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Transforming University Contributions to the Challenges of Environmental Sustainability: A Field Study

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Abstract

In 1987, the United Nation's Brundtland Commission on Environment and Development appealed for educational institutions to put the world onto the paths to sustainability. Since the 1980s, many universities have attempted to make crucial contributions to addressing the challenges of sustainability, at some level. Unfortunately, despite considerable activity, few universities have succeeded in realizing their potential to make significant contributions to environmental sustainability in research or education or as adopters of sustainable practices within their institutions.

This paper aims to assist universities in achieving greater contributions to the challenges of sustainability by examining drivers, inhibitors, activities and outcomes in a longitudinal field study of sustainability initiatives at a single university over a period of 20 years. Insights include, the key role for IS-enabled innovation and integrated roles for IS scholars.

Keywords

Green IS, IS research agenda, universities, field study

INTRODUCTION

The United Nations' Brundtland Commission's report (1987) popularized sustainable development. Subsequently, the principles of sustainability and sustainable development have been embodied in the UN Millennium Development Goals (UN 2010) and the UN Global Compact (UNGC 2010). The concept of sustainability is dynamic, entailing the continual engagement of an organization with a diversity of manifestations that may arise over time (UNGC 2010).

Environmental sustainability is receiving attention at political and organizational levels as the imperative for action to address environmental challenges is becoming increasingly urgent (Harvey 2011, IPCC 2007, Stern 2007, UN 2010). Scientific evidence that human behavior is creating such an adverse impact on the environment that current behavior is not sustainable has been accepted by the Intergovernmental Panel on Climate Change (IPCC 2007), the British government (Stern 2007), the European parliament (EU 2003), the United States government (NIC 2008), and the governments of 192 countries ratifying the United Nations Framework Convention on Climate Change (UNFCCC 2007). Consequently, there is broad-based, international determination for fundamental change in current political, social, and economic practices to achieve environmental sustainability.

Educational institutions and the scientific community are seen to "play a crucial part in putting the world onto sustainable development paths, in laying the groundwork for our common future" (UN 1987, p.16). Universities can realize this potential by actively promoting research and scholarship, through education to all students on aspects of sustainability, through outreach activities to their local, regional, national and international communities, and by achieving sustainability at all levels within their institutions (Sharp 2002).

Numerous studies have investigated sustainability initiatives in a range of universities (e.g., Brinkhurst etal. 2011, Carpenter and Meehan 2002, Clarke 2006, Kurland 2011, Sharp 2002, Stubbs and Schapper 2011, Wright 2002). But these examples of successful sustainability practices are not representative of the large body of universities. In 2008, a US survey conducted to, "track trends and advance knowledge about environmental

stewardship, sustainability activities and related curricular offerings in higher education" (NWF 2008). The findings, from over 1,000 institutions were that many activities aimed at "greening" campuses had been implemented but that only one-third of respondents had undertaken a strategic, integrated approach to sustainability (NWF 2008). The 2008 survey also found that in recent years the level of education on sustainability issues was at best static, if not in decline.

The success rate of one-third of colleges and universities meeting global sustainability objectives is similar to the rate of thirty to forty percent completely or mostly successful identified by a global survey on the management of organizational change of more than 1,500 executives in business, government and non-profits (McKinsey 2006).

A root cause of the problem of limited progress, or relative decline, in sustainability appears to be uncertainty about the meaning of the term and about how best to proceed to address the challenges of sustainability. These uncertainties have been identified in calls for: further research into effective implementations of sustainability in universities (Carpenter and Meehan 2002, Wright 2002); greater efforts to overcome resistance and to affect systemic transformation of universities into more sustainable organizations (Sharp 2002); and greater assistance to university administrators seeking more sustainable operations (ACTS 2011).

Consistent with the ACIS 2013 theme of Transforming the Future, the focus of the Green IS and Sustainability track, and in response to the limited contributions by higher education to sustainability despite considerable economic, educational, moral, and political motivation, this paper aims to assist universities to achieve greater contributions to the challenges of sustainability by comparing published details on successful implementations of sustainability in universities with the actual experiences of a university that struggled in its efforts to achieve success. In a longitudinal field study of sustainability initiatives at a single university over a period of 20 years, drivers, inhibitors, activities and outcomes are examined and compared with the literature. A conceptual model for strategic approaches to sustainability is proposed.

To address these aims the paper's structure following the introduction is: establishing relevance to IS; describing the research approach; reviewing a purposively selected range of relevant literature relevant to this article's aims; presenting the field study; developing a conceptual impact model based on the field study; testing the model through their comparison with the literature; and discussing the implications for assisting university executives and IS researchers to increase their contributions to addressing the challenges of environmental sustainability.

