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SUSTAINABLE ADOPTION AND IMPLEMENTATION IN COLLABORATIVE ENTERPRISE: A SYSTEMATIC LITERATURE REVIEW

[1]BOKOLO ANTHONY JNR, [2]MAZLINA ABDUL MAJID AND [3]AWANIS ROMLI

[123]Faculty of Computer Systems and Software Engineering,

Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang, Pahang, Malaysia

E-mail: [1]bkanjr@gmail.com, [2]mazlina@ump.edu.my, [3]awanis@ump.edu.my

ABSTRACT

Human life is reliant upon the natural environment, which, most would agree, is rapidly degrading; presently one of the most difficult problems that humanity faces is the sustainable development of our society, i.e. how to meet the needs of the present without compromising the ability of future generations to meet their own needs. The sustainable enterprise is one that contributes to sustainable development by simultaneously delivering economic, social, and environmental benefits. Sustainability has been increasingly becoming a tactical consideration for developing Green practices through balancing social, economic and environmental performance of collaborative enterprise (CE). As the perceived importance of eco-sustainability has grown, there has been increasing discussion on both eco-sustainable solutions. An understanding of the process, variables and related attributes that influence CE to adopt and implement sustainable practices may contribute in creating a Green CE. Presently there are a few Green ITIS and sustainability review paper published, however none of these review papers aimed at exploring Green process, variables (independent, moderating, mediating, control and dependent) and their related attributes in relation to adoption and implementation of Green practices in CE. Thus to get a clear understanding of how practitioners and decision makers implement and adopt sustainable practice in CE, this paper carries out a systematic literature review to investigate existing research in the domain of Green ITIS and sustainability in CE. Findings from this paper show that existing models and frameworks are limited with the capability to support IT practitioners to make strategic decision on how to implement and adopt Sustainable practice in CE. This paper also shows the Green ITIS process, variables and their related attributes to be considered in going Green in CE. Existing Sustainable models and frameworks developed in CE previously was also explored. Lastly the discussion, contribution, limitation, implication of the study, conclusion and future work is stated.

Keywords: *Green IT IS, Sustainability, Collaborative Enterprise, Variables, Attributes, Process.*

1. INTRODUCTION

Collaborative enterprises are under increasing social, economic, environmental and legal pressures to adopt and implement environmentally sustainable approaches for their services and products development. Consequently, enterprises are progressively attending to the triple bottom line recommended by Elkington [1], which includes being responsible for what they are doing in terms of social and environmental responsibilities, in addition to their economic responsibilities of maximizing profits [2]. Sustainability in collaborative enterprise is understood as a long term development of instantaneously optimizing economic, social and environmental performance while taking natural resource limitations into account, thus allowing for continuing enterprise processes without compromising the needs of future generations. The sustainability paradigm was identified as the next organizational megatrend and is allied with superior efficiency of production procedures and innovations that will change the viable setting and generate future business benefits [3].

Improving environmental performance and natural resource utilization is a significant element of sustainability. Thus, enterprise need to address environmental, societal goals and economic gains concurrently rather than viewing them as tradeoffs. Present challenges that can be reduced by practitioners in collaborative enterprise include the

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reduction of information technology (IT) related energy, waste and emissions. To reflect on these opportunities and challenges, two interrelated concepts was developed in the information system (IS) literature, that is, Green IT and Green IS. These two concepts are entrenched in the supposed difference between the definitions of IT and IS and in the role of IS and IT in initiating and solving environmental sustainability correspondingly [4].

IT refers to the software and hardware technologies that capture and process information, whereas IS represents a more inclusive mixture of IT, processes and people to advance practitioners, group and enterprise goals. Green IT refers to the reduction of negative environmental influence of IT by making the design, operation and disposal of IT Greener [4], [5]. On the other hand, Green IS refers to the use of information systems to enhance ecological sustainability through informating, automating and transforming enterprise processes, products, services and enterprise relationships and practices. Academicians, researchers and practitioners such as [6], [7] identified a wide range of areas where IT and IS can lessen the negative environmental effects, e.g., by reengineering of enterprise design and development procedures, fleet management, automating buildings, or teleconference enhance applications. Green ITIS can facilitate energy monitoring and environmental management systems, enable eco-environmental transparency if enterprise to regulating bodies and allow assessing the accomplishment of environmental targets.

Even though Green IT and Green IS are inter-related, they each have a different purpose and focus. Therefore, collaborative enterprises are required to deploy Green IS solutions as they practice Green IT. Green IT and Green IS ventures are anticipated to meet the dual objectives of enterprise becoming Green and at the same time making profits [6]. Presently collaborative enterprises are challenged to develop new models and tools to support sustainability attainment of practitioners. Although IT based enterprise had produced 1.3 percent of global GHG emissions as at 2007 and utilized 3.9 percent of electricity. Other assessment shows that between 2007 and 2020, IT shares of CO_2 emissions is expected to rise from 2.5 percent to approximately 2.8 percent on an annual growth rate of 1.4 percent as stated by Alemayehu [6].

In developing countries such as Australia, the carbon footprint of IT operation are estimated to be 2.7 percent of the country's total CO_2 emission [6]. Alemayehu [6] reported that a total 65.1 million Tonnes of electronic and electrical equipment was traded in international markets in the year 2012 and 45.6 million Tonnes of e-waste was produced in the same year. Moreover, running data centers and computers networks, comes along with huge sums of electricity consumption. As a result, IT usage is responsible for 2% of worldwide CO_2 emissions. The current 33.7 million enterprise servers which are presently installed globally consumed roughly 235 billion kWh of electrical power in 2012; this is equivalent to 1.3 % of the universal energy demand. Also, Green ITIS can be seen as important necessity for driving the revolution towards a more sustainable society, economy and enterprise. However, as IT has become a critical resource to all enterprise, it can be used to enables the beneficial reuse of energy across industries and waste flows which can result to a more resource utilization and lesser adverse environmental effects. Additionally, IT usage proposes opportunities to create sustainable society, enterprise, and a lesser carbon economy with a prospective of IT based enterprise reducing the 97 percent of emissions coming from other economy [8].

IS for eco-sustainability are mainly IS enabled enterprise practices and processes that enhances economic environmental viability. Green IT in collaborative enterprise refers to the use of specific hardware and software to achieve waste and energy consumption reduction. Examples of sustainable enterprise initiatives include Green data centers, virtualization software, etc. Whereas, Green IS in collaborative enterprise is the use and development of information systems to enable or support environmental sustainability strategies. Some examples of Green IS include eco-friendly information systems and Green resource management systems, etc. [9]. Regrettably, the lifecycle of IT infrastructures are associated with several negative environmental impacts. The engineering of IT hardware results to the lessening of rare resource. At the end of the creation lifecycle, obsolete IT hardware known as e-wastes are frequently illegally dumped and then transferred to emerging countries, where these harmful substances seriously threaten human's health.

Sustainable practices in collaborative enterprise can range from environmental technologies that include strategies such as operating methods for waste management practices pollution control equipment. Thus ITIS has an exceptional potential to add to environmental sustainability in enterprise business and social process by facilitating a socio

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technical sustainable development practice [9]. Thus an understanding of the process, variables and their related attributes that influence enterprise towards going Green may assist in both predicting future behavior and creating mechanisms to encourage more sustainable enterprise [10]. Thus there is need to identify the Green components or variables and their related attributes that influence enterprise behavior toward going Green. Also it is imperative to highlight the Green lifecycle or process that is to be applied by practitioners if they want to transform their enterprise to a sustainable enterprise.

Our motivation to carrying out this review is based on the fact that there are a few Green sustainability review paper published presently, however none of these review papers aimed at exploring Green variables and process in relation to the adoption and implementation of Green practices in collaborative enterprise. Thus to get a clear understanding of how practitioners and decision makers implement and adopting sustainable practice in collaborative enterprise, this papers carries out a systematic literature review to investigate existing research in the domain of Green ITIS and sustainability in collaborative enterprise to identify Green ITIS and sustainability process, variables and related attributes. We also aimed to review related models and frameworks that have been developed presently. Thus to accomplish these aims this paper carried out a systematic literature review suggested by Kitchenham and Charters [11] on existing literature related to Sustainable practice mainly in collaborative enterprise domain only. The scope of the systematic literatures review encompassed papers from 2007 till July 2016, since publication on sustainability relating to Green ITIS practice began from the year 2007/2008 as stated by [3], [12], [13]. A total number of 143 papers comprising of 4 papers from the pioneers of sustainability research [1], [14], [15], [16], 76 journal articles and 63 conference proceeding papers were selected and included to this SLR. These papers were selected based on certain criteria such as inclusive and exclusive criteria, cross reference check and quality assessment.

The structure of this paper is organized as follows: Section 2 presents the research method applied in this study. Section 3 describes the results and findings of the review. Section 4 is the discussion. Section 5 is the contribution, limitation and implications of the review. Finally, the conclusion and future work Section is presented in Section 6.

2. RESEARCH METHODS

A systematic literature review (SLR) aims to outline and evaluate the literature related to the research domain by utilizing an auditable and thorough methodology. We have adopted the methodology suggested by Kitchenham and Charters [11] to show the trend of Green ITIS for sustainability in collaborative enterprise research domain. The two primary objectives of this study are: to identify and summarize existing research on Green ITIS variables/components & their related attributes and lifecycle/process in relation to collaborative enterprise domain; and to identify and summarize existing Green IT or Green IS models or frameworks developed to help enterprise attain sustainability. Based on Kitchenham and Charters [11], completing systematic literature review involves quite a few activities such as planning the review, conducting the review, and reporting the finding from the review.

To commence the SLR process we first have to outline our research questions and, hence, our search strategy by classifying a set of appropriate keywords to execute the search on a predefined set of data sources. Then, we choose a number of primary studies also based on a predefined set of inclusion and exclusion criteria. Additionally, we extract the needed data and finally, we show the results of our work, and then we analyze these results in order to show which is the trend of that research in relation to Green ITIS process, variables and their related attributes if any from these primary studies and categorize them with respect to independent, moderating, control and dependent variable.

Therefore this section, describes the research method utilized for this systematic review. We firstly state the research questions, which define the aim of our review, and then we explain which protocol has been executed to search and collect related studies about Green ITIS process, variables and their related attributes.

2.1 Research Questions

The study started with ascertaining the needs for the systematic literature review. The aim of this work is to find out Green ITIS process, variables and their related attributes in collaborative enterprise domain, and then identify existing Green ITIS model or frameworks only related to collaborative enterprise only. Our corresponding research questions are:

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RQ1: What are the components or variables and their related attributes for Sustainable adoption in collaborative enterprise?

RQ2: What are the lifecycle or process involved in implementing Sustainable pratices in collaborative enterprise?

RQ3: What are the existing models or frameworks aimed at supporting the adoption and implementation of Sustainable practices in collaborative enterprise?

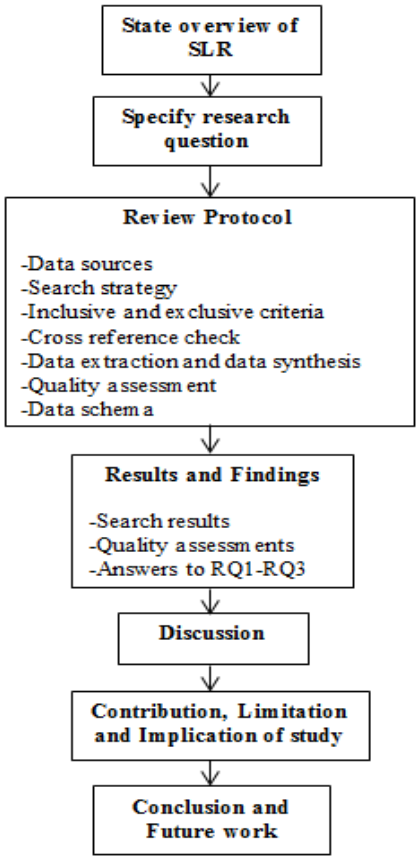

Figure 1: SLR Process for this Research Study

Figure 1 shows the SLR process that is carried out in this paper.

