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Darshana Sedera
Monash University, Australia, darshana.sedera@gmail.com

Sachithra Lokuge
University of Queensland

Bonny Tushi
Queensland University of Technology

Felix Tan
University of New South Wales

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Darshana Sedera
Monash University
Faculty of Information Technology
darshana.sedera@gmail.com

Sachithra Lokuge
University of Queensland
UQ Business School

Bonny Tushi
Queensland University of Technology
Information Systems School

Felix Tan
University of New South Wales
UNSW Australia Business School

Abstract:

With the growth of information technology (IT), there is a growing global concern about the environmental impact of such technologies. As such, academics in several research disciplines consider research on green IT a vibrant theme. While the disparate knowledge in each discipline is gaining substantial momentum, we need a consolidated multi-disciplinary view of the salient findings of each research discipline for green IT research to reach its full potential. We reviewed 390 papers published on green IT from 2007 to 2015 in three disciplines: computer science, information systems and management. The prevailing literature demonstrates the value of this consolidated approach for advancing our understanding on this complex global issue of environmental sustainability. We provide an overarching theoretical perspective to consolidate multi-disciplinary findings and to encourage information systems researchers to develop an effective cumulative tradition of research.

Keywords: Green IT/IS, Sustainability, Archival Analysis.

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1 Introduction

The proliferation of information technology (IT) is evident in every industry sector. With the advent of new technologies such as social media, mobiles, analytics, the Internet of things and cloud computing, the worldwide use of IT will likely grow even higher (Sedera et al. 2016). With the increasing usage of technologies, the energy and materials needed to develop, use, and manage IT will inevitably also grow (Guster, Hemminger, & Krzenski, 2009; Niyato, Chaisiri, & Sung, 2009). Moreover, researchers allude to the dangers of technology waste (Datta, Roy, & Tarafdar, 2010) and the great stress IT places on the environment (Forrest, Kaplan, & Kindler, 2008; Fuchs, 2008). Researchers have called for a global and a holistic approach to deal with this growing environmental sustainability issue concerning IT products and services (Ruth, 2009).

Scholars coined the term “green information technology” (green IT) to capture the broad stream of research on environmental sustainability and IT (Chetty, Brush, Meyers, & Johns, 2009; Chetty, Tran, & Grinter, 2008; Huang, 2009; Melville, 2010). Molla, Cooper, and Pittayachawan (2009, p. 1) argue that green IT is a “multifaceted construct that is intended to address both IT and non-IT (by using IT) related sustainability problems”. Green IT promotes the design, manufacturing, and management of IT equipment and services that consume energy throughout the lifecycle (Murugesan, 2008). Organizations have experienced considerable global, local, and social pressure to introduce green IT initiatives to minimize the negative impact of IT on the environment (Nishant, Teo, Goh, & Krishnan, 2012). Moreover, one can find ample evidence of organizations’ employing IT to reduce their operational impact on the environment (Harmon & Auseklis, 2009; Hasan, Ghose, & Spedding, 2009). Overall, with the increasing global emphasis on environmental sustainability, the emphasis on green IT is becoming a norm rather than a passing fashion (Bachour & Chasteen, 2010).

Over the past several years, many researchers have contributed to the discussion of green IT by consolidating current literature and by proposing research directions or management frameworks (e.g., Corbett, 2010; Lei & Ngai, 2013a; Wang, Brooks, & Sarker, 2015b). For example, Wang, Brooks, and Sarker (2015a) analyzed eight premiere academic information systems (IS) journals, three practitioner publications, and four information system conferences and introduced different facets of green IS and their inter-linkages. Idrissi and Corbett (2016) summarized information system research through the modernity lens. They identified four main patterns of modernity that have manifested in the research domain. While these two studies have contributed to a cumulative knowledge in our discipline, such studies have ignored the substantial research on the same topic in computer science and management science literatures. A multi-disciplinary approach would complement the IS research on green IT, and we need such a multi-disciplinary approach to resolve the looming issues on environmental sustainability (Lei & Ngai, 2013a; Nanath & Pillai, 2012b; Tan, Pan, & Zuo, 2011). Despite the strong anecdotal commentary on the need for a consolidated multi-disciplinary approach for studying green IT, such studies are still scant in information systems research.

We minimize this gap in research by systematically combining the research published in computer science, management and information systems disciplines. We believe that such a consolidated approach will 1) lead to a better understanding of green IT by providing an integrated approach of three core disciplines on green technologies and their impact and management and 2) assist IS researchers to understand common research gaps and opportunities to foster cross-disciplinary research with computer science and management. As such, this study is the first large scale multi-disciplinary study of green IT in information systems.

In conducting this archival analysis, we address the fundamental question:

> **FQ**: What important trends and patterns emerge from green IT research between 2007 and 2015 in information systems, computer science, and management?”

In total, we analyzed 390 papers from three disciplines. In this paper, we do not separate the meanings of the two terms “green IT” and “green IS”. We believe that such heuristics will distract the main objective of the paper. Consistent with recent research (e.g., Malhotra, Melville, & Watson, 2013; Van Osch & Avital, 2010) and aligning with our objectives, we consider green IT and green IS research as perspectives of the same research paradigm. For readability, we use the term green IT/IS throughout the remainder of this publication unless we need to specifically use a particular term.

The remainder of this paper proceeds as follows. In Section 2, we discuss the methodology, the pool of papers that we derived in this archival analysis using relevant bibliometric and demographic statistics such as origin of research, publications per year, and perused theoretical mechanisms in the green IT/IS literature. In Section 3, we provide details of the four segmentations derived through the analysis that focus on the core of green IT/IS and associated topics. In Section 4, we provide our observations of the three major disciplines on green IT. Then we discuss the key research areas that future research needs to address and provide innovation as a theoretical lens for future research. In Section 6, we conclude the paper.

2 The Overview of the Literature Sample

We analyzed green IT/IS literature published from 1 January, 2007, to 31 December, 2015. Brooks, Wang, and Sarker (2010) and Wang, Brooks, and Sarker (2015a) found that the term "green IT" appeared in the CIO magazine for the first time in 2007. We also corroborated as much and found that four papers mentioned "green IT" in 2007 (e.g., Elliot, 2007; Etzion, 2007; Feng & Cameron, 2007; Vlek & Steg, 2007). As a result, we decided to start analyzing papers from 2007 onwards. Altogether, we selected 41 journals and 54 conference proceedings to obtain papers for the analysis. The Financial Times 50 (FT50) journal list (https://library.mcmaster.ca/find/ft-research-rank-journals) inspired the outlets we chose. Specifically, using the FT50 journal list, we selected the leading IS and management journals for the analysis. Furthermore, we supplemented the above approach by selecting computer science journals using the SciMago journal ranking (http://www.scimagojr.com/journalrank.php?category=1706). Overall, we selected 12 journals and 20 conference proceedings. Appendix B includes the references for all the papers we reviewed in the archival analysis from 2007 to 2015.

In selecting the journals and conference proceedings, we adopted an inclusionary rather than exclusive approach. In doing so, we could canvass a substantial body of developing literature even though one might not consider some of the publication outlets to be highly rigorous. We selected journals and conference proceedings logically in that we followed the globally accepted tiered journal and conference structures. We read each paper we identified through the search in its entirety and determined its relevance. We identified the most relevant papers and classified them into four categories: 1) green IT/IS conceptualization, 2) green technology practices, 3) green IT/IS Adoption, and 4) literature reviews. Initially, two researchers independently searched for the papers and categorized them. We then identified additional papers via "snowballing" through the papers that we had already accumulated. To that end, we first included the journals in the Association for Information Systems' Senior Scholars basket of eight journals, the proceedings for all the major global IS conference (e.g., ICIS, AMCIS, ECIS, PACIS), and top-tier publications from the computer science and management disciplines.

We used the following keywords in the search: "green", "green IT", "green IS", "sustainable IT", "environmentally friendly IT", "green computer", "green innovation", "green ICT", "energy*", and "sustainabl*". We used several academic databases and search engines to conduct the search, such as ACM Digital Library, Science Direct, Emerald, Google Scholar, Emerald Engineering Database, InfoSci collection and IEEE Xplore Digital Library. Finally, we considered 390 papers (131 journal papers and 259 conference papers) from all three disciplines to be relevant for the analysis. Appendix C summarizes the archival analysis. Our initial review of the papers provided broad categories in research areas including strong reference to green IT/IS (such as how IT causes problems for environment), motivations for green IT, green IT lifecycle, and challenges and success factors. In Sections 2.1 to 2.5, we discuss how we categorized and analyzed the papers in detail.

2.1 Year-to-year Green IT/IS Literature

Comparing publications on green IT/IS year to year will show whether green IT/IS research has received its due place in academic agenda in the established conferences and reputed journals. Observing the number of journals published on green IT/IS, we found that the IS flagship journal *MIS Quarterly* carried the second highest number of papers (7) on green IT/IS in the IS discipline. The *Journal of the Strategic Information Systems* had nine papers on green IT/IS. We found seven papers in the *Communications of the AIS* and ten papers in the *Australasian Journal of Information Systems*. Overall among all journals, the highest number of publications appeared in 2011 (27 papers in total). The IS conference AMCIS accounted for 77 papers on green IT/IS and the premier IS conference ICIS accounted for 38 papers. Similarly, among all conferences, the highest number of publications appeared in 2011 (58). Among the management discipline papers, *Research Policy* had the highest number of publications on green IT/IS (15 papers in total). *IEEE Computer* had the highest number of green IT/IS publications in the computer science discipline (13 in total). Despite the growing collection of publications, the outlets were inconsistent in their focus on green IT/IS. Table 1 provides the total number of papers from journals and conference proceedings on a year-to-year basis. As we mention above, Table 1 demonstrates the increasing interest in green IT/IS since 2007 to 2011 and a plateauing (or declining) number of publications since then. We believe that this multi-disciplinary review of green IT/IS literature will help IS scholars to identify areas for novel research themes, inform their findings through the knowledge derived through management and computer science disciplines, and even identify cross-disciplinary publication outlets for IS research on green IT/IS.

Table 1. Proliferation of Green IT/IS Publications

Year	Number of journal papers	Number of conference papers	Total
2007	3	1	4
2008	4	12	16
2009	11	19	30
2010	17	34	50
2011	27	58	80
2012	23	43	64
2013	23	46	67
2014	12	16	23
2015	11	30	40
Total	131	259	390

2.2 Publications by Discipline

Next, we identified the publications according to the three disciplines to understand the origination of the papers. Note that we did not merely classify papers according to their journal/conference but rather carefully analyzed the concepts the papers presented. As such, a publication in each discipline will implicitly provide a specific view of green IT/IS. For example, in the IS discipline, green IT/IS research has focused predominantly on the implementation, application, and management of green IT/IS. Green IT/IS publications in computer science mainly focus on achieving methodical approaches to computation and its applications through a systematic study of the feasibility, structure, expression, and mechanization of the processes. Further, the computer science papers included optimization of algorithms that support acquisition, representation, analysis, storage, communications, and access to information. Green IT/IS publications in the management discipline focused predominantly on overseeing the organizational initiatives that organizations have adopted to implement green IT/IS. Green IT/IS papers in management discipline specifically focused on assessing its feasibility and subsequently facilitating the progress of green IT/IS initiatives. Table 2 depicts the number of publications for each of the three disciplines. From a pure technology development point of view, the lack of publications in computer science discipline raises concerns over the prominence that new technologies receive.

We note that we experienced difficulties in mapping approximately eight percent of the sample directly to one of the three disciplines. For example, we found publications in management journals that focused on the management incentives for adopting green IT/IS practices at the workplace. Similarly, a few computer science journals mentioned how green IT/IS algorithms must consider the dynamic nature in policy and management initiatives. We believe that such overlaps of the three disciplines demonstrate the strength and maturity of green IT/IS research in that the research publications consider a wider range of implications.

Table 2. Publications per Discipline

Discipline	Number of publications	Percentage of publications
Computer science	84	22%
Information systems	246	63%
Management	60	15%

2.3 Publications by Data Source (Country)

We also analyzed the papers based on the country they sourced their data from to show where green IT/IS initiatives and research have occurred globally. The country where research data originates from demonstrates 1) mandatory green IT/IS record keeping activities in certain countries and 2) willingness to reveal green IT/IS-related information. In general, one can consider countries that have not signed an international climate convention (e.g., Kyoto) to have limited record keeping and participation in green IS/IT initiatives. However, few publications provided details about where they sourced their data from: in fact, only 36 papers included the names of the countries where data was gathered from.

We found that Australia was the most cited country for green IT data collection: Specifically, 10 studies gathered data from Australia during the period we analyzed (Cater-Steel & Tan, 2011; Hasan, Ghose, & Spedding, 2009; Huang, 2008). The United States of America was the second most frequent country that researchers obtained green IS/IT data from (Bose & Luo, 2012; Chetty, Brush, Meyers, & Johns, 2009) followed by the United Kingdom (Chai-Arayalert & Nakata, 2011), Sweden (Bengtsson & Ågerfalk, 2011; Nazari & Karim, 2012), China (Cai, Chen, & Bose, 2013; Zhiwei, 2012), New Zealand (Molla, 2009), and the Netherlands. Only a handful of studies considered developing nations such as Morocco (Hanne, 2011), Hong Kong (Chow & Chen, 2009), Serbia (Kovačić, Zealand, & Vukmirović, 2008), South Africa (Lamb, 2011), India (Datta, Roy, & Tarafdar, 2010), and Bangladesh (Ansari, Ashraf, Malik, & Grunfeld, 2010). In general, as Lee, Park, and Trimi (2013) suggest, in developed countries, governments tend to lead green movements by providing continuous support both financially and by introducing regulations to create individual, business, and national awareness and motivation and responsibility for an environment friendly world. From our data sample, only five analytical papers (e.g., Kuo & Dick, 2010; Woodruff, Hasbrouck, & Augustin, 2008) collected data from multiple countries. Overall, our results highlight 1) that green IS/IT research lacks a focus on substantial polluters such as Brazil, Russia, India, and China; 2) that green IS/IT research does not adequately collect data from multiple countries given that green IS/IT concerns a global issue, and 3) that journals can play a more significant role in requesting authors to reveal their data-collection sources. Moreover, for future researchers, we found that 4) some countries (such as Australia and USA) are quite receptive to revealing data on their green IT/IS.

2.4 Publications by Theoretical Foundation

In Table D1 in Appendix D, we assess the theoretical foundations that the list of publications employed. By summarizing the theoretical lenses that the green IT/IS studies employed, we could understand the scope, limitations, and look for existing theories and frameworks to develop a new theory or apply an existing theory to investigate a new phenomenon. We identified 52 theoretical lenses that the past green IT/IS studies have employed. Most commonly used theories include the institutional theory (Butler, 2011) and the actor-network theory (Bengtsson & Ågerfalk, 2011). In depicting the results of our theoretical analysis in Table D1 in Appendix D, we show what theory each study adopts and how it uses that theory to understand green IT/IS.

Observing Table D1 in Appendix D, we can see that most studies employed organizational-level theories and that only a handful of studies considered individual- or group-level theories. The predominant focus on employing organizational level theories is understandable given that the overall focus of green IT/IS initiatives tend to be at the organizational level. However, by focusing on individual-level adoption, proliferation, management, and the benefits of green IT/IS initiatives, practitioners could get better insights into making green IT/IS initiatives successful. The analysis also showed that, while most researchers preferred to employ an established theory (e.g., institutional theory or the actor-network theory), others employed emerging theories (or developed new ones specifically for green IT/IS). The IT-business alignment framework is one of the best examples of a recent proposal where the authors examine a new framework such as strategic green IT alignment across a wide range of literature (Erek, Loeser, Schmidt, Zarnekow, & Kolbe, 2011). The multi-disciplinary analysis we present in this paper provides IS researchers with: 1) the awareness to understand theories employed in other disciplines, 2) the confidence to draw appropriate theoretical explanations to address gaps in green IT/IS research, and 3) the potential to develop new theories specific to green IT/IS.