RELEVANCE TO INFORMATION SYSTEMS (IS)

ICT is recognized as an essential source of solutions to the changed behaviors required to achieve sustainability (Stern 2007). The IS discipline is one of several disciplines with a focus on ICT. It is distinguishable in that IS: "examines more than just the technological system, or just the social system, or even the two side by side; in addition it investigates the phenomena that emerge when the two interact." (Lee 2001, p iii). Adoption and diffusion of ICT applications in support of responses to environmental sustainability is located at that point of interaction between technology and society and so is central to the IS discipline.

The IS discipline has been called on to undertake more high visibility research with high impact to avoid becoming marginalized (Agarwal and Lucas, 2005). Green IS is a field of study that is poised to make a critical contribution to society and also to the universities.

IS theoretical contributions in this domain, to date, have been modest but the level of IS contributions is rising rapidly (Elliot 2012). Further contributions will be aided by a recent call for greater commitment by IS researchers to theory relating to professional practice (Lee 2010). 'Theory-in-use' presented as generalizable frameworks and models based on analysis of examples of professional practice may serve to assist practitioners realize their goals while also increasing the relevance of IS researchers' empirical and theoretical contributions. This 'theory-in-use' approach was applied in the development of the model presented in Figure 1. Innovative opportunities for IS research arise from this model.

RESEARCH APPROACH

To address this paper's aims (see Introduction, above) relevant literature has been purposively selected (Miles and Huberman 1994), reviewed and tested. Consistent with the paper's aims, the literature was selected for its capacity to inform universities of key issues in planning and implementation of strategic, IS-enabled sustainability programs. A recent paper (Elliot 2012) proposed a conceptual model based on reviews of the literature seeking to assist sustainability practice in universities. This paper compares that model with a previously unpublished field study of sustainability practice in a university. Following this comparison, the model was reviewed and revised to facilitate improved sustainability practice in universities (see Figure 1).

Consistent with this paper's aims, the research questions were:

1. What drivers and inhibitors might influence improved contributions by universities?

2. To what extent can applications of technology facilitate increased contributions by universities through supporting drivers and mitigating inhibitors?

3. How and where might IS scholars support universities to resolve their sustainability challenges?

The most appropriate approach to address the research aims and questions was analysis of the literature to: identify applicable drivers and inhibitors; identify an applicable, generalizable model based on the literature; and, identify potential areas for applications of technology. This generalizable work was compared with a field study of a university with 20 years of experience in sustainable activities at an operational level that was not able to achieve a strategic contribution. This study's unit of analysis was the university's sustainability initiatives. Particular attention was given to the university's external and internal organizational context as influences on its initiatives; the initiatives and activities undertaken; and the outcomes. Organizational initiatives are social artifacts (Babbie, 2006) produced by managers and informed by participants, activities and outcomes in those initiatives. The model was subsequently reviewed, revised and presented with a research agenda for IS scholars.

REVIEW OF SELECTED LITERATURE

The initial issue for consideration, for research question 1, is the drivers and inhibitors of responses by universities to the challenges of environmental sustainability. A case study of developments in a large California public university with over thirty years of experiences in sustainability presents a detailed analysis of drivers and inhibitors of change (Kurland 2011). Drivers of change over that period confirmed prior research (e.g,, Bartlett and Chase 2004) including: leaders' core values with commitment to sustainability, availability of financial incentives to support initiatives, communications and community outreach. Significant drivers were also particular to the case, including a natural disaster causing $400 million in damage to buildings and other infrastructure that necessitated a rebuilding program at the same time as a state government mandate to improve energy efficiency in all buildings. Inhibitors of change in this case also confirmed prior research (eg, Velazquez et.al 2005): funding constraints; lack of communication and information sharing among campus stakeholders; lack of appropriate campus or government policies to support change; lack of shared values to promote change; shortage of time to commit to initiatives; and lack of capabilities to lead or teach due to lack of training.

The second issue, research question 2, is can applications of technology facilitate increased contributions by universities through supporting drivers and mitigating inhibitors and, if so, how? This question requires a broader consideration of the current status of contributions by universities.

University executives considering sustainability initiatives who seek assistance from these empirical models, understandably, may be overwhelmed by the diversity of approaches, focus, scope and breadth presented by the models. A selection of academic papers published in the premier journal in this field, the International Journal of Sustainability in Higher Education, presents additional perspectives to the empirical models. As with the empirical models, the academic models are shown with details of their origin, focus, scope and breadth of implementation. The academic perspectives predominantly report on the experiences of a single institution (Clarke 2006, Kurland 2011, Sharp 2002, Stubbs and Schapper 2011) although two papers include survey findings in addition to the single institution (Brinkhurst et.al. 2011, Carpenter and Meehan 2002). To assist universities attempting to affect change, a selection of international declarations on sustainability is compared with policies prepared at universities ratifying the declarations (Wright 2002). Several high level themes relating to sustainability implementations are identified (ibid).