2.2 Review Protocol

The review protocol for a systematic literature review involves a series of tasks that have to be carried out in order to answer the research questions listed in Section 2.1 of this review paper, and to achieve a valid and reliable results. Our review protocol comprises five main modules: the data sources that describe which scientific database have to be queried to retrieve relevant studies; the search strategy, which describes the strategies used to query the data sources; the study selection, which describes measures to select studies retrieved during the search strategy implementation; the data extraction, which explains how significant data about Green ITIS process, variables and attributes are extracted from each of designated primary studies; and the data synthesis, which helps to categorize the extracted results and lastly the quality assessment of the selected literatures. Each module is described in the following sections.

2.2.1 Data Sources

To execute the search on the Green ITIS, eco-sustainability literature, we select the following nine electronic libraries and performed the search on each of them.

- IEEE Explore
- ACM Digital Library
- Google scholar
- Wiley InterScience
- ISI Web of Knowledge
- Springer Link
- Research gate
- Science Direct
- Scopus

2.2.2 Search Strategy

In order to establish a search strategy, we start from the research questions and emphasized on which terms describe the studies that we want to review. For defining the search keyword for all the three research questions are well defined, so that as the review proceeds we can extract key terms like Sustainability, Green, process, variables and attributes, since they are strictly related to the aim of this study. Although, these key terms are not precisely enough, and the implementation of a query containing only these terms may be not expressively adequate. For these motives, the set of key terms is improved with synonyms or keywords related to the same topic *(i.e., "sustainable" is a synonym of "Green", "metrics" is a term related to the "attributes", "component" is a term related to the "variable", "life cycle" is a term related to the "process", "dimensions" is a term related to the "process"),* as suggested by Kitchenham and Charters [11].

For query string description, we applied a query string generated using Boolean "OR" operator among similar terms, and the "AND" operator

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among the three sets of keywords. Hence, the resultant query string is the following:

[RQS1] *(Green OR environmental OR sustainable OR sustainability OR "environmental friendly" OR "Green IS" OR "Green IT" OR "Green for IT" OR "Green for IS" OR "IS for Green" OR "IT for Green" OR "eco-friendly") AND (variables OR constructs OR components OR items) AND (attributes OR metrics OR measures OR indicators) AND ("collaborative enterprise" OR "enterprise" OR "organization" OR "educational institutions" OR "firms")*

[RQS2] (*Green OR environmental OR sustainable OR sustainability OR "environmental friendly" OR "Green IS" OR "Green IT" OR "Green for IT" OR "Green for IS" OR "IS for Green" OR "IT for Green" OR "eco-friendly")AND ("process" OR "lifecycle" OR dimensions) AND ("collaborative enterprise" OR "enterprise" OR "organization" OR "educational institutions" OR "firms")*

[**RQS3]** (*Green Model OR environmental model OR sustainable model OR sustainability model OR "environmental friendly model" OR "Green IS model" OR "Green IT model" OR "Green for IT model" OR "Green for IS model" OR "IS for Green model" OR "IT for Green model" OR "eco-friendly model") AND* (*Green framework OR environmental framework OR sustainable framework OR sustainability framework OR "environmental friendly framework" OR "Green IS framework" OR "Green IT framework" OR "Green for IT framework" OR "Green for IS framework" OR "IS for Green framework" OR "IT for Green framework") AND ("collaborative enterprise" OR "enterprise" OR "organization" OR "educational institutions" OR "firms")*

Where RQS is the research question search number, to filter our search further, we choose to scope the range of time of our research within 2007 and 2016 (July). This is because research in Green IT IS and sustainability in collaborative enterprise started from late 2007/2008 as previously mentioned in literature [3], [12], [13]. The studies and the articles listed in this literature are published within 2007 and 2016 (July); then, to get an appropriate set of studies, we decide to execute our search strategy mainly on abstracts sections. Searching only in title section may significantly decrease the set of results, excluding relevant studies that do not contain any definite keywords. Searching in the full text will definitely increase the number of found papers, comprising studies that may be out of the scope of this review.

2.2.3 Study Selection (Inclusion and Exclusion Criteria)

After the search strategy was performed, the study selection was performed next based on the resulting set of literatures. The selection was executed with respect to defined criteria, shown in Table 1. These criteria focus on the quality of selected literatures, in terms of language and source, and on the domain of this review, in terms of completeness and relevance.

2.2.4 Cross References Check (CRC)

After reading and studying the studies, we applied the snowballing search method as applied by Paolo, Qing and Patricia [16] in their SLR paper aimed at tracking all relevant references enclosed in the references section of each chosen primary studies. Then, we performed both study selection and data collection on this new set of literatures in the same way as they are described in the Section 2.2.3 of this review paper.

2.2.5 Data Extraction and Data Synthesis

After performing study selection on both search strategy implementation results and RQS results, the next phase of the review process is to extract and syntheses data based on primary studies. The objective of this phase is to collect all the process, variables, related attributes and related information related to existing Sustainable models and frameworks mentioned within the primary studies. Therefore, we gathered all the extracted and synthesized information within a word document that comprises the following fields:

- Study Name: the name of the current paper.
- Study Year: the publication year of the research paper.
- Green Process/Variable Name: the name of the current Green ITIS process/variable.
- Green Process/Variable Common Name: the name of process/variables that have similar features and, hence, they can be counted as a single process/variable.
- Green Process/Variable Description: brief textual description of the Green process/variable.
- Green Process/Variable Calculation: the formula used to calculate the process/variable (if any).

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- Green Process/Variable Unit: the measurement unit of the Green process/variable (i.e. seconds, US dollars ($), kWh, etc.).
- Measured Resource: the resource to be measured by means of the identified Green process/variable (i.e. CO_2, cost, etc.).
- Green ITIS-related: whether the Green process/variable is related to enterprise energy/power consumption or not.
- Green Process Type (Extracted Data + Rationale): documented description extracted from the literature based on the results generated by the current process; optionally, a justification to encourage the related type is provided.
- Green Variable Type: name that identifies the type of the Green variable, either independent, control, moderating, mediating or dependent variable.
- Green Process/Variable Context (Rationale + Extracted Data): text extracted from the literature describing eco-sustainability in relation to the current Green process/variable.
- Green Process/Variable Methodology: a methodology section describing how the Green process/variable was derived and validated by qualitative, quantitative or mixed methods, using interview, questionnaire, survey, document review etc.
- Green Variable Attribute: whether the Green variable is measured based on other Green attributes.
- Green Process/Variable Analysis: data analysis section describing how the data collected based on the Green process/variable/attributes was analyzed either using case study, Structural Equation Modelling (SEM), SPSS, etc.

Table 1: Inclusion and Exclusion Criteria

Inclusion criteria	Exclusion criteria
• The research paper is related to Green sustainability in collaborative enterprise. *Motivation:* The study recommends a framework, methods, or approaches to attain sustainability in collaborative enterprise.	• The research paper is not directly offering any approach, method, or technique to be used for Green sustainability in collaborative enterprise. *Rationale:* Green sustainability is mentioned, but the research is about something else than Green variables and process.
• The research paper proposes a documented set of variables or process regarding enterprise going Green. *Motivation:* The study delivers a set of that have an unambiguous and precise supporting description. E.g., a study may discuss about independent variables and control variables and provides a comprehensive explanation of those variables.	• The research paper is about Green variables or/and process that are not concerning collaborative enterprise. *Rationale:* variables or process may be related to a large set of domain. Since we used "variables" as a search keyword, it is possible to retrieve studies not related to methods or approaches concerning Sustainable practices or strategies in collaborative enterprise. • The research paper does not provide a description of Green variables or process *Rationale:* if there is a lack of evidence regarding variables, and if no explanation is provided, it is difficult to define properly the variable or process.
• The research paper is in the form of a scientific paper. *Motivation:* the study emphases on scientific matters, in order to validate a good level of quality. E.g., an article may be a journal part of a conference, and it may follow the stipulated publication templates, thus it contains abstract, introduction, research problem, related work, methodology applied proposed solutions, citations and references.	• The research paper is not in form of a scientific paper. *Rationale:* lack of rigorous methods and scientific contents can lead to little quality result. To meet our quality objectives, non-scientific matters have to be ignored. E.g., publications from collection of abstracts, magazine, oral presentations, or reports cannot be selected for the SLR.
• The research paper is written in English language. *Motivation:* publications in Computer Science, Management, Engineering, Social Science or any field that is based on Green ITIS or sustainability in collaborative enterprise required to be written in English is considered for our SLR.	• The research paper is not written in English language *Rationale:* If a retrieved paper is written in language other than English, it is discarded. Since the authors are currently writing this review paper in English language.

2.2.6 *Quality Assessment*

This final phase, aims to assess all included papers based on their content quality. This phase is carried out in relation to the data extraction and data synthesis phase and was used to ensure that the included literatures made a valuable impact to the SLR. To assess the quality of selected papers, we followed the quality assessment criteria suggested by Mohammad, Azizah and Nor [17]. These criteria are presented in Table 2. Grounded on [17] quality assessment criteria in SLR, we derived 16 criteria that involve the three main concerns related to the quality assessment of the papers selected for this review. The three main quality assessment criteria include:

Rigor: Has an appropriate and thorough approach been applied to key research methods in the paper?

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Credibility: Are the findings meaningful and well-presented?

Relevance: How beneficial are the findings to the Green ITIS and sustainability research community?

With this in our mind we proceed to state the quality assessment criteria naked on the rigor, credibility and relevance of the paper as shown below;

a. *Quality threshold*
   1. Is the paper grounded on research or is it merely a study based on lessons learned report based on domain experts' opinion?
   2. Is the research aim clearly stated in the literature?
   3. Is there an acceptable description of the perspective in which the research was implemented?
   4. Did the paper state any research question?

b. *Rigor*
   5. Was the research method applicable to resolve the research problem?
   6. Was the sampling method appropriate for the research?
   7. Was there an experimental, theoretical or scientific contribution in the research?
   8. Was the data collection method/technique suitable to answer the research question?
   9. What data analyses method was adopted?
   10. Was the data analysis satisfactorily in depth or surface?

c. *Credibility*
   11. Were the respondents or informants suitable and justifiable in the paper?
   12. Did the paper clearly report its findings?

d. *Relevance*
   13. Did the study contribute to the body of knowledge in its research domain?
   14. Were any variables, process or attributes mentioned?
   15. Was any techniques utilized in the study?
   16. Did the paper propose or develop any model or framework?

The first four criteria are the slightest quality threshold to assess the papers which do not meet the aims of the review. The next seven criteria (4-10) concerns the issue of rigor which considers the practical research methodology or techniques used and data analyses tools and techniques, and also the trustworthiness of its research results. Criteria 11 and 12 are related to the credibility of the selected papers which assures the significance, reliability and validity of research findings. And the final criteria (13-16) concerns the relevance of the selected paper in terms of if the papers contains any Green sustainability variables, process or attributes and if the papers contributes new knowledge of improves existing knowledge in the research domain in concern.

2.2.7 Data Schema

To collect the most pertinent information from the selected papers a data schema form was designed in order to simplify the process of evaluating the collected data. This form is shown in Table 2. The data schema was completed following the additional review of chosen studies by the researchers to agree on the studies to include in this SLR paper.

Table 2: Data Schema

Schema	Description
Simple information	It consists of the research title and the author(s) of the study.
Publication type	It refers to whether the publication is conference proceeding or journal.
Year	It refers to the year the paper was published.
Contribution	It refers to the research problem the paper addressed in the study.
Research tag	It identifies the research domain of the selected paper if its sustainability, eco-environmental, Green IS, Green IT, Green Computing or other related research area.
Focus of the research	It deals with the scope of the paper. It emphases on the depth and research/technical/scientific accomplishment of the research.
Research implication/ future works	It recommends the implication, future work and limitations related to the research in question.
Citations/ References	This helps us to check the references to find other similar research studies that can extend our knowledge and can be included to the SLR

Table 3 shows the quality assessment form we utilized to evaluate the journal articles and conference proceedings papers. Each selected papers are screened using the form below. However if any paper answers "No" for question 1, 2 and 3 the paper is directly excluded from the SLR process.

