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Sustainable Information Technology and Information System: A Systematic Literature Review, Taxonomy, and Agenda for Future Research

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A B S T R A C T

Sustainable Information Technology (IT) and Sustainable Information Systems (IS) were synonymous with Green IT-IS until recently the studies focused on sustainable IT-IS encompassing the interaction between economy, society, and environment. Here, is an attempt to understand the development in the emerging field of Sustainable IT-IS from Green IT-Green IS. The studies in the area of Sustainable IT-IS spare address diverse topics. This study attempts to provide a framework for the field of research and indicate potential research directions in the sustainable IT-IS domain. A detailed comparative analysis approach of 296 papers has been used to understand the progress of management research in Sustainable IT-IS vis-à-vis Green IT-IS. The review analyses the collated literature to understand the trends across the study period, development across various economies/ geographies, methodological approaches used, behavioral and theoretical aspects investigated, and finally, develop a taxonomy based on identified theses in the field of study. The study highlights that developed countries focus more on studies on the Sustainable IT-IS domain compared to other economies. It was evident that sustainable IS has received very limited focus. The study identifies 7 major themes and 29 subthemes forming the area of study during the evolution of Sustainable IT-IS through Green IT-IS. Subsequently, taxonomy was proposed to identify future research initiatives for investigation. The review comparing the evolution of research on managerial issues on Sustainable IT-IS vis-à-vis Green IT-IS is provided perhaps for the first time. The study provides an avenue for future research in the upcoming domain of Sustainable IT-IS.

Keywords: Sustainable IT-IS Taxonomy, Literature Review, Green IT, Green IS, Taxonomy, Comparative Analysis

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Ⅰ. Introduction

The challenges of climate change and social pressures have forced policymakers and researchers to shift their focus to a sustainable solution, in contrast to only green (environment) practices in the past few decades. This study views sustainability as a combination of society's economic, social, and environmental dimensions. Over years, sustainability was considered synonymous with the environment, which narrows the understanding of the concept. Sustainability encompasses the triple bottom line concept elucidating the interrelation of economic prosperity, society, and environmental performance. Technology plays a pivotal role in attaining the sustainability of any business.

Boudreau et al. (2008) identified the need for both Information systems (IS) and Information Technology (IT) to provide efficient and effective functioning of businesses. Mingay (2007) and Murugesan (2008) also indicated that Green IT-IS is a manifestation of the keen interest of an organization to sustain enterprise operations with environmental consideration. It intends to bring radical change in the operations of businesses resulting in a drastic reduction in operational costs, an increase in revenue growth, as well achievement of competitive advantage in the market (Melville et al., 2004). Despite the significant utility benefits of the digital revolution to mankind, there has been a concern raised about the ecological and societal impacts caused by IT and IS (Kumar and Kannegala, 2012).

Green IT closely refers more to the hardware and other infrastructure that can be better managed and designed from an environmental perspective (Sarkis and Zhu 2008). According to a study by Isberto (2018) around 17% of the total carbon footprint caused by technology is due to data centers. The electricity that is needed to run these data centers is close to 30 billion watts. These servers waste 90 percent of the energy they use because they run at full capacity all day long. Similarly, Green Information Systems (Green IS) are the improvement inflow, and management of information to support or enable environmental sustainability initiatives with indirect and positive impacts (Jenkins et al., 2011; Sarkis and Zhu, 2008). Subsequently, the impact of IT-IS on the other pillars of sustainability such as economic and social in addition to the environment also started gaining importance, leading to the emergence of sustainable IT-sustainable IS (or sustainable IT-IS). Sustainable IT-IS is considered an Information and Communication Technology (ICT) solution that not only consider the environmental aspect of ICT usage but also look at its economic and social benefits across process as well as practices within and beyond enterprises (Donnellan et al., 2011; Watson et al., 2010).

There have been several attempts in the past to understand various managerial challenges in the planning, execution, and monitoring phases of Green IT and Green IS. The reviews conducted on Green IT attempted to understand the following aspects: overlaps and differences between practitioner vs academic works of literature (Brooks et al., 2010); the importance of Green IT adoption (Lei and Ngai, 2013b); classify the antecedents based on technology – organization – environment theory (Deng and Ji, 2015); the concept from Green IT's business value, negative impacts of computing and IT as a tool for permeating environmental awareness (Nanath and Pillai, 2014); the phenomenon of Green IT as an administrative innovation (Zaman and Sedera, 2016) and implementation challenges in organizations (Asadi and Dahlan, 2017); Green IT practices as well as identifying factors during execution (Jailani and Abdullah, 2017). Several reviews have also been conducted on Green

IS intending to understand the role of Green IS innovation to enhance environmental sustainability (Melville, 2010); propose a practice-oriented Green IS framework (Butler, 2011); highlight the overlaps and the differences between the practitioner and academic kinds of literature (Brooks et al., 2012); understand the application of Green IS (Brauer et al., 2015), the scope of software management process (Anthony and Majid, 2016b) and role of decision support systems on Green IS research (Klör, 2016). Literature reviews over the years have also attempted to understand/compare both Green IT-IS in a study. Watson et al. (2010) reviewed energy informatics as a future research area. Jenkin et al. (2011) developed a multi-level research framework for Green IT-IS, whereas Loeser (2013) classifies the characteristics of Green IT vis-à-vis Green IS. Esfahani et al. (2015b) studied the literature on the adoption of Green IT and Green IS. The summary of the review papers is provided in <Table 1>.

However, reviews in recent years have started exploring the need for sustainable IT-IS in a business: the role of data centers in advancing sustainability (Santhanam and Keller, 2018), the use of IT for sustainable enterprise strategy (Anthony and Majid, 2016a), understand IT application on sustainable supply chain (Thöni and Tjoa, 2017), identify techniques to achieve sustainability and diffusing appropriate practices in the collaborative enterprise (Anthony et al., 2017). Brendel and Mandrella (2016) provides an overview of IS in the context of Sustainable Mobility Services. <Table 1> highlights the value addition that this study does to the body of knowledge in comparison to previous reviews on Green IT-IS and Sustainable IT-IS.

The present review captures the evolution of the sustainable IT-IS vis-à-vis Green IT-IS to identify potential gaps for future research and has the following objectives:

- Understand the progress of literature over the study period.
- Explore the relationship between the continent's economic development and its research contribution.
- Investigate the studies across the various level of analysis in the evolution of Green/Sustainable IT-IS.
- Identify the focus of various natures of studies across the level of analysis, behavioral aspects, methodologies used, and theoretical focus while moving from Green IT-IS to Sustainable IT-IS.
- Propose a taxonomy for sustainable IT-IS to categorize the managerial themes for future research.

Ⅱ. Review Methodology

The research papers considered for this study are confined to those published during the years 2008-2020 (May 2020) and only about the discussion on management perspective concerning Green IT-IS and/or Sustainable IT-IS. The papers are selected from international online databases such as Google Scholar, SCOPUS, and Science Direct. Keywords used for the search are primarily from the lens of sustainability like environmental and socially friendly technology, Green ICT, Green IT, Green IS, Sustainable ICT, environmentally friendly ICT, sustainable IS, Social aspects of IT/IS, Information and Communication Technologies, and Information Systems. Since the literature on this concept is comparatively scant, most of the journals and few premiere conference proceedings were considered. Studies concerning management aspects of Green and /or

<Table 1> Contribution of Present Literature Review Compared to Previous Reviews

Author (Year)	Context	Period of studies	GIT	GIS	Level			Taxonomy	Sustainable IT/IS	Trend	Methods used	Geographies
					(I)	(O)	(N)					
Brooks et al. (2010)	Practitioner and Academic Literature Difference	2007-2010	X			X				X		
Lei and Ngai (2013b)	Green IT Adoption	Not specified	X			X		X				
Nanath and Pillai (2014)	General	1990-2010	X			X				X		
Mogotlhwane (2014)	Carbon Emission	Not specified	X									
Deng and Ji (2015)	Green IT Adoption	Not specified	X			X						
Hadzovic (2015)	Policies	Not specified	X				X					
Zaman and Sedera (2016).	Administrative Innovation	2007-2015	X			X						
Asadi et al. (2017)	Organizational Research	2007-2016	X			X				X		
Harbla et al. (2017)	Green Computing Research	Not specified	X			X						
Jailani and Abdullah (2017)	Green IT Practice and Executional Factors	1992-2015	X			X						
Anthony et al. (2016a)	Sustainable Enterprise Strategy- Integration	2007-2016	X			X			X	X		
Santhanam and Keller (2018)	Role of Data Centres	2008-2015	X			X			X			
Berná et al. (2019)	Sustainable Technology Development	Not specified	X						X	X	X	X
Thoni and Tjoa (2017)	Sustainable Supply Chain Management	2008-2014	X			X					X	
Rabiah and Azizah (2018)	Applicability of Resource-Based Environmental Studies	1995-2015	X			X						
Butler (2011)	Practice-Oriented Green IS Framework	2009-2010		X		X						
Brooks et al. (2012)	Practitioner and Academic Literature Difference	2007-2010		X		X				X		

<Table 1> Contribution of Present Literature Review Compared to Previous Reviews (Cont.)