Two critical problems were identified from the literature: the low level of commitment to address the challenges of sustainability and the decline in educational programs. The first problem is based on three sources: the relatively small number of universities committing to sustainability declarations (Elliot 2012); a survey of university practices in the USA (NWF 2008) and a review by an expert in the field (Sharp 2002). The second problem is based on a survey of universities that had introduced education in sustainability previously but were withdrawing from their educational programs (NWF 2008). A Composite Framework is seen to address the uncertainties about how to proceed by specifying the elements essential for conception, design and implementation of a sustainability initiative from determination of strategic intent to engagement of staff and students in activities.

The current status is that there are many sustainability initiatives, although these are frequently in isolation. Isolated activities can lead to difficulties in maintaining momentum and progression towards a target, particularly in the absence of a holistic goal with high level support. A supportive technology infrastructure can

assist development of isolated initiatives by monitoring, mediating and reporting on activities which leads to a positive feedback loop.

Universities have undertaken considerable operational activity, i.e., initiatives with a narrow focus in function or location. One solution is to provide a high level of technology support to facilitate a holistic approach to institutionalize the change program and to present the opportunity to achieve significant progress that the change is driving itself.

Analysis of the models selected for their diversity of approaches shows limited attention to providing such technology support for institutions seeking to implement environmentally sustainable practices (Elliot 2012). However, two papers consider technology infrastructure to be integral (Kurland 2011, Sharp 2002). Both papers focus on sustainability initiatives at a single campus so can provide the level of detail absent in most papers but there is not much detail available. The case study following clarifies both the factors driving and inhibiting initiatives, as well as the critical role of technology infrastructure.

A CONCEPTUAL IMPACT MODEL

A conceptual impact model of relationships between human beings (categorized into stakeholders), technology, changed human behavior and an intended outcome of reduced degradations in the environment based on the literature was identified (Elliot 2012). As shown in that model, an intended outcome of changed behavior with an operational focus is an incremental reduction in environmental degradation to address a specific target area, eg waste production or water consumption in a specific function or location. Policies and strategies to achieve shared understanding and integrated activities leading to fundamentally changed behavior are intended to achieve significant progress towards sustainability targets at a whole of organization level, eg a university-wide campaign to significantly reduce energy consumption or utilization of renewable energy sources.

Different technologies can assist these changed behaviors, ranging from specialized equipment for energy generation, e.g., solar energy generation, to applications of general-purpose IT. Applications of IT include: mediating communications within and among stakeholders; facilitating changed human behavior within and among stakeholders; and supporting monitoring and evaluation of behavioral and environmental impacts. There is also a potential future role for applications of IT in moderation of the impacts of deteriorating quality of the environment, although future roles are not depicted since it deals with the current situation.

Empirical models tend to be either at such a high level as to provide little assistance or at a detailed level prescribing a course of action that may not be appropriate (see elements on Table 1). The Conceptual Impact Model presents a conceptual model representing the relationship between policies, strategies, operations, technology infrastructure and outcomes of changed behaviour. This relationship is cybernetic, i.e., each part of the model is a system that interacts with the other parts and the parts of the model are systems within a system (von Bertalanffy 1996).

Executives and educators seeking guidance from the selected models and frameworks will be disappointed at the limited assistance available from current models and this is an insight into possible reasons for low levels of education in sustainability by universities. At an executive level, the frameworks and models designed to assist and inform universities focus on administrational issues exclusively. Assistance to provide educational offerings appears to be overlooked. However, the Conceptual Impact Model shows how changes or fundamental changes to existing educational offerings, particularly with shared understanding and as part of integrated initiatives across universities, could address that oversight.

FIELD STUDY

This case study investigates environmental sustainability initiatives at University X between 1991 and 2010. Anonymity permits X's experiences to be described frankly and openly to maximise organisational learning. This period starts with a prolonged period of agitation by staff, students and alumni leading to the commissioning of an information system for tracking electricity, gas and water consumption. It ends in December 2010 just before the position of Manager Campus Sustainability, chiefly responsible for implementing the university's Environmental Policy, was declared redundant and the system used successfully to record and report on energy and water usage throughout the university's different campuses since 1999 was switched off.

Primary sources for this case were key participants in the sustainability journey over the 20 year period, policy documents and activity reports. The case was prepared by an author of this paper who was a participant in these events from 2005-2010. The University's sustainability activities are considered in four stages: *initiation*; *expansion*; *re-appraisal*; and *diversification and decline*.

Initiation

The initiation phase (1991- 2002) was characterized by increasing student, staff and alumni agitation for action by the university to develop and resource an environmental policy and strategy. This took place at a time of rapid growth in student and staff numbers at the University and staff capability in infrastructure management. Following an extended period of agitation from staff and student groups, an Environmental Policy was formally approved by the University's governing body in 2002. The policy was intended to guide development of academic programs in sustainability as well as operational activities. It covered energy and water efficiency, waste avoidance, environmental risk reduction, biodiversity conservation and staff and student engagement. A notable lack in the Environmental Policy was an explicit statement about accounting for and reducing greenhouse gas emissions.

