

AN INVESTIGATION INTO THE APPLICABILITY OF GREEN IT CONCEPTS INTO GREEN IS

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ABSTRACT

In the last five years, research on the role of IT in managing the environment has been accelerated by Information Technology (IT) practitioners such as Google, IBM and Microsoft as well as by the academic community. Research in this field seems to have been narrowed down in two areas; Green Information Technology (Green IT) and Green Information Systems (Green IS). Confusion reigns on whether green IT and green IS are the same thing or two different concepts. Within the academic community, a review of literature shows that there exists a difference based on the definition and scope of each of these concepts whereas practitioner research seems to be more focused on the former (green IT) where direct benefits can be easily accrued by individuals and customers and left out the part on Green IS. Most IS academic researchers have encouraged that more research needs to be directed to Green IS which has the potential to bring in more benefits in terms of organizations drive to reduce their environmental footprint. Green IT aims to reduce the IT induced global green house Gas emissions while Green IS tries to look at the innovative ways in which computing can be used as the solution to environmental pollution. The aim of this paper therefore was to investigate the applicability of Green IT concepts in Green IS. This was done by carrying out a tentative review of Green IT and Green IS research and then carrying out the comparisons between the two concepts to identify any gaps and overlaps. Later on, the researcher proposes future research areas based on the results.

Keywords:- Green IT, Green IS, Greenhouse gas, Computing, sustainability

1.INTRODUCTION

Environmental management has been a hot topic for research by both researchers and practitioners in the last two decades. Faced with the growing threat of global green house emissions, the global community has placed serious focus on trying to come up with solutions that can be applied to solve this growing threat to humanity. Governments and organizations have invested billions of dollars in coming up with more sustainable solutions to the environment (Molla, GITAM: A Model for the Adoption of Green IT, 2008). Deterioration of the natural environment poses risks and opportunities for business organizations. Some firms respond by adopting environmental management strategies (Melville, 2010). For example, the United Nations (UN) launched the "Building for the Future" initiative with the aim of encouraging the construction of Green Buildings. In this, they led by example by constructing for example their new office building that houses UNEP and UN-HABITAT at the United nations headquarters in Nairobi (UNEP, 2011); IBM in 2007 launched a \$1 billion a year service initiative to build and redesign data centers with the aim of reducing the energy consumed by data centers. IBM later as an extension of this Project launched another program that allows mainframe customers to monitor their energy consumption in real time (CACM, 2010). On the part of the organization, the desire to integrate environmental management strategies within the overall organization strategy has become essential. Information Communication Technology (ICT) has been viewed as both a cause of environmental pollution and on the other hand there has been a drive to find ways in which ICT can be exploited and used as a solution to this global phenomenon. The use of ICT as a solution to the environmental problem is driven by the fact that ICT permeates every level of the organization and the fact that it is an enabler to most of the organizations functions (Dedrick, 2010). Some organizations however adopt Green ICT because of its ability to save on energy and costs (Wabwoba., 2013) Therefore, the role of ICT on the environment has been discussed under the fields Green IT and Green IS (Osch, 2010). However, there is a lack of clarity as regards the distinction between Green IT and Green IS (McGibbon & Sewchurran, 2011). This lack of clarity has resulted in research that seems to have concentrated more on the concept of Green IT and in some cases failed to appreciate any differences that exist between Green IT and Green IS. This paper therefore seeks to analyze the level of research in this area and to identify any existing gaps as well as offer guidance on future research in this field. First, a literature review and definition of concepts is made. The

researcher then carries out a comparison based on literature review on these two fields and finally makes recommendations to support future research in this area.

2.METHODOLOGY

The researchers identified 29 articles from the research community published in the last 5 years touching on Green IT, Green IS and sustainability that were identified by the researchers. Out of these articles, 9 journal articles on Green IT were reviewed, 9 journal articles on Green IS, and 11 articles addressing sustainability and the role of computing in enhancing sustainability consisting mainly of research work from practitioners such as Google and IBM, regulatory bodies such as UNEP and government institutions and other bodies. This provided a rich source of information relevant in achieving the main aim of this paper which was to find out the difference between Green IS and Green IT, find out any overlaps and make recommendations on why future research needs to focus more on Green IS.

