interventions which institutions can use, and which intervention categories fall into each quadrants from Table 2. Both form the basis on King et al.'s taxonomy.

Categories of interventions to facilitate green IS innovation

King et al.'s taxonomy includes six types of interventions which can be used by institutions to influence IT innovation. Table 3 applies each intervention category to the green IS context. King et al.'s taxonomy assigns each intervention category to the four quadrants as shown in Table 4. The link between the intervention category and the quadrant is important because, as will be explained in the next section, each intervention type is interpreted differently by King et al. based on its quadrant.

Table 3. Categories of interventions to facilitate green IS innovation

Intervention category	Description
Knowledge building	Interventions stimulating the production of the substantive base of scientific/technical knowledge which is required so that producers can engage in green IS innovation.
Knowledge deployment	Interventions stimulating the dissemination of new knowledge (from individuals, organisations, repositories) about green IS innovation, including knowledge gained by producers and users from learning-by-doing.
Subsidy	Interventions focusing on specific green-related purposes or innovation outcomes, whereby an institution uses its resources/authority to reduce the costs or risks associated with 1) producers engaging in green IS innovation or 2) potential users demanding green IS innovations.
Mobilisation	Interventions encouraging potential users to demand green IS innovations and to think about these innovations in a specific way.
Standard setting	Interventions constraining the options for producers or users in line with larger green-related social or institutional objectives. They can be socially constructed agreements among interested parties outlining preferable green-related practices which are either voluntary or required by law. Given the debate around green-related knowledge and available green-related practices, these interventions can also impose particular meanings to or structure relating to these areas.
Innovation directive	Interventions commanding green IS innovations to be produced (by producers) or used (resulting in green IS innovation demand), or which require producers or users to engage in some activity which will facilitate green IS innovation (by producers) or demand for their production (by users).

Table 4. Mapping institutional roles against interventions (King et al. 1994)

	Supply-push	Demand-pull
Influence	Quadrant 1 (Influence-supply-push) Knowledge building Knowledge deployment Subsidy Innovation directive	Quadrant 2 (Influence-demand-pull) Knowledge deployment Subsidy Mobilisation
Regulation	Quadrant 3 (Regulation-supply-push) Knowledge deployment Subsidy Standard setting Innovation directive	Quadrant 4 (Regulation-demand-pull) Subsidy Standard setting Innovation directive

Tables 3 and 4 constitute the critical elements of King et al.'s taxonomy of interventions influencing IT innovation. In the next section we apply the taxonomy to frame discipline-wide questions relating to green IS.

APPLYING KING ET AL.'S TAXONOMY TO FRAME GREEN IS DISCOURSE

We next apply King et al.'s taxonomy to determine if it can serve as a useful lens for framing questions for our discipline around the debates and nature of future research on interventions facilitating green IS innovation.

Quadrant 1: Influence-supply-push

Knowledge building

King et al.'s taxonomy suggests that institutions can introduce interventions (i.e. research project funding) to encourage IS producers (academics and practitioners) to build the substantive scientific/technical knowledge required for green IS innovation. Examples of institutions which can introduce such interventions include government agencies and professional bodies. This raises the following questions for the IS discipline:

Q1.KB.1: What substantive knowledge building is required to facilitate green base, systems development and/or service green IS innovation? For example: 1) Are our existing analysis-design methodologies, trans-disciplinary team experience and stakeholder engagement methods adequate for producing green service IS innovations? Are green IS users the same or substantively different to traditional IS users? 2) How accurate is the IS

discipline's arguments that green IS innovation will produce a net reduction in negative environmental impact (e.g. carbon emissions, waste and natural resource depletion combined)? Do we have the necessary knowledge to answer this? Should our discipline pursue green IS innovation if there is no net reduction? 3) To what extent do non-IS institutions recognise the role of IS's contribution to green outcomes? If they do not, will they introduce interventions to facilitate green IS knowledge building and/or innovation?

Q1.KB.2: What involvement, if any, should our discipline have in debating the contested nature of green scientific/technical knowledge given the impact of this uncertainty on green IS innovation?

Q1.KB.3: How should we handle the trans-disciplinary nature of green IS knowledge building and what should be the complementary roles of research institutes (e.g. CSIRO, universities)?