Author (Year)	Context	Period of studies	GIT	GIS	Level			Taxonomy	Sustainable IT/IS	Trend	Methods used	Geographies
					(I)	(O)	(N)					
Brauer et al. (2015)	Green IS Solutions	2011-2014		X								
Anthony (2016b)	Software Management	2007-2016		X		X						
Klör (2016)	Decision Support System	Not specified		X		X						
EIdrissi and Corbett (2016)	Theory-Based	2000-2015		X	X	X				X		
Brendel and Mandrella (2016)	Sustainable Mobility Services	2006-2016		X		X			X			
Dedrick (2010)	General	Not specified	X	X		X						
Watson et al. (2010)	Energy Informatics	Not specified	X	X		X						
Melville (2010)	Innovation for Environmental Sustainability	2000-2007	X	X	X							
Jenkin et al. (2011)	Framework-Based	2007-2009	X	X	X	X				X		
Loeser (2013)	Definition	2008-2012	X	X								
Esfahani et al. (2015a)	General	2007-2014	X	X	X	X				X		
Esfahani et al. (2015b)	Adoption	2007-2014	X	X	X	X				X		
Khor et al. (2017)	Green IT/IS and Sustainable Consumption.	Not specified	X	X		X						
Anthony et al. (2017)	Collaborative Enterprise	2007-2016	X	X		X						
Klimova (2017)	Knowledge Management Systems and Process	Not specified	X	X								
Present Study	Evolution of Sustainable IT-IS from Green IT-IS	2008-2020	X	X	X	X	X	X	X	X	X	X

Note: (i) GIT: Green Information Technology (ii) GIS: Green Information Systems (iii) I: individual (iv) O: Organisation (v) N: Nation
X: indicates that the review discusses aspects captured by the column

sustainable IT-IS are only considered. Whereas, those with a focus on computer sciences (like studies on algorithms for reducing energy consumption) and purely on engineering with no discussion on managerial perspectives were excluded. Research studies published in journals and conference proceedings in the English language only are considered for analysis. If a study post minor extension of reputed conference proceedings were subsequently published in a journal publication, then only the journal has been considered for the review process (this avoids duplication of the paper in our study sample). The studies on exclusively social, economic, and socio-economic aspects are excluded from the analysis as it does not capture aspects of Green and/or Sustainable practices. The detailed filtering process used in identifying the selected 296 papers for this review is highlighted in <Table 2>.

<Appendix A> presents the list of Journals and Conference proceedings from which the selected papers were identified. The journal section was further divided into the journals with a focus on Information Technology and Systems exclusively, and the others. To highlight the significance/relevance and impact of the Journals to practitioners/researchers the quality assessment of the journals was done using ABDC and SCImago ranking-2016. It is observed that MIS Quarterly, Journal of Strategic Information Systems, Information Systems Journal, Australasian Journal of Information Systems, Communications of the

<Table 2> Filtering Process of Literature for This Study

Step	Particulars	#No. of papers
Stage1: Keywords used for the Study	*String:* primary keyword AND secondary keyword *Primary keywords:* Green ICT, Green IT, Green IS, Environmental friendly ICT, Sustainable IS, and Sustainable IT *Secondary keywords:* Information and Communication Technologies, Information Systems, Information Technology *Search Databases:* Google Scholar, SCOPUS, and Science Direct *Search space:* Title OR Abstract OR Keywords *Time filter:* Published in the years 2008 – 2020	2342
Stage2: Filtering Stage1 (Abstract /title)	*Inclusion criteria:* Management studies about Green or Sustainable ICT (IT/IS) *Exclusion criteria:* Redundant records, Magazines, Working papers, Market reports, Company/Industry reports, Editorials, and News reports Articles not written in English and studies on computer science and engineering	532
Stage3: Filtering Stage 2 (Article content)	*Inclusion criteria:* Articles need to be related to managerial aspects of Green and/or Sustainable IT-IS. *Exclusion criteria:* Management studies only economic, social and socioeconomic Technical studies on energy informatics, green computing, and other energy reduction mechanisms	356
Stage4: Final Selection	Inclusion criteria: Articles must be present in academic/ scholarly journals or reputed conference proceedings	296 GreenIT-IS 266 Sustainable IT-IS 30

Association for Information Systems, and Information Systems Frontiers are some of the Journals which have encouraged a higher number of studies in Green and/or Sustainable IT-IS domain. Whereas, American Conference on Information Systems, Pacific Conference on Information Systems and European Conference on Information Systems were preferred conferences. Still, there is an increased need for other leading Journals in the IT/IS domain to encourage research studies to understand managerial issues/challenges on sustainable IT-IS to meet.

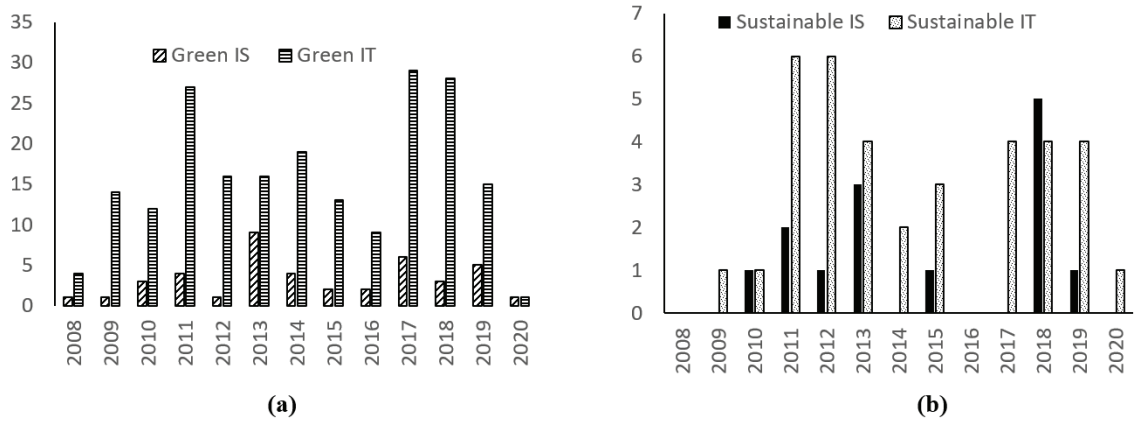
Ⅲ. Content Analysis

A detailed content analysis methodology as suggested by Seuring and Gold (2012) has been used in this study to understand the extent of maturity of literature and practice in the Sustainable IT-IS vis-à-vis Green IT-IS. Using an inductive approach each study has been coded and classified under various identified themes. The coding and classification procedure were iterative. The classification has been done by exploring the articles for commonalities repeatedly until no more themes/issues emerge. The points of differences in the coding of a paper between authors were resolved through discussion. This improved inter-rater reliability concerning coding and classification.

3.1. Progress of Research Across Study Period

The 21st century has seen an increase in acceptance of IT and IS applications by individual and corporate customers facilitating them through the improved speed of decision-making and efficient operations. This increased acceptance could also have led to additional new complexities in a business environment including customers (users), employers as well as other stakeholders (direct/indirect) behaviors. The growth in the IT and IS industry has increased the consumption of lead, plastics, mercury, etc. which are having a significant effect on the environment. The larger the impact on the environment, the need to study emerging issues/challenges of Green and sustainable IT-IS becomes imperative. Hence, practitioners and researchers have to make increased efforts to understand the emerging issues and improve the performance as well as the success rate of the growing IT and IS industry in a future digital economy. <Figure 1> illustrates the trend of studies in Green and Sustainable IT-IS across the period. It can be seen that sustainable IT-IS studies are relatively limited in the study period.

It is observed that 83.33% of studies are on Green IT and/or Green IS, where the academia and practitioners have concentrated on understanding avenues to significantly make the IT domain environmentally friendly. Processes like cloud computing, virtualization, and data center centralization were studied in Green IT over the years. This trend indicates the use of Green IT practices which can lay the ground for the higher success of Green IS. On reviewing the literature, it was found that relatively very few works have been done on Green IS which involves understanding aspects of the people and process involved (Molla and Zarnekow, 2017; Nanathand Pillai 2017). Whereas, studies on sustainable IT-IS have explored topics on regulations (Curry et al., 2018) and the development of these technologies (Martins and Grilo, 2017). However, with the Industry Revolution 4.0 (IR 4.0) commencing in the year 2013 (Martin, 2017), IT and IS are gradually adapting to newer and effective greener technologies (Zhu et al., 2015), and contributing to Sustainable IT-IS to literature is expected to rise in near future with more



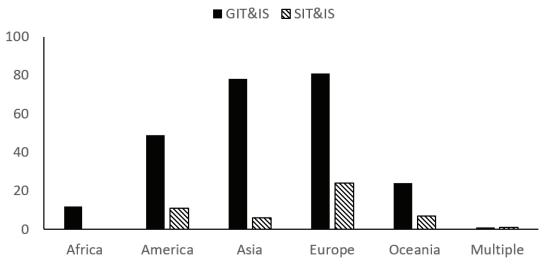
<Figure 1> Research Published on Green IT-IS and Sustainable IT-IS over the years

emphasis on various challenges posed by transformational digital technologies. European Commission in the year 2015 started the international Horizon-2020 research project CREMA (Providing Cloud-based Rapid Elastic Manufacturing based on the XaaS and Cloud model) as a major initiative to foster Industry 4.0. Hence, researchers should attempt to understand the influence of disruptive technologies such as the Internet of Things, Blockchain, Internet of Things (IoT), and Industrial Internet of Things (IIoT) on the business environment in the future. It could be seen that there is a consistent rise in the studies with a focus on the area of sustainable IT in the past decade. It was also observed that Sustainable Information System papers seem to grab the attention of practitioners (higher participation/studies in conferences) as it culminates the ideas of economic, social, and environment with people, process, and technology (Hertel and Wiesent, 2013) which are more attuned to needs for a practitioner. With the introduction of disruptive technologies in the industry, any effort by future researchers on the aspects of sustainability could make an appreciative contribution to this field.