3.LITERATURE REVIEW

DEFINING SUSTAINABILITY

Sustainability is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987). This means that sustainability goes beyond the drive for economic development to adopting organizational measures that are socially responsible and environmental friendly. Sustainability entails protection of the environment and natural resources as well as to provide social and economic welfare to the present and to subsequent generations (Hansmann, Mieg, & Frischknecht, 2012). He continues to argue that Sustainable development is development that is socially just and ethically acceptable. For purposes of this research we adopt this definition of sustainability as advanced by WCED.

Green IT

The information technology industry is directly responsible for 2% of global CO₂ emissions (Gartner, 2007). The IT industry will be responsible for 3% of the global CO₂ emissions by the year 2020 (Murugesan, 2008). The growth of Green Information Technology (Green IT) is focused therefore on reducing the harm on the environment caused by computing. Green IT focuses on Greening all aspects of Information Technology lifecycle, namely, manufacturing, use and disposal ((Osch, 2010), (Boudreau, Chen, & Huber, 2007) (Brooks, Wang, & Sarker, 2012)). Green IT is “ The study of designing, manufacturing, use and disposal of computers, servers and associated subsystems such as monitors, storage devices, printers and other communication devices efficiently and effectively with minimal or no impact on the environment” (Murugesan, 2008) Information Technology creates an environmental load because of the electrical power required for it to operate and the challenge of disposing obsolete computers and related devices (Brocke, Watson, Dwyer, & Elliot, 2013) Green computing is about the efficient use of computing and computers (Lakshmi, Sarwani, & Tuveera, 2012). They opine that anything ‘green’ considers social responsibility, economic viability and environmental impact. This, they say, aims to make computing more friendly to the environment, economy and to the society. “Green IT is about the optimal use of ICT to manage the environmental sustainability of business operations and supply chain including the products services and resources throughout their lifecycle” (Reena, 2008). This definition captures the aspirations of Green IT and Green IS. This is because ICT to some is the same as IT whereas in some cases ICT is viewed as an extended synonym for IT which tries to capture both IT and IS. In the year 2012, the royal society recommended that the term ICT should no longer be used in British Schools and with effect from 2014; the national curriculum was changed to use computing (National curriculum in England, 2013). According to (ACM, 2005), computing is “any goal oriented activity, requiring, benefiting from or creating computers. Computing includes designing and building hardware and software systems for a wide range of purposes; processing, structuring, and managing various kinds of information; doing scientific studies using computers; making computer systems behave intelligently; creating and using communications and entertainment media; finding and gathering information relevant to any particular purpose, and so on.” From this, it is inherent that Green Computing, Green ICT and Green IS simply refer to the same concept. This is because ICT, IS and computing scope goes behold the use of computing for input, process and storage to accommodate any area where computers have an effect or are applied. According to Wabwoba (2012), There is more to Green IT than just power consumption thus to them, defining Green IT based on power consumption and associated costs fails to put into consideration the role of IT as an enabler as IT goes behold purchasing and usage aspects to how IT can be applied to lessen other aspects of environmental pollution. This consideration of these two aspects under green IT brings together the overall aspect of green IT and Green IS under one view and hence fails to separate the concepts as they should be. Green technology targets to reduce the environmental impact of industrial activities and innovative technological developments driven by a growing population (Lakshmi, Sarwani, & Tuveera, 2012). Green computing is a requirement to protect the environment and save energy as well as operational expenses in the ever competitive world (Chakraborty, Bhattacharyya, Nargiza, & Bedajna, 2009).

Green IS

Information Systems (IS) integrates Information Technology solutions and business processes to meet the information needs of businesses and other enterprises enabling them to meet their objectives in an effective and efficient way (ACM,