Knowledge deployment

King et al.'s taxonomy suggests that knowledge deployment interventions in this quadrant includes education of IS producers so they gain (or immigration of IS producers with) the required green IS knowledge so that a nation can build capacity to produce green IS innovations. Examples of the institutions which can introduce such interventions include universities, government agencies, professional bodies, research institutes (e.g. CSIRO) and consultancy firms (e.g. KPMG). This raises the following questions for the IS discipline:

Q1.KD.1: How do we determine the state of green IS knowledge among IS producers (e.g. academics, vendors, outsourcing partners, manufacturers, etc)?

Q1.KD.2: How do we coordinate/integrate the knowledge deployment intervention roles among institutions? What role should our discipline have in shaping the complementary/competing roles of non-IS institutions in deploying green IS knowledge to IS producers?

Q1.KD.3: How do we design and deploy new or modified education programmes so they are effective and green? How do we assess what (possibly contentious, competing) green IS knowledge to deploy?

Subsidy

King et al.'s taxonomy suggests that subsidy interventions in this quadrant include: 1) offering funding for the development of specific types of green IS innovation; and 2) encouraging capital markets to or providing tax benefits (e.g. subsidising costs, providing low-interest loans) which stimulate Research and Development (R&D) associated with specific types of green IS innovations. Examples of the institutions which can introduce such interventions include government agencies and green special interest groups. This raises the following questions for the IS discipline:

Q1.S.1: Should we debate, research and/or prioritise (e.g. using green lifecycle assessment) which types of green IS innovation will be the focus of subsidies (e.g. base green IS innovation such as replacing legacy with virtualised IS infrastructure, reducing e-waste with closed loop supply chains, etc)?

Q1.S.2: Should we research the impact of subsidies on the effectiveness and progress of green IS innovation in terms of the green outcomes they achieve?

Innovation directive

King et al.'s taxonomy suggests that innovation directive interventions in this quadrant involve institutions becoming green IS producers themselves. Examples of institutions outside the IS academic and practitioner communities which could employ this intervention include government agencies, green special interest groups and environmental scientists. This raises the following questions for the IS discipline:

Q1.ID.1: To what extent should we depend on other institutions (including non-IS disciplines) becoming green IS producers in addition to IS academics and practitioners?

Q1.ID.2: Should we leave green IS innovation to non-IS disciplines? If so, should our role be merely supportive? Or should we focus only on base and systems development green IS innovations?

Quadrant 2: Influence-demand-pull

Knowledge deployment

King et al.'s taxonomy suggests that knowledge deployment interventions in this quadrant includes supporting the building of knowledge repositories for and providing education to individual or organisational green IS users to build their capacity to exploit and use green IS innovations more effectively. This would include building IS user capacity to apply IS not originally designed for, but still able to achieve, green outcomes. Examples of institutions which can introduce such interventions include universities, government agencies, professional bodies and IS vendors/consultants. This raises the following questions for the IS discipline:

Q2.KD.1: Should we debate and research which institutions (e.g. universities, IS/outsourcing vendors) will be most effective at developing, providing and/or evaluating knowledge deployment interventions?

Q2.KD.2: Should we debate and research the effectiveness of methods for accumulating and disseminating learning-by-doing knowledge of green IS producers/users (e.g. generic versus tailored knowledge)?

Q2.KD.3: Should we be involved in evaluating/assessing the green outcomes achievable by IS and/or should we research and provide the tools so that users can make an informed and effective choice when there are alternative green IS innovations which can be used to achieve the same green objective?

Subsidy

King et al.'s taxonomy suggests that subsidy interventions in this quadrant include institutions: 1) procuring green IS innovations; 2) providing, directly or indirectly, complementarities required for green IS innovation use (e.g. current spatial maps, environmental degradation data); and 3) suppressing (in)directly substitutes for green IS innovations by (e.g.) subsidising the costs of or providing low-interest loans to individuals and organisations to use green IS innovations instead of alternatives. Examples of institutions which can introduce such interventions include government agencies. This raises the following questions for the IS discipline:

Q2.S.1: To what extent should we be involved in debating, researching and developing the complementarities (e.g. environmental data and spatial models) on which green IS innovation depends?