3.2. Economic Development of the Continent and its Impact on Research Contribution

To understand the effect of economic growth of a region vis-a-vis the adoption of Green and sustainable practices in the IT and IS domain, the collated literature was segregated based on the continents in which the study was carried out. If the paper does not indicate the geographical area then the continents to which the authors belong have been assumed as the geographical location. Papers from South America and North America have been clubbed under America. It can be seen in <Figure 2> that most of the studies on Green IT-IS have been done in Europe followed closely by Asia. However, most studies on Sustainable IT-IS have been conducted in Europe followed by America.

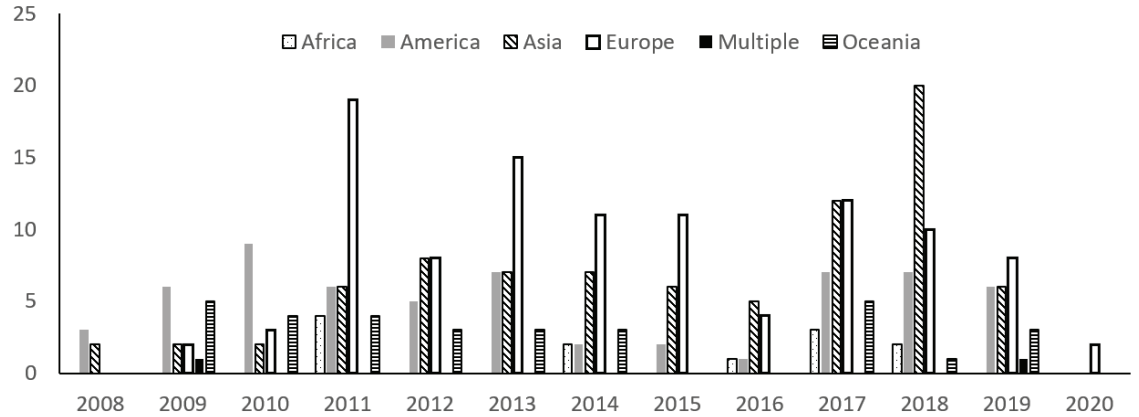
To better understand the growth of literature in the study period) across the themes (Green IT-IS vs Sustainable IT-IS) and continents, <Figure 2> has been expanded in <Figure 3>. It could be seen that there is a significant increase in studies in Europe post regulatory implementations of WEEE directive 2012/19/EU (Effective from 14 February 2014). This regulation requires companies to strictly follow and



<Figure 2> Studies in Different Economies of the World in Green IT-IS (GIT&IS) and Sustainable IT-IS (SIT&IS)

reduce pollution/waste/ natural resource consumption (in any form) with a positive impact on environmental improvement. This regulation also considers pollution by the IT sector which is heavily dependent on electrical and electronic items driven by power. Hence, most of the study concentrates on Green IT (Hardin-Ramanan, Chang and Issa, 2018). The Asian region also has seen significant growth in studies post-2018. Approximately 78% of electronic circuit components are exported by Asian countries (Workman, 2018) making researchers focus on this region to reflect on insights from the sourcing for the IT industry across the world. Asian countries (like China, and Japan) adopting IT/IS services significantly contribute to the increased concentration of studies. Some of the countries in Asia are recognized globally as the software development and support service hub of the world i.e., developing software and other types of information systems to improve efficiency in developed countries like America and Europe.

It can be seen that matured economies of Europe, Asia (especially China and Japan), and America invest more in environmentally conscious or sustainable initiatives compared to other developing economies. There is a lack of study on an underdeveloped economy. In the global economy, where collaborations and works happen across multiple geographies, especially in the IT and Systems industry, future studies must concentrate on Sustainable IT-IS issues across geographic boundaries (represented under 'Multiple' in <Figure 2> and <Figure 3>) within cultural, demographic, team management, political policy preferences, process, etc. An increasing trend (although not significant) has been observed in this area during the study period. There is a growing need for such studies especially in Asian Countries as more than 50% of the global population stays in these counties with a high level of pollution.

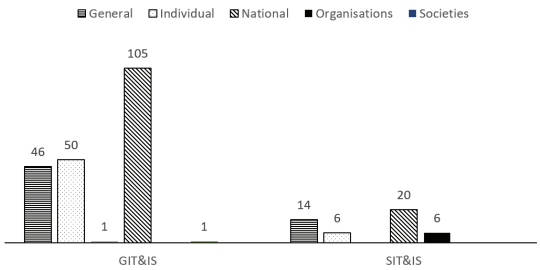


<Figure 3> Evolution of Studies (Green IT-IS & Sustainable IT-IS) in Different Geographical Contexts

3.3. Level of Analysis Conducted for Green IT-IS and Sustainable IT-IS domain

This section examines different levels of analysis in terms of the scale of sample space (i.e. general, individual, organizational, societies, and national) considered in the Green IT-IS and sustainable IT-IS literature. Studies on the individual's belief, attitude, awareness, etc come under the category of individual level of analysis (e.g. Pollard, 2015). On the other hand, studies relating to the adoption, diffusion, compliance, etc. in an organization are considered as organization level of analysis (e.g. Chen et al., 2011). Studies on protocols, and participation of citizens confined to a particular community or society (e.g. Steenhof et al., 2012). Lastly, studies concerning the policy formulation or challenges that occurred for the adoption and implementation of strategies/policies in a nation, on the whole, are considered at the national level of analysis (e.g. Lee et al., 2013). The general level of analysis is papers that covered the concepts of the domain and did not specify or restrict to a particular level of analysis (e.g. Butler (2017).

<Figure 4> illustrates the level of analysis considered in the Green IT-IS and sustainable IT-IS literature. It can be seen that significant studies have been done exploring various aspects of information technology as well as information systems at the national level, thus providing directions and policy frameworks for society, organizations, and individuals to build a healthy ecosystem for the adoption of Sustainable IT-IS. It can be seen that further studies at the societal, organizational, and individual levels need to be conducted so that national-level policies could be executed. It can also be observed the lack of involvement on the societal level till now which challenges the achievement of sustainable IT-IS objectives. National-level studies conducted on Green IT-IS could also be extended to include societal involvement in achieving sustainability goals.



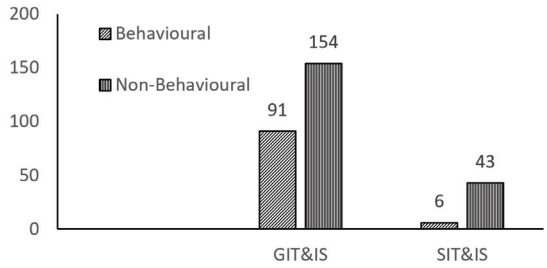
<Figure 4> Level of Analysis in Green IT-IS (GIT&IS) and Sustainable IT-IS (SIT&IS) Studies

3.4. Nature of Studies on Green IT-IS and Sustainable IT-IS

This section makes a conscious attempt to understand the various categories of nature of studies conducted in developing the body of knowledge on the Green IT-IS Domain. It compares the literature development across the study period on the following themes: Behavioural vs Non-Behavioural; Methodologies used in literacy development in the field across the study period, and various theoretical perspectives used while understanding the study areas.

3.4.1. Emphasis on Behavioral Studies in Green IT-IS and Sustainable IT-IS

The literature considered for the study was classified under two lenses namely: Behavioural and Non-Behavioural <Figure 5>. Behavioral studies focus on the behavioral (cultural, team, etc.) and the interrelationship between stakeholders involved in individual, organizational as well as supply chain relationships. Whereas, Non-behavioural studies focus on the issues concerned with the management



<Figure 5> Behavioural Studies on Green IT-IS (GIT&IS) and Sustainable IT-IS (SIT&IS)

of assets/information/ knowledge that may be material, financial or technological, hence mainly looking at the materialistic benefits of adopting the technology. It is observed that close to 67% of the total identified studies were addressing non-behavioral issues which are quite obvious as such issues are more visible and tangible for practitioners as well as researchers. Both Sustainable IT-IS and Green IT-IS desired benefits will be obtained with an enhanced emphasis on understanding the impact of behavioral issues in these domains during various stages of the life cycle. The focus on behavioral issues in Sustainable IT-IS is very scant and any contribution along these lines would enable the growth of literature in the domain.

3.4.2 Prominent Theories used in Green IT-IS and Sustainable IT-IS Studies

According to Haveman et al. (2019), "Theory guides us to what question to ask and tells us why they are important with logic as well as reasoning". Hence, knowledge of the prominent theories used in a field would enable researchers to focus on the area of investigation. <Table 3> lists the prominent theories in the research area Green IT-IS and Sustainable IT-IS. Although the potential use of a large number of theoretical views has been explored in Green IT-IS studies prominent among them were Institutional theory, Green theory, absorptive capacity theory, and Theory of planned behaviors. In contrast, very few theoretical lenses have been used during the research of sustainable IT-IS, hence, raises lots of scope for future research in many of the other relevant theories.