An expanding infrastructure program and commitments to campus renewal gave weight to staff and student agitation for the university to adopt the policy. There was also a view that the university was falling behind its peer universities in this area. Staff were appointed to implement the policy and funds set aside for ongoing program development – principally the *Sustainable Campus* program that ran for the remainder of the decade. This program was hosted by the Facilities Administration Office (FAO). The staff group became a reference group that, until 2006, met regularly with the Manager Environmental Sustainability and other FAO staff such as the Water and Energy Manager, to oversee development of the program. Development of the academic aspect took longer due to fluctuating membership of the steering committee.

Under the policy, a Utilities Information System was developed that, from 1999, reliably tracked performance of electricity, gas and water usage using a system of meters linked to on-line data management software. The Energy and Water Manager managed this initially until 2006 when a Utilities Officer was appointed to take over until 2010. The major motivations for this system were cost containment and the need for effective forward planning and reporting on performance.

Expansion

The expansion phase (2003-2006) led to increasing resources, scope and program sophistication with ambitious campus infrastructure development to support increasing student and staff numbers. A sustainability policy manager was appointed in 2003 and four support staff had been appointed by 2005. Following approval of the Environmental Policy by the university in 2002, the Campus Sustainability program was launched in 2003 to implement the operational aspects of the policy. The program aimed to lift the university's performance compared with peer universities from low performing to mid or high performing, in keeping with the university's drive to become recognized as a leading university nationally.

The program was successful in achieving improved water efficiency, Prolonged drought at the time the plan was developed and projected future pressures on potable water supply due to climate change were drivers leading to integrated water efficiency, water harvesting and re-use and ongoing planning to address projected constraints on potable water supply. Compliance with state government requirements for energy and water conservation came into effect during this period. The university was required to conduct detailed management and technical reviews and to prepare an action plan to reduce energy and water consumption on all campuses. The legislation did not require the plans to be implemented, only to have the plan in place. Drivers of initiatives were the necessity for regulatory compliance and the strong potential for cost savings since energy price increases were predicted.

Reappraisal

This phase (2006-2008) exhibited contracting finances, students and staff resulting from the Global Financial Crisis (GFC) and the appointment of a new President of the University. The new President instigated a restructure of administration in a lengthy process which saw the entire senior management team of FAO replaced in 2006, and again in 2008 when the second tier of senior executives across the university was removed. Preparation of the energy plan required by the state government took more than 2 years to develop. By the time of the plan's completion energy costs were beginning to be a crucial issue for management. An internal audit of the campus sustainability program in 2008 recommended to the senior executive that energy consumption performance targets be established to comply with government mandates. This recommendation was not approved. In 2008, dedicated sustainability staff were cut from 4 to 2 positions.

In late 2008, the senior executive appointed an external consultant to develop a high level review of the University's sustainability commitment. The outcome was advice to form the *Centre for Sustainability*, focusing on research and reporting to the Vice President Research. Concurrently, a multi-disciplinary postgraduate degree in sustainability was proposed with a wide variety of courses available from most of the academic schools. The coordinator of this degree program reported to the Vice President Learning and Teaching.

A s*ustainability assessment framework* was developed in 2007 by an external consultancy following a high level qualitative review of the operations of the entire university. The report addressed senior decision maker uncertainty about the value of the strategy already in place by producing a synopsis of performance data. The first report was released but there was no further progress as key senior staff supporting the initiative had their positions declared redundant in a restructuring.

A *triple bottom line report* developed by an academic team supported detailed and comprehensive data analysis, regular reporting and review. High level indicators were provided to assist senior decision makers in assessing the value of sustainability strategies and planning. The reporting system was commissioned in 2006. The first report in 2008 was presented to the University's governing body which led to formation of the Emissions Reduction Committee to address carbon emissions and the business benefits in reducing them. A s*ustainability strategy was* proposed in 2007 to develop a more strategic approach to providing information that could clarify increasing program complexity and management uncertainty. The draft strategy was acknowledged as providing clarity and simplicity but was not adopted by the University.

Diversification and decline

This phase (2009-2010) commenced with a set of integration projects aiming to enable inter-disciplinary efforts to address specific sustainability issues. This occurred against a backdrop of increasing fiscal restraint in the wake of the Global Financial Crisis. The university continued its responses to a contracting budget in the wake of the Global Financial Crisis and a university restructure driven through development of a strategic plan. The position of the Chief Operating Officer (COO) was declared redundant in 2009. Academic schools were reorganized in 2010. The national context included politicization of environmental sustainability which split community support for sustainability.