Q2.S.2: To what extent should we lobby institutions for subsidy interventions to favour green IS innovations over non-IS innovations for achieving green outcomes? Should we be involved in research which evaluates IS and non-IS green innovation alternatives to avoid technological determinism in IS?

Q2.S.3: Should we debate the technological deterministic argument which assumes green IS innovation is better than non-IS alternatives for achieving green outcomes? For example, should we discourage IS-based, geographically dispersed interactions in favour of individuals participating face-to-face in their local communities if such non-IS approaches will result in better green outcomes?

Mobilisation

King et al.'s taxonomy suggests that mobilisation interventions in this quadrant includes promotion and awareness campaigns to create (in)direct demand for green IS innovations among individuals and organisations which have not yet considered the potential of IS to solve (in part) their green objectives. Examples of institutions which can introduce such interventions include government agencies, green special interest groups, professional bodies and IS vendors/consultants. This raises the following questions for the IS discipline:

Q2.M.1: Should we research and debate which green IS promotion/awareness methods (e.g. educational websites, social media, mass customisation of promotional material, green assessment tools) are most effective?

Q2.M.2: How do we avoid or reduce the risk of the IS academic and practitioner communities engaging in "green washing" (i.e. promoting IS innovations as green when they have little or no environmental benefit, or are less effective compared to non-IS alternatives)?

Q2.M.3: Should we debate the role (if any) by the IS community in researching the ability of IS to change the environmental behaviours of users (e.g. by improving the visibility of environmental degradation)?

Q2.M.4: Should we debate what role (if any) we should have in general green campaigns, especially if the campaigns have the potential to generate demand for green IS innovation to address these problems?

Q2.M.5: Should we discourage users from proliferating devices (e.g. upgrading or having multiple devices) and encourage vendors to develop IS which operate on legacy devices? Is our complicity in the device-IS capability cycles (increasing device power and data storage leading to more complex IS which leads to needing more storage/speed) appropriate?

Q2.M.6: Should we discourage the increasing embedding of computing into all devices (e.g. washing machines) if such innovation leads to faster device obsolescence, thus causing greater negative environmental impact?

Quadrant 3: Regulation-supply-push

Knowledge deployment

King et al.'s taxonomy suggests that knowledge deployment interventions in this quadrant include mandating the education/training of individuals who will become potential IS producers. Examples of institutions which can introduce such interventions include government agencies, universities and professional bodies. This raises the following questions for the IS discipline:

Q3.KD.1: Should we debate if institutions need to mandate green IS knowledge to be embedded in IS curricula? If so, how and what new/modified methods or processes are needed to ensure such embedding occurs? How should we determine which (possibly conflicting) green IS knowledge should be embedded in IS curricula?

Q3.KD.2: To what extent (and, if so, how) should we mandate evaluation of newly trained/educated IS producers to ensure they have achieved adequate levels of green IS knowledge before entering the workforce?

Subsidy

King et al.'s taxonomy suggests that subsidy interventions in this quadrant include reducing liability, legal, administrative and/or competitive barriers so that IS producers find it favourable to engage in green IS innovation. Examples of institutions which can introduce such interventions include government agencies. This raises the following questions for the IS discipline:

Q3.S.1: What legal, liability, administrative and competitive barriers exist which are constraining green IS innovation? For example, is it cheaper to produce (or do market ideologies favour producing) IS innovation with higher environmental impact than green IS innovations?

Q3.S.2: To what extent should we debate and influence institutions to introduce subsidy interventions to facilitate green IS innovation? How do we evaluate and determine which interventions should be used?

Q3.S.3: Are there conflicting policies or competitive uncertainties around which green objectives to focus on (e.g. reduce emissions from legacy infrastructure versus waste produced when high emitting IT is replaced)?

Standard setting

King et al.'s taxonomy suggests that standard setting interventions in this quadrant include establishing standards which help facilitate green IS innovation by IS producers. Examples of institutions which can introduce such interventions include government agencies and professional bodies. This raises the following questions for the IS discipline:

Q3.SS.1: Should we (and, if so, how can we) standardise green IS knowledge in IS curriculum models to ensure (global?) consistency in the knowledge of future and current green IS producers?