2005). This definition by ACM captures the argument brought forward by (Brooks, Wang, & Sarker, 2012) (Dedrick, 2010) (McGibbon & Sewchurran, 2011) (Brocke, Watson, Dwyer, & Elliot, 2013), (Boudreau, Chen, & Huber, 2007) and (Watson, Boudreau, & Chen, 2010) who argue that Green IS is different from Green IT and consider Green IT to be a part of Green IS and thus propose more focus on Green IS research. Eliminating the 2% of global green house gas emissions caused directly by IT (Greening by IT) does not eliminate the threats on the environments caused by CO2 emissions as there still remains 98% CO2 emissions caused by other factors, this explains the relevance of Green Information Systems (Green IS). According to (Watson, Boudreau, & Chen, 2010), Green IS refers to “the design and implementation of information systems that contribute to sustainable business processes”. Innovative IS can help reduce environmental problems (Brocke, Watson, Dwyer, & Elliot, 2013). There is need for the development of Energy informatics that would recognize the role that IS can play in reducing CO2 emissions. This field of energy informatics would focus on finding ways in which information systems can be used to reduce energy consumption and contribute practical solutions to advance environmental sustainability (Watson, Boudreau, & Chen, 2010). Currently, many organizations have an opportunity to tackle sustainable development while at the same time improving productivity, cutting on costs and enhancing their productivity. Their poor environmental management practices result in many forms of waste: unused resources, energy inefficiency, friction, noise and Green gas emissions are all wastes that subtract from economic efficiency. These poor environmental practices could be improved by Green IS initiatives (Watson, Boudreau, & Chen, 2010). This demonstrates the direct benefits that an organization can gain by employing Green IT which is a part of the wider Green IS initiative. Green IS has the ability to integrate essential business processes, resource planning systems, manufacturing activities and extended supply chain to affect positive changes across the fundamental functions of governments, organizations and individuals, therefore there is need for organizations focused on sustainability to look at green IS as being critical to their other information systems which includes production and scheduling, accounting and finance, marketing and human resource management information systems (Curry & Donnellan, 2012) Watson (2010) asserts that “We need to demonstrate how the transformative power of information systems can be leveraged to create an ecologically sustainable society” (Watson, Boudreau, & Chen, 2010, p. 23). This assertion summarizes the role of Green IS in enhancing sustainability.

Green IT and Green IS, is there a difference?

According to (Brooks, Wang, & Sarker, 2012), the difference between Green IT and Green IS can be traced back to the difference between IT and IS, in that, IT transmits, processes or stores information whereas an Information System (IS) is an integrated and cooperating set of software using information technologies to support an individual, group or societal goals. According to the business dictionary, an Information System is “a combination of hardware, software, infrastructure and trained personnel organized to facilitate planning, control, coordination and decision making in an organization.” Information Technology is defined by Oxford dictionary as “the use of electronic equipments especially computers for storing and analyzing information. (Boudreau, Chen, & Huber, 2007) notes the differences between these two concepts and argues that: “An information technology (IT) transmits, processes, or stores information. An information system (IS) is an integrated and cooperating set of software using information technologies to support individual, group, organizational, or societal goals.” According to him, Green IT mainly focuses on energy efficiency and equipment utilization. In developing the curriculum for both Information Systems and Information Technology, the Association of Computing Machinery (ACM) differentiates between IT and IS and argues that “Information systems (IS) focus on the information aspects of Information Technology: information Technology (IT) is the complement of that perspective; its emphasis is on the technology itself rather than what it conveys” (ACM, 2005, p. 14). According to (Brocke, Watson, Dwyer, & Elliot, 2013), Green IS contrasts from Green IT in that Green IS is not limited to the energy efficiency and equipments utilization of Information technology but focuses on the analysis, design and implementation of information systems that play a role in the implementation of sustainable business processes. There is a high level of potential for Green information systems (Green IS) to bring together business processes, resource planning, direct and indirect activities and integrated supply chain to effect positive contributions across individuals, organizations and governments. (Curry & Donnellan, 2012) According to Watson (2008)

Green IT is mainly focussed on energy efficiency and equipments utilization and it addresses issues such as:

- Designing energy efficient chips and disk drives
- Replacing personal computers with energy efficient thin clients. This is also supported by (UNEP, 2011)
- Use of virtualization to run multiple operating systems on one server (CACM, 2011)
- Reducing the energy consumption of data centers (Google, 2011)
- Using renewable energy sources to power data centers
- Reducing electronic waste from obsolete computing systems
- Promoting telecommuting and remote computer administration to reduce transportation emissions

In contrast, Green IS refers to the design and implementation of information Systems that contribute to sustainable business processes Watson (2008). He opines that Green IS will help an organization to:

- Reduce transportation costs with a fleet management system and dynamic routing of vehicles to avoid congestion of traffic and minimize the consumption of energy

- Support team work and meetings when employees are distributed around the world thus reducing the impact of air travel.
- IS can move remote working beyond telecommuting to include systems that support collaboration, group document management and cooperative knowledge management.
- Track environmental information (such as toxicity, energy used, water used, etc.) about the creation of products, their components, and the fulfillment of services
- Monitor a firm's operational emissions and waste products to manage them more effectively
- Provides information to consumers so they can make green choices more conveniently and effectively.