Under a new Director, the Infrastructure Services division undertook a detailed review of all services and activities leading to a formal restructure in 2010. All director positions in the division were either made redundant or relocated in the university. The position of Manager Campus Sustainability (MCS) was established to facilitate consultation across the whole organization. Major initiatives proposed or launched in this phase were the: *Emissions Reduction Committee; Centre for Sustainability; Green Travel Plan*; *Green Workplace Champion;* and, *Sustainability Coordination Committee.* The *Emissions Reduction Committee (ERC)* was commissioned by the University's governing body. Using the information in the Triple Bottom Line report, the objective was to develop a business plan to reduce operational costs, improve business efficiency and reduce the university's carbon emissions. No extra staffing or resources were allocated. In 2010 energy costs continued to escalate. The committee did not meet in 2011.

The *Centre for Sustainability* was to coordinate sustainability commitments across the university and to develop an integrated program for leadership and outreach. There was a strong initial commitment, however, the Centre was launched before its governance structures were established and enthusiasm for initial activities rapidly dissipated. A *Green Travel Plan* was proposed in 2009 by leading academics to align university policy with research and to match similar plans in other universities. Comprehensive plans were prepared but not approved by the senior executive. A *Green Workplace Champion* program was implemented in 2009 to develop peer-to-peer leadership and learning across the organization. It was developed initially with the support of the COO who "steered" the plan through the process of senior executive approval. It was launched in August 2009 with 80 volunteers. After the COO's departure in October 2009, the program languished.

In 2011, a new group to coordinate sustainability across the university was established and a new policy prepared with the stated intent to support prevailing practices in sustainability. No resources were allocated to this group. The Utilities Information System developed in 1999 was decommissioned in 2010 due to concerns stated by the head of FAO about decreasing accuracy and the resulting perception of business risk. The position of system developer and operator was declared redundant, the staff member resigned, and the system with its accumulated wealth of information over 10 years was abandoned.

DRIVERS AND INHIBITORS

Literature on drivers of sustainability initiatives recognise the major motivators as being: compliance with government regulation; financial incentives; leaders' core values and, natural disaster requiring rebuilding (Bartlett and Chase 2004, Kurland 2011). University X's experiences present a much broader view of drivers in which the relative influence of drivers rose and fell over the 20 year period. University X's major motivators were: agitation by student, staff and alumni sustained for long periods (1990s, early 2000s); climate, prolonged period of drought and projected future pressures on potable water supply due to climate change (2003); compliance with state government requirements for water conservation and planned energy savings (2005+); cost containment, rapidly increasing energy costs and the need for forward planning and reporting on

performance (2006, 2008); environmental policy (2002) approved by the governing body to guide development of academic programs in sustainability as well as operational activities; expanding infrastructure program and commitments to campus renewal (2001-2007); external reviews of the University's commitments to sustainability (2007) and performance (2008); peer pressure, falling behind other universities in this area (2003-2006, 2009); rapid growth in student and staff numbers (2001 - 2007); university's drive to become recognized as a leading university nationally (2003+); and values of influential members of the University's governing body (2002, 2008). Two of the drivers identified in the literature were supported at University X. Compliance with government regulation and leaders' core values were both relevant, although at University X the core values resided more in influential members of the University's governing body than the senior executive.

Literature on inhibitors to sustainability initiatives include funding constraints and low prioritization; as well as the absence of support for communication and information sharing and lack of: appropriate campus or government policies for change; capabilities to provide leadership and teaching in the domain; and shared values to promote change (Kurland 2011, Velazquez et.al 2005).

The major inhibitors at University X include: diffused responsibilities to VP (Research), VP (Learning and Teaching), COO, CFO. FAO, ERC, the Centre for Sustainability and the postgraduate degree in sustainability all combining to inhibit shared understanding and integrated activities, particularly in association with funding constraints; expressions by the new head of Infrastructure services of lack of confidence in the accuracy of information collected on electricity, gas and water consumption (resulting in abandonment of the monitoring system in 2010); the Global Financial Crisis (2007-2011+) reducing discretionary income for sustainability initiatives; organizational disruptions arising from restructuring at university wide (2008,2010) and divisional levels (eg, FAO in 2006, 2007, 2009, 2010) and politicization of environmental sustainability in national and state government forums reducing levels of societal support (2007-2011+) Two inhibitors identified in the literature were clearly supported at the University, funding constraints and lack of communication and information sharing, with the case study providing a richness of detail previously unavailable. Other restraints in the literature were indirectly supported, e.g., many of the factors lacking positive influence, such as lack of communications and shared values, being attributable to diffused leadership, funding constraints and low prioritization.

TECHNOLOGY INFRASTRUCTURE

In response to a prolonged period of agitation by staff, students and alumni, University X developed a utilities information system that, from 1999 to 2010, reliably tracked performance of electricity, gas and water usage using a system of meters linked to on-line data management software.