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Table 3: Quality Assessment of Selected Papers

#	Quality Assessment Questions	Answers	
1	Is the paper grounded on research? Criteria ▪ Is the paper grounded on research or is it merely a study based on lessons learned report based on domain experts' opinion?	○ yes	○ No
2	Is the research aim clearly stated in the literature? Criteria ▪ Is there a research motivation for why the authors carried out the study? ▪ Is the research aligned to eco-sustainability, Green IT or Green IS? ▪ Does the research recount to any classification of design science, conceptual, empirical or study? ▪ Was the research findings and outcome stated in the paper?	○ yes	○ No
3	Is there an acceptable description of the perspective in which the research was implemented? Criteria ▪ The scope of the enterprise which adopted and applied sustainability/Green ITIS. ▪ The initiatives and strategies of Green ITIS implemented. ▪ The enterprise and context in which sustainability/Green ITIS used. ▪ The determination of adoption and implementing Green approach in the study.	○ yes	○ No
4	Did the paper state any research question? Criteria ▪ Was any research question(s) stated throughout the research paper, which is planned to be answered?	○ yes	○ No
5	Was the research method applicable to resolve the research problem? Criteria ▪ Did the author(s) justify the research design used and how they adopted the design?	○ yes	○ No
6	Was the sampling method appropriate for the research? Criteria ▪ Has the author(s) described how the cases or participants were identified and chosen? ▪ Are the cases or participants well-defined? ▪ Was the cases or participants representative of a particular population? ▪ Have the author(s) explained why the cases or participants they choose were the most suitable to deliver access to the form of information required by the research? ▪ Was the sample size suitably large?	○ yes	○ No
7	Was there an experimental, theoretical or scientific contribution in the research? Criteria ▪ Were there any controls in the implemented experimental, theoretical or scientific research?	○ yes	○ No
8	Was the data collection method/technique suitable to answer the research question? Criteria ▪ Were all measures clearly defined such as data unit and coding rules? ▪ Did the researcher(s) mention the measurement scales used?	○ yes	○ No
9	What data analyses method was adopted? Criteria ▪ Was the data collection method clearly stated (e.g. focus group, semi-structured interviews, questionnaire, observation etc.)? ▪ Did the author(s) justify the research methods that were selected? ▪ Has the author(s) specify the research methods clearly, in terms of how the data is to be collected from the participants (respondents or informants). ▪ If the adopted research methods was adjusted during the research, has the author(s) described why and how? ▪ Was the data collection tools stated (such as video recorder, etc.)? ▪ Did the author(s) attain data saturation for qualitative research method? ▪ Did the author justify the number of respondents based on existing works?	○ yes	○ No
10	Was the data analysis satisfactorily in depth or surface? Criteria ▪ Was there a comprehensive explanation of the data analysis procedure? ▪ Has satisfactory data been obtainable to support the research findings? ▪ Did the author(s) carryout data validity and reliability to ensure quality of data?	○ yes	○ No
11	Were the respondents or informants suitable and justifiable in the paper? Criteria ▪ Did the author(s) critically assess potential bias, their own role and impact during the construction of research questions, sample selection, data collection, data analysis and reporting of findings?	○ yes	○ No
#	**Quality Assessment Questions**		
12	Did the paper clearly report its findings? Criteria ▪ Are the findings clear enough for other researchers to understand	○ yes	○ No

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	▪ Has a satisfactory discussion carried out in the research? ▪ Has the author(s) conferred the credibility of their research findings may be data triangulation, participant validation, or other approaches? ▪ Were the limitations of the research unambiguously stated? ▪ Are the research findings and contributions discussed in relation to the main research questions? ▪ Are the research conclusions justified by the research results?		
13	Did the study contribute to the body of knowledge in its research domain? Criteria ▪ Did the author(s) deliberate the contribution of the research study makes to existing knowledge or how their research different from previous works? ▪ Did the author(s) discuss whether or how their research findings can be transferred to other research domains?	○ yes	○ No
14	Were any variables, process or attributes mentioned? Criteria ▪ Did the study present and describe Green or sustainability process, dimension or life cycle? ▪ Did the study mention any independent, control, moderating, mediating and dependent variables or constructs or components? ▪ Was any attributes, metrics, items, elements stated in the study?	○ yes	○ No
15	Was any techniques utilized in the study? Criteria ▪ Did the paper utilized any existing techniques or proposed a new technique in their research.	○ yes	○ No
16	Did the paper propose or develop any model or framework? Criteria ▪ Was a model, framework suggested, proposed or developed in the paper?	○ yes	○ No

3. RESULTS AND FINDINGS

This section presents the results and findings of the conducted systematic literature review. In the previous sections we explained the protocol we followed to identify the relevant primary studies and to extract relevant data about Green process, Green variables and their related attributes. In this section we show the results of the search strategy from the data sources. The findings show the total number of research studies selected for the SLR. The selected papers are based on the study selection (inclusion and exclusion criteria), Cross-references check (CRC), data extraction, data synthesis, quality assessment. This section also provides a platform to provide answers to the research question stated in Section 2.1 of this review paper.

3.1 Search Results

In the selection process we aimed to identify as much important papers for the systematic literature review. Figure 2 shows the process involved in selecting the papers for the SLR process. We commenced the search process by carrying out sing the search strategy to execute search queries from the data sources a total of 298 papers were found

comprises of 127 journal articles and 171 related conference proceeding papers. Then, we performed a duplicates check and we found 10 duplicates. Thus 10 papers were removed from the selected papers, which resulted to only 288 papers which comprises of 120 journal articles and 168 related conference proceeding papers. Next we implemented data extraction and data synthesis using data schema (see Table 2), on the 288 selected primary studies to ensure that this related to our research domain and to assist in the Cross-reference check (CRC) stage. Next we excluded 71 papers because these papers were not related to our research domain of Green ITIS and sustainability in collaborative enterprise. Thus we were left with 217 papers, 118 journal articles and 99 related conference proceeding papers.

Cross-reference check (CRC) was performed on the References Section of each selected study. In which we scanned the list of references and selected relevant papers that relates to Green ITIS and eco-sustainability research. In doing that we were able collect **18** new studies, resulting to **235** papers (**148** journal articles and **87** related conference proceeding papers). After running the **inclusion and exclusion criteria** (see Table 1), **59** papers were excluded from the initial list comprising **11** removed journal articles and **34** conference papers which resulted in a refined list of **176** papers. After applying the **quality assessment criteria 33** papers did not meet the first, second and third criteria, thus these papers were excluded from the SLR, (the excluded papers included **12** journal articles and **21** conference proceeding papers). Therefore the total number of paper was finally **143 papers** (**4** pioneer

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

papers, **76** journal articles and **63** related conference proceeding papers) was selected to be used for the SLR as seen in **Figure 3, Table 4, Figure 4 and Table 5**. The paper selection process can be seen in **Figure 2**. The quality assessment form can be seen in Table 3.

3.1.1 Quality assessment

The quality of the selected research papers was verified using a measurement instrument based on the defined criteria in Section 2.2.6 where the included study has been assessed based on their quality rigor, credibility, threshold, and relevance (refer to Table 3). Figure 3 shows the quality assessment groupings results for all included research paper. As it is noticeable practically all the selected research papers had the required quality to be included to this SLR. It can be seen that the quality assessment criteria "rigor, credibility, threshold, and relevance" possess at least 82% "Yes" response with less "No" response.

Quality assessment was carried out on the selected 139 papers. The other "4" papers were excluded from the quality assessment because these papers forms the foundation of sustainability research these papers includes [1], [14], [15], [16]. Figure 2 illustrates the SLR search process used to certify the quality of the selected paper. The selected 143 papers were utilized to answer the research questions states in Section 2.1 of this paper.

Figure 4 shows the total number of studies selected for the SLR. As seen in Figure 4, a total of 143 studies were selected for the SLR. The selected 143 studies comprises of 76 journals, 63 conference proceeding papers and another 4 papers which were added bases on these the papers being the founding fathers of sustainability research, the authors includes [1], [14], [15], [16] these authors first raised the motion on sustainability.

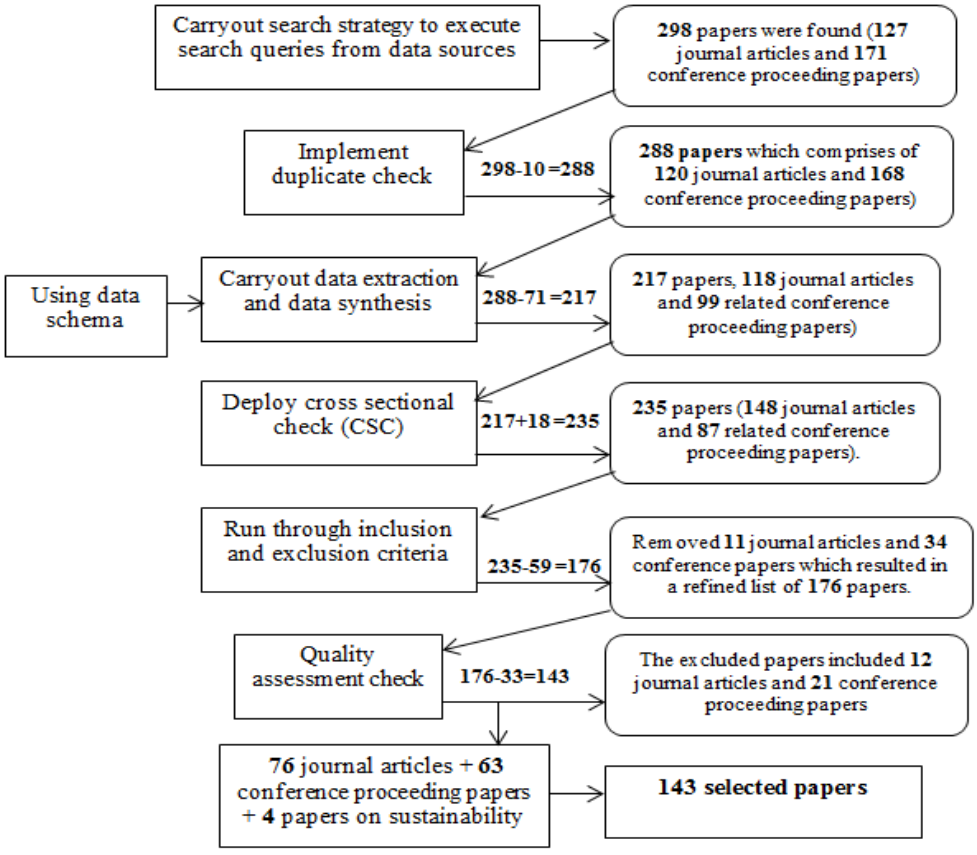

Figure 2: SLR Search Process

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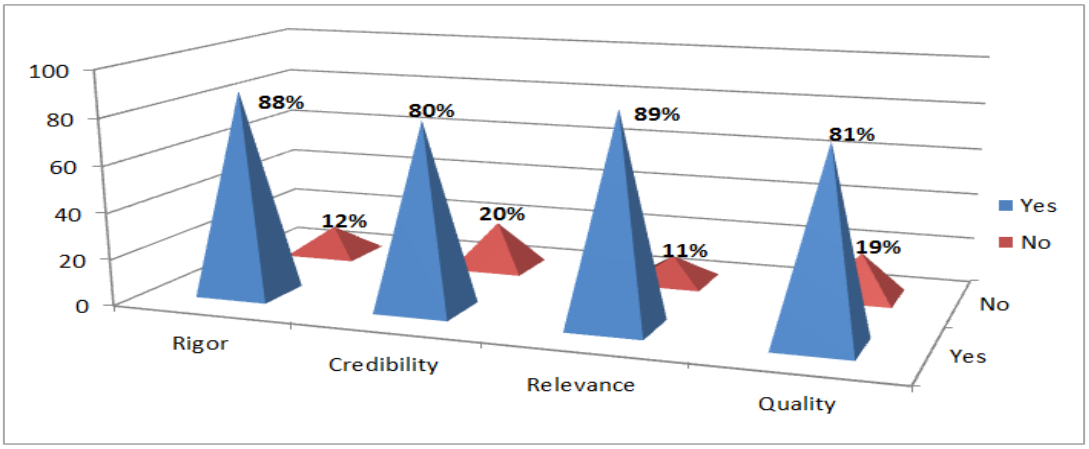