Q3.SS.2: Should we debate, develop and/or evaluate the effectiveness of green readiness or maturity models aimed specifically at green IS producers?

Q3.SS.3: To what extent should we be involved in developing standards which measure and assess the green outcomes achieved from the deployment of green IS innovations? Will the development of such standards reduce or avoid "green washing" with respect to green IS innovations?

Q3.SS.4: Should we be involved in determining which institution(s) will be responsible for establishing and enforcing these standards and how these standards should be enforced?

Innovation directive

King et al.'s taxonomy suggests that innovation directive interventions in this quadrant include institutions requiring organisations to invest certain amounts of their resources into R&D which will lead to green IS innovation. Examples of institutions which can introduce such interventions include government agencies, large trading partners and professional bodies. This raises the following questions for the IS discipline:

Q3.ID.1: Should we research, debate and lobby around institutions exercising their regulatory (e.g. government agencies) or market power (e.g. IS professional organisations, large trading partners with power over their suppliers) to require IS producers to invest in green IS innovation? For example: 1) Should there be a tax on IS infrastructure or limits imposed on natural resource use by the IT/IS industry due to its negative environmental impact? 2) Should IS producers be required to contribute R&D funding to a central pool (e.g. administered by professional organisations) to facilitate green IS innovation? 3) Should large customers insist that their suppliers invest in green IS innovation (and associated R&D) to reduce the negative environmental impact of the supplier's products/services?

Q3.ID.2: Should we research the environmental impact reductions achieved through innovation directives relating to green IS innovations?

Quadrant 4: Regulation-demand-pull

Subsidy

King et al.'s taxonomy suggests that subsidy interventions in this quadrant include requiring the use of green IS innovations so that individuals or organisations can receive support (e.g. government funding) for processes or products/services they might require. Examples of institutions which can introduce such interventions include government agencies, large trading partners and professional bodies. This raises the following questions for the IS discipline:

Q4.S.1: Should we lobby institutions to introduce criteria for their funding and other support programmes which result (indirectly) in green IS innovation use? For example: 1) Should we lobby the institutions to provide or require the use of green IS innovations when they introduce subsidy programmes to help individuals/organisations reduce their utility costs (e.g. energy/water)? This could include green IS innovations

which monitor/manage utility usage. 2) Should we lobby large customers to require green IS innovation use by their suppliers as the basis for their trading partner relationships?

Q4.S.2: Should we be involved in evaluating the effectiveness of such interventions in terms of whether the interventions result in green IS innovation use (and hence demand on IS producers to innovate)?

Standard setting

King et al.'s taxonomy suggests that standard setting interventions in this quadrant include institutions requiring: 1) green IS innovations to be used in any work undertaken for them; and 2) compliance with standards which would essentially require green IS innovations to be used. Examples of institutions which can introduce such interventions include government agencies, green special interest groups, large trading partners in supply chains and professional bodies. This raises the following questions for the IS discipline:

Q4.SS.1: To what extent should we be involved in lobbying (or helping) institutions to embed green IS innovation use requirements in their tendering/compliance standards?

Q4.SS.2: Should we engage in research which evaluates the effectiveness of the green IS innovations in enabling organisations to comply with these institutional standards?

Q4.SS.3: Should we engage in research investigating the extent to which green IS innovation use has become a norm/convention (over time) to which individuals/organisations are conforming?

Innovation directive

King et al.'s taxonomy suggests that innovation directive interventions in this quadrant include institutions requiring organisations to use green IS innovations or an institution altering its structures or operations in which green IS innovation use is needed as an indirect consequence. Examples of institutions which can introduce such interventions include government agencies. This raises the following questions for the IS discipline:

Q4.ID.1: Should we research, debate and lobby around institutions introducing innovation directives aimed (in)directly at IS users (e.g. carbon taxes, emission trading schemes) to require green IS innovation use?

DISCUSSION

Our preliminary work in the previous sections, which apply King et al.'s taxonomy within a green IS innovation context, has offered a range of insights which extend the discourse concerning future research directions for the green IS field. We will now discuss the major insights in relation to the existing literature and summarise the main themes of future discourse which can follow this work.