The operational information provided by this system was utilized to: develop policies for sustainable activities (2002); provide focus for the Campus Sustainability program (from 2003); comply with state government regulations requiring the largest 200 organizational consumers of electricity to present plans to reduce consumption (after 2005); enable external review of the University's performance in sustainability (2007); facilitate development of the triple bottom line report to assist senior executives to assess the value of sustainable activities (2008); and, inform the Emissions Reduction Committee established to constrain increasing energy consumption (2009). This system represented a critical component in sustainability initiatives over a period of 10 years.

A diverse range of non-IT infrastructure at University X was considered or utilized. It ranged from: low energy consumption light globes to a tri-generation power plant proposed for a new building development (although the power plant proposal was abandoned at the final approval stage due to cost constraints); waterless urinals to waste water harvesting; e-waste recycling to green composting to a fleet of hybrid cars. While these initiatives do not utilise IT directly, their efficient and effective operation was managed, monitored and reported by IT systems.

REVIEW AND REVISION OF FRAMEWORK AND MODEL

Following comparison of the Composite Framework and the field study of University X, the Composite Framework was amended to identify elements relying on technology infrastructure for effective and efficient implementation – particularly those elements requiring shared understanding and integrated activities. For each element, the nature of its interaction with the technology infrastructure is identified as being: [1] IT to inform decision makers directly from monitoring and evaluating changed behaviours and outcomes (where determinable); [2] IT to facilitate communications; and, [3] IT-enabled processes. Every element in the Composite Framework is informed, facilitated or enabled by IT, with seven of the 21 elements requiring technology support for all three purposes (see Figure 1).

