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Green Information Systems
What can we contribute?

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ABSTRACT

As mankind faces a number of environmental crises, green information systems is becoming an established research area. This essay looks at the existing green information systems literature, distinguishing between green IT (reducing the impact of IT on the environment) and green IS (information systems that have an impact on environmental issues beyond the area of IT). A large part of the existing research is found to take an uncritical, deterministic view. There is also, however, some research that follows the socio-technical tradition of IS research, which is particularly helpful for this topic. The essay shows how elements of socio-technical research have been successfully applied to the area of green IS, and develops ideas for further research.

INTRODUCTION

There is little doubt that mankind is heading towards a number of environmental crises. Issues like peak oil, global warming and the increasing strain on finite natural resources by a growing world population make it clear that we need to change our relationship with nature. There is mounting evidence for the impact mankind has on the environment. For example, Oreskes (2004) points out that there is scientific consensus that man's activities are affecting the earth's climate. As Melville (2010) puts it, "anthropogenic climate change is a reality" (p. 14).

Consequently, an increasing number of information systems (IS) researchers are starting to think about what our field can contribute to solve these issues. Green IS is a fairly new area of IS research, nevertheless it can be considered established as it has had conference tracks (aisnet lists 77 papers at IS conferences between 2009 and 2011) and journal issues (e.g. Journal of Strategic Information Systems 1/2011) dedicated to it. The question is how researchers go about their research and to what degree they reflect on and utilise the critical tradition of IS research.

Most authors distinguish between green IT and green IS. The former refers to the research of the environmental impacts of information technology (IT), the latter to applications of information systems that have an impact on environmental issues beyond the area of IT. This distinction goes back to Watson et al. (2008). The examples they give for green IS include fleet management systems to cut the costs of transport and systems to inform consumers about the environmental impact of products, thus enabling them to make more informed choices.

"Sustainability" is another term that should be defined. Following the triple bottom line approach (Elkington 1998), some authors (DesAutels & Berthon 2011) distinguish between economic, ecological, and social sustainability. Usually, however, authors take a narrower view on sustainability and take it to mean ecological sustainability only (Melville 2010). Thus they follow the definition given by the Brundtland Commission of the United Nations (WCED 1987), which defines sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

This essay will show that green IS research can benefit from a socio-technical research approach. For this, some perspectives on green IS will be presented, divided into approaches following the "green IT" and "green IS" paradigm. These will be followed by papers that go beyond this and use approaches from the tradition of socio-technical IS research. Finally, some opportunities for further research will be developed.

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GREEN IT

As Dedrick (2010) points out, the design, use and disposal of IT accounts for "2 percent of the total CO2 emissions in the U.S., similar to the emissions created by the entire airline industry" (p.175). This number is probably higher than most people would have guessed, so researching ways to reduce it – what we call "green IT" – is a worthwhile activity. There is a large body of research in this area, mainly from IT and management literature.

One example for an IS paper in the green IT tradition is Bodenstein et al. (2011), who analyse energy usage in data centres. Using mathematical cost models on simulated data centres, they find that data centres used by small and medium businesses in particular have great inefficiencies and thus a high potential for cost and energy savings. This is an interesting approach, but although this paper was presented at the European Conference on Information Systems (ECIS), its methodology is quite traditional, focusing on technical and business aspects. This reflects the fact that IS as a discipline does not exist in Germany – its closest equivalent is Wirtschaftsinformatik, a discipline that combines economics and informatics. We will see that the area of green IS can benefit from broader research perspectives.

A technology that is often associated with possible green side-effects is cloud computing. It has the potential to reduce the amount of hardware used as organisations are moving their systems into the cloud, i.e. onto shared servers run by a cloud provider. IS researchers (Willcocks et al. 2011) have not focused on the environmental aspects of cloud computing, but there are some contributions from practitioners and general publications. Heimbuch (2011) quotes research that says "cloud computing could be responsible for cutting [greenhouse gases] by as much as 38%" but points out that this depends on a lot of conditions, for example the data centres would have to run on renewable energy and the added energy used to access data in the cloud is not usually included. He ends by quoting a report that says "it seems that whether computing goes green depends less on the cloud than all of the people standing beneath it". This is an important point because in cloud computing, just like with all technologies, the technology will not have an impact on its own, it also has to be used in the right way.