2.5 Summary

The overview of green IT/IS literature suggests that scholars have paid considerable attention to green IT/IS topics and that such topics have proliferated in all disciplines. However, we observed that green

IT/IS publications have plateaued in recent times. While not a matter of concern, we suggest that green IT/IS researchers derive new cross-disciplinary findings that would attract top journals' and conferences' interest. We also identified how each discipline has contributed to the body of knowledge in green IT/IS. While each discipline's contribution to the green IT/IS domain is difficult to establish, the number of publications in each discipline demonstrate a healthy green IT/IS subdiscipline. We also found that a small number of studies have employed a cross-disciplinary approach that amalgamates multiple research disciplines. We see that such multi-disciplinary studies play a major role for the green IT/IS body of knowledge. Moreover, when observing the theoretical lenses each study applied, we observed a clear need for more individual- or group-level theoretical applications and an opportunity to develop new theories for green IT/IS. We found that IS studies rarely cross-referenced studies in the computer science and management disciplines and vice versa. We also observed that substantial research has been performed on green IT/IS implementation, the motivation for green IT/IS, and organizational readiness and capability to adopt green IT/IS. Considering the unit of analysis, we found that most empirical studies collected data at the organizational level (Cai, Chen, & Bose, 2013; Molla, 2009). A smaller number of studies gathered both organizational- and individual-level data (Chetty, Brush, Meyers, & Johns, 2009; Chetty, Tran, & Grinter, 2008). In terms of research methods employed, we observed studies that perused online surveys (Chai-Arayalert & Nakata, 2011; Kuo & Dick, 2010; Molla & Abareshi, 2011), analyzed secondary data sources (Chai-Arayalert & Nakata, 2011; Jain, Benbunan-Fich, & Mohan, 2011), and undertook mixed-method inquiries (Nazari & Karim, 2012).

3 Segmentation of Green IT/IS Research

Following our describing the study sample's background in Section 2, in this section, we describe how we inductively clustered the publications into coherent themes and subthemes. We focused on eliminating the boundaries of the disciplines imposed and inductively observe the green IT/IS research phenomenon. Note that we did not focus on achieving mutual exclusivity in mapping a paper into a single theme or subtheme; rather, we focused on deriving coherent themes and related subthemes that would serve as epistemological guideposts for IS researchers on the key notions of green IT/IS. Mapping the papers was a straightforward process that simply involved deriving contiguous phrases without modification and creating themes. The process is similar to that of an inductive research analysis (Krippendorff, 1980). In order to minimize individual errors of judgment, we each compared how we each mapped 25 percent of the papers. Doing so revealed an average inter-coder agreement of 97 percent for themes and an average of 86 percent agreement for their subthemes, which exceeds the requirements of Krippendorff (1980) who recommends that inter-coder reliability of such efforts to be at least 70 percent. We discussed discrepancies until we reached consensus and documented formal criteria for classification.

Based on the topics the papers covered, we derived four themes: 1) green IT/IS conceptualization, 2) green technology practices, 3) green IT/IS adoption, and 4) literature reviews. We discuss the current research in each theme to provide greater clarity for IS researchers. The four themes provide a simple and natural examination of a phenomenon and explain the concept, the technologies that deliver it, and its adoption.

3.1 Green IT/IS Conceptualization

Conceptualization includes defining the phenomenon of interest and its scope and boundaries and how the variables of the phenomenon interact (Dubin 1978). From analyzing the 390 academic papers in our sample, we found that green IT/IS conceptualizations differed considerably even across the same discipline. For example, Huang (2008) proposed that IT professionals can observe green IT/IS initiatives through the systems development lifecycle model a guideline for new system development and to manage existing green IT/IS initiatives. On the other hand, Molla, Cooper, and Pittayachawan (2009, p. 4) identified green IT as "a systematic application of environmental sustainability criteria to the design, production, sourcing, use and disposal of the IT technical infrastructure as well as within the human and managerial components of the IT infrastructure in order to reduce IT, business process and supply chain related emissions and waste and improve energy efficiency". Eastwood (2009) described green IT as a collection of strategic and tactical initiatives that directly reduces the carbon footprint of an organization's computing operation. Melville (2010, p. 2) defined IS for sustainability as "IS-enabled organizational practices and processes that improve environmental and economic performance". Watson, Boudreau, and Chen (2010, p. 24) argued that green IT/IS has too narrow of a focus and that researchers should extend it to include information systems. They defined IS as "an integrated and cooperating set of people, processes, software and information technologies to support individual, organizational, or societal goals".

Murugesan (2008) argued that green IT/IS is indicative of environmentally sound information technology. Information technology essentially refers to designing, implementing, and managing computers at both the individual and industry levels. Green IT/IS includes multiple aspects such as environmental sustainability, energy efficiency, economics, and the cost of disposal/recycling. Green technological innovation is the key to sustainable development. According to Nanath and Pillai (2012b), green IT/IS has two aspects: 1) that IT causes environmental issue (i.e., that IT has a direct effect on causing environment pollution) and 2) that one can use IT/IS to resolve environmental issues (i.e., that one can use IT to solve sustainable issues). Further, Loeser (2012) developed a typology of green information system strategies that illustrated four generic strategies: 1) green IS for efficiency, 2) for innovation, 3) for transformation, and 4) for credibility. They also highlighted how these strategies benefit organizations.

Murugesan (2008) proposed four domains of green IT/IS: green use, green design, green manufacturing, and green disposal of IT systems. Green use focuses on reducing the energy consumption associated with computers and other environment friendly information systems. Green design considers designing energy-efficient equipment, computers, servers, and cooling equipment. Green disposal proposes the repairing and the recycling of computers and electronic equipment that need to be discarded. Green manufacturing refers to manufacturing electronic machineries, computers, and other associated subsystems with minimal or no impact on the environment. Based on these domains, we can see that green IT/IS primarily focuses on reducing the use of energy and relevant costs while managing the increasing requirements for performance (Ijab, Molla, & Cooper, 2011). One can also consider green IT/IS as an optimal use of information and communication technology to manage enterprise activities in an environmentally sustainable manner. In simple terms, we can summarize "green IT/IS" as: 1) the minimizing of IT use's negative impact on the environment, 2) environmental issues that arise from IT use, and 3) the use of IT to minimize or counteract environmental issues.

However, most studies understood technology to cause environmental encumbrance (Boudreau, Chen, & Huber, 2008). For example, Ruth (2009) discussed how IT causes problems to the environment and presented numbers of statistical data to prove the negative impact (e.g., excess power consumption, reliance on toxic chemicals, data centers and servers, e-waste). For example, Fuchs (2008) discussed the relationship of new information and communication technologies and sustainable development. Fuchs (2008) highlighted myths about sustainable information and communication technologies and criticized them by explaining the downsides of these technologies. Fuchs (2008, p. 308) further stated that "environmental problems are social problems, not technological problems, they are neither caused by science and technology as such, nor can they be solved by science or technology as such". Further, Wang and Wang (2011) analyzed the data on the electricity consumptions in the IT industry including the telecommunication and computer industries and by household computers in five major cities in China in order to demonstrate the necessity of green computing. Hasan, Ghose, and Spedding (2009) analyzed climate issues at individual and organizational levels and how information systems cause environmental problems. They suggested ICT tools as the best solution for Australia's current situation. Hasan et al. (2009) also claimed that the Internet is one of the main reasons for environmental issues and proposed strategies to convert ICT as a source of solutions to environmental problems.

In reviewing the literature and focusing on how IT can help, our analyses indicate that green IT/IS has already had a measurably positive effect on efforts to reduce energy consumption. We also found a recurring emphasis on ways that green IT/IS has been responsible for detrimental outcomes that result from the overuse of information networks. To describe how IT supports the environment, Lee, Park, and Trimi (2013) highlighted that organizations can achieve green IT/IS environmental friendliness through two strategies: 1) the greening of IT/IS itself (i.e., reducing the energy IT products need and their CO2 emissions), and 2) greening via IT/IS (i.e., using IT for greening purposes). In line with these strategies, Rush, Melville, Ramirez, and Kobelsky (2015) examined the degree to which enterprise information systems capability impacts organizational greenhouse gas emissions and highlighted IT's role in firm sustainability programs and the value of information to pollution reduction.

However, organizations are reluctant to adhere to green IT/IS practices without immediate value propositions. Osch and Avital (2010) argued that green IT/IS focuses predominantly on environmental facet of sustainability. Researchers uphold green IT/IS as promoting environmental sustainability through the adoption of innovative technologies. Osch and Avital (2010) highlighted that green IT/IS cause significantly less harm to the environment due to reasons such as 1) reductions in the use of toxic raw materials, 2) upgrading of existing systems as an alternative to replacement, and 3) recycling rather than outright disposal. In supporting this view, Lun, Lai, Wong, and Cheng (2015) proposed the "greening and performance relativity" concept and used an input-output analytic approach to investigate how greening operations relate to firm performance in shipping operations. They found a positive association between greening and firm performance in shipping operations. Trimi and Park (2013) highlighted the importance of sustainability and overviewed how some leading organizations and non-profit organizations have already undertaken green IT/IS initiatives. Along that vein, Seidel, Recker, and vom Brocke (2013) provided insights on how a global software solutions provider implemented environmentally sustainable business practices in response to emerging environmental concerns. They identified four important functional affordances originating in information systems that influence organizations and individuals. Schmidt, Erek, Kolbe, and Zarnekow (2011) described that green IT/IS also contributes to the IT departments by improving the internal operations. Similarly, Harmon, Demirkan, and Raffo (2012) and Thambusamy and Salam (2010) highlighted that organizations that use IT strategically to enable their environmental sustainability strategies can achieve competitive advantage, legitimacy, and a better reputation from their corporate ecological-responsiveness initiatives. In examining the reputation and legitimacy, Nishant, Teo, and Goh (2011) analyzed 160 news reports of green IT/IS initiatives by publicly traded organization over a six-year period and found positive relationships between the green IT/IS announcements and the market value. Similarly, Rahim & Rahman (2013) identified a relationship between the natural resource-based view and green IT/IS capability. They argued that pollution prevention and product stewardship can accelerate both the greening of IT and greening via IT.

In summary, the definition of green IT/IS has evolved from being more specific to the terms such as "environmental sustainability" (Molla, Cooper, & Pittayachawan, 2009; Molla, Pittayachawan, Corbitt, & Deng, 2009) or "carbon footprint" (Eastwood 2009) to profuse and broader themes that scholars have described as "people, processes, software and information technologies to support individual, organizational, or societal goals" (Watson, Boudreau, & Chen, 2010). These extensions of green IT/IS from its original myopic definition to a more liberal overarching one demonstrates the maturity and the proliferation of green IT/IS domain. The broadening definition of green IT/IS will allow IS researchers to contribute more to the common discussions ranging from technical to business management.

We made a similar observation in relation to green IT/IS's scope and boundaries. Early green IT/IS studies derived a dichotomous relationship between IT/IS as the cause and environmental issues as the "effect" (Boudreau, Chen, & Huber, 2008). As such, these studies addressed only technological issues and observed the dependent variable "environmental issues" (Boudreau, Chen, & Huber, 2008). However, recent studies in all three disciplines seem to have removed IT/IS as the problem and instead treated it as a contributor in attaining environmental sustainability (e.g., Seidel, Recker, & Vom Brocke, 2013).

3.2 Green Technology Practices

We derived the green technology practices theme predominantly from the literature in the computer science discipline. It captures the studies that focused on the technical perspective of green IT/IS literature and, more particularly, on product design, longevity of products, and efficient algorithms to facilitate green IT/IS (Murugesan, 2008). In addition, several studies focused on mechanisms for low energy usage and how one can take advantage of existing opportunities to further virtualize user interactions. Overall, we can group papers under green technologies into two streams: 1) technical solutions and 2) soft solutions. Technical solutions refer to how technology itself can be redesigned so that it harms the environment less (Garg, Gupta, Goh, & Desouza, 2010). These solutions focus on the energy-efficient equipment and eco-friendly hardware in terms of using, designing, and manufacturing and disposing (Murugesan, 2008). Soft solutions refer to approaches that are non-technical in nature and focus on behavioral outcomes and initiatives for raising awareness. Apart from explaining environmentally friendly hardware, many scholars proposed soft solutions to promote green IT/IS. On the other side, soft solutions drew the attention of behavioral attitudes such as paperless offices, less printing or printing on both sides, and video and mobile conferencing (Ansari, Ashraf, Malik, & Grunfeld, 2010; Enokido, Aikebaier, & Takizawa, 2011). For example, in an early study of green IT/IS, Vlek and Steg (2007) identified several challenges of human behaviors and environmental sustainability, including the significant effect of behavioral and/or environmental changes on human wellbeing. Moreover, scholars considered education and training for the soft solutions (Herrick & Ritschard, 2009) and focused on IT users' beliefs and behaviors toward green computing (Chow & Chen, 2009). In order to further understand the studies that focused on the technical practices, we employ seven categories as per Garg, Gupta, Goh, and Desouza (2010), who discuss the environment friendly practices in IT using 1) algorithmic efficiency,

2) resource allocation, 3) power management, 4) virtualization, 5) data centers design, 6) material recycling, and 7) product longevity.

3.2.1 Algorithmic Efficiency

Algorithmic efficiency focuses on optimizing the efficiency in selecting, deploying, and managing software. The term "efficiency" in the literature relates to minimizing the amount of resources that IT/IS consumes. As such, algorithmic efficiency assists in reducing the resources that are consumed and attaining an optimal level. Algorithmic efficiency involves rewriting program code to take less time and process less data in obtaining results (Siddavatam, Johri, & Patole, 2011). Algorithmic efficiency ensures that switching from a linear algorithm to an indexed search algorithm could reduce resource utilization possibly to a close to zero (Mukherjee & Sahoo, 2010). Enokido, Aikebaier, and Takizawa (2011) proposed the computation and transmission rate based (CTRB) algorithm to select a server in a set of servers to reduce the total power consumption of the servers and the overhead of a load balance. They claimed that more power consumption can be reduced by using the CTRB algorithm than the traditional round-robin (RR) algorithm. Further, they explained that the overhead of a load balancer can be further reduced in the CTRB algorithm than the extended power consumption laxity-based (EPCLB) algorithm. Similarly, Cheung and Jacobsen (2011) investigated resource allocation algorithms for the publish/subscribe systems to be able to use system resources to achieve maximum efficiency. They developed a bit vector-supported resource-allocation framework to minimize system-wide message rates, broker load, hop count, and the number of allocated brokers. This approach can reduce the average broker message rate by up to 92 percent and the number of allocated brokers by up to 91 percent.

Siddavatam, Johri, and Patole (2011) developed an algorithm to calculate different machines' processor utilization according to the "load distribution" in a network and proposed a strategy to use the least amount of energy possible by using resources optimally in data centers. Zhang, Li, and Zhang (2010) discussed reducing energy consumption by two new heuristic task-scheduling algorithms: the STFCMEF-SA algorithm and the LTFCMEF-SA algorithm. They designed, implemented, and evaluated these algorithms for optimizing the server power consumption in data center and cloud computing. The two algorithms focus on reducing energy consumption by improving the processing speed in computers. Researchers have also investigated effective algorithms for storage-based power consumption. For example, Inoue, Aikebaier, Enokido, and Takizawa (2012b) discussed the storage-based power consumption (SBPC) model in order to perform storage and computation processes on a server. One can use this four-state SBPC model to reduce execution time and power consumption.

3.2.2 Resource Allocation

Resource allocation is another technology practice that organizations use—especially in data centers to optimize software and its deployment. "Dynamic" resource allocation redirects traffic to data centers that are more energy efficient and to server centers that use economies of scale to achieve reductions in energy use. Atkinson, Schulze, and Klingert (2014) introduced the concept of "green specifications" that detail the process to optimize resource allocation (e.g., energy usage) in data centers. This notion inspired organizations to adopt more environmentally friendly IT consumption to help the environment and for organizational benefits. Green specifications provide an important foundation for minimizing the environmental impact of computing service consumption by describing the relationship between different consumption choices (at different quality of service levels) and environmental impact in a way that the widest possible range of stakeholders can understand. Further, Baek and Chilimbi (2010) presented a simple and flexible framework called "green" for energy-efficient computing and argued that, using loop and function approximation, "green" can support energy-conscious programming. Several organizations have implemented this framework in their search applications and have experienced significantly better performance and less energy consumption with maintaining quality of service. Beloglazov and Buyya (2010) offered an energy-efficient resource-management approach for virtualized cloud data centers that reduces operational costs by substantial energy savings and, at the same time, provides the required quality of service. In extending this discussion, Beloglazov, Abawajy, and Buyya (2012) derived an architectural framework and principles for energy-efficient cloud computing and argued that this model can offer significant cost reductions and that it demonstrated high potential for the improvement of energy efficiency. After conducting a survey of research in energy-efficient computing, they proposed architectural principles for energy-efficient management of clouds, energy-efficient resource-allocation policies, and scheduling algorithms considering the expected quality of service. They also highlighted open research challenges that can bring substantial benefits to both resource providers and consumers. Similarly, Guevara, Lubin, and Lee (2014) highlighted that the addition of heterogeneous hardware introduces more complexity and volatility to latency-sensitive applications. Further, they proposed that a resource-allocation mechanism that leverages architectural principles can overcome both obstacles.