First, our application of King et al.'s taxonomy suggests it is a useful lens for examining institutional interventions which can influence green IS innovation. Some authors have provided insights into this area with respect to base green IS innovations using Institutional Theory more generally (e.g. Butler 2011) but our major contribution has been to apply King et al.'s taxonomy in its entirety and considering also systems development and service green IS innovations. We recognise, however, that further work is required to refine the disciplinary questions and debates arising from the taxonomy to address issues such as overlap. For example, there are overlapping questions posed relating to the role of large organisations influencing green IS innovation production and/or use (e.g. Q3.ID.1, Q4.S.1 and Q4.SS.1). Our application of King et al.'s taxonomy should therefore be seen as a starting point for framing a future research agenda which identifies and explains the way diverse interventions can facilitate, expedite, constrain (e.g. intervention inconsistencies) or delay green IS innovation.

Second, this preliminary work provides a starting point for future research to examine whether King et al.'s taxonomy from 1994 needs refinement for contemporary IS. Future research such as green IS literature analysis and empirical work can establish whether there are categories or specific types of interventions which are not captured by this taxonomy. Similarly, future studies can determine if King et al.'s assignment of intervention types to particular quadrants in Table 4 requires modification. For example, King et al. only position knowledge building in the influence-supply-push quadrant. The rationale for this is not clarified, but is implied by their argument that mandating any IS producer to innovate is rarely successful because innovation *"…occurs when a complex and fuzzy set of capabilities, attitudes and incentives come together in an individual or, less often, a group"* (King et al. 1994, pp 157-8). By extension this implies that mandating substantive knowledge building, on which innovation depends, will also not guarantee success. In a green IS context the question arises as to whether institutions are mandating/influencing the building of substantive green scientific/technical knowledge which depends on IS innovation? Examples may include institutions commissioning IS innovation such as simulation models (Huang and Chang 2003) and knowledge repositories to assist with building new, substantive green knowledge which, in the scientific community, is highly contested (Shaft et al. 1997). This suggests King et al.'s taxonomy may need modifying for a green IS context to include "knowledge building" in the influence-

supply-push and/or regulation-demand-pull quadrants. This will depend, for instance, on where we draw the boundaries between green scientific/technical knowledge and green IS scientific/technical knowledge.

Third, the taxonomy and our application for a green IS context can help further extend the debate in IS journals such as MIS Quarterly (e.g. Baskerville and Myers 2002; Benbasat and Zmud 2003; Yoo 2010) about the boundaries of the IS discipline relative to other (reference) disciplines. The taxonomy is useful here in that the supply-push quadrants, focusing on IS producers, enables discipline-wide questions to be posed which have a direct impact on the IS discipline, with a particular focus on base and systems development green IS innovation. For example, some authors (Fernandez et al. 2009; Melville 2010) have started to pose questions and undertake research relevant to Q1.KB.1 concerning the adequacy of our discipline's knowledge to produce green IS innovations in the form of our IS analysis-design methodologies. For those who believe that the IS discipline or its journals should focus on artefacts and the practice of IS (e.g. Benbasat and Zmud 2003) then the supply-push quadrant (and its interventions to facilitate associated green IS innovation) may hold more importance than the demand-pull quadrant. The demand-pull quadrant, by contrast, will be more relevant to those who see research potential in service green IS innovations (e.g. Melville 2010) for purposes such as changing peoples' behaviour to be greener. However, the disciplinary questions (e.g. Q1.ID.1) arising from the taxonomy, and the work of others (e.g. Bengtsson and Agerfalk 2011) in the green IS field, imply that IS academics/practitioners may not be the only IS producers, which will increasingly blur this distinction.