Figure 3: Quality Assessment Results Of Selected 76 Journals Articles + 63 Conference Papers (139 Papers)

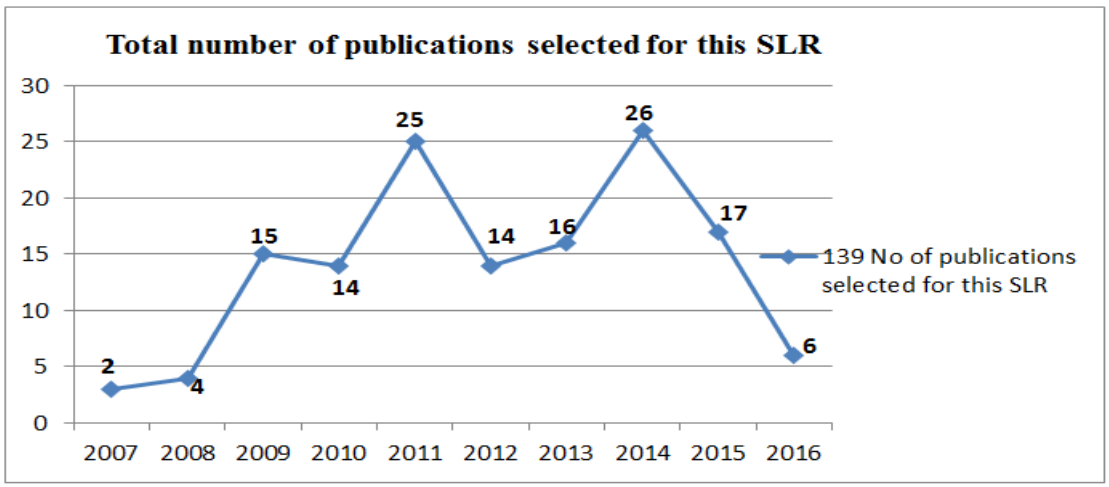

Figure 4: A Total of 139 Studies Included in this SLR

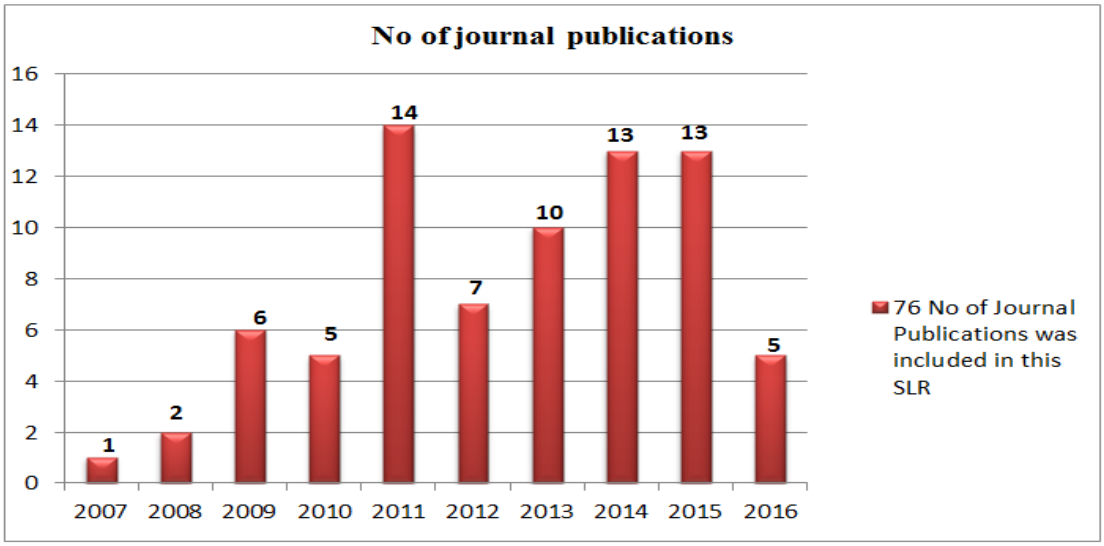

Figure 5: Total Numbers of Journal Articles Included in this SLR

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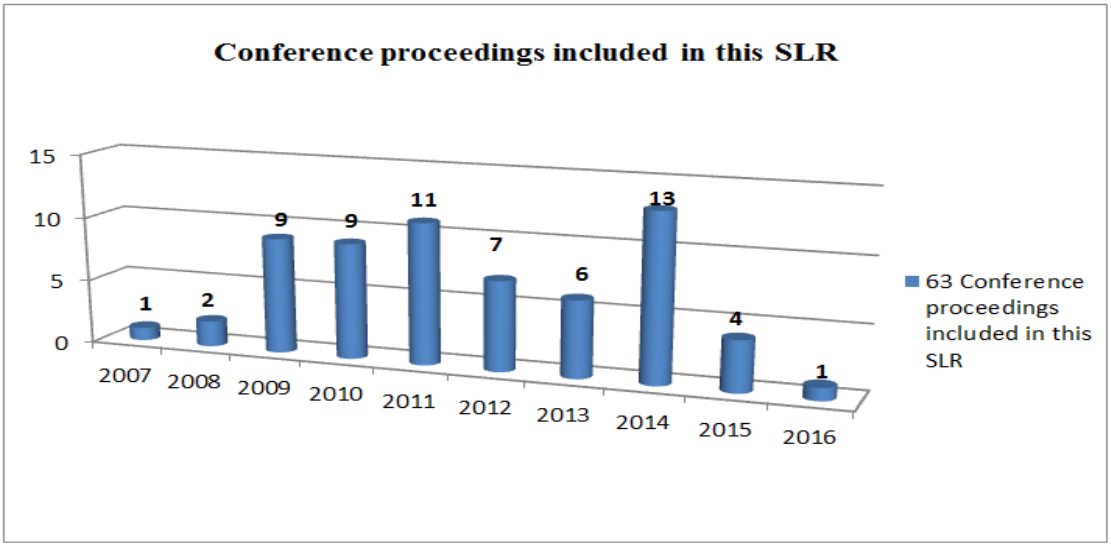

Figure 6: Total Numbers of Conference Proceedings Included in this SLR

However these "4" papers are not included in Figure 4, Figure 5, Figure 6, Table 4 and Table 5. It can be seen that Green ITIS and sustainability research in collaborative enterprise domain started in 2007, where 2007 has the lowest publication of "2" papers, followed by 2008 with "4" papers. Next is 2016 with 6 papers. 2009 has "15" papers. 2010 has "14" papers. 2013 has a number of "16" publications. 2015 has a total number of "17" papers, 2012 has a total of "14" papers. 2011 has the second highest publications with a total of "25" papers. Lastly 2014 has the highest publications with a total of "26" papers. Figure 5 shows the total number of journals selected for the SLR. As seen in Figure 5 and Table 4, a total of 76 journal articles were selected for the SLR. Figure 6 shows the total number of conference proceedings selected for the SLR. As seen in Figure 6 and Table 5, a total of 63 conference proceedings papers were selected for the SLR.

Table 4: List of Journal Included in this SLR

Journal	#	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Computers in Human Behavior	2								*	*	
Australasian Journal of Information Systems	8			**		****			**		
International Journal of Applied Information Systems (IJAIS)	1										*
Current Opinion in Environmental Sustainability	1									*	
Key Engineering Materials	1								*		
International Journal of Production Research	1									*	
Information & Management	1							*			
Communication of the Association for Information Systems	4				*	*	*	*			
Inf Syst Front	4							****			
Computer Standards & Interfaces	1							*			
Management Research Review	1							*			
International Journal of Logistics: Research and Applications	1							*			
Green Business Process Management	1						*				
International Journal of Physical Science	1						*				
Telecommunication Policy	1						*				
Working Papers on Information Systems	2					*	*				
Journal of Computational Intelligence and Electronic Systems	1						*				
Interdisciplinary Journal of Contemporary Research in Business	1						*				
Organizacija	1										*
International Journal of Strategic Decision Sciences	1									*	
ARPN Journal of Engineering and Applied Science	1									*	
Journal of Soft Computing and Decision Support System	4								*	*	**

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

International Journal of Digital Information and Wireless Communications (IJDIWC)	1										*
REA-Revista de Adminustracao de Empresas	1									*	
International Journal of Advance Technology in Engineering and Science	1									*	
Sustainability	1									*	
Resource, Conservation and Recycling	1									*	
Asia Pacific Management	1									*	
Applied Mathematics & Information Sciences	1									*	
Qual Quant	1									*	
International Journal of Computer Trends and Technology (IJCTT)	1								*		
Procedia –Social And Behavioral Sciences	2								**		
Procedia Engineering	1								*		
Journal of Management Systems	1								*		
Problems of Sustainable Development	1								*		
Information Technology & People	1								*		
Journal of Cleaner Production	1								*		
Sis.uta.fi	1							*			
Journal of Strategic Information Systems	4					****					
Journal of Computer Information Systems	3			*	*	*					
Communications of the IBIMA	1					*					
Sustainable Computing: Informatics and Systems	1					*					
Information and Organization	1					*					
MIS Quarterly	2				**						
Green IT Working Paper	3			**	*						
International Journal of e-business Management	1			*							
Information Systems A Global Text	1		*								
Journal of Systems & Information Technology	2	*	*								
	Journal = 76 Articles										

Table 5: List of Conference Proceedings Included in this SLR

Conference Proceeding	#	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Pacific Asia Conference on Information System (PACIS) Proceedings	10			*	*	*		*	****	*	*
SDM 2nd International Conference on Sustainable Design and Manufacturing	1									*	
MCIS Proceedings	1					*					
SAICSIT Proceedings of the South African Institute for Computer Scientists and Information Technologists Conference	2					*	*				
Australasian Conference on Information Systems	8		**	**	*	*	*	*			
Proceedings of ASBBS Annual Conference, Las Vegas	1						*				
European Conference on Information System (ECIS) Proceedings	6			*		***			**		
GREENS, Zurich, Switzerland	3						*	**			
Proceeding of the Americas Conference on Information Systems	9				***	**	*	*	**		
Hawaii International Conference on System Science	3			*			*	*			
Second International Conference on Advance in Computing and Communication Engineering	1									*	
Third International Workshop on Requirements Engineering for Sustainable Systems	1								*		
Proceedings of Third International Conference on Green Computing, Technology and Innovation (ICGCTI2015), Serdang, Malaysia	1									*	
International Conference of Advance Informatics: Concepts, Theory and Application (ICAICTA)	1								*		
28th International Conference of Advance Information Networking and Applications Workshops	1								*		
Confluence the Next Generation Information Technology Summit	1								*		
European Conference on Information Management and Evaluation	1								*		
International Conference on Computer and Information Sciences (ICCOINS)	1								*		
Technics Technologies Education Management	1						*				

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Green ICT: Trends and Challenges	1					*					
IDT Mini-Conference on interesting Results in Computer Science and Engineering	1					*					
Proceeding of the International MultiConference of Engineers and Computer Scientists (IMECS)	1				*						
Semana de Engenharia	1				*						
IEEE International Conference on Industrial Engineering and Engineering Management (IEEEM)	2				**						
ASEE/IEEE Frontiers in Education Conference	1			*							
Portland International Conference on Management and engineering technology (PICMET) Proceedings	1			*							
International Conference on Information Systems	1			*							
International Symposium on High Density Packaging and Microsystem Integration (HDP)	1	*									
31st International Conference on Software Engineering-Companion Volume (ICSE).	1			*							
	Conference Proceeding = 63 Papers										

3.2 Variables and Related Attributes for Sustainable Adoption in Collaborative Enterprise

With reference to the first research question; what are the components or variables and their related attributes for Sustainable adoption in collaborative enterprise? The answer to research question 1 is discussed in this Section.