3.2.3 Power Management

Power management is a crucial function of IT that allows the IT operations to run in a low power consumption mode during the periods of reduced activity. Power management encompasses data center power, operating system support, power supply, storage, video cards and display (Jenkin, Webster, & McShane, 2011). This technique ensures that organizations use industry standards for power-saving functions that afford centralized control to network administrators and promote energy-reduction practices among end users (Rao, Saravanakumar, Sundararaman, Parthasarathi, & Ramesh, 2011). Rao, Saravanakumar, Sundararaman, Parthasarathi, and Ramesh (2011) offered an intelligent green IT/IS technique to reduce energy consumption considering such actions such as "logoff", "shutdown", and "hibernate" by enabling the adaptive management of the desktops through the system profiling and application of machine-learning techniques. Moreover, Germain-Renaud et al. (2011) presented an ontology-oriented approach that offers the perspective of combining semantic and logical inference for achieving energy-efficiency in IT systems. Furthermore, the study sample included specific references in relation to power management in terminal servers. For example, Niyato, Chaisiri, and Sung (2009) proposed an optimal power management method that observes the state of a server farm and makes the decision to switch the operation mode (i.e., active or sleep) of the server to minimize the power consumption while meeting the required performance.

Power management also concerns enforcing compliance for computer power supply units to have them operating at maximized efficiency. For example, Kurokawa et al. (2010) proposed a new digitally controlled DC-DC converter with transient response characteristics and claimed that their method will ease environmental pressures. Further, Garroppo et al. (2013) focused on network power management in telecommunication infrastructures. Specifically, they identified four energy-aware network design problems with related mathematical models for reducing the power consumption of the current and future Internet. Their investigation led to the identification of a pool of diverse network power-management approaches, including the first mixed integer non-linear programming model for the power-aware network design with bundled links. Chaudhari et al. (2012) developed the energy-aware network-management system framework based on the centralized decision management system and claimed that it can save approximately 10-16 percent of power at the cost of one to five percent end-to-end delay overhead. Young Choon and Zomaya (2011) addressed the energy-aware scheduling of precedence-constrained parallel applications for multiprocessor or multicomputer systems that comprise heterogenous resources, such as grids and clouds. They developed a novel objective function that confirmed the quality of schedules and energy consumption. They argued that, because their proposed algorithms incorporate relative superiority and make span-conservative energy reduction, the proposed algorithm greatly contributes to reducing energy consumption. Their experimental results showed a great reduction in energy waste.

Apart from the IT system and network, another important aspect concerns managing the power consumption of service centers. Salomie et al. (2011) offered an energy-aware context model for representing the service center energy/performance related data in a uniform and machine interpretable manner. They used this model as the primary resource to generate run-time adaptation plans that indicate the greenness level of service centers. In addition, Kocaoglu, Malak, and Akan (2012) highlighted that a layered architecture incorporates the concept of minimum energy consumption for communication links and computer networks with multiple terminals, where emission-reduction approaches based on information theory are impractical.

Further, researchers have paid attention to business processes such as the supply chain to identify ways of minimizing energy consumption. For example, Xie (2015) investigated decision processes of a supply chain that had to adhere to regulations about energy-saving levels. The data revealed that both regulation and structures have significant impacts on supply chain performance. Further, it also revealed that the policy maker should set the threshold value of energy saving levels with respect to the decentralized chain. Further, Dick, Drangmeister, Kern, and Naumann (2013) incorporated sustainability issue to the arbitrary software development process by proposing an agile extension for software development processes. Proposed agile methods aim to produce "greener" software from scratch by reducing energy consumption. Kipp, Jiang, and Fugini (2011) proposed "green metrics", a set of energy-related metrics that measure the "greenness" of an application and detect where it consumes and wastes energy—an example of better managing power through improving an application's design and execution. The authors considered an application scenario to show how monitoring and evaluation of the green metrics helped to improve energy efficiency. In addition to software development methodologies, Røpke (2012), focusing mainly on energy impacts, explored the environmental directionality of information and communication technology innovation and the broadband transition. Further, for individual energy consumption and power management, Valogianni, Ketter, and Collins (2014) suggested a mobility integrated energy management IS artifact that supports a smarthome owner's decision regarding the use of household appliances and charging electric vehicles.

In the same subtopic of green IT/IS power management, another stream of researchers focused specifically on the storage options such as solid-state flash memory and on online storage practices to find cost-reduction measures applicable to this emerging form. For example, Baliga, Ayre, Hinton, and Tucker (2011) discussed how cloud computing can enable more energy-efficient use of computing power, especially when the computing tasks are of low intensity or infrequent. Inoue, Aikebaier, Enokido, and Takizawa (2012a) presented the storage-based power consumption model to reduce power consumption and execution time. Further, Grimm, Erek, and Zarnekow (2013) proposed a methodological framework for carbon footprint of IT-Services based on the phases of lifecycle assessment to study and to present a comparison of information and communication technology-related energy consumption for offline and online storage.

3.2.4 Virtualization

Through the analyses, we found substantial research focused on virtualization. Virtualization refers to the process of running two or more logical computer systems on one set of physical hardware (Bose & Luo, 2011). From a green IT/IS perspective, virtualization unplugs the original hardware and ensures power reduction and cooling consumption. Schrödl and Simkin (2014) proposed the integration of the circular economy with established concepts for inter-organizational systems. They introduced the notion of a circular economy supply chain framework that integrates the circular economy model with supply chain operations reference model based on virtualization techniques. Chang (2009) adapted the concept and integrated it with Xen para virtualization and honeynet technologies to design virtual research platforms that further enhance the use of virtualization. Dasilva, Lu, Bessis, and Yongzhao (2012) discussed virtual desktop infrastructure as a solution to rising energy costs and the global warming issue without compromising on service quality. By using VMware and Wyse technology to implement a small test virtual desktop environment, they identified that hypervisor and virtual desktop machines can offer a much more effective use of power, save on hardware, and deploy new servers and desktops more quickly and cost effectively. Furthermore, Yamini and Selvi (2010) suggested a new approach for cloud virtualization that reduces energy consumption by using a new clique star cover algorithm to connect more number of nodes with a minimum number of servers. According to Lamb (2011), cloud computing has become the ultimate way to virtualize IT resources and to save energy. Extending and improving the virtualization research, Liu, Masfary, and Li (2011) argued that green IT/IS and cost savings can be achieved through server virtualization technologies since they provide a method of reducing physical space, carbon footprint, and, most importantly, electrical costs.

3.2.5 Data Center Design and Management

Data centers are one of the contentious aspects in environmental sustainability (Jenkin, Webster, & McShane, 2011) because they are one of the heaviest energy consumers in the world. The considerations for data centers found in the literature include detailings of data center design, layout, implementation, daily maintenance, and support systems (Doh, Kim, Park, Kim, Choi, Lee, & Noh, 2010). Pernici et al. (2012) presented views on using information systems for improving sustainability and the energy efficiency of the data centers. Gupta et al. (2011) suggested a green data center simulator to study the energy efficiency of data centers under various geometries, workload characteristics, platform power management schemes, and scheduling algorithms. Doh et al. (2010) identified the necessity of greener data centers and introduced zero energy for unused servers (ZEUS). They developed a new memory technology and showed that the proposed energy savings approach consumes energy in proportion to user requests with configurable service of quality. Based on observations made on the used data center, they discussed the requirements for real deployment. Lamb (2011) overviewed the importance of implementing green IT/IS and identified power issues at data centers in South Africa and discussed the solutions to these power issues, such as virtualizing servers and data storage. Furthermore, Molla and Cooper (2014) provided suggestions for data center managers to follow either a tactical-incremental or a deep-green strategy to manage the implementation of green practices. The deep-green strategy expands the measures of the tactical-incremental strategy to redesign data centers in a way that helps to neutralize greenhouse gas emissions. Mata-Toledo and Gupta (2011) discussed issues of global warming and the increase of toxic waste generated by electronic devices in the context of green data centers. They also highlighted the necessity of creating “green data centers” to save the environment and how green data centers can be made efficient both environmentally and financially by reducing energy consumption.

Vykoukal, Wolf, and Beck (2009) presented a “green grid”—an architectural approach to green IT/IS. They discussed the use of virtualization technology to improve airflow management systems to reduce cooling requirements. The Green Grid is a global consortium founded in 2007 dedicated to advancing energy efficiency in data centers. The consortium focuses on improving data center infrastructure efficiency. On similar lines, Liu et al. (2009) proposed a data center architecture called GreenCloud. GreenCloud uses virtual machine technology to reduce data center power consumption while maintaining the desired quality of service. Liu et al. (2009) argued that GreenCloud architecture can save up to 27 percent of energy because it enables comprehensive online monitoring, live virtual machine migration, and virtual machine placement optimization. Kong and Liu (2015) made similar observations. Berral et al. (2010) extended data center power management to green energy-aware power management data centers and concurred with Liu et al. (2009). Such a framework provides an intelligent consolidation methodology using turning on/off machines, power-aware consolidation algorithms, and machine-learning techniques to deal with uncertain information while maximizing performance. Importantly, the authors revealed that, when the level of uncertainty increases, this approach is close to the optimal placement and performs better. Rao, Kiran, and Reddy (2010) discussed the opportunities and adoptable methods for achieving the energy efficiency in data centers by presenting a study on data center virtualization. In addition, Chaudhry et al. (2015) discussed about thermalware scheduling and associated techniques for green data centers.

Apart from the technical solutions, Stansberry (2013) highlighted that, for enterprise data center operators who want to continue in-house operations, the future depends on documenting costs and performance. They provided a solution for the accountability issue in data centers. Metzger et al. (2012) outlined the process of increasing computing capacity while simultaneously reducing the amount of energy required without increasing the actual size of the data center. Feng and Cameron (2007) provided a Green500 list to encourage the high-performance computing community and operators of Internet data centers to design more power-efficient supercomputers and large-scale data centers.

3.2.6 Materials Recycling

Materials recycling refers to donating and making available for salvage unrequired components (Cameron, 2009a). Krikke (2008) highlighted major impacts of electronic waste (i.e., waste of hazardous electronic equipment) on the environment and described recycling electronic waste as a solution. Yang, Qi, and Low (2010) observed the “incorporation cost” and “resource efficiency” of material recycling to introduce better recycling technologies by minimizing process waste and improving resource efficiency, which reduces the cost of the recovery process. Cameron (2009a) focused on reducing environmental waste in all phases of the computing lifecycle. Wang (2008) and David (2008) considered the complete lifecycle of computer products from production to operation to recycling to understand where materials recycling can be introduced.

Lauridsen and Jørgensen (2010) provided a multi-level perspective by employing the transition theory to better understand outcomes electronic waste. Ansari et al. (2010) discussed material recycling associated with electronic waste. They described methods for electronic waste management through disposing and recycling mobile phones and batteries. Further, they discussed ways of raising awareness on upcoming developments for green IT/IS in Bangladesh about how organizations should consider both the hardware disposal and humanistic concerns in implementing green IT/IS initiatives.

3.2.7 Product Longevity

Product longevity concerns reducing computing hardware’s ecological footprint by focusing on upgrading components instead of replacing them completely. Hobby, Rydell, Sjogren, and Williams (2009) introduced a total cost of ownership (TCO) perspective and focused on why organizations dispose products rather than upgrading them. In their assessment, they included a multitude of environmental factors that influence climate change and other factors that organizations highly demand, such as usability, performance, and durability. They identified several challenges, such as branding exercises by software and hardware vendors, lack of knowledge of product longevity, and lack of empathy for environmental issues, that contribute to lack of product longevity. Further, Pitt, Parent, Junglas, Chan, and Spyropoulou (2011) discussed how smartphones can act as green technologies and as an integral part of green information systems to achieve a sustainable environment. The authors used four dimensions of ubiquitous commerce to prove that many organizations are trying to pursue and elevate environmentally sound strategies by using the unique characteristics of smartphones.

In summary, we derived the green technology practices theme through the literature that denotes a research paradigm that relates to computing hardware and software. Most of the research in this stream of research appeared in computer science journals and conferences. We observed through the number of citations for the published work and through the years that the publications appeared that research in this theme (on topics such as algorithms, resource allocation and optimization, power management, virtualization, data center design and management, material recycling, and product longevity) were at a mature stage. Many studies in this theme built on new ideas based on the established notions in prior submissions or acknowledged how they related to their colleagues' work. In other words, we observed a clear cumulative tradition of research.

3.3 Green IT/IS Adoption

Green IT/IS adoption, focuses on why organizations to adopt green IT/IS, the factors that enable or inhibit green IT/IS adoption, and the challenges in green IT/IS adoption. We found a substantial number of publications that focused on why organizations adopt green IT/IS. Some commonly mentioned motivational factors include: awareness, cost reduction, and government legislation.

3.3.1 Awareness

Awareness of green IT/IS plays a key role in whether organizations adopt green IT/IS initiatives (Woodruff, Hasbrouck, & Augustin, 2008). Awareness refers to ways that key individuals can expand the general recognition and acceptance of green IT/IS throughout organizations (Corbett, Webster, Sayili, Zelenika, & Pearce, 2010; Vazquez, Rocha, Dominguez, Morales, & Ahluwalia, 2011). The term awareness broadly captures recognition of effective policies, necessary regulations, the complete range of benefits and positive outcomes from the implementation of green IT/IS (Ansari, Ashraf, Malik, & Grunfeld, 2010; Chou & Chou, 2012). Using 35 green households in the United States, Woodruff, Hasbrouck, and Augustin (2008) concluded that social networking is important mechanism for creating environmental awareness. Further, Chow and Chen (2009) studied IT users' beliefs and behaviors towards green computing. They identified that IT user's intention to practice green computing depends on individual aspiration and awareness.

Bohnsack, Pinkse and Kolk (2014) highlighted the importance of the awareness of sustainable technologies and highlighted the benefits of green IT/IS initiatives. They provided four business model archetypes and suggested that incumbent and entrepreneurial organizations approach business model innovation in distinctive ways.

3.3.2 Drivers

Overall, a wish to reduce carbon emissions and introduce sustainability requirements into organizations drive green IT/IS practices (Curry & Donnellan 2012). Early research on green IT/IS scholars identified that: 1) economical, 2) regulatory, and 3) ethical motivations represent the most important drivers of green IT/IS (Molla, 2008; Murugesan, 2008). Much of the later research agreed with these earlier motivations. For example, according to Bose and Luo (2011), cost efficiencies, adherence to regulations, and resource limitations primarily drive green IT/IS adoption. In discussing green IT/IS benefits, Brooks, Wang, and Sarker (2012) stated that they fall in two major categories: environmental benefits and cost-reduction benefits. Cai, Chen, and Bose (2013) proposed a model based on the political-economic framework and considered stakeholder theory to identify that political factors such as public concerns and regulatory forces and economic factors such as cost reduction and differentiation drive the adoption of green IT/IS initiatives. Molla and Abareshi (2011) investigated motivational factors to adopt green IT/IS in organizations and analyzed how organizational eco-sustainability influences the adoption of green IT/IS. They highlighted that eco-efficiency motives and eco-effectiveness motives have a stronger influence than eco-responsiveness motives and eco-legitimacy motives on whether an organization adopts green IT/IS.

According to Nazari and Karim (2012), various factors that depend on an organization's situation influence green IT/IS adoption and its process. However, they asserted that innovation is the most influential factor that affects green IT/IS adoption. Gholami, Sulaiman, Ramayah, and Molla (2013) presented motivational drivers for green IT/IS adoption and identified an organization's impact on the environmental performance is a key motivational factor. Moreover, they identified that institutional forces contribute to the formation of managerial psychic states for green IT/IS adoption in organizations. Simmonds and Bhattacherjee (2014) extended the resource-based view (RBV) by proposing a green IT/IS resource-based view (GIT-RBV) model. They highlighted that green IT/IS initiatives have four adoption motives: environmental, social, economic, and legitimation. Environmental motivational factors include green IT/IS properties (material toxicity, recyclability, and energy usage), social responsibility pressure, eco-effectiveness, and eco-efficiency. Economic motivational factors include cost reduction, product differentiation, adaptability to changing context, and eco-efficiency. Legitimation motivational factors include pressures from regulators, consumers, shareholders, and the community.