Ⅳ. Taxonomies for Sustainable IT-IS based on Green IT-IS Literature

Nickerson et al. (2013) compared the literature of various disciplines and proposed a method for taxonomy development. The applicability of the taxonomy was demonstrated in the literature on IS. The present study proposes an extension of Nickerson et al. (2013) taxonomy to the field of sustainable IT-IS through Green IT-IS. Basing the literature classification using the theoretical underpinning of the technological development process of Caetano et al. (2011), which consists of six distinct stages (invention, project scope, technology concept development, technology development, technology optimization, and technology transfer) that begin with a concept and end with a technology that is ready to be integrated into the development of a product, service, or process. Based on internal competencies at each of these six levels, market and technological trends can be used by the organization to realize the distinct stages. Taking cues from the technology development process and adapting to the Sustainable IT-IS vis-à-vis Green IT-IS, 7 stages are considered the need for technology transformation (NTT) forming the invention stage, Framework Development (FD) synonymous to the project scope stage, Initiating Transformation (IT) identical to technology concept development, Adoption and Technology Development Cycle (TDC)

<Table 3> Prominent Theories used in Green IT-IS and Sustainable IT-IS studies

Prominent Theories used in Green IT-IS			
Theories	Number of Papers	Theories	Number of papers
Institutional Theory	9	Eco-Innovation Theory	1
Green Theory	5	Elaboration Likelihood Model	1
Absorptive Capacity Theory	4	Green IT Readiness Framework	1
Theory of Planned Behaviour	4	Green IT Framework	1
Natural Resource-Based View Theory	3	Theory of Reasoned Action	1
Resource-Based View	3	Motivation Theory	1
Belief – Action – Outcome (BAO) Framework	2	Norm Activation Theory	1
Maturity Model	2	Self-Determination Theory	1
Stakeholder Theory	2	Structuration Theory	1
Technology Acceptance Model	2	Theory of Organizational Motivation	1
Technology-Organization-Environment Framework	2	Theory of Practice	1
Contextual Theory	1	Upper Echelon Theory	1
Diffusion of Innovation	1	Value Model	1
Duality Theory	1	World Systems Theory	1
Prominent Theories used in Sustainable IT-IS studies			
Theories	Number of Papers	Theories	Number of Papers
Absorptive Capacity Theory	1	SICT-Capability Maturity Framework	1
Actor-Network Theory	1	Social Exchange Theory	1
Belief – Action – Outcome (BAO) Framework	1	Sustainability Assessment Framework	1
Energy Informatics Framework	1	Technology-Organization-Environment Framework	1
Institutional Theory	1	Transaction Cost Theory	1
Resource-Based View	1	Transition Theory	1

forms the technology development stage, Evaluation identified as technology optimization and lastly the Governance to technology transfer stages.

<Table 4> presents 7 stages and 29 subthemes that could be identified after analyzing the sample literature on Sustainable IT-IS (including the transition from Green IT-IS). Finalization of the identified 7 stages and 29 subthemes over the study period (refer to <Figure 6> and <Table 4>) was carried out using the two-step process: Initially, individual authors coded each of the manuscripts on a subtheme (issues) being discussed in each sample literature, subsequently, they discussed among themselves and after several iterations reach the identified themes and sub-themes.

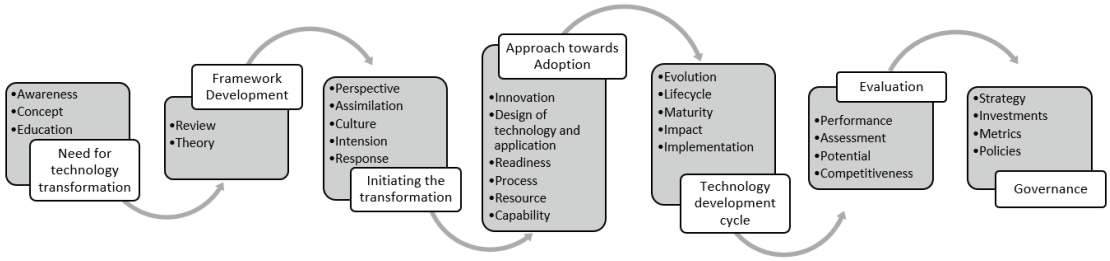
While the 7 stages of sustainable IT-IS are detailed as some of the interesting propositions provided from the view of the literature review in comparison with the Green IT-IS and Sustainable IT-IS taxonomies created in <Figures 7> and <Figure 8> respectively.

<Table 4> Themes and Sub-Themes

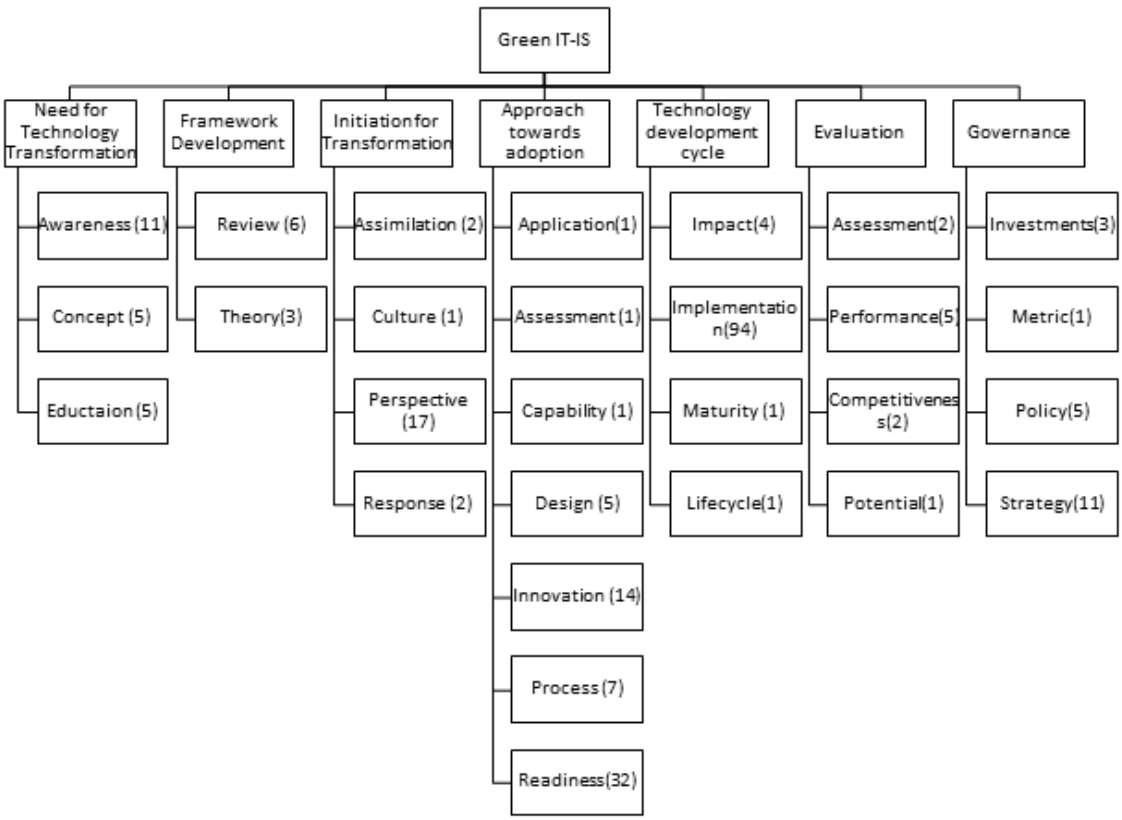
Major Themes	Sub-Themes	Definition
Need for Technology Transformation (NTT)	Awareness	Perception of a situation
	Concept	Ideas and notions regarding the technology
	Education	Educating the target on the technology
Framework Development (FD)	Review	Understand the development of models of technology and critical point of view during the growth of technology
	Theory	Frame principles for the use of technology
Initiating the Transformation (IT)	Perspective	Point of view of the usage of technology with purpose/value
	Assimilation	The process of taking in and fully understanding the usage of technology
	Culture	The behavior of people toward the use of technology
	Intension	The specific purpose of usage of technology
	Response	Stakeholder reaction to the use of technology
Approach towards Adoption	Innovation	Practicing, developing, and innovating new parts to the technology for usage
	Design of Technology and Application	Develop a blueprint of the technology and its application
	Readiness	Check full preparedness to utilize the technology including its acceptance and integration
	Process	Plan a series of actions/activities in the process (including technology consumption) that are taken while utilizing technology
	Resource	Managing inputs necessary for the usage of the technology
	Capability	Individual's capability of using technology
Technology Development Cycle (TDC)	Evolution	Growth of technology
	Lifecycle	The entire cradle-to-grave process of using the technology
	Maturity	The termination of growth utilizing the technology
	Impact	a marked effect of technology
	Implementation	Plan into effect of using technology in application /use
Evaluation	Performance	Fulfillment of the tasks utilizing technology
	Assessment	The evaluation of technology for assessment (including its feasibility)
	Potential	Capacity to develop something better
	Competitiveness	Technology that is better than the traditional ones
Governance	Strategy	Plan of action for sustained usage of technology
	Investments	Financial support for utilizing the technology
	Metrics	Development of the standard of measurement for assessing the technology
	Policies	Rules of technology and principles of action

4.1. Need for Technology Transformation (NTT)

The first stage of any technology transformation is to check for the need and feasibility of the technol-