Osch (2010) captures the difference between these two concepts. He opines that there are two primary approaches to sustainability one that focuses on how to reduce the negative ecological impact of information technologies, (referred to as Green IT or greening by IT), and the other focuses on how to leverage information technologies for solving our environmental problems (referred to as Green IS or greening by IT). The former approach, Green IT, treats information technologies as part of the problem and addresses the question of how to reduce their ecological footprint by cutting CO2 emissions, energy consumption, and waste throughout their lifecycle, that is, in the processes of designing, producing, using, and disposing IT-related services and artifacts. The latter approach, Green IS, considers information technologies or information systems as part of the solution and analyzes their potential role in helping organizations to manage their environmental footprint (Osch, 2010). In a review on Green IS research, (Brooks, Wang, & Sarker, 2012) noted the challenge of limited research towards Green IS and argued that “much of green computing studies identified focus on Green IT.” They thus suggest that future studies should be redirected more on the more encompassing phenomenon of Green IS. This, they argue is because Green IT is a part of Green IS. Green IS offers a greater potential in research and practice than Green IT because it tackles a much larger problem. It has the ability to make entire systems more sustainable compared to just reducing the energy required to operate information technologies. (Boudreau, 2007) concludes that as much as Information systems literature has been able to examine how computer based systems can support a variety of business systems in order to improve the efficiency and effectiveness of organizational functions, very few studies have been focused on how green IS implementation can help in improving an organization’s performance by enabling new sustainable processes and practices (Boudreau, 2007) Green IS refers to the design and development of strategic organizational systems that contribute to sustainable measures of a business whereas Green IT focuses on energy efficiency and utilization of equipments in organizations. Watson (2010) concludes that as much as Green IS covers both infrastructural and organizational objectives of environmental technology, environmental sustainability which includes an integrated nature and collection of systems for enhancement of individual, organization societal and environmental objectives, is more general (Watson et al., (Osch, 2010) Identifies and discusses the three facets of technology as follows



Figure 1: Nested approaches to sustainability: adopted from (Osch, 2010)

Osch emphasize the fact that Green IT is a component of Green IS whereas these two can be exploited to enhance sustainable innovation. He summarizes the three approaches to sustainability as shown (Osch, 2010)

Table 1: Summary of approaches to Green and sustainable computing. Adopted from (Osch, 2010)

	Green IT	Green IS	Sustainable Innovation
Focal point	IT artifact	Environment	Society
Description	Reducing IT footprint	Managing environmental footprint	Generating overall sustainable value for all stakeholders
Driver of change	Regulations	Costs and regulatory compliance reporting	Technical and social innovation
Nature of change	Reactive	Reactive/proactive	Generating overall sustainable value for all stakeholders
Dimension of sustainability	Environmental sustainability	Environmental sustainability	Social and Environmental sustainability

Areas of Overlap

There is a clear difference between Green IT and Green IS according to past research. Each of these facets of sustainability is focused on a given aspect which if exploited can reduce the global environmental green house gas emissions. However, most academic researchers seem to discuss these two facets as one without placing a boundary between the two (Green IT and Green IS) or fully ignored the Green IS concept. On this, Watson (2010) poses that “we propose that future research be directed to the more encompassing field of Green IS” Green ICT is a process that tries to focus on the strategic deployment of computing and related operations to dynamically, responsibly and in a sustainable manner align the goals of an organization with the green objectives (Wabwoba, Stanley, Wanyembi, & Omiemo, 2013). Green ICT has been known with different names by different people and places leading to no agreed standard on definition. Some view it as Green IT, others as green computing yet others as Green IS (Wabwoba, Wanyembi, & Omuterema, 2012) Thus from this we can argue that a conflict exists on the definition and understanding of green computing concept. It should be noted that a very thin line exists between IT and IS, in that Information systems are intrinsically related to Information Technology. This means that all concepts that apply to Green It can be discussed as part of Green IS because IT provides the infrastructure on which ISs are implemented. According to (Watson, 2008) we need IT to run the information systems that will support sustainable business practices.