Kuo (2010) identified that competitive pressures, legitimation pressures, social responsibility pressures, organizational factors, and technological constraints are highly influential to the extent of green IT/IS practice in organization. Based on a survey, they claimed that, rather than responding to external pressures or pursuing competitive advantage, green IT/IS initiatives are more likely to be motivated from employees' sense of responsibility. Further, Butler (2011a) used the lens of institutional theory to explain the forces that act on organizations from in both the institutional environment and the organizational fields in relation to environmental sustainability and regulatory compliance. Further, by applying organizational theory, the author described the strategic endogenous arrangements that organizations introduce using green IT/IS to support sensemaking, decision making, and knowledge creation on environmental sustainability. Finally, Chen et al. (2009) examined institutional pressures that can motivate the adoption of green practices across organizations and found that mimetic and coercive pressures significantly drive green IT/IS adoption.

Focusing at the individual drivers for green IT/IS adoption, Chetty et al. (2009) explored how and why people power-down their machines and the potential for energy savings. They analyzed 20 households' computer power management habits in United States and derived several socio-economic characteristics that influence.

3.3.3 Readiness

In synthesizing the literature, we also found another stream of studies on organizational readiness for green IT/IS adoption. Such studies focused on evaluating whether organizations are ready to engage in a green IT/IS initiative and on observing whether they have the necessary resources, appropriate policies, forward-looking corporate vision, and drive for innovation and sustainability in their mission statements to convert to green IT/IS (Molla, Cooper, & Pittayachawan, 2009; Vazquez, Rocha, Dominguez, Morales, & Ahluwalia, 2011). To examine green IT/IS readiness, Molla et al. (2008) proposed a framework called "G-readiness". The framework includes measures of preparedness relating to environmental responsiveness and competitiveness. The G-readiness framework is based on the concept of the e-readiness framework and purports to help organizations evaluate their readiness for adopting green IT/IS. The G-readiness framework comprises five themes (i.e., attitude, policy, practice, technology, and governance) and illustrates how each of them influences sustainability. Molla, Cooper, and Pittayachawan (2009) extended the G-readiness framework and provided a reliable and valid instrument to operationalize the G-readiness model. They argued that green IT/IS policy, green IT/IS practice, and green IT/IS governance have a higher impact than attitude and technology on G-readiness. Molla and Cooper (2010) made further improvements to the G-readiness framework to understand the drivers, values, and antecedents of green IT/IS. They argued that organizations must understand G-readiness before approaching green IT/IS initiatives as undesirable situation may arise otherwise. Bose and Luo (2011) also proposed a green IT/IS readiness index and highlighted that, to initiate green IT/IS, an organization needs both technology and behavioral changes.

3.3.4 Critical Success Factors

Several studies observed the critical success factors in green IT/IS. Such studies highlighted important attributes that green IT/IS initiatives need to succeed. Among those factors, several studies commonly considered resource allocation, management commitment throughout the lifecycle, and economic value (de Medeiros, Ribeiro, & Cortimiglia, 2014). For example, Cooper and Molla (2012) studied organization's IT capability to identify the processes and the factors that influence an IT organization's green IT/IS capability. They highlighted that the absorptive capacity of green IT/IS initiatives depends on whether the organization acquires comprehensive external knowledge and prior experience. Dao, Langella, and Carbo (2011) discussed sustainability and examined the availability of IT resources and the integration of IT resources with human resource management and supply chain management resources to help organizations to develop sustainability capabilities. They highlighted that the ability to integrate human resource management and supply chain management through IT resources are critical for organizations to develop sustainability capabilities. Further, Loock, Staake, and Thiesse (2013) argued that individual goal setting to influence green IT is a critical success factor in green IT/IS studies.

Sarkar and Young (2009) argued that senior IT managers need to make a strong commitment to implement green IT/IS (through managing IT infrastructure) for such initiatives to be successful. From their case study, they derived two drivers that organizations need to consider before embarking on green IT/IS initiatives. Specifically, they argued that: 1) a convincing cost model and 2i) thorough awareness of the benefits can motivate IT managers to build positive attitudes towards green IT/IS initiatives. In a similar manner, Gholami et al. (2013) discovered a significant relationship between senior managements' attitude and their considerations for green IT/IS adoption. Yunus et al. (2013) also confirmed the imperative role of the top management for an organization to successfully adopt green IT/IS and achieve environmental sustainability. Further, some studies focused on specific industry sectors and derived specific critical success factors. For example, Marett, Otondo, and Taylor (2013) analyzed the factors for the successful and sustained use of green IT/IS in the trucking industry in USA.

Successful green IT/IS initiatives require user and management participation. For example, Fradley, Rampersad, and Troshani (2013) employed actor-network theory to investigate the heterogeneous actors' engagement in complex patterns of interaction in their green IT/IS development efforts. For an organization to continue green IT/IS initiatives, they need to measure the initiatives' outcomes and performance.

3.3.5 Management Frameworks

Grant and Appan (2014) identified that organizational meta-structures influence employee commitment, which, in turn, influence the adoption of green IT/IS practices. Loock, Staake, and Landwehr (2011) analyzed social influence on individual behavior on the energy consumption and identified that information systems can help individuals to solve environmental problems by identifying and managing end users' behavior. Further, Tan, Ling, and Zuo (2011) investigated the process of achieving green leadership with a comprehensive and empirically supported framework for attaining and enacting green leadership.

Bachour and Chasteen (2010) identified factors for success of green IT/IS projects in organizations and established two models for green IT/IS project management: 1) organizational project success evaluation to ensure that the green IT/IS project satisfies all related stakeholders and 2) alignment with the overall organization's strategy. Erek et al. (2011) derived a strategic green IT/IS alignment framework to assess how organizations can align green IT/IS initiatives with corporate sustainability goals and business objectives. The framework purports to guide the decision makers to select an appropriate green IT/IS strategy to achieve corporate sustainability targets and to leverage with competitiveness. In addition, Chai-Arayalert and Nakata (2011) discussed green IT/IS in detail (strategy, practice, and measurement) and proposed a framework to analyze green IT/IS in higher education institutions. Further, in terms of green IT/IS strategy, Molla (2009) investigated the influence of the regulatory, normative, and economic drivers and motivating factors for green IT/IS adoption and proposed a green IT/IS reach-richness matrix to classify green IT/IS strategies and initiatives to assess both the breadth and depth of green IT/IS adoption. Further, Schmidt et al. (2010) provided an initial conceptual framework and analyzed data from 116 IT departments on the predictors of green IT/IS adoption to offer recommendation for CIOs and IT managers on green IT/IS and how to link green IT/IS with the organization's IT and business strategy.

Similarly, Simmonds and Bhattacherjee (2012), through an interpretive analysis, proposed technology, organization, and environment framework and a six-stage IT implementation model for green IT/IS implementations. Mohan et al. (2012) provided a conceptual foundation for managers and IT professionals to better understand the nature of green IT/IS initiatives and proposed a framework to suggest that organizations should tailor their structures and processes to foster—not stifle—innovation depending on the nature and focus of different initiatives. Further, adhering to green practices and green IT/IS systems is important to induce green behavior in both non-IT systems and society (Zhiwei, 2012).

Wati and Koo (2011) proposed a new structural model based on the popular balanced scorecard to manage green IT/IS initiatives. They incorporated the environmental aspects of technology into the scorecard measurement. The green-IT balanced scorecard evaluates technology performance by integrating environmental aspects and investigates both the tangible and intangible assets of green IT/IS investments. It also aligns IT performance and business performance and transform the results into competitive advantage (Wati & Koo, 2001). Scherer, Palazzo, and Seidel (2013) presented a theoretical framework for applying different management response strategies and explored the management of paradoxes by structural, contextual, or reflective means. Khavul and Bruton (2013) highlighted a process to promote sustainability for those in developing countries. They revealed that, if sustainability-enhancing innovations introduced in developing countries are to stick, they need to be designed with local customers, networks, and business ecosystems in mind.

Mann, Grant, and Mann (2009) proposed a theory that applies a quality-management paradigm to suggest a practical three-step implementation framework with a unique sustainability-based feedback mechanism. Ghose et al. (2010) outlined a business process-driven management framework to optimize an organization's existing operations to reduce their carbon emissions impact. In addition, Kerschbaum, Strüker, and Koslowski (2011) presented a secure sustainability benchmarking service to overcome the information-sharing problem. Chen and Yoon (2010) proposed a general framework that organizations can use a green IT/IS checklist based on cloud deployment and service models. This management framework addresses security, privacy, regulations, and compliance concerns common in green IT/IS initiatives. Hilpert, Kranz, and Schumann (2014) provided directions for initiating and designing green IT/IS for sustainability reporting and proposed the information system design theory. This theory comprises a set of primarily prescriptive statements that describe how to construct the class of green IT/IS for sustainability reporting, and it contributes to solving tradeoffs between environmental data transparency, complexity, and data collection efforts. Further, Stindt et al. (2014) provided a design-science approach to improve the quality of corporate sustainable decision making.

Cater-Steel and Tan (2011) explored the relationship between IT service management and green IT/IS and introduced a framework that views green IT/IS as a service management initiative. Similarly, Dubey and Hefley (2011) proposed an initial set of green IT/IS service-management extensions to the Information Technology Infrastructure Library (ITIL) to address green IT/IS in the full lifecycle to confirm best green practices. Pauwels, Cattrysse, Duflou, and Mulder (2012) investigated whether "enterprise ontology" is a feasible methodology in modelling global IT service-management processes to enable organizations to quantify and minimize these processes' ecological impact. In extending green IT/IS service management, Khan and Khan (2013) proposed a green IT/IS outsourcing-assurance model to assist outsourcing vendors to ensure greenness of the organizations and to develop energy-efficient software at a low cost.

3.3.6 Benefits of Green IT/IS

A reduction in operational costs represents one primary driver for why organizations undertake green IT/IS initiatives. As such, studies considered cost reduction as one of the most desired benefits of a green IT/IS initiative (Grant & Marshburn 2014). Unhelkar (2012) argued that cost reduction is an excellent driver for an organization to implement green IT/IS strategies such as minimizing energy consumption (improving energy efficiency); reducing the use of raw materials and equipment, recycling equipment, and waste; and optimizing storage and inventory. Mithas, Khuntia, and Roy (2010) assessed the business value of green IT/IS initiatives and highlighted their ability to conserve energy, reduce costs, and increase profits.

Flammer (2013) extended the view of "environment as a resource" and revealed that the value of environmental corporate social responsibility depends on external and internal moderators. They highlighted that the negative stock market reaction to eco-harmful behavior has increased while the positive reaction to eco-friendly initiatives has decreased. Further, Datta, Roy, and Tarafdar (2010) argued that IT services providers can influence other organizations to adopt IT sustainability by delivering a sustainable IT services value chain and providing access to sustainability-related expertise.

Simmonds and Bhattacherjee (2014) highlighted that one can observe the value outcomes of a green IT/IS through environmental and economic benefits. The environmental benefits include reduced resource consumption, reduced waste and emissions, and green innovation, while the economic benefits include cost reduction (reduced resource conservation, reduced waste disposal, compliance with regulations) and product differentiation. In addition to these two salient benefits, they argued that "positive customer perception" constitutes another benefit of adhering to green IT/IS practices. Similarly, green IT/IS initiatives purport to enhance an organization's image among its clientele, which leads to overall positive outcomes in public relations and an increase in market share (Esty & Winston, 2009; Vazquez, Rocha, Dominguez, Morales, & Ahluwalia, 2011). Babik and Iyer (2011) examined the relationship between corporations' messages to shareholders and their environmental and social responsibility and found a significant positive relationship between the two.

Nishant, Teo, and Goh (2013a) studied 115 global organizations' secondary data on green IT/IS and performance measures to observe the impact of green IT/IS adoption on organizational performance. They found that green IT/IS adoption had a positive relationship with market valuation and innovativeness but not with profitability. Dedrick (2009) considered reviewing existing green IT/IS research to present a model of IT investment and carbon productivity. Nishant (2012) used natural the resource-based perspective theory to identify the relationship between green IT/IS adoption and measures of organizational performance. They examined the impact of different dimensions of sustainability portfolio and identified that the comprehensive adoption of green IT/IS is in most organizations' interests. In describing the benefits of green IT/IS, Herrick and Ritschard (2009) presented the economic benefits of green IT/IS and green IT/IS initiatives from a theoretical point of view and compared the initiatives with practical experience. They provided "what to do" and "how to do" suggestions with examples that cover how to design, use, and dispose of hardware.

3.3.7 Levels and Phases of Green IT/IS Adoption

Kovačić, Zealand, and Vukmirović (2008) mentioned that researchers have studied the factors that influence organizations to adopt IT innovations at three levels: macro, meso, and micro. In relation to green IT/IS, macro-level studies consider green IT/IS adoption across a country or region, meso–level studies consider green IT/IS adoption in an organization or industry, and micro-level studies consider green IT/IS adoption by individuals. Exemplifying a macro-level study, Hanne (2011) studied the importance of developing countries' adhering to green IT practices. Contributing to the country or national level, Hanne (2011) discussed green IT/IS in detail and illustrated the importance of green IT/IS adoption in developing countries and introduced green purchasing policy as an example.

Few studies in our literature sample observed how organizations adopt green IT/IS initiatives. Hedman, Henningsson, and Selander (2012) analyzed how organizations transform as they become more ecologically effective with the help of green IT/IS and developed a process model of how organizations turn eco-effectiveness. Lei and Ngai (2012) presented a theoretical framework that comprised green IT/IS initiation, adoption, and routinization to provide insights and better understanding about proper interventions that organizations can implement to assimilate green IT/IS. Bose and Luo (2012) provided a step-by-step process-management approach to assist business managers to adopt green IT/IS and argued that the management approach would help IT managers to be conscious about environment and use greener technologies in the organization. Further, Zheng (2014) discussed the role of business strategies in the process of green IT/IS adoption and classified them into either proactive or reactive strategies. They applied the technology-organization-environment framework to propose a green IT/IS adoption model that includes the factors of business strategies and three aspects (regulations, competitiveness, and ecological responsibility) of green IT/IS motivations to investigate the critical factors that may influence the green IT/IS adoption. Similarly, Nedbal et al. (2011) considered a theory-based approach to link outsourcing with sustainable IS to examine the possibilities of organizations' engaging in green and sustainable initiatives. They proposed a model based on the technology-organization-environment framework and diffusion of innovation theory to incorporate implementation success and technology acceptance and the transaction cost theory for the integration of outsourcing success.

3.3.8 Green IT/IS Issues and Challenges

Several studies observed the challenges in green IT/IS initiatives. Overall, such studies highlighted issues in the implementation cost, the need to purchase new technology, maintenance and upgrades, and the cost of training and retraining (Molla, 2009; Seidel, Recker, Pimmer, & Vom Brocke, 2010). Also, some studies observed the conflicts that may arise between the imperative of environmental sustainability and developments in supply costs that may occur through an increase in demand for green IT/IS (Hobby, Rydell, Sjogren, & Williams, 2009).

Gavrilovska, Zdraveski, and Trajanov (2013) discussed the challenges that Macedonian companies have faced to implement green IT/IS concepts and highlighted the implementation activities such as analyzing obstacles, maintaining long-time benefits, and ensuring they profit from implementing green IT/IS. Marett, Otondo, and Taylor (2013) considered the U.S. trucking industry to study how truck drivers' continuous use of "bypass systems" have hampered green IT/IS initiatives' success in the industry.. They found that the awareness of environmental benefits did not influence drivers' use the systems introduced through the green IT/IS initiative. Moreover, they found that direct economic benefits and industry pressures influence the truck drivers to engage in green IT/IS initiatives in a positive manner.

Personal and personality factors in managers and users such as "self-doubt" have played a substantial role in determining the success of the green IT/IS initiatives. Self-doubt refers to the negativity around questioning the performance of green IT/IS initiatives. Sonenshein, DeCelles, and Dutton (2014) examined the role of self-evaluations in influencing individual support for environmental issues and revealed that, even among the most dedicated green IT/IS supporters, self-doubt plays an important negative role in their engagement.

Korte, Lee, and Fung (2012) analyzed the issues related to green IT/IS initiatives in medium- and large-sized businesses and multinational corporations. They found that large organizations have more conflicts between environmental sustainability and IT investment. Chou (2013) identified the potential risk factors and uncertainties that might have a negative effect on green IT/IS practices. Chou demonstrated the importance of understanding risk factors in green IT/IS initiatives as early as possible to prepare the organization in advance. Koo, Chung, and Lee (2013) discussed how constant increases in IT performance levels places conflict with the need to maintain environmental sustainability. Further, they discussed how the continual practice of upgrading and replacing hardware results in a greater usage of harmful raw materials and resulting costs from recycling or disposing of them. Koo, Chung, and Lee (2013) studied end users' characteristics and analyzed what factors lead them to want to use green IT/IS devices. They applied motivation theory to explain the relationship between motivation aspects and perceived usefulness and "group theory" to analyze how the reference group moderates the relationship.