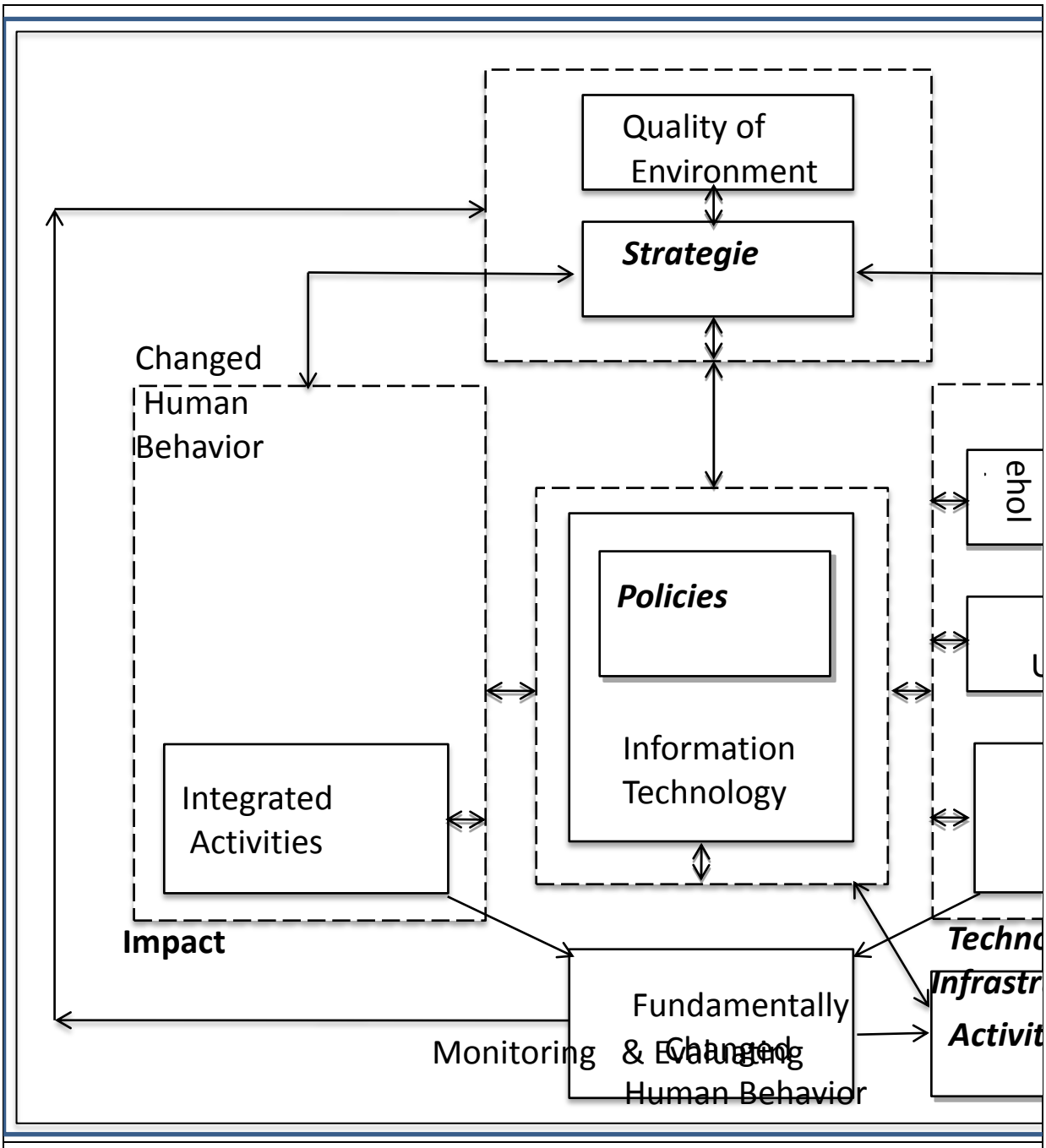

Figure 1: Conceptual Impact Model of the Cybernetic Relationship between University Stakeholders, University Policies, Strategies, Activities, Technology Infrastructure, Determinable and Indeterminable Outcomes of Technology-enabled Changed Behaviors and the Quality of the Environment (adapted from Elliot 2012)

The Conceptual Impact Model (Figure 1) has also been revised to capture the contributions of the technology infrastructure and to highlight the experiences of University X with its many standalone sustainability activities over a period of more than 20 years but its failure to integrate those activities in pursuit of an achievable strategy or goal. The technology infrastructure is disaggregated into IT and non-IT components. The IT components: facilitate communications between stakeholders, activities and strategies; link elements in the model to the shared understanding and integrated activities; mediate interactions between other elements in the model; and monitor changed human behaviors and their intended or unintended impact on the quality of the environment.

The importance of strategic responses by universities to the challenges of environmental sustainability that require fundamental change to behaviors and achieve determinable outcomes is emphasized in the revised conceptual model as requiring shared understanding and integrated activities. Critically, strategic level responses

require strategic intent to achieve intended outcomes that improve the environment. Standalone activities implemented in isolation, even when implemented over a lengthy period of time, most likely lead to an indeterminable impact on the quality of the environment or any other significant outcome. This is because the strategic intent to achieve a pre-specified outcome is lacking, Those factors identified in the literature as being essential to successful change outcomes: a goal, vision, mission or objective; sponsorship by a senior executive over an extended period; prioritization of effort; appropriate resource allocation; and efforts to engage stakeholders at all levels over time; simply, were not present at the University of X throughout the case study period. As seen in the experiences of our field study university, activities may provide the semblance of progress in the short term. However, if the organization lacks commitment or capability to affect change in pursuit of a communicable objective then the most likely determinable outcome will be disaffection of enthusiastic supporters of that change.

DISCUSSIONS AND IMPLICATIONS

Appropriate application of the revised Composite Framework and Conceptual Impact Model could assist university executives to make an improved contribution to sustainability by identifying the steps that need to be taken; the nature of IT systems in support of each step; and the necessity for strategic intent; shared understanding and integrated activities to make a determinable contribution to the level of quality of the environment. IS applications are essential for mediation, facilitation, monitoring, evaluation and reporting progress, and, as and where required, in moderating the impact of a dynamically deteriorating environment on universities and their societies. In these ways, IS scholars can contribute to supporting drivers of change, overcoming resistance to change, and addressing the diverse challenges of environmental sustainability, for the benefit of all concerned.

Thirty-five years ago, universities were called on to make a foundational contribution to resolving the challenges of environmental sustainability (UN 1987). Although many universities have undertaken a diversity of activities under the banner of sustainability over the years, few have achieved determinable outcomes. Approximately 1/3rd have adopted a strategic approach with shared understanding and integrated activities towards stated objectives. That leaves most efforts being characterized as activities without outcomes (NWF 2008). This paper and its research questions address this situation, The paper aims to assist universities to achieve greater contributions to the challenges of sustainability by clarifying the drivers and inhibitors of university initiatives in sustainability and by proposing a model of IS-enabled sustainability innovation for universities. The key role for IS scholars is integrated with the framework and model.

The first research question, what drivers and inhibitors influence university initiatives, has been addressed through the review of purposively selected literature (Miles and Huberman 1994) and a revelatory field study, see above. Major drivers in the literature were expanded to reflect the breadth of motivators and their changing influence over the case study's 20 year period, see above. The second research question, can applications of ICT facilitate increased contributions by universities, was addressed by review of selected literature and testing a Conceptual Impact Model (Figure 1) by comparison with the technology-enabled infrastructure identified in the case study as being a facilitator of the changes required. The final question, how and where can IS scholars support universities to address sustainability challenges, is clarified by the revised Composite Framework with its numerous roles for application of Technology Infrastructure.