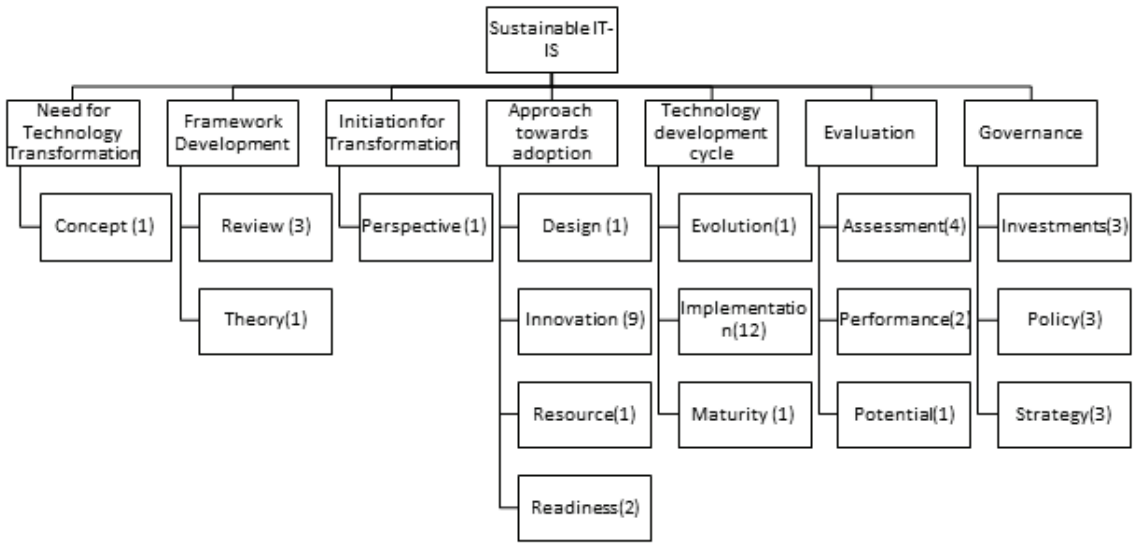


<Figure 6> Classification of Literature in Sustainable IT-IS vis-à-vis Green IT-IS



<Figure 7> Green IT-IS Taxonomy from literature

ogy itself. To understand and appreciate the need for Sustainable IT-IS by identifying the voice of technology (basic and applied research), identifying the voice of the consumer (market research), defining the enterprise's strategic planning; determining the technology strategy, and generating ideas; The studies in Green IT-IS have explored the extent of need through awareness, education and developing concepts in behavioral and non-behavioral aspects. But for sustainable IT-IS these concepts seems to be unex-



<Figure 8> Sustainable IT-IS Taxonomy from literature

plored and thereby the following proposition is made

Proposition 1: Insightful studies on the need for technology transformation have a better scope in this research domain. Primarily to focus on unexplored dimensions of Sustainable IT-IS such as building awareness, and developing concepts in the area. Moreover, research is required to provide a unanimous definition of Sustainable IT-IS for the area to progress. The studies could either be Behavioural/Non-Behavioural and can follow any of the stages of Literature development such as conceptual, empirical, case studies, or models.

4.2. Framework Development (FD)

Once the need for technology transformation is identified, the definition of the technology's scope, the mapping of future goals, the conduct of literature searches, the patent searches, and the identification of prospects. The frameworks, theory, and associated concepts require clarity and that can be represented as the second stage of progress in a research area. In comparison with Green IT-IS, sustainable IS-IT is yet to develop reviews and theories, and thereby the following proposition

Proposition 2: To build the foundation of Sustainable IT-IS stronger, the area has to have more contributions to developing frameworks in terms of theory building and review. This would enable better clarity of concepts helping a systematic understanding of the area.

4.3. Initiating the transformation (IT)

Stage three of a field is to begin the initiation of technology transformation after investigating the need for technology transformation and developing frameworks. Here, defining the features of the new technology, identifying the impact of technology on the company, identifying the potential of the idea under specific conditions through preliminary experiments, identifying the necessary resources and solutions to the gaps identified, designing product platforms, tech-

nology needs, conducting benchmarking of existing technology, developing a network of partners. In this stage, perceptions, assimilation, culture, initiation, and response of the individuals, society, organization, or even the nation at large are to be identified before rolling out the technology. Primarily to understand the attitude of the end users. In Green IT-IS literature, a large number of studies have explored this stage of literature, however, the case is not the same in Sustainable IT-IS. Thereby the following proposition.

Proposition 3: To study the initiation of sustainable IT-IS in terms of perception, assimilation, culture, intent, and reaction a behavioral study is essential to discover additional characteristics in this field for the advantage of healthier ecosystems and to develop valuable policies. A comparison of the initiation of transformation from the behavioral aspects across countries from a global perspective would provide interesting insights.

4.4. Approach toward Adoption

Stage four of the development process is the adoption stage where determining commercially viable products and processes, breaking down system functions into smaller components, specifying system architecture, using mathematical models to express the ideal function of technology, developing and testing prototypes, and determining the potential market impact of these possibilities, get ready to put the business case into practice, and identify and assess critical parameters becomes vital. In the literature on Green IT-IS, there has been a lot of work on the ways to adoption, which begins as the fourth stage to acceptance of technology. Studies are using an empirical or a case methodology, and studies in sustainable IT-IS are comparatively scarce. Thereby future studies in this area can address these topics. Thereby the following proposition:

Proposition 4: To study the approaches taken towards sustainable IT-IS adoption could either be through innovation, design of new technology and its application, readiness, process, and capabilities. It becomes vital to study the approaches toward the adoption of sustainable technology to develop learnings and models for effective and productive outcomes.

4.5. Technology development cycle (TDC)

After the adoption phase, the technology tends to develop and get stabilized over time. This phase is named as technology development cycle. Technology development can be viewed as a process meant to outline or clarify in depth or steps, figure out the potential for, acquire, or cause to develop progressively, knowledge in a certain area, including its practical application. It is also possible to think of maturity as a measure of how developed technology is (just like with anything else) since development can also be related to the idea of maturation and to be mature implies a condition of full development. While studies in Green IT-IS have explored this phase in literature, studies in Sustainable IT-IS are relatively lower and thereby the following proposition:

Proposition 5: To study the inclusive progress of sustainable IT-IS research areas in terms of evolution, lifecycle, maturity, and impact, a longitudinal study is essential to discover deeper aspects in this field for the benefit of sustainable development at the societal, national, or organizational level.

4.6. Evaluation

The sixth stage attempts to assess and evaluate the technology and the products, when the technology gets matured it tends to be assessed for performance,

potential, and capabilities this forms the sixth stage. The development of platform subsystems, analysis of elements that may lead to platforms, implementation, and optimization of experiments, and data analysis from experiments become pivotal at this stage. The research area in Green IT-IS and Sustainable IT-IS have seen seldom contributions in this stage and thereby the following proposition:

Proposition 6: To measure Sustainable IT-IS adoption and implementation, it is important to assess the Sustainable IT-IS applications, practices, and processes thereby studies that emphasize the assessment can ensure better adoption of Sustainable IT-IS.

4.7. Governance

After the technology is assessed for its benefits, the next stage of developing guidelines, measures, and policies for sustained utilization of the technology is attained. In this stage, the technology is administered appropriately. The practice of exercising political, economic, and administrative control over the creation, adoption, and use of technology in communities is known as technology governance. It can be operationalized through physical and virtual architectures that control risks and rewards, as well as norms (such as rules, standards, and customs). Technology governance covers not only the operations of businesses, civil society organizations, and professional communities but also those of the official government. In the broadest sense, it encompasses all of the various ways that people and organizations influence technology, as well as the various ways that technology influences social order. The studies in Green IT-IS have seen some contributions but relatively very less in Sustainable IT-IS thereby the following proposition:

Proposition 7: Towards ensuring Sustainable IT-IS is being effectively implemented and practiced, it is vital to understand and develop policies, measures, practice guidelines, investments, and strategies for effective implementation of technology across individuals, organizations, and nations.

<Appendix B> provides a taxonomy classifying the literature in the study period from the perspective of behavioral/nonbehavioral, methodologies used to understand various themes with subthemes for the progress of Green IT-IS to Sustainable IT-IS. This taxonomy could be used to guide future researchers to identify gaps (leading to research questions) on various themes and subthemes, which could be explored with appropriate methodologies from a behavioral/nonbehavioral perspective in enhancing sustainable IT-IS practices. Such new studies could suggest successful policies to improve the sustainable performance of the IT-IS industry.

Ⅴ. Conclusion

Increasing global emphasis to reduce the negative environmental impact of various industries across all economies have led many researchers and practitioners to study various aspects of *greening a business. Most of the modern industries in the global world depend heavily on Information systems and Information technologies, hence research has also been initiated in Green IT-IS in the past decade. However, the studies from Green IT-IS have transcended a new set of research domains named Sustainable IT-IS domain, these studies emphasize the impact on industries and firms on the third pillar of social (society), in addition to conventional economic and environment. Hence, perhaps for the first time, a comprehensive systematic literature review on managerial issues using a detailed content analysis

approach has been carried out. The study attempts to understand the evolution of the field of sustainable IT-IS from Green IT-IS. An attempt is made to understand the development of the literature across time series, geographies/ economies, managerial issues, theoretical perspectives explored, etc.