3.4 Literature Reviews

Given that several studies reviewed the green IT/IS literature, they warranted a separate theme. Such studies tended to observe technology (Brooks, Wang, & Sarker, 2010; Corbett, 2010; Lei & Ngai, 2013a; Nanath & Pillai, 2012a) and technology management independently (Brooks, Wang, & Sarker, 2012; Howard & Lubbe, 2012).

Etzion (2007) provided one of the first literature reviews in the green IT/IS domain; in particular, the author observed the research on environmental strategy since 1992. The author analyzed papers under three levels: firm, industry, and organizational environment. Further, the author highlighted that practitioners were paying more attention to green IT/IS research and called for academics to contribute to this research area. Babin and Nicholson (2009) performed an extensive literature search and preliminary fieldwork to identify how global IT outsourcing vendors have transformed their environmental responsibility capabilities. They highlighted that environmental responsibility issues will become important for outsourcers to demonstrate stakeholders' environmental concerns. Harmon and Auseklis (2009) reviewed the literature on green IT/IS to identify influences of green computing on sustainable IT services. They identified critical issues and leverage points to improve customer value, business value, and societal value. Moreover, they identified core principles to guide sustainable IT service design and the driving factors of green computing adoption. Elliot (2011) selected, analyzed, and synthesized relevant literature to develop a framework for IT-enabled business transformation. The framework 1) defined environmental sustainability and 2) identified major challenges and possible solutions in environmental sustainability. Vazquez, Rocha, Dominguez, Morales, and Ahluwalia (2011) reviewed the green IT/IS literature to study the "green" movement in the IS discipline by using content analysis. This meta-analysis revealed that organizations have increasingly become aware of adopting green technology.

By analyzing prior literature, several authors suggested different frameworks. For example, Scott and Watson (2012) proposed a framework to measure the value of green IT/IS. Nanath and Pillai (2012b) proposed a similar framework that focuses on helping organizations gain long-term green IT/IS advantages by categorizing factors into three dimensions (i.e., sustainable culture, business process, and organizational properties). They also found that, of the three business process and organizational properties influenced the sustainability of green IT/IS initiatives the most. Schödwell, Erek, and Zarnekow (2013) analyzed green performance indicators to assess the environmental performance of data centers by considering energy, greenhouse gas, and resource efficiency. Lee, Park, and Trimi (2013) presented green IT/IS initiatives that leading countries have undertaken and classified literature according to whether they 1) define green IT/IS, 2) identify green IT/IS programs for sustainable growth, 3) identify growth in green IT/IS markets, and 4) present possible green IT/IS strategies. Rawai, Fathi, Abedi, and Rambat (2013) reviewed the literature on cloud computing in construction management and found that organizations can reduce both energy consumption and CO_2 emissions by using cloud computing technology for construction collaboration. Wang, Brooks, and Sarker (2015a) highlighted possible future research areas for green IT/IS research.

4 Discussion

In synthesizing green IT/IS literature from the three disciplines, we found a wealth of research on various topics. Using an inductive approach, we collated literature under four main themes: conceptualization, technology practices, adoption, and literature reviews. We graphically depict the relationship between the four themes below in Figure 1.

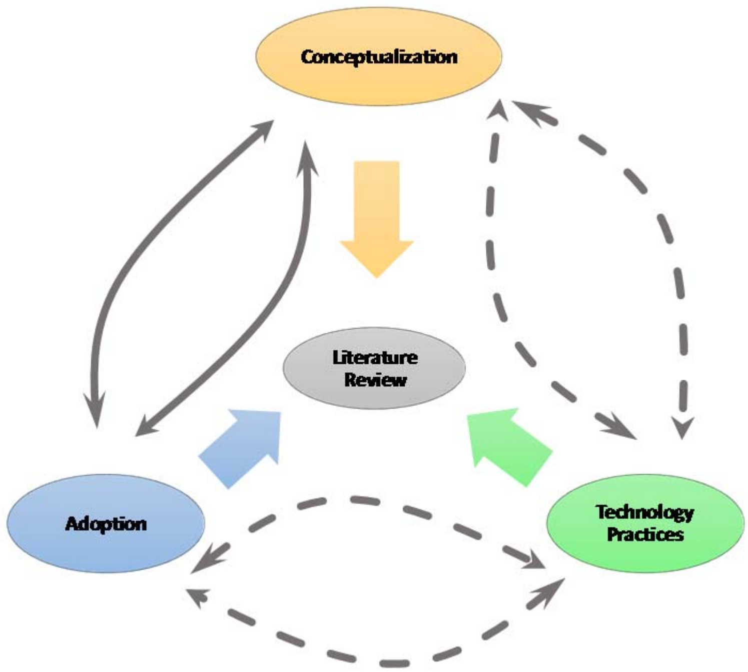

Figure 1. The Relationship between the Four Themes Derived through the Literature Review

From analyzing the literature, we make four observations:

1. The literature on green IT/IS demonstrates the state of green IT/IS research in information systems, computer science, and management disciplines. The number of publications that we observed, coverage for green IT/IS topics in top-tier journals in the three disciplines, representativeness of the research in terms of the country, use of theory and method demonstrate characteristics of a maturing research. However, we might ask whether green IT/IS research has received its due place considering green IT's global importance? We think that our journals and conferences can provide more opportunities for researchers to publish much more on this question of global importance.
2. Overall, the four themes evidence a healthy discussion on green IT/IS. Given the number of research publications that we considered, we argue that green IT/IS research has developed sufficient knowledge. We witnessed both new research and a cumulative tradition of research.
3. We observed very little interaction between each theme that we derived. For example, the technology practices theme aligned closely with the literature from computer science and did not contribute to or received from other themes. Similarly, while the literature in the adoption theme contributed to the conceptual discovery, they barely discussed the specific technologies available in the technology practice theme. This lack of recognition of the existing knowledge between the three disciplines of computer science, information systems, and management may prevent IS researchers from engaging in high-impact research. We posit that IS research should focus on core technologies rather than taking an omnibus view of green IT/IS. For example, studies could observe specific technologies and contexts to provide in-depth or

revelatory case studies (e.g., Seidel, Recker, Pimmer, & vom Brocke, 2014). Given the relative nascent state of IS research in green IT/IS, such in-depth studies would allow researchers to develop a granular understanding of this complex phenomenon.

4. As Dubin (1978) stated, like in any conceptualization, green IT/IS as a phenomenon will only benefit from strong conceptual work that derives appropriate constructs and their relationships. While the rudimentary similarities between traditional IS and green IT/IS may tempt IS researchers to employ existing theories to explain green IT/IS, we encourage fresh thinking on developing an understanding to explain how and why events occur, which will provide a foundation for more advanced theorizing (Gregor, 2006).

5 A Common Path Forward: Green IT/IS as an Innovation

To consolidate the green IT/IS research, we identified that the phenomenon of green IT/IS has received both academic and practitioner attention. Our analysis of 390 academic papers published from 2007 to 2015 revealed one persistent issue: green IT/IS research inhibits a cumulative practice and lacks a coherent research lens through which one can investigate the green IT/IS research phenomenon. In revisiting the 390 academic papers, we found that the existing literature has identified green IT/IS as optional activities or set of corporate responsibility activities organizations launch. However, we propose "innovation" as a possible research lens. Considering green IT/IS as an innovation is apt for several reasons, which we discuss next.

First, almost all nations are engaged in green IT/IS activities. According to 2016 Environmental Performance Index, countries such as Finland, Iceland, and Sweden are ranked highest and Libya and Haiti the lowest. Even though green IT/IS has become a trend like innovation, it is new to many organizations, countries, and societies. The limited natural resources on Earth and the pressure from the environmental activists in some cases have made it mandatory for organizations and countries to engage in such initiatives. Countries and organizations must react to this social and environment pressure in order to survive. Going green has become the latest trend; however, it has myriad benefits for business. Such benefits include, tax advantages, increased efficiency of the business activities, reduced waste, and a positive public response. Like innovation, green IT/IS can also be attained at different layers (e.g., the individual, managerial, technical, project, and organizational, and societal levels). Like innovation, different triggers and inhibitors can apply to each of these different levels. According to our analysis, most of the management studies studied how the policies affect the green IT/IS initiatives, whereas most IS studies studied the adoption of green IT/IS initiatives. According to vom Brocke, Seidel, Loos, and Watson (2013), green IS and sustainability studies are important for organizations and all nations because they answer the most critical threat human race has ever faced.

We also identified that, even though all papers identified green IT/IS initiatives as a new idea, practice, or process in organizations, only Zaman and Sedera (2015) and Bose and Luo (2011) identified green IT/IS initiatives as innovations in organizations. An innovation according to Crossan and Apaydin (2010, p. 1155) is a "production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems". This definition considers a more generalized view of innovation that occurs in everyday organizations. This view considers that organizations can adopt innovation and that innovation can be new to such organizations as opposed to the view of Garcia and Calantone (2002) who ideate innovation as new to the world. A new initiative can be internally initiated and adopted. As such, following the above view, green IT/IS initiatives can be a new idea, process, or activity that adds value to the adopting organization. Contemplating green IT/IS as an innovation in an organization opens myriad paths for academics to study. The theoretical positioning of green IT/IS initiatives as an innovation provides a theoretical scope to studies and helps researchers gain insights from the well-established innovation context. Studies have highlighted the difficulties in adopting innovation in organizations. Similarly, green IT/IS is considered as an expensive, risky, and value-added initiative that organizations thrive to attain.

Further, future studies of green IT/IS can wear the lens of innovation and consider the below areas as well:

- **Type of innovation**: treating green IT/IS as an innovation provides an opportunity to study it through the widely classified typologies of innovation such as radical innovation, incremental innovation, product innovation, process innovation, technical innovation and administrative innovation (Benner & Tushman, 2003; Damanpour, 1987; Damanpour, 1991; Lokuge & Sedera 2014b; Norman & Verganti, 2014). Administrative innovation impacts on the social systems, whereas technical innovation represents new ideas, processes and practices that pertain to products, processes and technology (Daft & Becker, 1978; Damanpour, 1987; Damanpour & Evan, 1984). For each of these innovation types, different antecedents and adoption patterns exists (Daft, 1978; Daft & Becker, 1978; Knight, 1967). In our analysis, we identified that most IS papers investigated the adoption framework whereas most computer science papers discussed soft and technical solutions in green IT/IS. One of the advantages of applying the theoretical lens of innovation to green IT/IS initiatives is that the researcher can apply the fundamentals of innovation and study deep insights of green IT/IS. For example, the adoption patterns, antecedents, and the inhibitors for different types of innovations vary (Wolfe, 1994). Identifying and scoping any investigation into green IT/IS early on helps researchers build up propositions using the existing literature.

- **Green IT/IS innovation modes**: innovation can also have quite differing degrees of transformation that one can divide into three types of modes: incremental, quantum, and disruptive innovation. The incremental innovation mode refers to modest stepwise improvements or incremental improvements in an initiative (Lokuge & Sedera 2014a). The quantum innovation mode refers to a major improvement to an existing technology that displaces current technology (Maxwell, 2009). The disruptive innovation mode refers to a major improvement to an existing technology that makes the existing technology completely inessential (Maxwell, 2009). Similarly, applying the innovation modes to green IT/IS can extend Gavrilovska, Zdraveski, and Trajanov's (2013) and Molla's (2009) work in which they highlight the challenges regarding green IT/IS initiatives. The innovation modes lens will pave new path for green IT/IS researchers to investigate 1) how organizations can maintain green IT/IS initiatives' economic benefits and 2) their risks.
- **Green IT/IS innovation facilitators and inhibitors**: many academic papers examined the facilitators (antecedents) and inhibitors of innovation (Jansen, Van Den Bosch, & Volberda, 2006; Lokuge & Sedera 2016). These facilitators and inhibitors vary on different factors. Most of the green IT/IS research to date has focused on studying the inhibitors and facilitators of green IT/IS initiatives. The major advantage for the green IT/IS researchers for applying the lens of innovation to green IT/IS is that it opens an avalanche of established and tested inhibitors and facilitators of innovation. Applying the existing literature to carry out revelatory case studies or surveys will ease the pressure of green IT/IS researchers.
- **Dimensions of green IT/IS innovation**: studies generally differentiate innovation by the radicalness speed of the innovation process and by the frequency at which organizations deliver innovations to the market (Barkema, Baum, & Mannix, 2002; Benner & Tushman, 2003; Hill & Rothaermel, 2003; Lokuge & Sedera 2014c). In the past decade, innovation speed was one of the most widely researched areas in innovation (Banu Goktan & Miles, 2011; Kessler & Chakrabarti, 1996; Vega, Du, & Vanhaverbeke, 2013) because academics and practitioners realized the importance of shortening the complete lifecycle of innovation (Banu Goktan & Miles, 2011; Dumaine, 1989; Vega, Du, & Vanhaverbeke, 2013). Innovation speed refers to the time between the ideation or the initial development of an idea and the commercialization of an innovation (Kessler & Chakrabarti, 1996). Innovation frequency refers to how often an organization introduces and delivers new products and services to the market (Pettigrew, Woodman, & Cameron, 2001). One can measure the success of green IT/IS initiatives through the lens of innovation speed and frequency, which represents another pathway for green IT/IS research.
- **Green IT/IS innovation strategies**: considering green IT/IS as an innovation, the other important aspect the researchers can invest is green IT/IS innovation strategies. To better understand the process of green IT/IS innovation in organizations, one needs to understand the strategic initiatives they initiate and evaluate their success, which includes the important decision of "make versus buy" green IT/IS innovations. Organizations can apply different innovation strategies depending on their characteristics (Lokuge et al. 2016). However, the internal versus external sourcing of new technology or the make versus buy decision remains a complex and understudied phenomenon in innovation management (Veugelers & Cassiman, 1999), which opens new pathways for green IT/IS researchers.

6 Conclusion

In the contemporary business world, organizations need to pay more attention to corporate social responsibility and sustainability initiatives (Dao, Langella, & Carbo, 2011). According to Porter and Kramer (2006), organizations should maintain their long-term profitability and survival by balancing their social and environmental goals. They also highlight that sustainability has become a critical checkpoint of organizations' long-term survival. As such, sustainability phenomenon has attracted the attention of academics in many disciplines.

We conducted this study to better understand the state green IT/IS, identify key gaps, and identify concepts that have reached theoretical saturation. Further, we conducted this study to consolidate green IT/IS studies in the management, computer science, and information systems disciplines and to highlight and establish emerging trends and future directions in the green IT/IS research. We analyzed 390 academic papers (84 from computer science, 246 from information systems, 60 from management), which included 131 journal papers and 259 conference papers from 2007 to 2015. In doing so, we highlighted the established emerging areas in the green IT/IS discipline and identified gaps in the literature. The literature shows scholars' increased interest in this interesting and imperative topic. Further, we found that the academics have increasingly adopted a multi-disciplinary approach. Most IS researchers have adopted different theories and frameworks from the management and computer science disciplines.

However, we found that the green IT/IS studies are scattered, and we found plenty of research gaps. To solve these issues, we suggest that researchers apply the innovation research lens to examine green IT/IS. As a future research pathway, academics can apply this research lens and study multiple facets such as types of green IT/IS initiatives, modes of green IT/IS initiatives, facilitators and inhibitors of green IT/IS, dimensions of green IT/IS, and strategies of green IT/IS.

Further, we found that we need a consolidated view of green IT/IS. In this paper, we focused on providing a consolidated view of the green IT/IS literature. We provide the theories and frameworks that research has adopted so far. In consolidating these scattered green IT/IS papers, we open up various opportunities for researchers to establish cumulative knowledge, and we help them position their work and identify potential focuses in future studies.

We acknowledge that we may have excluded a small number of green IT/IS studies published prior to 2000. While we recognize the contributions of such studies, omitting them does not mean we do not provide a multi-disciplinary view of green IT/IS because: 1) the number of papers (sample size) we considered was sufficiently large to minimize such biasness, 2) much of the literature on green IT/IS occurred after the term green IT was coined in 2007, and 3) the inclusion of a small number of related papers published prior to 2007 would not have changed our overview of the green IT/IS literature (see Section 3).