People and their conflicting interests also influence the question of how to price IT. DesAutels & Berthon (2011) compare the prices of conventional notebooks to sustainable notebooks that were awarded the EPEAT Gold label, the highest award for sustainably produced electronics. Based on a review of green IT literature, they point out that notebooks are amongst the products with the highest associated environmental costs. "the cost of a notebook to the consumer represents a fraction of its total wider environmental and social cost – by a multiple of 10" (p. 114). Despite this, they find no significant price differences between conventional and sustainable notebooks, and conclude that the costs to the environment and society are not included in the notebooks' market price. This may mean that the costs of sustainable notebooks are offloaded on society, the "commons" – although they point out their research is not sufficient to answer this question. It does reflect the fact that price is the most important factor for consumers buying electronics, and that charging the real costs to individuals rather than society will meet with big market and political resistance.

We can see that the impact of IT on the environment and its use of limited resources are considerable, so research on how to reduce them is required. Information systems have, however, the potential to enable far greater savings, as we will see in the next section.

GREEN IS

Since IT is causing 2% of the CO2 emissions in the U.S., it may be worth going beyond IT use and thinking about what information systems can contribute to help reduce the remaining 98% of emissions. This is what green IS research is trying to achieve. As information systems are used in all parts of life, it is easy to come up with examples for their use in this area. One interesting practical example is United Parcel Service, which has employed a software to improve the routes of its delivery vans in order to eliminate left turns (which, in the US, mean waiting at red traffic lights). Over one year, this has cut routes short by 28.5 million miles and reduced CO2 emissions by 31,000 tons (Lovell 2007). This shows how IS can be used to achieve significant energy savings.

Not all cases are as clear-cut though. Looking at green IS research, we find that researchers are concerned with the impact new technologies can have on environmental issues, but tend to take these effects for granted. A relevant example is Pitt et al. (2011), who introduce smartphones as "both green technologies and (…) integral parts of green information systems" (p. 27) before looking at "green" iPhone apps. The examples they give include an app to visualize a car's energy usage and give advice on how to lower it and a "smart home" app that allows users to turn the lights, heating etc. on and off from wherever they are. It is obvious, however, that they take the desired effect of the technology for granted

without reflecting on how it will be achieved when technology is part of a social context. Rather than assuming that technology will have the desired effect, it would be interesting to look at such apps from a social shaping of technology perspective (see Howcroft et al 2004). This could include asking questions about how these apps are shaped by society, and also how they are enacted by users.

Watson et al. (2008) add a psychological element to their studies by noting that "we are addicted to information" (p. 3). Considering how IS can contribute to sustainable business processes, they propose some potential frameworks to identify green IS opportunities. One is based on the theory of information drives where they identify four information drives - ubiquity, uniqueness, unison and universality - noting that any efforts to change industry or society must make sure these drives are satisfied in a physical and informational sense – otherwise people will not accept new solutions. In the case of ubiquity, users expect ubiquitous internet access and, similarly, they will expect ubiquitous availability of transport options (e.g. bus frequency, number of bus stops). The authors describe the Paris bike rental system, Vélib, as a successful example that fulfils the four needs both from an information and a physical perspective.

They then discuss further "frameworks for promoting thinking about organisational sustainability" (p. 11). For example, they try to relate Ghemawat's (2007) AAA triangle to sustainability, arguing that the elements of Ghemawat's framework (Aggregation, Adaptation, Arbitrage) can not only be combined with the goals of organisational sustainability such by using green initiatives as a way to distinguish from competitors – arbitrage, but can also be used as a starting point to identify opportunities for green initiatives.

The finding that organisations will only carry out sustainability initiatives if they do not hurt their profits is not new, and the use of Ghemawat's framework here seems far-fetched and not very convincing.