The applicability of the Conceptual Impact Model may be limited by the literature selected and by the constraints in their testing, even by comparison with a revelatory case. However, the Framework and the Model contribute to addressing a persistent problem of low levels of university contributions to sustainability in universities by identifying gaps in current understanding and presenting tested and revised models of sustainability application in institutions of higher education. The implication for university executives is that an appropriate technology-enabled infrastructure is essential to support the various initiatives and to achieve the shared understanding and integrated activities required for fundamentally changed behaviour.

REFERENCES

ACTS 2011. New benchmarking / reporting tool. http://www.acts.asn.au/index.php/2011/05/new-benchmarkingreporting-tool/

Agarwal,R. and Lucas, H.C. 2005. "The information systems identity crisis: focusing on high-visibility and high-impact research," MIS Quarterly (29:3) 381-398.

Bartlett, P. and Chase, G. (2004), Sustainability on Campus: Stories and Strategies for Change, MIT Press, Cambridge, MA.

Brinkhurst, M., Rose, P., Maurice, G. and Ackerman, J.D. 2011. "Achieving campus sustainability: top-down, bottom-up, or neither?" International Journal of Sustainability in Higher Education, (3:1), 19-37.

Carpenter, D. and Meehan, B. 2002. "Mainstreaming environmental management". International Journal of Sustainability in Higher Education, (12:4), 395-429.

Clarke, A. 2006. "The campus environmental management system cycle in practice", International Journal of Sustainability in Higher Education, (4:7) 374-389.

EU. 2003. "Directive 2002/95/EC of the European Parliament and of the Council on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment," Official Journal of the European Union (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri= OJ:L:2003:037:0019:0023:en:PDF).

Elliot, S. and Lavarack, J. 2012 'IS-Enabled Innovation to Overcome Resistance and Improve Contributions to Sustainability by Universities: An IS Research Agenda', *Proceedings of the 16th Pacific Asia Conference on Information Systems PACIS 2012 - "IS Innovation in Pacific Asia"*, Ho Chi Minh City, VN. 15th July 2012

Harvey, F. and Vidal, J. 2011. Global climate change treaty in sight after Durban breakthrough, Guardian, December 11. http://www.guardian.co.uk/environment/2011/dec/11/global-climate-change-treaty-durban

IPCC. 2007. Climate Change Synthesis Report: Summary for Policymakers, Geneva: Intergovernmental Panel on Climate Change (http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_

Kurland, N.B. 2011. "Evolution of a campus sustainability network: a case study in organizational change". International Journal of Sustainability in Higher Education, (12:4), 395-429.

Lee, A. S. 2001. Editorial, MIS Quarterly, (25:1) iii-vii.

Lee, A.S. 2010. "Retrospect and prospect: Information Systems research in the last and next 25 years", Journal of Information Technology, (25) 336-348.

McKinsey 2006, Organizing for successful change management, McKinsey Quarterly, June.

Miles M. B., and Huberman A. M. 1994. Qualitative Data Analysis: An Expanded Sourcebook (2nd ed.), Thousand Oaks, CA: Sage Publications.

NWF 2008, Campus Environment 2008: A National Report Card on Sustainability in Higher Education, National Wildlife Federation, USA

NIC. 2008. Global Trends: 2025: A Transformed World, Washington, DC: National Intelligence Council.

Sharp, L. 2002. "Green campuses: the road from little victories to systemic transformation". International Journal of Sustainability in Higher Education. 3: 2

Stern, N. 2007. The Economics of Climate Change, Cambridge University Press.

Stubbs, W. and Schapper, J. 2011. "Two approaches to curriculum development for educating for sustainability and CSR. International Journal of Sustainability in Higher Education", (12:3), 259-268.

UN. 1987. Our Common Future: Brundtland Commission on Environment and Development, United Nations, Oxford, UK: Oxford University Press.

UN. 2010. The Millennium Development Goals Report, Published by the United Nations Department of Economic and Social Affairs, June. ISBN:978-92-1-101218-7.

UNFCCC. 2007. "Status of Ratification of the Convention," Geneva: United Nations (http://unfccc.int/essential_background/convention/status_of_ratification/items/2631.php).

UNGC. 2010. UN Global Compact: A New Era of Sustainability, UNGC / Accenture CEO Study, http://www.businessandleadership.com/reports/partner/25-accenture/report/106-a-new-era-of/

Velazquez, L., Munguia, N. and Sanchez, M. (2005), "Deterring sustainability in higher education institutions: an appraisal of the factors which influence sustainability in higher education institutions", International Journal of Sustainability in Higher Education, (6:4) 383-91.

von Bertalanffy, L. 1996. General System Theory: Foundations, Development, Applications (rev. ed.), New York: George Braziller.

Wright, T.S.A. (2002) "Definitions and frameworks for environmental sustainability in higher education", International Journal of Sustainability in Higher Education, (3:3) 203-220.

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