Case for green Is

The most notable argument for Green IS as opposed to the over emphasized Green IT is emphasized by Watson (2008). He argues that “the distinction between IT and IS helps identify the different domains of opportunity and recognize that the higher payoff will be from Green IS despite the current greater attention to Green IT which strongly emphasizes on data center energy reduction” (Boudreau, Chen, & Huber, 2007). He opines that Green IS offers a greater potential than Green IT because of its ability to tackle a larger domain. Green IS addresses a range of problems beyond just reducing the energy required to operate Information Technologies. Long term policy frameworks and goals for sustainable development such as the Kyoto Protocol have led to the establishment of a wide variety of policy programmes notably in the areas of energy, transport, building and manufacturing (OECD, 2009, p. 28). This means that industrial and government policies and regulations have been directed towards the reduction of energy consumption especially in the field of Information Technology (ACM, 2008). In encouraging research towards Green IS, (Osch, 2010) stresses that Information Systems have a greater potential in dealing with environmental management as opposed to Information Technology. He opines that Green IT is driven by regulations whereas Green IS is driven by a desire to cut costs. From this, we can conclude that any business determined to cut costs and increase its revenue base and at the same time play an active role in environmental conservation should consider tapping on the benefits of Green IS. According to Watson (2010), an information system ties together the various elements of information Technology to provide a complete solution. Watson opines that much of the current practitioner literature, focuses on Green IT, this therefore makes it so narrow in terms of the expected results and hence there is need to extend this research to Information Systems. they propose that research should move from the commonly used Green IT to the more encompassing Green IS as it “Incorporates a greater variety of possible initiatives to support sustainable business processes” they conclude that clearly, Green IS is inclusive of Green IT (Watson, Boudreau, & Chen, 2010, p. 24). To understand green IS, a deeper analysis into the functional aspects of organizations and their subsystems needs to be done: this is because IT permeates every level of an organization and its role as an integrating and unifying technology provides essential green benefits for any organization that aims to improve its competitive advantage sustainably. These functional structures of organizations include finance and accounting, engineering and design, marketing, human resource and manufacturing. Each of these functional structures can be analyzed as consumers of IT to find out how information systems can be leveraged to provide the much needed solution to environmental pollution. More so, studies on Green IT and Green Is needs to be incorporated as part of computing syllabus. As proposed by Watson (2010), the creation of a field of energy informatics would create a new field that would be essential in entrenching environmental skills within the computing community.

Conclusion and Recommendations

We can conclude that there exists a clear difference between Green IT and Green IS. This conclusion is supported by the findings of (Boudreau, Chen, & Huber, 2007) (Osch, 2010) (Watson, Boudreau, & Chen, 2010) (Brocke, Watson, Dwyer, & Elliot, 2013) (Brooks, Wang, & Sarker, 2012). Green IS is a new and promising research area in the domain of Information Systems that concerns with the use of information systems to reduce an organization’s carbon footprint. More focus needs to be directed to Green IS because of the potential that it holds. Hence, we are of the view that the academic community needs to direct its efforts to green IS and provide frameworks for implementation that organizations can use. It is notable that a number of models and frameworks for Green IT have been proposed yet there seems to be very limited research towards this as regards Green IS. Green IS offers many advantages that any organization should aim to tap on. Investments in Green IS should not be seen as a cost of doing business but rather as a way of cutting on costs by reducing the energy consumed and reduction of the carbon footprint of other aspects of an organization. More so, Green IS promotes Social responsibility on the part of the organization: in that as firms make huge investments to improve their financial position, they should realize that they have a responsibility in the

protection of the environment. There is also need to analyze Green IS mechanisms that can be employed by small and medium size (SME) organizations in order for them to play a role in reducing their carbon footprint. This will be essential because based on a review of literature, focus seem to concentrate more on addressing the carbon footprint of large organizations and large-scale IT investments.

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