The present study is apt at this juncture to direct the flow of future research in the domain of sustainable IT-IS. Study on Sustainable IT-IS has been steadily increasing over the years but have not yet received the much-needed emphasis. Most of these studies are observed to be in matured economies, thus providing more future opportunities to expand studies to other economies for a successful global business where supply/customers would also be in the developing or/and underdeveloped economies. This further highlights the need for sustainable IT-IS. For an organization to succeed in the age of IT/IS, studies across management disciplines on both behavioral as well as non-behavioral issues should be encouraged to fulfill the overall objectives of Sustainable IT-IS and subsequent sustainability goals. Finally, various themes and subthemes have been identified from the collated literature influencing the development of Sustainable IT-IS from Green IT-IS. This was further extended to proposing taxonomy, where the classification is based on behavioral aspects across methodology, themes, and sub-themes. This taxonomy could guide in identifying future research direction while comparing present studies on sustainable IT-IS with Green IT-IS.

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<Appendix A>

Journals/ Conference Publishing Issues from 2008-2020			
Sl. No.	Green Information Technology and Systems (IT & S) Focus Journals	No. of Papers	Ranking #
1	Journal of Strategic Information Systems	5	A*
2	MISQ	4	A*
3	Information Systems Journal	3	A*
4	International Journal of Information Management (2); Information & Management (2)	4	A*
5	Research Policy (1); Journal of Management Studies (1); Journal of Management Information Systems (1); Information and Organization (1); Decision Support Systems (1)	5	A*
6	Journal of Cleaner Production	10	A
7	Australasian Journal of Information Systems	5	A
8	Technological Forecasting & Social Change (3); Communications of the Association for Information Systems (3); Information Systems Frontiers (3)	9	A
9*	Computers in Human Behaviour (2); Journal of Business Ethics (2); Journal of Enterprise Information Management (2); Information Technology & People (2); Journal of Computer Information Systems (2)	10	A
10	Business and Society (1); Ecological Economics (1); Industrial Management & Data Systems (1); Information and Software Technology (1); MIS Quarterly Executive (1)	5	A
11	Information Processing and Management (1); Information Systems Management (1); Information Technology & Tourism (1); Journal of Systems and Information Technology (1); Telecommunications Policy (1); Benchmarking: An International Journal (1); Information Technology for Development (1); International Journal of Accounting and Information Management (1); Management Decision (1); Social Responsibility Journal (1)	10	B
12	Computer	9	C
13	Telematics and Informatics	3	C
14	Global Business Review (1); International Journal of e-Business Management (1); Journal of Cases on Information Technology (1); Management Research Review (1); World Review of Science, Technology and Sustainable Development (1)	5	C
15	IT Professional	9	N/A
16	Computer Standards & Interfaces (3); IFAC Papers Online (3); Sustainable Computing: Informatics and Systems (3)	9	N/A
17	Electronic Journal of Information Systems Evaluation (2); IEEE Software (2); Journal of Information, Communication and Ethics in Society (2); Journal of Soft Computing and Decision Support Systems (2); Sustainability (2); International Journal of Social Ecology and Sustainable Development (2)	12	N/A
18	Advances in energy research(1); China: An International Journal(1); Communications & Strategies(1); Communications of the IIMA(1); Computer Communications(1); Energy Procedia(1); Environmental Impact Assessment Review(1); Environmental Modelling and Software(1); Future Generation Computer Systems(1); GSTF International Journal on Education(1); IEEE Communications Magazine(1); IEEE Internet Computing(1); IEEE/ACM International Symposium on Cluster Computing and the Grid(1); IET Software(1); IJCSI International Journal of Computer Science(1); Infosecurity(1); International Journal Communication Networks and Distributed Systems(1); International Journal in Foundations of Computer Science & Technology(1); International Journal of Advanced Computer Research(1); International Journal	43	N/A

<Appendix A> (Cont.)

Journals/ Conference Publishing Issues from 2008-2020			
Sl. No.	Green Information Technology and Systems (IT & S) Focus Journals	No. of Papers	Ranking #
	of Advanced Research in Computer Science and Software Engineering(1); International Journal of Emerging Research in Management &Technology(1); International Journal of Information Technology & Management(1); International Journal of Management, Accounting and Economics(1); International Journal of Supply Chain Management(1); International Journal of Sustainability Education(1); International Journal of Technology Management & Sustainable Development(1); International Journal Production Economics(1); ITALICS: Innovations in Teaching & Learning in Information & Computer Sciences(1); Journal Economics of Innovation and New Technology(1); Journal of ASIAN Behavioural Studies(1); Journal of Green Engineering(1); Journal of Information Science and Technology(1); Journal of Public Policy & Environmental Management(1); Journal of Strategic Innovation & Sustainability(1); Journal of Supercomputing(1); Journal of Theoretical and Applied Information Technology(1); Optical Switching and Networking(1); Procedia - Social and Behavioral Sciences(1); Procedia Computer Science(1); Quality - Access to Success(1); RAE: Revista de Administração de Empresas(1); Renewable and Sustainable Energy Reviews(1); Technology for Smart Futures(1)		
	TOTAL	160	
Sl. No.	Sustainable Information Technology and Systems (IT & S) Focus Journals	No. of Papers	Ranking #
1	MIS Quarterly	3	A*
2	Journal of Strategic Information Systems (2); MISQ (2)	4	A*
3	Quality - Access to Success (1); Research Policy (1);	2	A*
4	Information Systems Frontiers	2	A
5	Australasian Journal of Information Systems (1); International Journal of Accounting Information Systems (1); Journal of Business Ethics (1);	3	A
6	Journal of Documentation	1	B
7	European Journal of Innovation Management (1); Foresight (1); Sustainable Development (1)	3	C
8	IT Professional (2); Sustainable Computing: Informatics and Systems (2); Journal of Information, Communication and Ethics in Society (2);	6	N/A
9	Agricultural Informatics (1); Computer Networks (1); Computer Standards & Interfaces (1); Environmental Science and Pollution Research volume (1); IEEE Transactions on Industrial Electronics (1); Journal of Digital Imaging(1)	6	N/A
	TOTAL	30	
Sl. No	Conferences with most Publications (Details in the Reference Section)		No. of Papers
1	Pacific Conference on Information Systems		23
2	American Conference on Information Systems		20
3	European Conference on Information Systems		13
4	Australasian Conference on Information Systems		4
5	International Conference on Information Systems		4

<Appendix A> (Cont.)

Sl. No	Conferences with most Publications (Details in the Reference Section)	No. of Papers
6	ICT for Sustainability	2
7	IEEE Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON)	2
8	IEEE/ACM International Conference on Green Communications and Computing	2
9	International Conference & Expo on Emerging Technologies for a Smarter World (CEWIT)	2
10	International Symposium on Applied Sciences in Biomedical and Communication Technologies	2
11	ACM/IEEE workshop on Autonomic computing in economics(1); ACM SIGUCCS fall conference: communication and collaboration(1); Design, Automation & Test in Europe, Design, Automation & Test in Europe Conference & Exhibition(1); Electronics Goes Green 2012(1); Fourth Asia-Pacific Symposium on Internetware(1); IEEE 33rd International Telecommunications Energy Conference (INTELEC)(1); IEEE International Conference in MOOC, Innovation and Technology in Education(1); IEEE International Conference on Dependable Systems, Services and Technologies (DESSERT)(1); IEEE International Conference on Industrial Engineering and Engineering Management(1); International Association for Management of Technology Conference(1); International Conference on Advanced Information Networking and Applications Workshops(1); International Conference on Computer Science and Information Technologies(1); International Conference on Computing and Convergence Technology (1); International Conference on Computing, Communication and Security (ICCCS)(1);International Conference on Contemporary Computing and Informatics (IC3I)(1);International Conference on Green Technologies (ICGT)(1);International Conference on ICT Convergence (ICTC)(1);International Conference on Informatics, Electronics and Vision(1); International Conference on Information and Communication Technology for The Muslim World(1); International Conference on Information Management and Processing (ICIMP)(1); International Conference on Information, Communication and Automation Technologies(1); International Conference on Orange Technologies (ICOT)(1); International Conference on Quality in Research (QiR)(1); International Conference on Sustainable Energy Information Technology(1); International Conference on Transparent Optical Networks (ICTON)(1); International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO)(1); International Journal of Digital Information and Wireless Communications(1); International Workshop on Green and Sustainable Software(1); IST-Africa Conference Proceedings(1); SIGMIS Conference on Computers and People Research(1); Southern African Institute for Computer Scientist and Information Technologists Annual Conference(1); Vision 2020: Innovation, Development Sustainability, and Economic Growth(1)	32
	TOTAL	106