Not surprising for a new research area, there have been a number of other attempts to define frameworks to guide the future directions of green IS research. One of the most exhaustive ones is Jenkin et al. (2011). They explain the lack of research on green IS with the fact that green IT/IS is a new topic and with the "general lack of awareness of the impacts of IT/S on organizations' environmental footprints" (p. 34). They propose a framework for future research, based on existing frameworks (e.g. from the management and psychology literature). The levels of their framework are:

- environmental sustainability motivating forces

- environmental sustainability initiatives

- overall environmental orientation, both of organisations and employees

- environmental impacts

They especially point out the importance of alignment – environmental orientation will be higher when there is alignment within and between levels, for example initiatives should align with employees' environmental orientation, and employees' environmental orientation should align with the organisation's environmental orientation. This focus on the individual is an important point, it should not be ignored in these highly emotional issues. Nevertheless, as Jenkin et al. (2011) point out, most research on green IS is focused on the organisational level only.

The psychological point of view is taken up by Melville (2010), who gives a solid overview of potential research areas from a US perspective. He finds that "Information systems are an important but inadequately understood weapon in the arsenal of organizations in their quest for environmental sustainability" (p. 14) and that IS researchers are "uniquely equipped to analyze issues at the intersection of information, organizations, and the natural environment" (p. 2). He defines a number of possible research issues in the areas of

- philosophical perspective and theory

- research methodology and data sources

- sustainability phenomena

- IS and individual sustainability actions.

The paper provides a good starting point for researchers planning to undertake green IS research. It is also interesting to see that Melville points out the heterogeneity of the IS field and its variety of research methods and world views as one of its strengths in dealing with new challenges.

This heterogeneity was described by Avgerou (2000). IS is a field shaped by a variety of thematic areas and theoretical approaches, which is also reflected in its geographical scope and institutional arrangements. As a research discipline, it is strongly influenced by North American business schools, which leads to a research focus on business studies and could suggest, as Avgerou warns, that "the mission of IS research is to produce knowledge on IT which is useful for business management" (p. 574).

The focus on North America is also reflected in the fact that all the research papers presented in this section come from the US or Canada. Moreover, with the exception of Melville, they tend to take a hands-on, positivist approach to these issues. This can be a legitimate approach, but papers in the socio-technical tradition of IS show that there is much to be gained by applying these perspectives.

SOCIO-TECHNICAL PERSPECTIVES

The European socio-technical tradition of IS research looks at the network of organizations, people, cultures, and processes that form the IS system. As it is based in the social sciences, research methods are usually interpretive or critical (Avgerou 2000). It has a tradition of reflecting on the assumptions of technology use and illuminating the interplay between people and technology.

The interplay between people, technology and society in green IT/IS looks to be a promising area for socio-technical research. So far, however, much research is stuck describing single technologies (green IT) or the use of IS in society without critical reflection (green IS). In this section, I am going to present some ideas from papers that go beyond this.

The need for clear definitions is made obvious by Ali & Bailur (2007). They start out by trying to define sustainability, finding that in the ICT for development literature, there are five types of sustainability - financial, social, institutional, technological, environmental - with the last one actually being used least. They go on to question if sustainability is at all possible, offering Ciborra's (2004) concept of bricolage as an alternative - "Nothing has ever been sustainable, and nothing will ever be. Change is inevitable", p. 12. While this may be debatable (most proponents of sustainability would argue that it is not the same as stasis), it is a great idea to introduce Ciborra's idea of bricolage into the green IS debate. Ciborra presents tinkering as an alternative to top-down planning of IS innovation, arguing that in the messy reality of organisations, innovation can seldom be easily implemented, but must be negotiated through deals and on-the-spot changes. He recommends organisations to use tinkering strategically, arguing that distributed, improvised approaches to innovation can be more successful than traditional top-down ones. Clearly, these ideas could be relevant in the specific case of green IS innovation.