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Appendix A: Journals and Conferences Used for the Analysis

Table A3. Journals Reviewed

AJIS	*Australasian Journal of Information Systems*
BISE	*Business & Information Systems Engineering*
CAIS	*Communications of the Association for Information Systems*
CHB	*Computers in Human Behavior*
CSI	*Computer Standards & Interfaces*
EDS	*Environment, Development and Sustainability*
F	*Foresight*
FGCS	*Future Generation Computer Systems*
IEEES	*IEEE Software*
ACMSUR	*ACM Computing Surveys*
IEEEC	*IEEE Computer*
ACMTOCS	*ACM Transactions on Computer Systems*
COR	*Computers and Operations Research*
IEEETPDS	*IEEE Transactions on Parallel and Distributed Systems*
IJAIM	*International Journal of Accounting and Information Management*
IJBM	*International Journal of e-Business Management*
IJBR	*International Journal of Business Research*
IJCS	*International Journal of Computer Science*
IJPE	*International Journal of Production Economics*
IJSE	*International Journal of Sustainable Engineering*
IM	*Information & Management*
IO	*Information and Organization*
IP	*IT Professional*
JCIS	*The Journal of Computer Information Systems*
JMS	*Journal of Management Systems*
JSI	*Journal of Social Issues*
JSIS	*Journal of Strategic Information Systems*
JTR	*Journal of Technology Research*
JAIS	*Journal of the Association for Information Systems*
MD	*Management Decision*
MISQ	*Management Information Systems Quarterly*
RSER	*Renewable and Sustainable Energy Reviews*
SB	*Service Business*
SOIJ	*Strategic Outsourcing: An International Journal*
AMJ	*Academy of Management Journal*
AMR	*Academy of Management Review*
ASQ	*Administrative Science Quarterly*
JOM	*Journal of Management*
JOMS	*Journal of Management Studies*
RP	*Research Policy*
SMJ	*Strategic Management Journal*

Table A2. Conferences Reviewed

ACIS	Australasian Conference of Information Systems
ACMSIGMISCPR	ACM SIGMIS Computers and People Research
AMCIS	Americas Conference on Information Systems
AOM	Academy of Management
BI	Business Insights
BP	BLED Proceedings
ECIS	European Conference on Information System
EGG	Electronic Goes Green
EPDN	Electrical Power Distribution Networks
EPTC	Electronics Packaging Technology Conference
GCTI	Green Computing, Technology and Innovation
GTC	Green Technologies Conference
GSS	Green and Sustainable Software (GREENS)
HICSS	Hawaii International Conference on System Sciences
ICCF	International Conference on Computing Frontiers
ICEECN	International Conference on Energy-Efficient Computing and Networking
ICCESCE	International Conference on Challenges in Environmental Science and Computer Engineering
ICCISIS	International Conference on Complex, Intelligent, and Software Intensive Systems
ICCCGC	International Conference on Cluster, Cloud and Grid Computing
ICDASC	International Conference on Dependable, Autonomic and Secure Computing
ICDCS	International Conference on Distributed Computing Systems
ICEETSW	International Conference & Expo on Emerging Technologies for a Smarter World
ICGCC	International Conference on Green Computing and Communications
ICGCTI	International Conference on Green Computing, Technology and Innovation
ICGSEW	International Conference on Global Software Engineering Workshops
ICIMTR	International Conference on Innovation Management and Technology Research
ICIS	International Conference on Information System
ICISACCIS	International Conference Industry Session on Autonomic Computing and Communications Industry Session
ICNBIS	International Conference on Network-Based Information Systems
ICRIIS	International Conference on Research and Innovation in Information Systems
ICSKG	International Conference on Semantics, Knowledge and Grids
ICUC	International Conference on Ubiquitous Computing
ICWETT	International Conference and Workshop on Emerging Trends in Technology
IDC	Inter Documentation Company
IDETCCIEC	International Design Engineering Technical Conferences and Computers and Information in Engineering Conference
IGCCW	International Green Computing Conference and Workshops
ISIEC	Informing Science & IT Education Conference
ISCCG	International Symposium on Cluster Computing and the Grid
ISTAS	International Symposium on Technology and Society
IP	IT Professional
IPEC	International Power Electronics Conference

Table A2. Conferences Reviewed

ISSOSE	International Symposium on Service Oriented System Engineering
PACIS	Pacific Asia Conference on Information System
PIC	Progress in Informatics and Computing
PICMET	Portland International Centre for Management of Engineering and Technology
NCC	National Conference on Communications
RASTSCC	Recent Advances in Space Technology Services and Climate Change
SAICSITC	South African Institute for Computer Scientists and Information Technologists Conference
SCHFCS	SIGCHI Conference on Human Factors in Computing Systems
SIGUCCS	Special Interest Group on University and College Computing Services
SST	Sustainable Systems and Technology
TMESW	Technology Management in the Energy Smart World (PICMET)
TF	Telecommunications Forum (TELFOR)
WCS	World Congress on Services (SERVICES-1)

Appendix B: References of Papers Read

Table B1. Papers Used in the Archival Analysis

Year	Reference	Total
2007	Elliot (2007), Etzion (2007), Feng & Cameron (2007), Vlek & Steg (2007)	4
2008	Chaabane, Ramudhin, Paquet, & Benkaddour (2008), Chetty, Tran, & Grinter (2008), David (2008), Elliot & Binney (2008), Forrest, Kaplan, & Kindler (2008), Fuchs (2008), Huang (2008), Kovačić, Zealand, & Vukmirović (2008), Krikke (2008), Martinez & Bahloul (2008), Matten & Moon (2008), Molla (2008), Molla, Cooper, Corbitt, Deng, Peszynski, Pittayachawan, & Teoh (2008), Murugesan (2008), Sayeed & Gill (2008), Wang (2008), Woodruff, Hasbrouck, & Augustin (2008)	16
2009	Babin & Nicholson (2009), Berrone & Gomez-Mejia (2009), Cameron (2009a, 2009b), Capra & Merlo (2009), Chang (2009), Chen, Watson, Boudreau, & Karahanna (2009), Chetty, Brush, Meyers, & Johns (2009), Chow & Chen (2009), Daly & Butler (2009), Dedrick (2009), Eastwood (2009), Eder (2009), Erek, Schmidt, Zarnekow, & Kolbe (2009), Esty & Winston (2009), Guster, Hemminger, & Krzenski (2009), Harmon & Auseklis (2009), Hasan, Ghose, & Spedding (2009), Herrick & Ritschard (2009), Hobby, Rydell, Sjogren, & Williams (2009), Huang (2009), Liu, Wang, Liu, Jin, He, Wang, & Chen (2009), Mann, Grant, & Mann (2009), Molla (2009), Molla, Cooper, & Pittayachawan (2009), Molla, Pittayachawan, Corbitt, & Deng (2009), Niyato, Chaisiri, & Sung (2009), Peloza (2009), Petrini & Pozzebon (2009), Ruth (2009), Sarkar & Young (2009), Sayeed & Gill (2009), Schmidt, Erek, Kolbe, & Zarnekow (2009), Vykoukal, Wolf, & Beck (2009)	30
2010	Ansari, Ashraf, Malik, & Grunfeld (2010), Bachour & Chasteen (2010), Baek & Chilimbi (2010), Beloglazov & Buyya (2010), Benitez-Amado, Perez-Arostegui, & Tamayo-Torres (2010), Berral, Goiri, Nou, Julià, Guitart, Gavaldà, & Torres (2010), Berrone, Cruz, Gomez-Mejia, & Larraza-Kintana (2010), Brooks, Wang, & Sarker (2010), Cameron (2010a, 2010b, 2010c), Capra, Formenti, Francalanci, & Gallazzi (2010), Chen & Yoon (2010), Cooper & Molla (2010), Corbett (2010), Corbett, Webster, Sayili, Zelenika, & Pearce (2010), Dada, Staake, & Fleisch (2010), Darnall, Henriques, & Sadorsky (2010), Datta, Roy, & Tarafdar (2010), Dedrick (2010), Doh, Kim, Park, Kim, Choi, Lee, & Noh (2010), Doh, Howton, Howton, & Siegel (2010), Garg, Gupta, Goh, & Desouza (2010), Ghose, Hoesch-Klohe, Hinsche, & Le (2010), Hasan (2010), Iacobelli, Olson, & Merhout (2010), Ijab, Molla, Kassahun, & Teoh (2010), Kim & Ko (2010), Kuo & Dick (2010), Kuo (2010), Kurokawa, Maeda, Shibata, Maruta, Takahashi, Bansho, Tanaka, & Hirose (2010), Lauridsen & Jørgensen (2010), Louis & Cazier (2010), McLaren, Manatsa, & Babin (2010), Melville (2010), Mithas, Khuntia, & Roy (2010), Molla & Cooper (2010), Osch & Avital (2010), Schlieter, Juhrisch, & Niggemann (2010), Schmidt, Erek, Kolbe, & Zarnekow (2010), Schmidt, Schmidtchen, Koray, Kolbe, & Zarnekow (2010), Seidel, Recker, Pimmer, & Vom Brocke (2010), Shove & Walker (2010), Smarr (2010), Späth & Rohracher (2010), Thambusamy & Salam (2010), Rao, Kiran, & Reddy (2010), Van Osch & Avital (2010), Van Osch, Bohnsack, & Avital (2010), Vykoukal (2010), Watson, Boudreau, & Chen (2010), Yamini & Selvi (2010), Yang, Qi, & Low (2010), Ying & Al-Hakim (2010), Zhang, Li, & Zhang (2010)	51

Table B1. Papers Used in the Archival Analysis

2011	Alaraifi, Molla, & Deng (2011a), Alaraifi, Molla, & Deng (2011)b, Aoun, Vatanasakdakul, & Bunker (2011), Aoun, Vatanasakdakul, & Cecez-Kecmanovic (2011), Babik & Iyer (2011), Babin & Nicholson (2011), Baeriswyl, Przepiorka, & Staake (2011), Baliga, Ayre, Hinton, & Tucker (2011), Bengtsson & Ågerfalk (2011), Benitez-Amado & Walczuch (2011), Bodenstein, Schryen, & Neumann (2011), Boehm, Freundlieb, Stolze, Thomas, & Teuteberg (2011), Bose & Luo (2011), Butler (2011a, 2011b), Cater-Steel & Tan (2011), Chai-Arayalert & Nakata (2011), Chang, Yen, Li, Chang, & Chen (2011), Chen, Watson, Boudreau, & Karahanna (2011), Cheung & Jacobsen (2011), Corbett (2011), Curry, Hasan, Hassan, Herstand, & O'Riain (2011), Dao, Langella, & Carbo (2011), De Villiers, Naiker, & van Staden (2011), DesAutels & Berthon (2011), Dubey & Hefley (2011), Elliot (2011), Enokido, Aikebaier, & Takizawa (2011), Erek, Loeser, Schmidt, Zarnekow, & Kolbe (2011), Friedemann, Dehler, Friedrich, Haack, & Schumann (2011), Germain-Renaud, Furst, Jouvin, Kassel, Nauroy, & Philippon (2011), Graml, Loock, Baeriswyl, & Staake (2011), Gupta, Gilbert, Banerjee, Abbasi, Mukherjee, & Varsamopoulos (2011), Hanne (2011), Hjalmarsson & Lind (2011), Jain, Benbunan-Fich, & Mohan (2011), Jenkin, Webster, & McShane (2011), Jung, Kim, & An (2011), Kerschbaum, Strüker, & Koslowski (2011), Kipp, Jiang, & Fugini (2011), Kranz & Picot (2011), Krishnan & Teo (2011), Krishnan, Teo, & Nishant (2011), Lamb (2011), Lee, Oh, Koo, & Sarkis (2011), Liu, Masfary, & Li (2011), Loeser, Erek, Schmidt, Zarnekow, & Kolbe (2011), Loock, Staake, & Landwehr (2011), Loos, Nebel, Gómez, Hasan, Watson, vom Brocke, Recker (2011), Mata-Toledo & Gupta (2011), McWilliams & Siegel (2011), Molla & Abareshi (2011), Molla, Cooper, & Pittayachawan (2011), Müller, Sonehara, Echizen, & Wohlgemuth (2011), Nedbal, Wetzlinger, Auinger, & Wagner (2011), Nishant, Teo, & Goh (2011), Parker, Fraunholz, Zutshi, & Crofts (2011), Pitt, Parent, Junglas, Chan, & Spyropoulou (2011), Rao, Saravanakumar, Sundararaman, Parthasarathi, & Ramesh (2011), Romijn & Caniëls (2011), Ruch, Schmidt, Decker, & Kolbe (2011), Ryoo, Koo, & Wati (2011), Salomie, Cioara, Anghel, Moldovan, Copil, & Plebani (2011), Schiller & Merhout (2011), Schmidt, Erek, Kolbe, & Zarnekow (2011), Schmidt & Kolbe (2011), Siddavatam, Johri, & Patole (2011), Strüker, Weppner, & Bieser (2011), Ijab, Molla, & Cooper (2011), Tan, Ling & Zuo (2011), Thies & Stanoevska-Slabeva (2011), Thoroe, Appelhanz, & Schumann (2011), Vazquez, Rocha, Dominguez, Morales, & Ahluwalia (2011), Volkoff, Bertels, & Papania (2011), Vykoukal, Beck, & Wolf (2011), Wang & Wang (2011), Wati & Koo (2011), Watson, Boudreau, Chen, & Sepúlveda (2011), Yim (2011), Young Choon & Zomaya (2011), Zampou & Pramatari (2011), Zhang, Liu, & Li (2011)	85
2012	Aksanli, Venkatesh, & Rosing (2012), Beloglazov, Abawajy, & Buyya (2012), Bose & Luo (2012), Brooks, Wang, & Sarker (2012), Butler (2012), Califf, Lin, & Sarker (2012), Chaudhari, Nottath, Subramanian, & Murthy (2012), Chou & Chou (2012), Chowdhury, Cavalcanti, El-Said, Mazza, & Ghosh (2012), Cooper & Molla (2012), Corbett (2012), Corley, Cazier, & Vannoy (2012), Costantini & Mazzanti (2012), Curry & Donnellan (2012), Dasilva, Lu, Bessis, & Yongzhao (2012), De Marchi (2012), Dorsch & Häckel (2012), Eesley & Hannah (2012), Erek, Loeser, & Zarnekow (2012), Flath, Ilg, & Weinhardt (2012), Fradley, Troshani, Rampersad, & De Ionno (2012), Garud & Gehman (2012), Goetzinger, Brandt, & Neumann (2012), Harmon, Demirkan, & Raffo (2012), Hedman, Henningsson, & Selander (2012), Hovorka & Corbett (2012), Howard & Lubbe (2012), Ijab, Molla, & Cooper (2012), Inoue, Aikebaier, Enokido, & Takizawa (2012a, 2012b), Joo & Kim (2013), Kocaoglu, Malak & Akan (2012), Kock, Santaló, & Diestre (2012), Korte, Lee, & Fung (2012), Kossahl, Busse, & Kolbe (2012), Kossahl, Kranz, Opitz, & Kolbe (2012), Kurnia, Rahim, & Gloet (2012), Lei & Ngai (2012), Lettice, Smart, Baruch, & Johnson (2012), Loeser (2012), Loock, Landwehr, Staake, Fleisch, & Pentland (2012), Markard, Raven, & Truffer (2012), Metzger, Stevens, Harmon, & Merhout (2012), Mohan, Ramesh, Cao, & Sarkar (2012), Molla & Abareshi (2012), Nanath & Pillai (2012a, 2012b), Nazari & Karim (2012), Nishant, Teo, Goh, & Krishnan (2012), Pauwels, Cattrysse, Duflou, & Mulder (2012), Pernici, Aiello, vom Brocke, Donnellan, Gelenbe, & Kretsis (2012), Qiu, Neumann, & Goetzinger (2012), Røpke (2012), Scott & Watson (2012), Seidel & Recker (2012), Simmonds & Bhattacherjee (2012), Stolze, Janßen, & Thomas (2012), Strueker & Dinther (2012), Takeda, Rowe, Habib, de Corbière, & Antheaume (2012), Thies & Stanoevska-Slabeva (2012), Thompsen, Olivera, Rodríguez, & Joan (2012), Thongmak (2012), Uddin & Rahman (2012), Unhelkar (2012), Vom Brocke, Watson, Dwyer, Elliot, & Melville (2012), Watson, Lind, & Haraldson (2012), Winkler von Mohrenfels & Klapper (2012), Xu (2012), Zhang (2012), Zhiwei (2012)	66