3.2.1 Independent Variable

The process, variables and related attributes are deduced based on finding from the literatures. The citations are based on the researchers mentioning the variables and related attributes directly on their model/framework or indirectly in their research study. The selected 143 research papers were utilized to provide us with the process, independent, moderating, control & dependent variables and related attributes. References to all citations are provided in the reference Section of this paper. Figure 7 and Table 6 shows the independent variables to be considered in collaborative enterprise for adopting a sustainable organization.

3.2.2 Independent Variable Attributes

The attributes for the independent variables stated in the Figure 7 and Table 6 are presented in this Section. The citations are based on the researchers mentioning the attributes only and not describing the attribute.

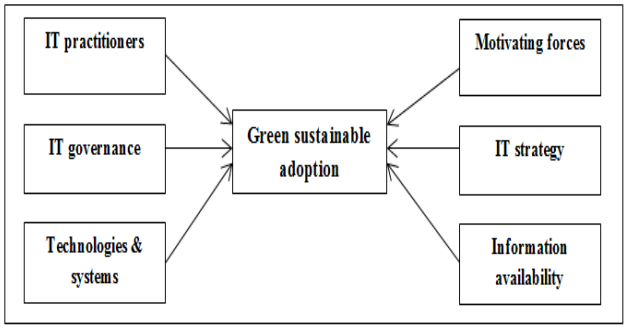

Figure 7: Illustration of Independent Variables for Sustainable Adoption in Collaborative Enterprise

A. IT Practitioners Attributes

IT practitioner's variable is measured by the attributes shown in Figure 8 and Table 7.

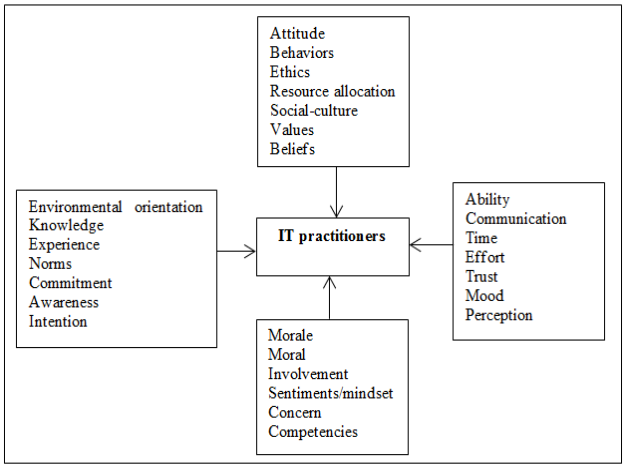

Figure 8: Representation of IT Practitioners' Attributes for Sustainable Adoption in Collaborative Enterprise

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Table 6: Independent Variables for Sustainable Adoption in Collaborative Enterprise

Independent Variables	Description	References
IT practitioners (IT professional, employee, staffs, individuals, society, IT human infrastructure)	IT practitioners includes IT professional, employee, staffs, individuals, society, IT human infrastructure in the enterprise that implements and adopt Green practices. IT practitioners' commitment is required for enterprise in planning deploying, implementing, maintaining and validating enterprise system with environmental deliberations in mind. Thus IT practitioners' collaboration is based on their stakes and shared interest in fulfilling the requirements or objectives of the enterprise. Thus IT practitioner's actions can influence how Green practices are implemented and diffused to achieve sustainability in their enterprise. According to Tracy, Webster and McShane [18] practitioners' attitude, ethics and social culture will determine how he/she will care for the environment. Also previous researchers such as Stan, Vanessa, Hepu, Alemayehu and Siddhi [19] mentioned that the practitioners' action is a determinant that influences enterprise' decision to go Green.	This variable was mentioned by [4], [7], [8], [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30], [31], [32], [33], [34], [35], [36], [37], [38], [39], [40], [41], [42], [43], [44], [45], [46], [47], [48], [49], [50], [51], [52], [53], [54], [55].
IT governance (Organization, management, corporate governance, Green governance)	IT governance this variable is inclusive of organizational management, corporate governance and Green governance. This variable comprises a set of guiding sustainability principles for the information systems function in organizations. Also comprises the management of all ITIS activities including tactical foresight regarding changes in enterprise. IT governance offers a medium for defining the enterprise process. It is the operating pillar that defines the administration of Green initiatives in software industries [4], [18], [31], [36], [37], [38], [3]. IT governance is a variable that defines the management administrative decision making (roles, responsibilities, accountability and control) of Green initiatives.	This variable was suggested by [2], [3], [4], [5], [7], [10], [18], [19], [20], [21], [22], [23], [24], [25], [27], [31], [33], [35], [36], [37], [38], [39], [46], [49], [56], [57], [58], [59], [60], [61], [62], [63], [64], [65], [66], [67], [68], [69], [70], [71], [72].
Technologies & systems (IT infrastructure, IT facilities)	Technologies & systems comprises of IT infrastructure, IT facilities in the enterprise. The technologies includes the network critical physical infrastructure such as ventilating, cooling, and power delivery; communications technologies and IT network such as network devices and physical servers and shared services such as electronic data interchange and enterprise-wide databases and business applications that utilize the shared infrastructure for sourcing analysis and purchasing of IT related facilities [10], [23], [32], [73].	This variable was stated by [10], [13], [18], [20], [22], [23], [27], [30], [32], [56], [57], [10], [23], [24], [25], [33], [34], [61], [64], [65], [66], [68], [70], [73], [74], [75], [76], [77], [78], [79].
Motivating forces (Pressure, institutional forces/pressure, stakeholders)	Motivating forces includes pressure, institutional forces/pressure and stakeholders' pressure. Motivating forces is a variable that influences sustainability decision making goal in collaborative enterprise. These forces are commercial pressure mainly stems from increasing energy costs, leading to the need for enterprises to lessen power consumption of IT hardware. Lowering energy costs is often associated with the aim to achieve economic advantage. Another motivation forces stated previously is governmental pressure for Green ITIS principally stems from various forms of environmental standards and regulations enforced by governments around the world. Social pressure is employed by the cumulative clients/end users' call for Green solutions and the increased positive public awareness of Green initiatives [17], [20], [81], [46]. Thus pressure can also influence practitioners' integration of Green practices, such pressures includes mimetic, coercive, and normative pressure.	This variable was discussed by [4], [9], [17], [20], [46], [77], [81], [82], [83], [84], [85], [86], [87].
IT strategy (Business strategy, Green strategies)	IT strategy is ascribed to business strategy and Green strategies. IT strategy mainly involves depiction of the enterprise in terms of its routine, scope and management structure. This variable determines how practitioners implement their enterprise strategies. The strategy used by an enterprise to accomplish its objectives is very vital in the adoption of Green practices. IT strategy mainly aims to support enterprise in decrease their operating expenses in product and services design and development. Enterprise wanting to adopt Green practice must first develop a suitable IT strategy that acknowledges the importance of environmental issues by enacting environmental practices [18], [19], [45]. There is need to substitute a culture that encourages practitioners to tryout ideas about environmental issues reduction aligned with business integration. Furthermore research by [56] found out that when practitioner notice a strong signal from their enterprise management regarding environmental issues, they are more likely to be involved in adopting and implementing environmental friendly initiatives. The business strategy is an important role in enterprise going Green, the strategy applied can influence the business development direction and promote enterprise to get more competitive advantages in the long-term. The fundamental functions of strategic aims to support enterprises cut their product and operation cost.	This variable was presented by [18], [19], [23], [24], [25], [26], [45], [56], [85], [88], [89], [90], [91], [92], [93], [94], [95].
Information availability (Information, Information dissemination, information organization)	Information availability comprises of Green information, information dissemination and information management in the enterprise. Green ITIS aims to support enterprise achieve environmental sustainability initiatives and outcomes. Development toward enterprise going Green cannot be successfully undertaken without specific information provided through an established Green knowledge source [7], [61], [96]. Lack of information, therefore, becomes a hindrance to achieving environmental outcomes and improving environmental performance in collaborative enterprise.	This variable was recommended by [3], [7], [61], [96], [35], [39], [43], [95], [97], [98], [99], [100], [101], [102], [103], [104], [105].

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Table 7: IT Practitioners Attributes for Sustainable adoption in Collaborative Enterprise

IT Practitioners Attributes	Description	Citations
Attitude	Attitude is the degree to which an individual assesses a behavior as un-favorable. With reference to sustainability attitude reflects a practitioner's evaluative judgment about the current process adopted in the enterprise, whether the current practice is either harmful or beneficial to the environment. Attitude is an affective characteristic of practitioners; it measures the extent to which practitioners are aware of and interested in going Green. Thus a positive attitude is necessary for Green ITIS adoption to be successful.	[18], [4], [26], [97], [98], [106], [107], [108].
Behaviors (personality)	This is the way in which practitioners' acts or conducts themselves while carrying out their business process, particularly towards going Green.	[18], [4], [26], [97], [98], [106], [107], [108].
Ethics	This is the moral principles that direct practitioners behavior or in implementing Green activity. It mostly deals with decent principles.	[20], [21], [22], [86], [109].
Resource allocation/availability	These are those tangible and intangible assets which are made available in enterprise. These resources if made available can assist practitioners in practicing Green initiates'.	[10], [18], [19], [30], [79]
Social-culture (lifestyle)	Involves practitioners' beliefs, customs, practices and behavior that exist within an organizational process. It is the way in which a practitioners work daily.	[73], [40], [65].
Values (mission)	These are the standards or principles of behavior of practitioners based on their judgment of what is important in enterprise business process.	[9], [73], [40], [65], [89], [110].
Beliefs	Refers to an enduring group of perceptions and cognition about the concept of Green ITIS and enterprise sustainability.	[9], [26], [36], [38], [73], [40], [41], [48], [50], [51], [65], [89], [91], [110].
Environmental orientation	This is the practitioners' basic attitude, beliefs, or feelings in relation to practicing Green ITIS.	[9], [75].
Knowledge (cognition)	Knowledge can be defined as a justified certainty that increases an entity's capacity for operational action. Knowledge is hold by practitioners and it is required for the utilization of physical resources within CE. Knowledge can embody a state of mind, a process, an object, a capability or a condition. Knowledge is an asset such as information, knowledge as a resources can be seen as capabilities which include the understandings, insights and applied know how of practitioners in CE.	[2], [18], [20], [21], [22], [27], [31], [48], [59], [69], [86], [87], [90], [109].
Experience	The skill or knowledge acquired by a period of practical experience can influence practitioners to adopt Green practices, because the experienced practitioners are more open to new ideas such as going Green.	[87], [111], [59], [62], [93], [40], [87], [95].
Norms	Norm a person's perception that most people who are important to him/her think he/she should or should not perform the behavior in question, in this case going Green and adopting Green practices in CE, thus norm in Green adoption is a belief that the processes by which practitioners implement their enterprise process should be improved.	[7], [9], [10], [73], [40], [65], [89], [100], [110], [73].
Commitment	This is the quality or state of practitioners being dedicated to the Green cause, Green activity implementation.	[5], [18], [113], [61], [66], [63], [81], [38], [31].
Awareness	This is the measure of practitioners' perception or knowledge of sustainability and eco-environmental process.	[19], [75], [55], [113], [43], [114], [115].
Intention	Can be observed as a subjective probability that practitioners will really infuse and diffuse Green strategies in their enterprise.	[107], [84], [108], [44], [40].
Morale	This is the enthusiasm, confidence and discipline of practitioners at a particular time in relation to going Green.	[56], [61], [84], [85].
Moral	Concerned with the practitioners principles of right and wrong behavior in relation to caring for the environment. Mostly associated with or derived from the code of conduct that is considered right or acceptable by governmental and non-governmental bodies and the society.	[56], [61], [84], [91], [85]
Involvement (interest)	The condition or fact of being associated or participating in adopting and implementing Green practices. This is influenced by the interest of practitioners (the feeling of wanting to know or learn about Green ITIS and sustainability).	[57]
Sentiments/ mindset	The opinion or view that is expressed or held by practitioners in ration to adopting Green practices.	[18], [57], [44]
Concern (action)	This attribute reflects practitioner's evaluation of the relationship between the environment and their actions by measuring egoistic, bio-centric and social-altruistic values. This attribute is also measures the degree to which practitioners thinks that the environment is at risk to enterprise and societal activities.	[24], [106], [63], [68]
Competencies (expertise)	This is the ability of practitioners to implement Green practices efficiently or successfully.	[24], [25], [26], [94], [43], [17]
Desire	Is mostly practitioners strong feeling of wanting or wishing to implement Green initiatives.	[98
Ability	This is practitioners' possession of the means or skill to do utilize Green ITIS infrastructures.	[19], [37], [87], [43], [48

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

IT Practitioners Attributes	Description	Citations
Communication (communicate, partnership)	The is the means used by practitioners to exchange or impart Green ITIS and sustainability information by writing, speaking or utilizing some other medium.	[2], [103], [93], [94], [17], [78
Time	This is the persistent progress of existence as affecting practitioners' involvement with the application of Green practices.	[17
Effort	Relates to practitioners vigorous or determined attempt to go Green.	[17
Trust	Firm or fixed belief in the reliability, truth, or ability that exists among practitioners in enterprise is a determinant of Green IT IS adoption in enterprise. Trust in enterprise can lead to acceptance of Green practices without investigation or evidence by other practitioners.	[72].
Mood	A temporary state of mind or feeling of practitioners can determine if they will attempt to go Green, thus they may not adopt Green initiatives if they are angry or sad.	[48].
Perception	The values of the practitioners are influenced by what the organization aims to achieve.	[48].