The same idea is voiced by Hasan (2010), who compares the political efforts to reduce greenhouse gas emissions (e.g. the 2009 Copenhagen summit on climate change) to a top-down IS development project and argues that, like in IS development, bottom-up approaches could be more successful. As IS research has a tradition of researching failures of (usually) top-down projects, it has "credentials in the space for understanding the pitfalls of top-down design" (p. 2). She points out that "wicked" or complex problems may not be amenable to top-down solutions. She sees climate change as a wicked problem as it is full of inherent contradictions, for example the fact that a transition to electric cars could increase CO2 emissions as most electricity in the US comes from coal.

Hasan is arguing for a multi-faceted approach using both bottom-up and top-down approaches. In order "to influence behaviour in complex socio-technical systems" associated with climate change (p. 5), she mentions socio-technical systems theory as a method to be used. The point she is making is a very valid one – certainly IS can contribute valuable insights here. The methodology of this article is a bit weak, as it only relies on two small studies conducted by Hasan and her associates.

The most coherent effort to combine green IS with the European tradition of IS research is the article by Berthon et al. (2011), who argue for a third level of analysis beside green IT and green IS, which they call "green information views", these are ways of thinking about our relationship to technology and nature. What sets this paper apart from most literature on the topic is that they use one of the elements of critical IS research - Heidegger's theory of technology as gestell - in order to arrive at new insights. The authors argue, as we have seen, that existing literature takes an instrumental view on technology, and attribute some of the failures of IT (see the productivity paradox) to this. Following Heidegger, they point out that, while technology is commonly viewed as instrumental, it should also be seen as revealing. The way a compass reveals a world of magnetic fields, technology can become a way of seeing the world (what Heidegger calls gestell) and thus shapes the observers in the process. It is this conceptual dimension of technology that makes it "an active subject, shaper of people and revealer of new worlds" (p. 592). The view of the environment is changing as well. Berthon et al. describe four paradigms of human-nature interaction - naive, efficiency, romantic and transformative. The latest one of these, "transformative", assumes that after centuries of human exploitation, "what we think of as the 'natural' world is a myth" (p. 595) – it sees nature as a human product that is shaped by technology.

In my opinion, this is an important insight. Technology is shaping our view of nature, and it can make us see or ignore parts of the world. An example of this is given in the documentary film "The end of

suburbia", where energy expert Matthew Simmons says (The End of Suburbia 2004):

The only scientists that seem to have taken [peak oil] very seriously are the old-timers, whereas the young guys are mesmerized by the technology. We created a generation and a half of Nintendo geologists that sit at their workstations and basically move around images until they say "wow – look at that bright spot!"

ANALYSIS / CONCLUSION

Even this limited review of literature shows the breadth of the topic, the different focus areas (green IT vs. green IS) and the different approaches taken by researchers trying to define the future research areas. The papers summarised under "green IT" show approaches that are highly relevant from a practical perspective but have little theoretical depth. The "green IS" papers represent solid IS research shaped by their national/ cultural background, for example, following the North American research tradition. These include cross-disciplinary approaches, like the psychological elements in the frameworks by Watson et al. (2008) and Jenkin et al. (2011) as well as the broad approach by Melville (2010), who asks how to apply different philosophies and methodologies to green IS research.

The possibilities of applying socio-technical research practices to the area of green IS are touched upon by the approaches in the third group, "socio-technical perspectives" here. Both the idea of applying bottom-up approaches (Ali & Bailur 2007, Hasan 2010) and the critical reflections on our relationship to nature and technology as outlined by Berthon et al. (2011) show that these approaches can provide valuable insights.

There is a wide scope for future research outlined in many of the theoretical articles. This shows that there are many good areas for research in this field. The relationship between people and technology is certainly an important area for future research. IS has a tradition of researching the relationship between IT and people – this could possibly be extended to technology and people.

We have also seen that there is a shortage of practical research, such as researching actual cases of information systems and finding out how, for example, bottom-up approaches or bricolage, work in practice. With the growing environmental issues outlined in the beginning, it is safe to assume that the field of green IS can only grow in importance. And if doing research in this area can help to mitigate the effects of climate change, there is also a moral motivation to do it.

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