Fourth, a number of our posed questions (e.g. Q1.KB.1, Q2.S.3, Q2.M.2, Q2.M.5, Q2.M.6) arising from applying King et al.'s taxonomy to green IS emphasises the importance that, as a discipline, we engage in critical debate and research as to whether IS (including its base IT) will collectively achieve reduced environmental impact. In other words, should our discipline assume IS innovation is good for the environment or instead ensure research is undertaken to verify this assumption? If IS innovation is not good for the environment, do we have an obligation to redirect our research and/or lobbying efforts to address this? DesAutels and Berthon (2011) provide a useful start for such a debate when arguing that notebook manufacturers and consumers favour competitive advantage and low cost (respectively) and instead assign the total environmental costs (e.g. pollution, depletion of non-renewable natural resources) of such devices to the planet. This suggests that the net impact of such green IS innovation on the environment may be negative. While the influence of the IS discipline on this much wider problem may be limited, the taxonomy provides insights into the range of interventions which our discipline can at least debate, lobby on and research to "do our bit". Given our symbiotic relationship with the IT manufacturing industry we can employ our own interventions (e.g. education and certifications of IS producers) and encourage the development of other interventions which can lead the IT/IS industry toward redressing this problem.

Our future research will involve conducting a systematic analysis (e.g. coding) of the emergent green IS literature against King et al.'s taxonomy which we have applied to the green IS context. This will serve a few purposes. For example, it will enable IS scholars to determine particular quadrants and/or intervention areas which have been overlooked and present future research opportunities. It will also enable us to track debates and developments in the field on a longitudinal basis. We can use the taxonomy to compare the scholarly, practitioner and multi-disciplinary literatures to develop a holistic picture of the institutional forces which are influencing the development, maturity, progress and failures of the green IS field as a whole. This work will be complemented by empirical research (e.g. interviews with and surveys of IT/IS, environmental and other institutional experts) based on the taxonomy to develop further this holistic picture of the future of the green IS field.

CONCLUSION

In this paper we considered how the IS discipline could (re)consider its engagement with the green IS discourse. We conclude that the discipline can play a role through both traditional responses (e.g. descriptive studies of green IS methodologies, organisational best practice, maturity models, etc), but also through more active engagement in the form of participation and advocacy in shaping green policy and regulation. By applying the Institutional Theory based taxonomy of King et al. (1994) to the green IS context, we derived several pertinent disciplinary questions and issues through which the discipline can engage with the green IS discourse. We believe this set of questions and issues will be helpful for the IS discipline to reflect on its current level of engagement, and to focus future contributions and interventions to this important discourse.

REFERENCES

Baskerville, R.L. and Myers, M.D. 2002. "Information systems as a reference discipline", *MIS Quarterly* (26:1), pp 1-14.

Benbasat, I. and Zmud, R.W. 2003. "The identity crisis within the IS discipline: defining and communicating the discipline's core properties", *MIS Quarterly* (27:2), pp 183-94.

Bengtsson, F. and Agerfalk, P.J. 2011. "Information technology as a change actant in sustainability innovation: insights from Uppsala", *The Journal of Strategic Information Systems* (20:1), pp 96-112.

Bose, R. and Luo, X. 2011. "Integrative framework for assessing firms' potential to undertake green IT initiatives via virtualization – a theoretical perspective", *The Journal of Strategic Information Systems* (20:1), pp 38-54.

Brown, D.H. and Thompson, S. 2011. "Priorities, policies and practice of e-government in a developing country context: ICT infrastructure and diffusion in Jamaica", *European Journal of Information Systems* (20:3), pp 329-42.

Butler, T. 2011. "Compliance with institutional imperatives on environmental sustainability: building theory on the role of Green IS", *The Journal of Strategic Information Systems* (20:1), pp 6-26.

Butler, T. and McGovern, D. 2012. "A conceptual model and IS framework for the design and adoption of environmental compliance management systems", *Information Systems Frontiers* (14:2), pp 221-35.

Capra, E., Formenti, G., Francalanci, C. and Gallazzi, S. 2010. "The impact of MIS software on IT energy consumption", *18th European Conference on Information Systems*, Pretoria, South Africa, 6-9 June.

Chen, A.J., Watson, R.T., Boudreau, M.-C. and Karahanna, E. 2010. "An institutional perspective on the adoption of green IS & IT", *Australasian Journal of Information Systems* (17:1), pp 23-45.

Chen, A.J.W., Boudreau, M.-C. and Watson, R.T. 2008. "Information systems and ecological sustainability", *Journal of Systems and Information Technology* (10:3), pp 186-201.

Dao, V., Langella, I. and Carbo, J. 2011. "From green to sustainability: information technology and an integrated sustainability framework", *The Journal of Strategic Information Systems* (20:1), pp 63-79.