B. IT Governance's Attributes

IT governance's variable is measured by the attributes shown in Figure 9 and in Table 8.

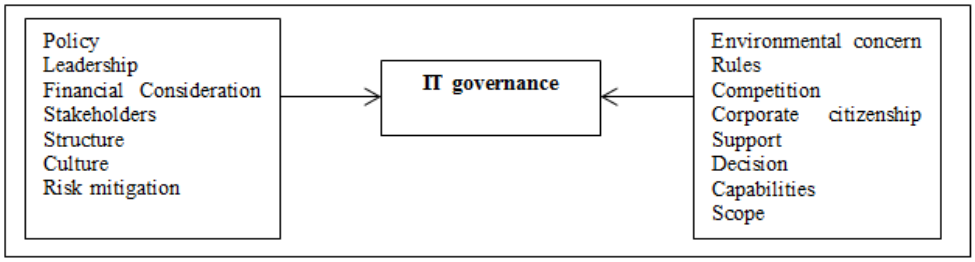

Figure 9: Outlines IT Governance' Attributes for Sustainable Adoption in Collaborative Enterprise

Table 8: IT Governances' Attributes for Sustainable Adoption in Collaborative Enterprise

IT Governance Attributes	Description	Citations
Policy (guidelines, general requirements, principles)	These are Green principles or course of action proposed or adopted by the managerial board in the enterprise.	[39], [46], [49], [56], [57], [72].
Leadership	This is management action of directing and leading all the staffs in an organization to practice Green IT IS.	[18], [31], [42], [113].
Financial Consideration (cost saving, budget, economics, low cost)	This is the amount the management is willing to invest into Green processes.	[116], [71], [45].
Stakeholders	These are person(s) with an interest or concern about Green ITIS process. These people all have similar interest of implementing eco-friendly strategies in their enterprise.	[7], [79].
Structure	How and who are involved in the management board can also determine if they will encourage Green strategies.	[2], [3], [4], [5], [7], [62], [63].
Culture	This is the customs, ideas and social behaviour of management board members regarding Green strategies.	[2], [3], [4], [5], [7], [62], [63], [69], [70], [71], [72], [117].
Risk mitigation (risk reduction, risk control)	This is the process involved in identifying, making decisions, treating and monitors environmental risk that surfaces from enterprise and society activities. These risk are harmful to the environment thus should be adequately mitigated, reduced and controlled.	[118], [119], [120], [121], [122], [123].
Environmental concern	Pertains to practitioners' interest or involvement in having a specific connection with or responsibility for caring for the ecosystem.	[7], [9].
Rules	These are regulations relating to environmental protection and preservation presented by the management.	[7].
Competition	This is mainly the activity or condition of enterprise striving to win or gain popularity and having a good reputation or good branding for being a Green establishment among other organizations.	[56].
Corporate citizenship	Involves the social responsibility of enterprise and the extent to which management must meet ethical, legal and economic responsibilities, as established by institutional forces and shareholders.	[56].

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Support	This attributes measures the amount of encouragement or approval given by management towards Green ITIS adoption to practitioners by being actively interested in and concerned for the success of the enterprise going Green.	[124],
IT Governance Attributes	**Description**	**Citations**
Decision (Decisions making)	These are Green resolution or conclusion reached after consideration by the management. This attribute also measures the action of deciding how the enterprise can implement Green practices.	[21], [22], [23], [24], [25]
Capabilities	Refers to the physical tangible and feasible in-tangible infrastructures and assets that represent management ability to deploy and co-ordinate resources to implement Green practices.	[125], [2], [3], [4], [5], [7]
Scope (size)	This attribute represents the extent at which the management is willing to implement Green initiates across the enterprise.	[64], [70].

C. *Technologies & System's Attributes*

Technologies & system's variable is influenced by the attributes illustrated in Figure 10 and Table 9;

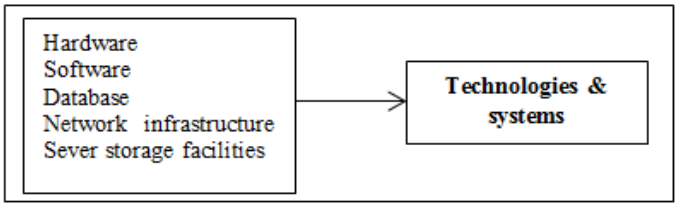

Figure 10: Illustration of Technologies & System' Attributes for Sustainable Adoption in Collaborative Enterprise

Table 9: Technologies & Systems' Attributes for Sustainable Adoption in Collaborative Enterprise

Technologies & Systems Attributes	Description	Citations
Hardware	This attributes comprises wiring, machines, and other physical infrastructure, components of a computer or other electronic facilities that are deployed and utilized to implement Green practice.	[10], [13], [18], [20], [22], [27], [30], [32], [56], [57], [10], [23], [24], [25], [33], [34], [61], [64], [65], [66], [68], [70], [73], [74], [75], [76], [77], [78], [79].
Software (application)	These are the computer programs and other systems applications used by practitioners to Green their enterprise process.	
Database (application, server)	This are layers of structured set of data retained in a computer, and can be accessible in various methods such as enterprise data centers when Green strategies can be stored and reused.	
Network infrastructure	These are the complete network that enables network operations, management, and communication connectivity of practitioners when they utilize the enterprise network system for carrying out business process.	
Sever storage facilities	This is the server that is used to store, access, secure and manage digital data, Sustainable files and services. Enterprise used such server for accessing and storing Green data through the Internet and over shared network	

D. *Motivating Forces' Attributes*

Motivating forces' variable is measured by the attributes shown in Figure 11 and in Table 10;

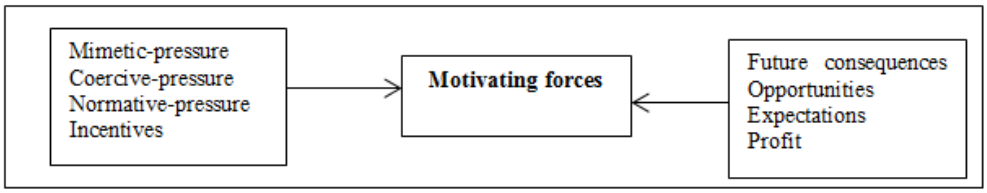

Figure 11: Interaction of Motivating Forces Attributes for Sustainable Adoption

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Table 10: Motivating Forces 'Attributes for Sustainable Adoption in Collaborative Enterprise

Motivating Forces Attributes	Description	Citations
Mimetic pressure (trend in society, following other organization, reputation building)	This is the pressure to imitate operationally similar successful enterprise in the same business area without necessarily considering the enterprise context. Mimetic pressure is supposed to certainly impact the intention of enterprises to assimilate Green practices. This is in line with the findings by Alenka et al. [55] that established a positive impact of mimetic pressure on the adoption of Green practices.	[85], [86], [87], [113], [38], [55], [91], [42]
Coercive pressure (government, regulatory body)	Refers to pressure chastised in societal dependencies and expectations towards other enterprises Also, various industry regulations and government exert coercive pressure on enterprises and determinedly drive the diffusion of Green ITIS. The empirical findings provided by [87], [113] as well as [38] indicate that coercive pressure form government, regulatory bodies encourage enterprise to implement Green practices.	
Motivating Forces Attributes	**Description**	**Citations**
Normative pressure (pressure within the enterprise)	Pressure that is embedded in the current process of professionalization. This pressure arises from the interchange of best practices among practitioners across different enterprise. Normative pressure is pressure within the enterprise. It is derived when the management induces practitioners to implement and adopt Green practices. In line with this, [4], [91], [42] mentioned that Green practices assimilation is driven by normative pressure.	[85], [86], [87], [113], [38], [55], [91], [42].
Incentives (financial support and allowances)	If an enterprise rewards their organizational staffs for practicing Green practices, thus can encourage practitioners to implement more Green initiates. Presently Government of some countries such as Australia, New Zealand, USA and European Union etc. provides incentives and reimburse enterprise that implement Green practices.	
Future consequences	If the consequence of future action is observed as harmful, and the practitioner declares the responsibilities, a sense of guilt will surface because the attribution of harmful consequence that will occur in future. This can lead to practitioners changing their attitudes and practicing Green ITIS.	
Opportunities	This is the set of circumstances or time that makes it possible for practitioners and management to do go Green. Since going Green is quiet easy. Enterprise can decide to adopt invest in Green ventures.	
Expectations	If practitioners and management are mostly influenced by the strong belief that going Green will lead to enterprise cost saving and reduction of resources they will support the Green movement.	
Profit (economic, cost benefit)	If there exists a financial gain, particularly in the difference between the amount earned from practicing Green initiatives and the amount spent in operating, buying, or deploying these Green initiates, then enterprise will be encouraged to go Green.	

E. IT Strategy's Attributes

IT strategy's variable is measured by the attributes shown in Figure 12 and Table 11;

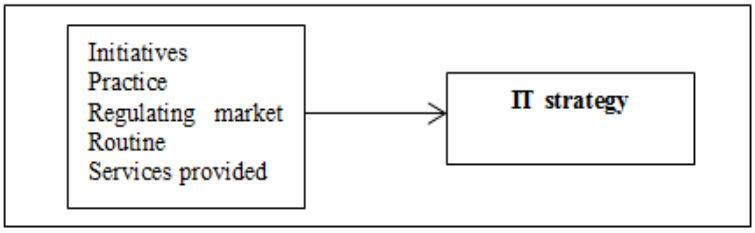

Figure 12: It Strategy's Attributes for Sustainable Adoption in Collaborative Enterprise

Table 11: IT strategy's Attributes for Sustainable Adoption in Collaborative Enterprise

IT Strategy Attributes	Description	Citations
Initiatives (Practice, schemas)	This is the current act or scheme employed by practitioners in the enterprise. The initiatives employed by the enterprise will influence Green strategy.	[18], [23], [24], [25], [26], [45], [85], [88], [89], [90], [91], [92], [93], [94], [95].
Practice (procedure, methods, approaches)	This is the present habitual, customary, or expected way or procedure of carrying out enterprise process. Thus the current process can influence enterprise Green strategy.	
Regulating market (market forces)	This is the market where the government controls the determinants of demand and supply, such as who is allowed to purchase from the market, and/or what amounts may be charged. Thus these market forces can affect enterprise going Green.	
Routine (activities, tasks)	These are sequence of actions regularly followed in the enterprise. These routines will also affecting the enterprise integrating Green strategies into their business process.	
Services provided	The specific amount of services offered to the general public by the enterprise will determine if they can practice Green strategy or not.	