Table B1. Papers Used in the Archival Analysis

2013	Antonioli, Mancinelli, & Mazzanti (2013), Benitez-Amado, Llorens-Montes, & Fernandez-Perez (2013), Berrone, Fosfuri, Gelabert, & Gomez-Mejia (2013), Bradshaw & Donnellan (2013), Brandt, Feuerriegel, & Neumann (2013), Brenig, Reichert, & Strueker (2013), Busse, El Khatib, Brandt, Kranz, & Kolbe (2013), Cai, Chen, & Bose (2013), Cameron (2013), Chou (2013), Chowdhury, Dewan, & Quaddus (2013), Cooper & Molla (2013), Corbett (2013), Davis, Russell, & Galvan (2013), Dewan, Biswas, Chowdhury, & Quaddus (2013), Dick, Drangmeister, Kern, & Naumann (2013), Erskine & Füstös (2013), Flammer (2013), Fradley, Rampersad, & Troshani (2013), Garroppo, Giordano, Nencioni, and Scutellà (2013), Gavrilovska, Zdraveski, & Trajanov (2013), Gholami, Sulaiman, Ramayah, & Molla (2013), Grimm, Erek, & Zarnekow (2013), Hilpert & Schumann (2013), Ho & Lin (2013), Jiang & Chen (2013), Joo & Kim (2013), Khan & Khan (2013), Khanna & Venters (2013), Khavul & Bruton (2013), Kim, Kim, Han, & Jackson (2013), Kim (2013), Kim, Moon, & Yin (2013), Koo, Chung, & Lee (2013), Krishnadas & Pillai (2013), Krogstie, Stålbrøst, Holst, Gudmundsdottir, Olesen, Braskus, Jelle, Kulseng (2013), Lee, Park, & Trimi (2013), Lei & Ngai (2013a, 2013b), Lin, Yang, & Hsu (2013), Loeser (2013), Loock, Staake, & Thiesse (2013), Malhotra, Melville, & Watson (2013), Marett, Otondo, & Taylor (2013), Moeller, Erek, Loeser, & Zarnekow (2013), Nishant, Teo, & Goh (2013a, 2013b), Parmiggiani & Hepsø (2013), Rahim & Rahman (2013), Rawai, Fathi, Abedi, & Rambat (2013), Rogers, Jenkin, Corbett, & Webster (2013), Scherer, Palazzo and Seidl (2013), Schmidt & Busse (2013), Schödwell, Erek, & Zarnekow (2013), Seidel, Recker, & Vom Brocke (2013), Smeitink & Spruit (2013), Stansberry (2013), Stiel & Teuteberg (2013), Trimi & Park (2013), Vom Brocke, Seidel, Loos, & Watson (2013), Vom Brocke, Watson, Dwyer, Elliot, & Melville (2013), White (2013), Whiteman, Walker, Perego, Stockholms, & Stockholm Resilience (2013), Wunderlich, Kranz, & Veit (2013), Yang, Li, & Tan (2013), Yunus, Jailani, Hairuddin, & Kassim (2013), Zhang, Jiang, Yang, & Sun (2013)	69
2014	Atkinson, Schulze, & Klingert (2014), Bener, Morisio, & Miranskyy (2014), Bohnsack, Pinkse & Kolk (2014), Boone & Ozcan (2014), Cooper & Molla (2014), Flüchter & Wortmann (2014), Fuenfschilling & Truffer (2014), Grant & Appan (2014), Grant & Marshburn (2014), Guevara, Lubin, & Lee (2014), Hess (2014), Hilpert, Kranz, & Schumann (2014), Kim, Kim, Han, Jackson, & Ployhart (2014), Lei & Ngai (2014), Mancha, Muniz, & Yoder (2014), Mishra, Akman, & Mishra (2014), Molla & Cooper (2014), Nomani & Cater-Steel (2014), Opitz, Krüp, & Kolbe (2014), Oppong-Tawiah, Webster, Staples, Cameron, & de Guinea (2014), Parker, Bellucci, Torlina, Fraunholz, & Zutshi (2014), Schrödl & Simkin (2014), Seidel, Recker, Pimmer, & vom Brocke (2014), Simmonds & Bhattacherjee (2014), Sonenshein, DeCelles & Dutton (2014), Stiel (2014), Stindt, Nuss, Bensch, Dirr, & Tuma (2014), Valogianni, Ketter, & Collins (2014), Zheng (2014), Zhou (2014)	28
2015	Abraham & Mohan (2015), Akman & Mishra (2015), Angeles (2015), Appelhanz & Schumann (2015), Ballasiotes, Boudreau, Lian, & Watson (2015), Bandi, Bose, & Saxena (2015), Bojanova, I., Voas, & Hurlburt (2015), Brauer, Eisel, & Kolbe (2015), Chaudhry, Ling, Manzoor, Hussain, & Kim (2015), Deng & Ji (2015), Deng, Ji, & Wang (2015), Ekman, Raggio, & Thompson (2015), Esfahani, Abdul, & Zakaria (2015), Frehe (2015), Fridgen, Gründler, & Rusic (2015), Godbole & Lamb (2015), Gohar & Indulska (2015), Kocak (2015), Haraldson (2015), Howard, Lubbe, & Klopper (2015), Jnr & Pa (2015), Karlsson, Haraldson, & Holmberg (2015), Khan, Al Mesfer, Khan, Khan, & Van Zutphen (2015), Kong & Liu (2015), Lamb & Marimekala (2015), López (2015), Lun, Lai, Wong, & Cheng (2015), de Luis, Cruz, Arcia, & Márquez (2015), Pollard (2015), Rivera & Kurnia (2015), Rush, Melville, Ramirez, and Kobelsky (2015), Schmidt, Hildebrandt, Eisel, & Kolbe (2015), Seidel, Székely, & vom Brocke (2015), Tognetti, Grosse-Ruyken, & Wagner (2015), Wang, Brooks, & Sarker (2015a, 2015b), Watson, Holm, & Lind (2015), Watts (2015), Wijesooriya, Heales, & McCoy (2015), Xie (2015), Yesudas (2015), Zalewski & Sybramanian (2015)	41

Appendix C: Number of Papers Reviewed for the Analysis

Table C1. Number of Papers Reviewed (Journals)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total	
AJIS	-	-	-	3	5	-	-	2	-	10	*AJIS*
BISE	-	-	2	-	2	-	2	-	-	6	*BISE*
CAIS	-	-	-	1	1	1	1	1	2	7	*CAIS*
CHB	-	-	-	-	-	-	-	1	2	3	*CHB*
CSI	-	-	-	-	-	1	1	-	-	2	*CSI*
EDS	-	1	-	-	-	-	-	-	1	2	*EDS*
F	-	-	-	-	-	1	-	-	-	1	*F*
FGCS	-	-	-	-	-	1	-	-	-	1	*FGCS*
IEEES	-	-	-	-	-	-	-	1	-	1	*IEEES*
ACMCSUR	-	-	-	-	-	-	-	-	2	2	*ACMCSUR*
IEEEC	1	-	2	4	-	4	2	-	-	13	*IEEEC*
ACMTOCS	-	-	-	-	-	-	-	1	-	1	*ACMTOCS*
COR	-	-	-	-	-	-	1	-	2	3	*COR*
IEEETPDS	-	-	-	-	1	-	-	-	-	1	*IEEETPDS*
IJAIM	-	-	-	-	-	1	-	-	-	1	*IJAIM*
IJBM	-	-	1	-	-	-	-	-	-	1	*IJBM*
IJBR	-	-	1	-	-	-	-	-	-	1	*IJBR*
IJCS	-	-	-	-	1	-	-	-	-	1	*IJCS*
IJPE	-	-	-	-	-	-	1	-	1	2	*IJPE*
IJSE	-	-	-	-	-	1	-	-	-	1	*IJSE*
IM	-	-	-	-	-	-	1	-	-	1	*IM*
IO	-	-	-	-	1	-	-	-	-	1	*IO*
IP	-	2	-	-	2	1	-	-	1	6	*IP*
JCIS	-	-	2	1	-	1	-	-	-	4	*JCIS*
JMS	-	-	-	-	-	1	-	-	-	1	*JMS*
JSI	1	-	-	-	-	-	-	-	-	1	*JSI*
JSIS	-	-	1	-	8	-	-	-	-	9	*JSIS*
JTR	-	-	-	-	1	-	-	-	-	1	*JTR*
JAIS	-	-	-	-	-	-	1	-	-	1	*JAIS*
MD	-	-	-	-	-	-	1	-	-	1	*MD*
MISQ	-	-	-	2	1	-	4	-	-	7	*MISQ*
RSER	-	-	-	-	-	1	-	-	-	1	*RSER*
SB	-	-	-	-	-	-	1	-	-	1	*SB*
SOIJ	-	-	-	-	1	-	-	-	-	1	*SOIJ*
AMJ	-	-	1	-	-	-	1	2	-	4	*AMJ*
AMR	-	1	-	-	-	-	-	-	-	1	*AMR*
ASQ	-	-	-	1	-	1	-	-	-	2	*ASQ*
JOM	1	-	1	1	2	1	-	1	-	7	*JOM*
JOMS	-	-	-	-	-	1	3	-	-	4	*JOMS*
RP	-	-	-	4	1	6	1	3	-	15	*RP*
SMJ	-	-	-	-	-	-	2	-	-	2	*SMJ*
Total	3	4	11	17	27	23	23	12	11	131	Total

Table C2. Number of Papers Reviewed (Conferences)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total	
ACIS	-	2	-	-	1	1	2	-	3	9	ACIS
AMCIS	-	2	4	12	14	14	10	7	14	77	AMCIS
AOM	-	-	-	1	-	-	6	-	-	7	AOM
BI	-	-	1	-	-	-	-	-	-	1	BI
BP	-	-	-	-	-	1	-	-	-	1	BP
ECIS	-	-	2	3	12	5	4	2	1	29	ECIS
EGG	-	-	-	-	-	1	-	-	-	1	EGG
EPDN	-	-	-	-	-	1	-	-	-	1	EPDN
EPTC	-	2	-	-	-	-	-	-	-	2	EPTC
GCTI	-	-	-	-	-	-	1	-	-	1	GCTI
GTC	-	-	-	1	-	-	-	-	-	1	GTC
GSS	-	-	-	-	-	-	1	-	-	1	GSS
HICSS	-	-	-	1	1	-	1	-	-	3	HICSS
ICCF	-	-	-	1	-	-	-	-	-	1	ICCF
ACMSIGMISCPR	-	-	-	-	-	-	-	-	1	1	ACMSIGMISCPR
ICCESCE	-	-	-	1	-	-	-	-	-	1	ICCESCE
ICCISIS	-	-	-	-	2	1	-	-	-	3	ICCISIS
ICCCGC	-	-	-	1	3	-	-	-	-	4	ICCCGC
ICDASC	-	-	-	-	2	-	-	-	-	2	ICDASC
ICDCS	-	-	-	-	1	-	-	-	-	1	ICDCS
ICEECN	-	-	-	1	-	-	-	-	-	1	ICEECN
ICEETSW	-	-	-	-	1	-	-	-	2	3	ICEETSW
ICGCC	-	-	-	-	3	-	-	-	-	3	ICGCC
ICGCTI	-	-	-	-	-	-	1	-	1	2	ICGCTI
ICGSEW	-	-	-	-	-	-	1	-	-	1	ICGSEW
ICIMTR	-	-	-	-	-	1	-	-	-	1	ICIMTR
ICIS	-	-	3	3	7	12	4	5	4	38	ICIS
ICISACCIS	-	-	1	-	-	-	-	-	-	1	ICISACCIS
ICNBIS	-	-	-	-	-	1	-	-	-	1	ICNBIS
ICRIIS	-	-	-	-	-	-	1	-	-	1	ICRIIS
ICSKG	-	-	-	-	-	-	1	-	-	1	ICSKG
ICUC	-	1	-	-	-	-	-	-	-	1	ICUC
ICWETT	-	-	-	-	2	-	-	-	-	2	ICWETT
IDC	-	1	-	-	-	-	-	-	-	1	IDC
IDETCCIEC	-	-	-	1	-	-	-	-	-	1	IDETCCIEC
IGCCW	-	-	-	-	1	-	-	-	-	1	IGCCW
ISCCG	-	-	1	-	-	-	-	-	1	2	ISCCG
ISIEC	-	1	-	-	-	-	-	-	-	1	ISIEC
ISSOSE	-	-	-	-	1	-	-	-	-	1	ISSOSE
ISTAS	-	-	-	1	-	-	-	-	-	1	ISTAS
IP	-	-	-	-	1	-	-	-	-	1	IP
IPEC	-	-	-	1	-	-	-	-	-	1	IPEC

Table C2. Number of Papers Reviewed (Conferences)

PACIS	1	2	3	3	5	3	12	2	3	34	PACIS
PIC	-	-	-	1	-	-	-	-	-	1	PIC
PICMET	-	-	1	-	-	-	-	-	-	1	PICMET
NCC	-	-	-	-	-	1	-	-	-	1	NCC
RASTSCC	-	-	-	1	-	-	-	-	-	1	RASTSCC
SAICSITC	-	-	-	-	-	1	-	-	-	1	SAICSITC
SCHFCS	-	1	1	-	-	-	-	-	-	2	SCHFCS
SIGUCCS	-	-	1	-	-	-	-	-	-	1	SIGUCCS
SST	-	-	1	-	-	-	-	-	-	1	SST
TMESW	-	-	-	-	1	-	-	-	-	1	TMESW
TF	-	-	-	-	-	-	1	-	-	1	TF
WCS	-	-	-	1	-	-	-	-	-	1	WCS
Total	1	12	19	34	58	43	46	16	30	259	Total

Appendix D: A Summary of Theoretical Foundation

Table D1. Theoretical Frameworks (Used) in Green IT Literature

Theoretical foundation	Sample references	Explanation/paper brief
Actor-network theory	Aoun, Vatanasakdakul, & Cecez-Kecmanovic (2011)	Studies the use of collaborative technologies for eco-mobilization among environmental non-governmental organizations to achieve shared environmental goals.
	Bengtsson & Ågerfalk (2011)	Investigates the effects of a sustainability initiative in the municipality of Uppsala, Sweden, and focuses on understanding the driving forces of sustainability initiatives and examining the roles of human and non-human actors in that process.
	Fradley, Rampersad, & Troshani (2013)	Investigates heterogeneous actors' engagement in complex patterns of interaction in their green IS development efforts.
	Garud & Gehman (2012)	Applies dynamic capabilities perspective. Explores the implications of each perspective for policy, research and strategy. Also, reinterprets the concept of dynamic capabilities based on the three perspectives.
Belief-action-outcome framework	Gholami, Sulaiman, Ramayah, & Molla (2013)	Studies the motivational drivers of a company for green IS adoption and identifies the impact on the environmental performance of the organization.
	Melville (2010)	Studies how society and shape beliefs about green products (beliefs), the actions taken to develop green products (actions), and the impacts of these beliefs and actions on the environment and the organization (outcome).
	Mithas, Khuntia, & Roy (2010)	Investigates antecedents and consequences of green IT implementation and finds that the commitment of top management plays an important role in the implementation of green IT in organizations.
	Stiel (2014)	Identifies the values and research issues of discrete event simulation in green IS research and illustrates the causal relations between organizational, social and physical structures, individual objects as well as the outcomes in their interaction.
Business transformation framework	Elliot (2011)	Business transformation framework addresses four key issues of uncertainty: 1) what is environmental sustainability, 2) major challenges of environmental sustainability, 3) what is being done about these challenges, 4) what needs to be done.
Complex adaptive systems theory	Khanna & Venters (2013)	Highlights that intermediaries are important for the design of ICT systems in urban infrastructure prototyping.
Contextual theory	Cooper & Molla (2013)	Using contextual theory, the authors uncover that absorptive capacity theory has a medium- to large-scale effect on green IT assimilation,
Contingency theory	Opitz, Krüp, & Kolbe (2014)	Demonstrates the fit between contingencies and the company-specific configuration of Green IT as the organizations will be able to select the most successful green IT governance form by better understanding how contingency factors shape green IT governance.
	Schmidt & Kolbe (2011)	Highlights that the organizations' IT governance depend on contingency factors.
Diffusion of innovation	Bose & Luo (2011)	Assesses green IT initiatives and the green IT implementation stages at the organizational level.
	Nedbal, Wetzlinger, Auinger, & Wagner (2011)	Links outsourcing with sustainable IS to examine the possibilities of organizations engaging in green and sustainable initiatives.