DesAutels, P. and Berthon, P.R. 2011. "The PC (polluting computer): Forever a tragedy of the commons?", *The Journal of Strategic Information Systems* (20:1), pp 113-22.

Elliot, S. 2011. "Transdisciplinary perspectives on environmental sustainability: a resource base and framework for IT-enabled business transformation", *MIS Quarterly* (35:1), pp 197-236.

Fernandez, W., Bergvall-Kareborn, B., Djordjevic, M., Lovegrove, K. and Nayar, S. 2009. "Using design as boundary spanner object in climate change mitigation projects", *Australasian Journal of Information Systems* (16:2), pp 51-69.

Huang, A.H. 2009. "A model for environmentally sustainable information systems development", *Journal of Computer Information Systems* (49:4), pp 114-21.

Huang, G.H. and Chang, N.B. 2003. "The perspectives of environmental informatics and systems analysis", *Journal of Environmental Informatics* (1:1), pp 1-7.

Ijab, M.T., Molla, A., Kassahun, A.E. and Teoh, S.Y. 2010. "Seeking the "green" in "green IS": a spirit, practice and impact perspective", *14th Pacific-Asia Conference on Information Systems*, Taipei, Taiwan, 9-12 July.

King, J.L., Gurbaxani, V., Kraemer, K.L., McFarlan, F.W., Raman, K.S. and Yap, C.-S. 1994. "Institutional factors in information technology innovation", *Information Systems Research* (5:2), pp 139-69.

Lyytinen, K. and Rose, G.M. 2003. "The disruptive nature of information technology innovations: the case of internet computing in systems development organizations", *MIS Quarterly* (27:4), pp 557-95.

Melville, N.P. 2010. "Information systems innovation for environmental sustainability", *MIS Quarterly* (34:1), pp 1-21.

Molla, A. and Abareshi, A. 2012. "Organizational green motivations for information technology: empirical study", *Journal of Computer Information Systems* (52:3), pp 92-102.

Molla, A., Cooper, V. and Pittayachawan, S. 2011. "The green IT readiness (g-readiness) of organizations: an exploratory analysis of a construct and instrument", *Communications of the AIS* (29:pp 67-96.

Parker, C.M., Zutshi, A. and Fraunholz, B. 2010. "How Australian small businesses are using their websites to communicate CSR initiatives", *2010 Academy of Management Annual Meeting*, Montreal, Canada, 6-10 August.

Pernici, B., Aiello, M., vom Brocke, J., Donnellan, B., Gelenbe, E. and Kretsis, M. 2012. "What IS can do for environmental sustainability: a report from CAiSE'11 panel on green and sustainable IS", *Communications of the AIS* (30:pp 275-92.

Pitt, L.F., Parent, M., Junglas, I., Chan, A. and Spyropoulou, S. 2011. "Integrating the smartphone into a sound environmental information systems strategy: principles, practices and a research agenda", *The Journal of Strategic Information Systems* (20:1), pp 27-37.

Rogers, E.M. 2003. *Diffusion of Innovations*, 5th edn. New York: Free Press.

Scott, W.R. 2008. *Institutions and organizations*, 3rd edn. Los Angeles: Sage Publications.

Shaft, T.M., Ellington, R.T., Meo, M. and Sharfman, M.P. 1997. "A framework for information systems in life-cycle-oriented environmental management", *Journal of Industrial Ecology* (1:2), pp 135-48.

Swanson, E.B. 1994. "Information systems innovation among organizations", *Management Science* (40:9), pp 1069-92.

Watson, R.T., Boudreau, M.-C. and Chen, A.J. 2010. "Information systems and environmental sustainable development: energy informatics and new directions for the IS community", *MIS Quarterly* (34:1), pp 23-38.

Yoo, Y. 2010. "Computing in everyday life: a call for research on experiential computing", *MIS Quarterly* (34:2), pp 213-31.

Zhang, H., Liu, L. and Li, T. 2011. "Designing IT systems according to environmental settings: a strategic analysis framework", *The Journal of Strategic Information Systems* (20:1), pp 80-95.

COPYRIGHT