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F. Information Availability's Attributes

Information availability's variable is measured by the attributes shown in Figure 13 and Table 12;

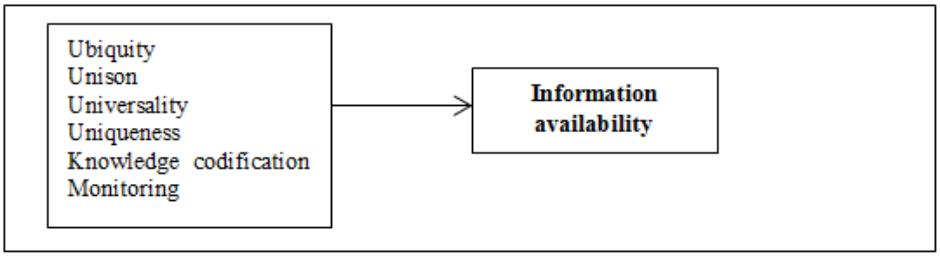

Figure 13: Relationship of Information Availability's Attributes for Sustainable Adoption in Collaborative Enterprise

Table 12: Information availability's Attributes for Sustainable Adoption in Collaborative Enterprise

Information Availability Attributes	Description	Citations
Ubiquity (communicate, exchange)	According to Watson et al. [7] the need for information by practitioners leads them to seek IS that offers ubiquity such as the usage of systems to communicate with other practitioners. This is the usage of information to communicate and to have access to information unconstrained.	[3], [7], [35], [39], [43], [95], [97], [98], [99], [100], [101], [102], [103], [104], [105].
Unison (transfer, flexibility)	Same information, have consistent information. Unison, which is involved when all practitioners in a project uses corresponding schedule	
Universality (sharing, access)	Universality involves services that have more functionality such as systems that provide practitioners with the latest Green information relating to the environment and climate. This involves latest information with more functionality and incompatibilities reduction across enterprise business process.	
Uniqueness (processing)	This comprises of precise and unique information. Uniqueness involves application such as enterprise resource planning (ERP) systems to manage the transportation of developed products/services to end users/ consumers.	
Knowledge codification (Explicit and tacit knowledge/information access, dissemination)	Knowledge can be categorized into tacit and explicit knowledge. Tacit knowledge is associated to people and is acutely rooted in commitment, action and involvement in a specific context, which makes it inflexible to transfer such as skills. Tacit knowledge, which is related to know how, can only be discovered through its application. Explicit refers to knowledge that that can be transferred in formal, systematic language and is created by combining or externalizing reference models, applications and manuals. Thus codification of knowledge is the process of transferring tacit knowledge into explicit knowledge.	
Monitoring (reporting)	Involves the availability of information to assist practitioners to observe and check enterprise progress of implementing and adopting Green strategies over a period of time.	

3.2.3 Control Variable

This section explores and presents the control variables for adopting Green ITIS practices derived from the literatures as shown in Figure 14 and described in Table 13, where Figure 14 shows the control variables that are to be considered in Sustainable adoption in collaborative enterprise. These control variables are constant in the enterprise.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

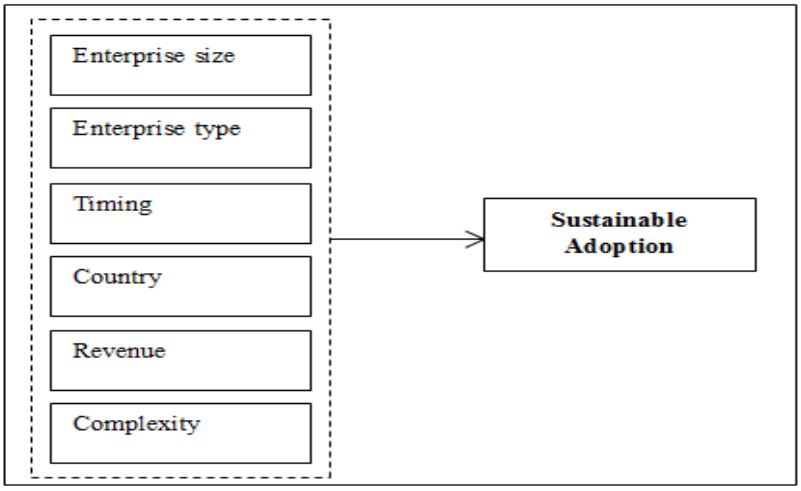

Figure 14: Interaction of Control Variables for Sustainable Adoption in Collaborative Enterprise

Table 13: Control Variables for Sustainable Adoption in Collaborative Enterprise

Control Variables	Description	Citations
Enterprise size (number)	The size of enterprise may affect if the practitioners in the organization will adopt Green practices or not, which strongly correlate to enterprise routine. Thus, the present study includes enterprise size based on enterprise's total assets in terms of the practitioners in the enterprise. According to Sulaiman et al. [44] sustainable enterprise strategic adoption varies according to the size of the enterprise. Smaller enterprise have a less sophisticated understanding of technical issues while larger enterprise are usually in possession of more infrastructure, finance and human resources.	[44], [56], [4], [23], [66], [80], [45], [81], [17], [121].
Enterprise type/industry sectors	Enterprise in diverse industry sectors may accomplish differently in terms of Sustainable practice adoption and implementation in their enterprise. As enterprise in different industry sectors have different needs, it appears that those in more information intensive sectors are more likely to adopt Green strategies than those in less IT intensive sectors.	[56], [44], [4], [23], [66], [80], [45], [81], [17],
Control Variables	**Description**	**Citations**
Timing (earliness)	The time an enterprise first adopt Green strategies may affect its implementation due to first mover benefit. Thus our research includes timing as a control variable to recognize when an enterprise starts to adopt and implement Sustainable practices.	[45], [80], [81], [17], [121].
Country (corporate citizenship)	According to Jens et al. [80] stating that the topographical site of the country effects the adoption and implementation of Green practices in any enterprise, thus the administration decisions in countries will differ from one country to the other.	[80], [97], [68], [22].
Revenue	The income acquired by an enterprise over a period of time will influence if the enterprise adopts and implements Green strategies in its enterprise process.	[100], [63], [94], [90].
Complexity	This is the current state of the enterprise in terms of the enterprise business process being complicated or intricate.	[56].

3.2.4 Moderating Variable

This section searches and presents the moderating variables for adopting Green ITIS practices derived from the literatures as shown in Figure 15 and in Table 14; Figure 15 shows the moderating variables that moderates IT practitioners (IT professional, employee, staffs, individuals, society, IT human infrastructure) and IT governance (Organization, management, corporate governance, Green governance) variables.

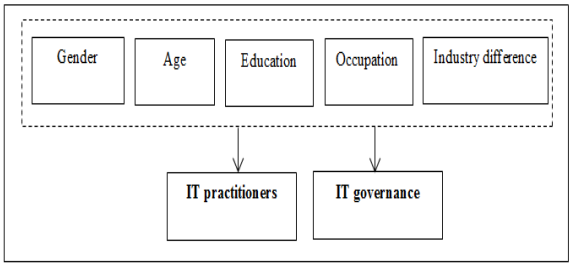

Figure 15: Representation of Moderating Variables for Sustainable Adoption in Collaborative

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Table 14: Moderating Variables for Sustainable Adoption in Collaborative Enterprise

Moderating Variables	Description	Citations
Gender	The relationship between practitioners and management gender in relation to the implementation of Green practices has produced diversified results. However, gender differences have been found not to have an effect on practitioners implementing Green practices in their enterprise [24].	[8], [24], [39], [66], [108], [50], [51], [99], [107].
Age	A number of researchers have explored the relationship between age and attitudes and behavior toward Green practices adoption in enterprise. Some have reported important relationship between age, behavior and environmental attitudes [26], [40].	[8], [24], [26], [39], [40], [66], [108], [50], [51], [99], [107].
Education	Several studies have examined the influence of education on sustainable practice in enterprise. However, the findings are indecisive. Some found negative correlation between the educational levels of practitioners in relation to sustainable practice. Thus there is a positive link between practitioners and management age in relation to Greening their enterprise, as their age increases their association in sustainable activities like in the reuse, recycle, refurbish, reduces, also increases.	[8], [39], [66], [108], [50], [51].
Occupation (working experience)	The current occupation of practitioners may influence the adoption of Green practices in their enterprise. Practitioners that have more working experience relating to Green initiatives may easily continue to implement Green practices.	[8], [66], [108].
Industry difference	This variable cannot be ruled out, because practitioners in IT based enterprise may easily adopt Green practices unlike practitioners in other industries such as banking, industry etc.	[8].

3.2.5 Dependent Variable

This section discusses the dependent variable (Implementation and adoption of Green practices) for adopting and implementing Green ITIS practices derived from the literatures is shown in Table 15; the dependent variable; decision making support is measured in enterprise by considering either the sustainability consideration (pollution prevention practice, service steward practice & clean technology practice) or ecological consideration (eco-efficiency, eco-equity & eco-effectiveness). Figure 16 and Table 15 outlines the attributes to be considered as outcome of the dependent variable. Figure 16 shows the outcome of the dependent variable (Implementation and adoption of Green practices) The outcome of the dependent variable is influenced by the action or influence of the independent, control and moderating variables stated previously and the process described in Section 3.3 of this paper. Thus the independent, control and moderating variables influences the adoption of Green practices, while the process influences the implementation of Green practices in collaborative enterprise. As seen from Figure 16 the dependent variable can be measured in terms of sustainability consideration and ecological consideration for sustainability attainment.

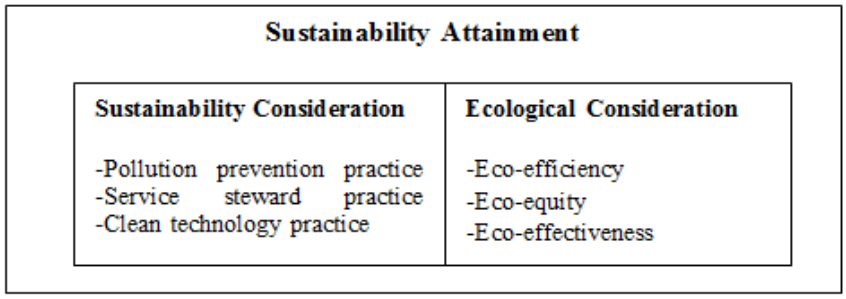

Figure 16: Sustainability Attainment in Collaborative Enterprise

Table 15: Dependent Variables for Sustainability Attainment in Collaborative Enterprise

Dependent Variable	Description (Sustainability and Ecological Consideration)	Citations
Pollution prevention practice	Mostly concerns the control and mitigation of contaminating emissions and wastes during and after development procedures. In enterprise pollution prevention practice involves innovation and use of IS to lessening pollution produced by enterprise processes. In mitigating pollution, thus practitioners use IS technology such as innovative carbon and energy assessment and control application or telematics systems to reduce enterprise's carbon footprint.	[3], [15], [18], [7], [28], [61], [100],
Service steward practice	Requires environmental effects to be considered all through enterprise processes. Mainly comprises service for development and design in enterprise. This practice is generally based on the ethics of the	[8], [19], [22],

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

	practitioners and management. In enterprise, service stewardship practice includes innovation and use of information system such as innovative digital platforms, conference and collaboration system that improve the eco-friendly of product and service implementation.	[23], [24], [25],
Clean technology practice	Clean technology or sustainable development practice includes the use of modern application or systems to change enterprise processes by implementing and adopting practices that improve and preserve resources, low waste, non-polluting, and energy efficient strategies. Clean technology practice in enterprise involves usage of IS such as sustainable data and learning controlling systems that change enterprise operations.	[21], [61], [36], [33], [126], [127].
Eco-efficiency	Refers to enterprise's ability to offer competitive services that fulfill end users' needs and bring value of life while progressively reducing ecological impacts. Thus eco-efficiency associations traditional efficiency goals with ecological concerns, and can be seen as the provision of competitively products and services that satisfy human needs and bring quality of life, while progressively reducing ecological effects and resource usage throughout enterprise business process in line with the earth's resonant capacity .	
Eco-equity	Is mainly concerned with the equal rights of people to environmental resources and an enterprise's social responsibility for future generation to come. It anticipates for fair distribution and dispersal of natural resources between present and future generations.	
Eco-effectiveness	Aims to reduce pollution and lessen depletion of natural resources by guiding practitioners and enterprises' responsiveness to the important and fundamental elements of environmental issues through fundamental redesign of Green approaches. Eco-effectiveness also means doing the right thing, such as adopting sustainable practices that make possible long-term prosperity of the environment.	