<Appendix B>

Green IT Taxonomy Based on Methodology and Issues from Major Themes				
Behavioural/ Non-behavioural	Stage of Literature Development	Major Themes	Sub-Themes	References
Behavioural (71)	Conceptual (20)	Need for Technology Transformation	Awareness (2)	Chou and Chou (2016); Pattinson (2017)
			Education (1)	Ravesteijn, Boekman, Plessius, Henk & lid lectoraat (2013)
		Initiating the Transformation	Perspective (2)	Corbett (2010); Din (2018)
		Approach towards Adoption	Readiness (5)	Bose, Luo and Robert (2012); Chun Fong Lei (2014); Lei and Ngai (2014); Radu (2014); Molla, Cooper, Corbitt, Deng and Peszynski (2017)
		Technology Development Cycle	Implementation (10)	Chou (2013); Dalvi-Esfahani, Rahman and Zakaria (2011); Fairweather (2018); Lee, Park, Hyun and Silvana (2013); Murugesan (2008); Pitt, Parent, Junglas, Chan and Spyropoulou (2011); Qi Deng, Shaobo, Wang (2017); Cramer (2012); Mann, Grant and Mann (2009)
	Empirical (38)	Need for Technology Transformation	Awareness (5)	Ahmad, Bello and Nordin (2013); Chugh, Wibowo and Grandhi (2017); Din, Haron and Ahmad (2013); Malison and Thammakoranonta (2018); Taruna, Singh and Joshi (2018)
		Initiating the Transformation	Perspective (8)	Chow and Chen (2009); Coffey, Tate and Toland (2013); Sarkar and Young(2009); Chaurasia (2018); Dalvi-Esfahani, Ramayah and Nilashi (2017); Ojo, A. O., Raman, M. and Downe, A. G. (2019); Schmidt, Schmidtchen, Koray, Kolbe and Zarnekow (2011); Du Buisson and Naidoo (2014)
		Approach towards Adoption	Readiness (13)	Bandi, Bose and Saxena (2015); Chen, Watson, Boudreau and Karahanna (2009); Dezdar (2015); Koo and Chung (2019); Milovantseva (2018); Molla and Abareshi (2011); Molla (2009); Molla (2019); Molla and Abareshi (2012); Nizam and Vilhi (2018); Pollard (2019); Yoon (2018); Molla, Cooper and Pittayachawan (2011)
		Technology Development Cycle	Impact (1)	Koo, Chung and Nam (2014)
			Maturity (1)	Molla, Pittayachawan, Corbitt and Deng (2009)
			Implementation (6)	Arnfalk, Pilerot, Schillander and Grönvall (2016); Hu, Hu, Wei, and Hsu, (2018); Molla, Abareshi and Cooper (2014); Nash and Wakefield (2019); Przychodzen, Gómez-Bezares, and Przychodzen (2018); Radu (2013)
		Governance	Investments (1)	Cazier, Shao and Louis (2010)
			Strategy (2)	Deny Arthawan Sugih, Nugroho, and Hartanto (2018); Vykoukal (2010)

<Appendix B> (Cont.)

Green IT Taxonomy Based on Methodology and Issues from Major Themes				
Behavioural/ Non-behavioural	Stage of Literature Development	Major Themes	Sub-Themes	References
Behavioural (71)	Case (11)	Need for Technology Transformation	Awareness (1)	Ah-Lian, Eric, Rondeau, Andersson, Jari, Georges and Jean-Philippe (2012)
		Initiating the Transformation	Assimilation (1)	Thongmak (2017)
		Approach towards Adoption	Innovation (1)	Zhang and Liang (2012)
			Readiness (2)	Hernandez and Ona (2016); Molla and Cooper (2017)
		Technology Development Cycle	Implementation (5)	Chai-Arayalert and Nakata (2011); Chou and Chen (2017); Hanne (2011); Lamb (2011); Okafor and Martins (2017)
		Evaluation	Assessment (1)	Marques, Bachega and Tavares (2019)
	Literature Review (2)	Framework Development	Review (1)	Lei and Ngai (2013)
		Approach towards Adoption	Readiness (2)	Deng and Ji (2015)
Non-Behavioural (125)	Conceptual (54)	Need for Technology Transformation	Awareness (1)	Kim (2011)
			Education (2)	Stuckia and Woerterb (2019); Suryawanshi and Narkhede (2011)
		Framework Development	Review (4)	Buchalcevova (2016); Geert-Jan, Nikki and John (2013); Jenkin, Webster and McShane (2011); Raju, Lindmark, Delaere and Ballon (2013)
			Theory (2)	Soiraya (2012); Uddin, Okai and Saba (2017)
		Initiating the Transformation	Culture (1)	Bhogal and Campbell (2019)
			Perspective (1)	Aronson (2008)
		Approach towards Adoption	Readiness (1)	Molla (2009)
			Process (1)	Lambert, Deruyck, Heddeghem, Lannoo, Joseph, Colle, Pickavet and Demeester (2015)
			Innovation (6)	Aleksic (2015); DesAutels and Berthon (2011); Faucheux and Nicolaï (2011); Herrmann, Saraev and Scheidt (2012); Kant (2009); Ranbhise (2016); Elliot (2011)
			Design (1)	Butler and Daly (2017)
		Technology Development Cycle	Impact (3)	Hankel (2014); Shah, Christian, Patel, Bash and Sharma (2018); Grossman (2011)
			Implementation (24)	Elliot and Derek (2017); Herrick and Ritschard (2009); Cameron (2009); Cameron (2010); Dick, Drangmeister, Kern and Naumann (2013);

<Appendix B> (Cont.)

Green IT Taxonomy Based on Methodology and Issues from Major Themes				
Behavioural/ Non-behavioural	Stage of Literature Development	Major Themes	Sub-Themes	References
Non-Behavioural (125)	Conceptual (54)	Technology Development Cycle	Implementation (24)	Fors and Lennerfors (2018); Jindal and Gupta (2018); Kazovsky, Gowda and Prat (2017); Kuon and Dick (2009); Nordman, and Christensen, (2010); Park and Jeong (2011); Ruth (2018); Unhelkar (2011); Aion, Bhuiyan and Jabed (2015); Andreopoulou (2012); Bose and Luo (2011); Capra, Francalanci and Slaughter (2012); Hussain and Subramoniam (2012); Mohan, Ramesh, Cao and Sarkar (2012); Patón-Romero, Baldassarre, Rodríguez and Piattini (2018); Subburaj, Kulkarni and Jia (2014); Tomlinson, Silberman and White (2017); Wilbanks, (2008); Williams, Thomond and Mackenzie (2014)
		Evaluation	Competitiveness (1)	Anthony and Majid (2013)
		Governance	Investments (1)	Jongsaguan and Ghoneim (2017)
			Strategy (4)	Atkinson, Schulze and Klingert (2014); Butler and Hackney (2017); Peng (2012); Riaz, Gutiérrez and Pedersen (2009)
	Empirical (37)	Need for Technology Transformation	Awareness (1)	Sabharwal, Agrawal and Metri (2018)
			Education (1)	Klimova, Rondeau, Andersson, Porras, Rybin and Zaslavsky (2016)
		Approach towards Adoption	Readiness (1)	Molla, Cooper and Pittayachawan (2010)
			Design (2)	Takeshita, Yamanaka, Okamoto, Shimizu and Gao (2018); Zhang, Liu and Li (2013)
			Readiness (3)	Cai, Chen and Bose (2013); Cooper and Molla (2014); Thomas, Costa and Oliveira (2019)
		Technology Development Cycle	Implementation (20)	Anthony Jnr (2019); Cater-Steel and Tan (2010); Dolci, Lunardi, Salles, Carolina, Alves and Paula (2011); Vykoukal, Wolf and Beck (2014); Ardito and Morisio (2014); Bener, Miranskyy and Raspudic (2017); Bohas and Poussing (2016); Carter and Rajamani (2019); Cecere, Corrocher, Gossart, and Ozman (2014); Godbole and Lamb (2015); Lennerfors, Fors and van rooijen (2015); Sayeed and Gill (2017); Suryawanshi and Narkhede (2011); Akman and Mishra (2015); Cecere, Rexhäuser and Schulte (2019); Issa, Issa and Chang (2014); Jailani, Abdullah, Kartiwi and Hussin (2016); Nganji and Brayshaw, (2010); Patón-Romero, Baldassarre, Rodríguez and Piattini (2019); Zhang and Xie (2015)
			Maturity (1)	Foogooa and Dookhitram (2014)
		Evaluation	Competitiveness (1)	Chuang and Huang (2015)
			Performance (1)	Mithas, Khuntia and Roy (2013)
		Governance	Policy (3)	Hardin-Ramanan, Chang and Issa (2018); Opitz, Krüp and Kolbe (2017); Schmidt and Kolbe (2011)
			Metrics (1)	Uddin and Rahman (2018)
			Strategy (2)	Chuang and Huang (2018); Riaz, Gutierrez and Pedersen (2009)

<Appendix B> (Cont.)