Table D1. Theoretical Frameworks (Used) in Green IT Literature

Dual process theory	Watts (2015)	Reports on a laboratory experiment conducted to investigate interactions between the design of two different corporate sustainability ratings databases and users' perceptions of the usefulness of their content.
Ecological modernization theory	Nishant (2012)	Highlights that per-capita energy efficiency research and development investment is negatively associated with per capita emissions. Also applies the natural resource-based view to examine the impact and the extent of green IS adoption on organizational performance including the impact of different dimensions of sustainability portfolio.
	Ryoo, Koo, & Wati (2011)	Highlights that the green IT practice coordination has a positive effect on environmental performance. Also uses complementarity theory.
Elaboration-likelihood model	Esfahani, Abdul, & Zakaria (2015)	Addresses the process of influence that can shape the perceptions of individuals towards the adoption of green IT.
Evolutionary innovation theory	Romijn & Caniëls (2011)	Investigates the evolution of Jatropha biofuel in Tanzania.
Extended model of goal-directed behavior	Loock, Staake, & Thiesse (2013)	Outlines how information systems plays a key part in encouraging energy saving measures in domestic settings with emphasis on the importance of the goal setting initiatives required to affect these outcomes (argues that extended model of goal-directed behavior is a redefinition of theory of planned behavior).
Feedback interventions theory	Yim (2011)	Highlights that the energy competition has positive influence in reducing energy consumption for cohesive dorms.
Functional affordance framework	Seidel, Recker, & vom Brocke (2013)	Identifies important functional affordances that originate in information systems.
Implementation framework	Mann, Grant, & Mann (2009)	A practical three step implementation framework with a unique sustainability-based feedback mechanism to understand what combination of green IT practices might optimally benefit in different scenarios.
Information processing theory	Corbett (2011)	Develops a model to improve the effectiveness of electricity demand management in an organization.
Information system design theory	Hilpert, Kranz, & Schumann (2014)	Provides directions for design of green IS for sustainability reporting (SR).
Institutional theory	Butler (2011a)	Explains the forces act on organizations in the institutional environment and the organizational fields in relation to environmental sustainability and regulatory compliance.
	Berrone, Cruz, Gomez-Mejia, & Larraza-Kintana (2010)	Highlights that family-controlled public firms protect their socio-emotional wealth by having a better environmental performance than their non-family counterparts.
	Berrone, Fosfuri, Gelabert, & Gomez-Mejia (2013)	Argues that greater regulatory and normative pressures concerning environmental issues positively influence companies' propensity to engage in environmental innovation.
	Berrone & Gomez-Mejia (2009)	Highlights that firms with an explicit environmental pay policy and an environmental committee do not reward environmental strategies more than those without such structures, which suggests that these mechanisms play a symbolic role. Further, paper uses agency perspective and environmental management literature to develop hypotheses.
	Corbett (2012)	Highlights that under institutional pressures, organizations may take a wait and see approach.
	Daly & Butler (2009)	Analyzes the effects that regulative, normative and cultural-cognitive influences have in shaping environmental responsibility in organizations.

Table D1. Theoretical Frameworks (Used) in Green IT Literature

	Doh, Howton, Howton, & Siegel (2010)	Investigates the relationship between the corporate social responsibility and firm financial performance. The delicate interplay among different social performance assessments, reputation, and measures of financial and operating performance may serve as an advanced indicator of social performance and one type of social performance assessment may temper market reactions to another.
	Fuenfschilling & Truffer (2014)	Discusses water management and, by using an institutional perspective, highlights that levels of structuration can be conceptualized as degrees of institutionalization. Thus, the paper considers institutionalization as a variable with different effects on actors and the stability of the system.
	Lei & Ngai (2012)	Uses information processing theory and organization theory as theoretical lenses and develops a theoretical framework on the assimilation of green IS.
	Matten & Moon (2008)	Investigates how and why corporate social responsibility differs among countries and how and why it changes. Also, the paper highlights the rise of corporate social responsibility in Europe.
	Sarkar & Young (2009)	Provides an understanding the drivers of corporate environmentalism and analyzes how external social pressure influences organizational behavior and policymaking.
IT alignment framework	Erek, Loeser, Schmidt, Zarnekow, & Kolbe (2011)	The strategic green IT alignment framework can guide decision makers in selecting an appropriate green IT strategy for achieving corporate sustainability targets leveraged with competitiveness.
Lifecycle framework	Ijab, Molla, Kassahun, & Teoh (2010)	Conceptualizes "green IS" and offers a theoretical framework called the green IS lifecycle framework based on what, where, how, and when to inscribe green into IS. In the proposed framework, what indicates "the inscription and enactment of values of eco-sustainability", where indicates "spirit, practice and impact", how indicates "design and development", and when indicates "pre-use, use and post-use".
Motivation-opportunity-ability model	Graml, Loock, Baeriswyl, & Staake (2011)	Highlights that socio-psychological concepts such as motivation are supporting energy conservation behavior.
Natural resource-based view	Benitez-Amado & Walczuch (2011)	Focuses on the relationships between information technology, environmental organizational issues, and performance. Drawing on the perspective of IT-enabled capabilities and the literature on organizations and the natural environment, this study introduces the construct capability of proactive corporate environmental strategy.
	Chen, Watson, Boudreau, & Karahanna (2009)	Investigates the pressures to motivate the adoption of green practices across organizations. The paper also uses institutional theory and highlights that mimetic and coercive pressures significantly drive green IS and IT adoption.
	Dao, Langella, & Carbo (2011)	Integrating IT resources with the HRM and SCM resources that influence firms to develop sustainability capabilities.
	Nishant, Teo, & Goh (2013a)	Analyzing of different sustainability practices that can create competitive advantage for the organization.
	Rahim & Rahman (2013)	Identifying the relationship between natural resource-based view and green IT capability.
Organizational citizenship behavior	Kim, Kim, Han, Jackson, & Ployhart (2014)	Highlights that psychological and social conditions and processes shape voluntary workplace green behavior in organizational settings.
Organizational reform theory	Chang, Yen, Li, Chang, & Chen (2011)	Highlights that organizational culture, individual demands, and value are important factors that influence accountants' attitudes.

Table D1. Theoretical Frameworks (Used) in Green IT Literature

Organizing vision framework	Fradley, Troshani, Rampersad, & De Ionno (2012)	Employment to facilitate organizing vision processes to help organizational actors to understand of how the variety of their interests can be served by green IS.
Planetary boundaries	Whiteman, Walker, Perego, Stockholms, & Stockholm Resilience (2013)	Introduces a new development in the natural sciences—the delineation of nine “planetary boundaries” that govern life. Further, the paper discusses planetary boundaries framework for corporate sustainability, including governance and institutional challenges.
Political-economic framework	Cai, Chen, & Bose (2013)	Identifies the political factors (public concerns and regulatory forces) and economic factors (cost reduction and differentiation) for the adoption of green IT.
Porter’s competitive positioning	Loeser, Erek, Schmidt, Zarnekow, & Kolbe (2011)	Develops the green IT alignment framework for an organization using a positivist approach. The paper also uses resources based view as the theoretical lens.
Practice theory	Ijab, Molla, & Cooper (2011)	Identifies how organizations use green IS.
	Ijab, Molla, & Cooper (2012)	Discusses the emergence and the recurrent use of green IS practice in organizations to understand the complexity of practice phenomenon.
	Shove & Walker (2010)	Analyses how variously sustainable practices come into existence, how they disappear, and how interventions of different forms may be implicated in these dynamics.
Principal agent theory	Brenig, Reichert, & Strueker (2013)	Using principal agent theory, the paper proposes that hidden actions (fraud) lead to market failure and highlights the prospects of a standardized IS solution for moral hazard in smart grids.
Process modelling concepts	Ghose, Hoesch-Klohe, Hinsche, & Le (2010; Gohar & Indulska (2015)	Presents a framework for optimizing the emission of carbon in existing business processes.
Readiness framework	Molla, Cooper, Corbitt, Deng, Peszynski, Pittayachawan, & Teoh (2008)	Proposes a G-readiness framework for measuring the preparedness of organizations for adopting green IT.
Reference group theory	Koo, Chung, & Lee (2013)	Explains the relationship between motivation aspects, perceived usefulness, and group theory to analyze how the reference group moderates the relationship using motivation theory.
Resource-based view	Jung, Kim, & An (2011)	Develops relationships among information and knowledge and demonstrates significant effects on green management performances in an organization.
	Kim (2013)	Applies the concepts from industrial organization economics and the resource-based view with path dependence and suggests that deregulation may not always provide greater opportunities for incumbents and the extent to which incumbents differentiate on the green dimension may be constrained by their prior resources.
	Krishnan & Teo (2011)	Posits that the relationships of electronic-government development and electronic-business development in a country with its environmental sustainability depend on national environmental factors such as human capital, public institutions, macro-economic stability, and gross domestic product per capita.
	McWilliams & Siegel (2011)	Analyzes the value of adopting corporate social responsibilities in a firm,
	Nishant, Teo, & Goh (2011)	Highlights that there are positive relationships between the green IT announcements and the cumulative abnormal returns.
	Vykoukal, Wolf, & Beck (2009)	Highlights that green IT has economic and ecological benefits and it increases companies' competitiveness.
Resource dependence theory	Datta, Roy, & Tarafdar (2010)	Examines the nature of the exchange relationship between IT service providers and client organizations.

Table D1. Theoretical Frameworks (Used) in Green IT Literature

	De Villiers, Naiker, & van Staden (2011)	Investigates the relationship between firm environmental performance and board characteristics. The paper also uses the agency theory-driven predictions and reveals that environmental performance is higher in firms that have larger boards, larger representation of active CEOs on the board, and more legal experts on the board.
Self-determination theory	Wunderlich, Kranz, & Veit (2013)	Investigates the role of endogenous motivation on the adoption of green IS.
Social presence theory	Loock, Staake, & Landwehr (2011)	Highlights that descriptive and injunctive normative feedbacks that websites deliver have significant effects on energy consumption.
Socio-technical system theory	Seidel, Recker, & Vom Brocke (2013)	Studies how an organizational work system can be transformed to attain environmental sustainability targets.
Source-position-performance framework	Krishnan, Teo, & Nishant (2011)	Highlights that the government and business IT readiness lead to differentiation in government and business ICT usage, which, in turn, affects the national sustainability in terms of economic, environmental and social developments.
Stakeholder theory	Chowdhury, Dewan, & Quaddus (2013)	Develops a comprehensive sustainable supply chain management framework in the context of RMG supply chain.
	Darnall, Henriques, & Sadorsky (2010)	Reveals that smaller firms are more responsive to value-chain, internal, and regulatory stakeholder pressures. It further highlights that the relationship between stakeholder pressures and environmental strategy tends to vary with size.
	Dewan, Biswas, Chowdhury, & Quaddus (2013)	Assesses an analytic hierarchy process integrated quality function deployment approach to show how to achieve sustainability of e-business.
	Kim & Ko (2010)	Distinguishes green IT leaders from green IT followers by considering the key financial and accounting variables and their relation to the pressure being applied by the stakeholder. Paper also uses resource based view as a theoretical frame.
	Kock, Santaló, & Diestre (2012)	Investigates the impact of corporate governance mechanisms on firm environmental performance. Paper highlights that board of directors, managerial incentives, the market for corporate control, and the legal and regulatory system determine firms' environmental performance levels.
	Lin, Yang, & Hsu (2013)	Applies topology of legitimacy to understand actors' strategies of green IS.
	Peloza (2009)	Investigates the relationship between corporate social performance and company financial performance.
Structuration theory	Grant & Appan (2014)	Scrutinizes the role of structuration theory in the routinization of green IS practices (GISP) that helps to achieve tangible and intangible organizational benefits.
Technology acceptance theory	Akman & Mishra (2015)	Analyzes the adoption of green IT among IT professionals in public and private sector. According to the results of the paper, the technology acceptance model supports green IT. The results also highlight the importance and the impact of external factors on green IT acceptance.
Technology organization environment	Alaraifi, Molla, & Deng (2011a)	Highlights that the sensor IS assimilation is influenced by sensor IS context, data center context, organization context, and environment context.
	Krishnadas & Pillai (2013)	Provides a green IT implementation model with strong theoretical foundation. Further, the paper uses theory of reasoned action and theory of planned behavior for theoretical positioning.
	Lei & Ngai (2013b)	Discusses green IT adoption.

Table D1. Theoretical Frameworks (Used) in Green IT Literature

	Simmonds & Bhattacherjee (2012)	Identifies factors that influence each stage of IT-based initiatives in an organization. This paper also uses IT implementation model as the theoretical basis.
	Zheng (2014)	Proposes a green IT/IS adoption model of the factors of business strategies (proactive strategy and reactive strategy) and three aspects (regulations, competitiveness & ecological responsibility) of green IT/IS motivations.
Theory of absorptive capacity	Cooper & Molla (2012)	Study of an IT organization's green IT capability.
	Cooper & Molla (2014)	Using the theory of absorptive capacity, paper introduces a model that explains why and how green IT practices, technologies, and values are embedded in IT, people, management, and infrastructure of organizations.
Theory of continuous improvement	Mann, Grant, & Mann (2009)	Proposes a three-step implementation process for green IT by using a positivist approach.
Theory of normative conduct	Loock, Landwehr, Staake, Fleisch, & Pentland (2012)	Highlights that reference groups that are close in terms of geographical proximity are more effective than more distant groups. This paper also includes Social learning theory and social identity theory.
Theory of operational and dynamic capabilities	Benitez-Amado, Llorens-Montes, & Fernandez-Perez (2013)	Highlights an organization's proficiency to manage talent support, sustainable operations strategy, and increase organizational performance.
	Zhang, Jiang, Yang, & Sun (2013)	Builds and empirically tests a research model that examines how emerging economy firms respond to green management pressures and what they gain from adopting green management practices. Further, the paper uses institutional theory together with the dynamic capabilities view.
Theory of organizational motivation	Molla & Abareshi (2011)	Identifies the motivations (influential factors) for adoption of green IT in organizations and empirically shows the factors affecting adoption of green IT.
	Molla & Abareshi (2012)	Investigates the motivational factors that influence green IT adoption by organizations.
Theory of planned behavior	Busse, El Khatib, Brandt, Kranz, & Kolbe (2013)	Investigates the effect of cultural factors on the adoption of eco-innovations. This paper also uses value belief norm theory.
	Kranz & Picot (2011)	Uses technology acceptance model and highlights that intention is influenced by secondary sources' influence and environmental concerns.
	Mancha, Muniz, & Yoder (2014)	Explores the decision making factors of green behavioral intentions. Also, examines preservation and utilization attitudes and behaviors in organizational settings.
	Pollard (2015)	Examines the beliefs and behaviors of IT users in green computing (TPB is an extension to the model of TRA).
	Zhang (2012)	Highlights how IT supports green consumption of an organization.
Theory of reasoned action	Chow & Chen (2009)	Examines the belief and behavior of IT users in green computing.
	Mishra, Akman, & Mishra (2014)	Investigates human behavior for the adoption of green IT.
Transaction cost theory	Nedbal, Wetzlinger, Auinger, & Wagner (2011)	Integrates outsourcing success.
Transition theory	Lauridsen & Jørgensen (2010)	Highlights the role of sustainable niche initiatives in electronics compared to multi-regime interaction.

About the Authors

Darshana Sedera has authored over 100 peer-reviewed publications on digital business transformation, enterprise systems, innovation management, technology use, outsourcing and social media. His work has been published in journals such as *Journal of the Association for Information Systems*, *Journal of Strategic Information Systems*, *Information and Management*, *Communications of the Association for Information Systems*, Journal *of Information Technology Theory and Application*, and *Australasian Journal of Information Systems*. His research has been funded by several Australian Research Council grants.

Sachithra Lokuge received her PhD from the Queensland University of Technology in Brisbane, Australia in 2015. She has several years of experience in working with outsourcing organizations as a business analyst. Her work has been published in journals such as *Information and Management*, the *Communications of the Association for Information Systems,* and *Journal of Information Technology Theory and Application*. She has also papers published in the International Conference on Information Systems, Americas Conference on Information Systems and Pacific Asia Conference on Information Systems.

Bonny Tushi received her masters by thesis from the Queensland University of Technology in Brisbane, Australia, in 2015. A publication derived from her Master's thesis on "An archival analysis of green information technology: The current state and future directions" has been published in Americas Conference on Information Systems.

Felix Ter Chian Tan is a lecturer of Information Systems, Technology and Management at the UNSW Business School, The University of New South Wales. His research interests include the development of digital platforms, Chinese IT management and practice, and enterprise systems and people in organizations. He is a member of the Digital Enablement Research Group, a research group based at UNSW Business School. His research work has been published in ranked academic journals and conferences including *Communications of the AIS, International Journal of Information Management, Australasian Journal of Information Systems, International Conference of Information Systems,* and *European Conference of Information Systems*.