Green IT Taxonomy Based on Methodology and Issues from Major Themes				
Behavioural/ Non-behavioural	Stage of Literature Development	Major Themes	Sub-Themes	References
	Case (14)	Need for Technology Transformation	Awareness (1)	To, Chung and Lai (2012)
		Initiating the Transformation	Response (1)	Yang, Li and Tan (2014)
		Approach towards Adoption	Innovation (1)	Godbole and Lamb (2018)
			Capability (1)	Cooper and Molla(2019)
		Technology Development Cycle	Maturity (1)	Foogooa, Bokhoree and Dookhitram (2011)
			Implementation (7)	Al-Zamil, Saudagar and Jilani (2018); Bai, Kusi-Sarpong and Sarkis (2017); Joumaa and Kadry (2012); Slocum and Lee (2010); Tsivor (2011); Yang, Li and Kang (2018)
		Evaluation	Assessment (1)	Dzoro and Telukdarie, (2016)
		Governance	Strategy (2)	Hba and Manouar (2018); Lamb and Marimekala (2018)
	Model (11)	Approach towards Adoption	Design (1)	Frachtenberg (2012)
			Innovation (4)	Kern, Dick, Naumann and Hiller (2015); Mumtaz, Yang, Monteiro, Rodriguez and Politis (2017); Naumann, Dick, Kern and Johann (2011); Rinaudo, Gangemi, Calimera, Macii and Poncino (2011)
			Assessment (1)	Bomhof and Van Hoorik (2009)
		Technology Development Cycle	Implementation (4)	Grange, Da Costa and Stolf (2018); Niyato, Chaisiri and Sung (2017); Rondeau, Georges, Hossain and Habibullah (2017); Rao, Saravanakumar, Sundararaman, Parthasarathi and Ramesh (2010)
		Evaluation	Performance (1)	Lange (2010)
	Literature Review (9)	Need for Technology Transformation	Concept (3)	Harbla, Dimri, Negi and Chauhan (2017); Nanath and Pillai (2019); Brooks, Wang and Sarker (2010)
		Approach towards Adoption	Process (2)	Klimova (2017); Mogotlhwane (2014)
			Application (1)	Rabiah and Azizah (2018)
		Technology Development Cycle	Implementation (2)	Jailani and Abdullah (2017); Asadi and Dahlan (2017)
		Governance	Policies (1)	Hadzovic (2015)

<Appendix B> (Cont.)

Green IS Taxonomy Based on Methodology and Issues from Major Themes				
Behavioral / Non-behavioral	Stage of Literature Development	Major Themes	Sub-Themes	References
Behavioural (20)	Conceptual (2)	Technology Development Cycle	Implementation (1)	Seidel, Recker and Brocke(2013)
		Governance	Strategy (1)	Curry, Hasan, Hassan, Herstand and Seán O'Riain (2011)
	Empirical (14)	Initiating the Transformation	Perspective (5)	Dalvi-Esfahani, Ramayah and Nilashi (2017); Gholami, Sulaiman, Ramayah and Molla (2013); Kranz and Picot (2011); Loock, Staake and Thiesse (2013); Paulsson et al. (2019)
		Approach towards Adoption	Readiness (4)	Chen, Watson, Boudreau and Karahanna (2009); Dalvi-Esfahani and Rahman (2016); Dalvi-Esfahani, Ramayah and Rahman (2017); van Wijk, Zietsma, Dorado, de Bakker, Martí, Carberry, Bharati, Levy and Chaudhury (2019)
			Process (1)	Yang, Sun, Zhang, Wang and Cao, Lisha (2014)
		Evaluation	Performance (1)	Nishant (2013)
			Potential (1)	Seidel, Székely and Brocke(2012)
		Technology Development Cycle	Implementation (2)	Loeser, Recker, Brocke, Jan vom, Molla and Zarnekow (2017); Nanath and Pillai (2017)
	Case (3)	Framework Development	Review (1)	Hedman and Henningsson (2013)
		Initiating the Transformation	Response (1)	Ijab, Molla and Cooper (2011)
		Technology Development Cycle	Implementation (1)	Ijab, Molla and Cooper (2013)
	Literature Review (1)	Technology Development Cycle	Implementation (1)	Butler (2011a)
Non-Behavioural (29)	Conceptual (13)	Initiating the Transformation	Assimilation (1)	Lei and Ngai (2014)
			Perspective (1)	El Idrissi and Corbet (2014)
		Framework Development	Theory (1)	Butler (2017)
		Approach towards Adoption	Innovation (1)	Castelli, Schönau, Stevens, Schwartz and Jakobi(2015)
			Design (1)	Beister, Dräxler, Aelken and Karl (2014)
			Process (3)	Anthony and Majid (2018); Yang, Sun, Zhang and Wang (2016); Yang, Sun, Zhang and Wang (2019)

<Appendix B> (Cont.)

Green IS Taxonomy Based on Methodology and Issues from Major Themes				
Behavioral / Non-behavioral	Stage of Literature Development	Major Themes	Sub-Themes	References
Non-Behavioural (29)	Conceptual (13)	Technology development cycle	Lifecycle (1)	Huang (2008)
			Implementation (2)	Qing, Patricia and Simone (2013); Weiss (2017)
		Governance	Policies (1)	Cooper and Molla(2010)
			Investments (1)	Jongsaguan and Ghoneim(2017)
	Empirical (6)	Approach towards Adoption	Readiness (1)	Chen, Watson, Boudreau and Karahanna (2011)
		Technology development cycle	Implementation (3)	Anthony Jr (2020); Anthony, Majid and Romli (2018); Ijab, Molla, Kassahun and Teoh (2010)
		Evaluation	Performance (2)	Anthony Jr (2019); Meacham, Toms, Green, and Bhadauria (2013)
	Case (4)	Technology development cycle	Implementation (4)	Bradshaw and Donnellan (2013); Anthony Jn (2020); Savita, Razip, Shafee and Mathiyazhagan (2018); Hasan, Ghose and Spedding (2009)
	Model (1)	Approach towards Adoption	Innovation (1)	Kurkalova and Carter (2017)
	Literature Review (5)	Need for technology transformation	Concept (2)	Loeser (2013); Dedrick (2010)
		Technology development cycle	Implementation (2)	Khor, Thurasamy, Ahmad, Halim and May-Chiun (2017); Watson et al. (2010); Brauer, Eisel and Kolbe (2015)
Behavioural (6)	Conceptual (3)	Initiating the Transformation	Perspective (1)	Hasan and Meloche (2013)
		Approach towards Adoption	Innovation (1)	Hankel, Astsatryan and Narsisian, (2015)
		Technology Development Cycle	Implementation (1)	Nguyen, Cheriet, Lemay, Reijs, Mackarel and Pastrama (2017)
	Survey (2)	Approach towards Adoption	Readiness (1)	Datta, Roy and Tarafdar (2010)
		Governance	Strategy (1)	Qing, Patricia and Simone (2012)
	Literature (1)	Approach towards Adoption	Innovation (1)	Melville (2010)

<Appendix B> (Cont.)

Sustainable IT & IS Taxonomy Based on Methodology and Issues from Major Themes				
Behavioral / Non-behavioral	Stage of Literature Development	Major Themes	Sub-Themes	References
Non-Behavioural (43)	Conceptual (22)	Framework Development	Review (3)	Enokido and Takizawa (2013); Schmidt, Hildebrandt, Eisel and Kolbe (2018); Steenhof, Weber, Brooks, Spence, Robinson, Simmonds, Kiddle, Aikema, Savoie, Ho, Lemay, Fung and Cheriet (2012)
			Theory (1)	Dao, Langella and Carbo (2018)
		Approach towards Adoption	Resource (1)	Batool, Sharif, Islam, Zaman, Shoukry, Sharkawy, Gani, Aamir and Hishan (2019)
			Innovation (6)	Duan and Deng (2018); Gorbenko, Tarasyuk, Kor and Kharchenko (2017); Harmon and Demirkan (2011); Nedbal, Wetzlinger, Wagner and Auinger (2011); Patrignani and Whitehouse (2015); Townsend (2014)
		Technology Development Cycle	Maturity (1)	Donnellan, Sheridan and Curry (2011)
			Implementation (3)	Chowdhury (2013); Nuss (2013); Røpke (2012)
		Governance	Investments (1)	Abraham and Mohan (2015)
			Strategy (2)	Harmon, Demirkan and Raffo (2012); Andreopoulou (2012)
		Evaluation	Assessment (2)	Hsieh (2018); Yong-Woon Kim (년도); Jeongil Yim (년도); Ki-shik Park (년도); Hyoung Jun Kim (2012)
			Performance (1)	Seethamraju and Frost, (2019)
			Potential (1)	Florea, Sommer and Ahmadabadi (2013)
	Survey (9)	Approach towards Adoption	Innovation (1)	Corbett, Webster and Jenkin (2018)
			Readiness (1)	Chong and Olesen (2017)
		Technology Development Cycle	Implementation (1)	Jayaprakash and Pillai (2019)
		Evaluation	Assessment (1)	Martins and Grilo(2017)
			Performance (1)	Molla (2011)
		Governance	Policy (2)	Patón-Romero, Baldassarre, Rodríguez and Piattini (2014); Prasad, Green and Heales (2012)
			Investments (2)	Hertel and Wiesent (2013); Langer (2009)
	Case (7)	Approach towards Adoption	Design (1)	Malhotra, Melville and Watson (2013)
		Technology Development Cycle	Implementation (5)	van Osch and Avital (2018); Bengtsson and Ågerfalk (2011); Bull (2011); Hjalmarsson and Lind (2011); Curry, Guyon, Sheridan and Donnellan (2018)
		Governance	Policy (1)	Ju, Liu and Feng (2018)

<Appendix B> (Cont.)

Sustainable IT & IS Taxonomy Based on Methodology and Issues from Major Themes				
Behavioral / Non-behavioral	Stage of Literature Development	Major Themes	Sub-Themes	References
	Mathematical Model (4)	Technology Development Cycle	Evolution (1)	Fang, Liu, Yang and Liu (2019)
			Implementation (2)	Bodenstein, Hedwig and Neumann (2011); Ekman, Raggiom, Thompson (2015)
		Evaluation	Assessment (1)	Sheme, Holmbacka, Lafond, Lučanin and Frashëri (2018)
	Literature (1)	Need for Technology Transformation	Concept (1)	García Berná, Fernández Alemán, Carrillo de Gea, Nicolás, Moros, Toval, Mancebo, García and Calero (2019)

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