3.3 Process or life cycle for sustainable implementation in collaborative enterprise

With reference to the second research question; what are the lifecycle or process involved in implementing Sustainable practices in collaborative enterprise? The process or lifecycle involved in implemented Green practice in enterprise is presented in this Section. According to Mohamad et al. [136] life cycle is same as process. Each of the cited reference mentioned the process in their study, thus they were included in the citations column of the Table 16. Thus the answer to research question 2 is discussed in this section as shown in Figure 17 and Table 16. Figure 17 shows the Green process or lifecycle, the process starts with the creation, the next phase is the production followed by the sourcing and then the usage and lastly disposal. To implement a sustainable Green practice in collaborative enterprise practitioners and management should be ready to adhere to each phase stated Table 16.

Table 16: Process for Sustainable Implementation in Collaborative Enterprise

Green Process	Description	Citations
Creation (design/building/ deploy/development/extraction)	From a creation or design viewpoint, Green ITIS refers to the role of IT and IS in supporting enterprise's sustainability initiatives. This is implemented when practitioners utilize systematic information systems for their enterprise process, carbon foot print analysis and environmental management in their production and development activities. It also encompasses IT based low CO_2 enterprise solutions such as IP telephony, telecommuting, web based business services, thin client, virtual collaboration and videoconferencing.	[56], [22], [23], [24], [25], [59], [26], [136], [63], [64], [13], [34], [58], [36], [93], [43], [72], [128], [129], [130], [131], [132], [133], [134], [135], [136], [137], [138], [139], [140], [141].
Production (manufacturing/ distribution)	Develop systems with automated components, computers, and other auxiliary subsystems with limited impact on the environment. This phase emboldens operative processes and increases the reutilization and reuse proportion of developed products. Moreover, this phase also involves sterile delivery systems to encourage minimal unwanted materialization, which increases the competence of enterprise, thereby lowering resource consumption.	
Sourcing (procurement/purchase)	In sourcing or procurement Green ITIS entails the practice of eco-sustainable preferable IT infrastructure purchasing in enterprise. This involves eco-sourcing practices such as, evaluation of the Green track record of software application, integrating Green issues such as recyclable design and packaging in merchant evaluation, analysis of the environmental foot print of an IT hardware & ICT services providers and addition of social concerns such as the presence of harmful materials in IT process in Green procurement decisions	
Usage (operation)	From a usage or operation viewpoint, Green ITIS includes reducing IT induced CO_2 emissions, structural avoidance results in reduction installed power capacity, enhancing energy efficiency in powering and cooling of enterprise IT assets. This process aims to bring about energy consumption decrease by optimizing power utilization without reducing installed power base.	
Disposal (end of life)	From disposal or end of life perspective, Green ITIS denotes practices in reusing, recycling and disposing IT hardware in an ethical ecological environmental manner. It involved the recycling, refurbishing, reducing and reuse of resources	

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

3.4 Sustainable models and frameworks in collaborative enterprise

With reference to the third research question; what are the existing models or frameworks aimed at supporting the adoption and implementation of Sustainable practices in collaborative enterprise? Table 17 shows existing related models or frameworks that has been proposed or developed by researcher from 2008- till July 2016, however only models/frameworks that present variables and/or process are included in the review. Since publication on sustainability relating to Green ITIS practice began from the year 2007/2008 as stated by [3], [12], [13]. The existing models and framework (Table 17) can be seen in Appendix A. The reviewed models and frameworks individually assist enterprise to achieve sustainability by caring for the environment, reducing energy consumption, lessening CO_2 emission, reducing enterprise cost of doing business. However none of the models or frameworks specifically aims to support the decision making of practitioners and management in adopting and implementing Green practice in collaborative enterprise.

4. DISCUSSION

Sustainable adoption and implementation has been a major focus for collaborative enterprise for the past decade as the rate of power for data centers has increased swiftly. Researchers and academicians in IS discipline can direct environmental sustainability into the digital age and also contribute to a healthy earth for generations to come [66], [142]. Presently environmental sustainability is one of the most essential global encounters of the 21st century, according to one of the world's prominent climatic scientist James Hansen; our universal climate is approaching leaning points. Changes are starting to appear, and here is a potential for quick changes with effects that would be irrevocable, if slow fossil fuel emissions during the next few decades is not rapidly reduced. Due to lack of efficient action to lessen Greenhouse gas emissions, the prediction for many on planet earth are due to harmful planetary overheating is not comfortable. By virtue of their control in the global economy, collaborative enterprise can play a crucial role in promoting environmental sustainability and mitigating climate change [79].

Enterprise can adopt environmental sustainability initiatives; first by informing practitioners, stakeholders and decision makers of the need to make changes to organizational strategies, by motivating practitioners and management to enforced actions to attain environmental objectives, and secondly by assessing the effects of their enterprise process on economic, social and environmental performance also known as 3Ps- planet, people and profit; Triple Bottom Line (Economic, Social and Environmental) [1], [2], [14], [17], [21], [22], [23], [74], [75], [58], [59], [62], [30], [66], [13].

Green ITIS is a vital and adequately implicit weapon in the arsenal of enterprises in their pursuit for implementing and adopting sustainable practices by empowering new initiatives and procedures in support of enterprise going Green. Protecting the eco-system for the long-term existence of man and other species on the planet is the obligation of every human. While Green ITIS plays an imperative role in caring for the environment, it also adds considerably to its deterioration. IT practitioners need to proximately take a more practical and accountable role to battle this issue [33]. It is inadequate to resolve the environmental effect of IT usage simply by recycling obsolete and outdated hardware at the end of the lifecycle the issue needs to be resolved at the beginning and during the lifecycle of enterprise business process [96]. However, findings from the literatures posed that practitioners and management are challenged by not knowing how to implement and adopt Green practices, as mentioned by Craig & Paul [20] highlighting that there is need for a model with the capability to support practitioners in adopting Green practices. Robert & Nora [58] suggested that there is need to develop a model to assist enterprise in the development and implementation of sustainable IT service.

A study by IBM shows that majority of enterprise do not have a sustainable model or approach less alone the capability to develop one [26]. An ideal reference model outlining, tasks, responsibilities roles and processes and in the scope of sustainable practice for the entire enterprise seems useful to practitioners [111], [143]. Presently there is lack of a framework to assist managerial decision making, thus there is need to develop an approach to support collaborative enterprise towards achieving and

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maintaining the Green strategies in development process [83]. Chunguang & Joseph [120] added that there is a need for an approach to aid in strategic assessment and implementation of sustainable practices, since available approach to perform these tasks are still limited, especially practical and flexible approaches. Chunguang & Joseph [120] also mentioned that a decision tool or model can greatly benefit managerial decision making, if developed and appropriately used by practitioners. Based on the review there is need for an approach to support collaborative enterprise in implementing and adopting Green practices.

5. CONTRIBUTION, LIMITATION AND IMPLICATION FOR RESEARCH & PRACTICE

5.1 Contribution

This study contributes to the limited academic and research work in this area and allows other academicians to better apprehend the process, variables and related attributes to be taken into consideration to achieve environmental sustainability in collaborative enterprise. Therefore, this review paper may provide researchers, academicians and practitioners with guidance as they conduct future research and develop their own theories. Also new theories can be developed based on the process, variables and attributes in this paper. Lastly this review paper presented existing models and frameworks that have been developed by other researcher across the years (from 2008 till July 2016) related to collaborative enterprise domain only, although a finding from this study is based on secondary data derived from existing research relating to Green ITIS and sustainability in collaborative enterprise domain. This review paper may also be used a road map for researcher that have interest in venturing into Green ITIS in other domains. We also made an important relationship between the process or lifecycle and variables and their related attributes, even though such relations has been theoretically recognized by researcher such as [70], there is a scarcity of review research related to Green process, variables and attributes. In particular, this study provides pragmatic support for the complementary effects between the variables and their related attributes in driving the adoption of implementation of Green and sustainable practice in collaborative enterprise.

5.2 Limitation

This study is poised by several limitations, among these limitations is the fact that this review paper only included Green IT IS and sustainability research related to collaborative enterprise domain only, other papers related to Green IT and Green computing in industrial, manufacturing, agricultural domains etc. was excluded from the review. Also the review includes research papers relating to sustainability from 2007/2008, there have been publications relating to sustainability from 1994 -2004 as seen by publication from [15], [1], thus it is possible that some relevant papers have been ignored in the review. The researchers also excluded papers not written in English language, this is also a limitation because important secondary data may have been lost. Pertaining to the existing models and frameworks reviewed, out of the 139 papers reviewed only papers that presents a model or framework that comprises of variables, attributes or process were included. Variables or attributes or any equivalent of these findings were included in the review of existing models and frameworks. Lastly several papers related to Green ITIS and sustainability was not included in this review paper because they do not provide answers to our research question stated in Section 2.1.

5.3 Implication for Research and Practice

The study has several implications for practitioners and researchers. In terms of research, it studied the call for a body of IS review research that investigates and explores on the variables and attributes influencing the adoption and implementation of Green and sustainable practice in collaborative enterprise. Although several researchers such as [21], [23], [46], [47], [54] [123] have all investigated on the variables that influence enterprise go Green, this review papers presents a comprehensive list of all the process, variables and attributes to be considered by practitioners and management in going Green in their enterprise. This paper, therefore, represents one of the few review studies regarding the implementation and adoption of Green practice in collaborative enterprise. These findings can be helpful to practitioners and researchers attempting to understand how enterprise can care for the environment and also consider the social and

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

economic aspects. This study also enhances the research on Green practices by presenting and describing existing works that has been done in this research domain.

The importance of Green ITIS can be seen as one of the approach to be used to address climate change, which is one of the greatest challenges facing this generation. Decreasing Greenhouse gases requires major commitments from enterprise and consequently, more research into how enterprise can apply Green ITIS and be motivated towards this trend would be valuable to practitioners, individuals, management and society. The research and practical insights derived exploring Green ITIS adoption and implementation assists in gaining a clear understanding of the variables and attributes that can be used to increase and improve the extent of Green and sustainable practice initiation in collaborative enterprise. This may then allow enterprise to lessen the environmental impact of their IT processes and operations as well as allowing them to utilize the presented process or lifecycle to improve environment enactment in other areas throughout the enterprise.

Therefore this paper contributes to research and practice in several ways. The contribution to practices and research is three pronged (based on the three research questions answered). First, it represents one of the few studies focusing on the Green IT IS variables and related attributes. The heightened importance of ecological sustainability has generated a body of research on green practices. Secondly, the Green process or lifecycle have been a missing piece of the eco-sustainability puzzle which has been ignored by practitioners when they carry out their business process. Most practitioners only implement the end of life phase also known as disposal, which is not enough for an organization to claim that its business or development process is Green [96]. Lastly by drawing upon the existing model and frameworks developed to assist enterprise go Green; we identified the research and practical contributions and gasps that need to be resolved.

6. CONCLUSION AND FUTURE WORK

This research is an answer to call from researchers as Navneet & David [110] request for academicians and researchers to focus research to help support practitioners decision making process. This research followed a systematic literature review methodology as the main technique. As the aim of the review is to develop a clearer and deeper conceptualization of sustainability and Green ITIS in collaborative enterprise, a review of the sustainability and Green ITIS practitioner and academic literature as well as literature on the Green process, variables, their related attributes and review of existing Green models and frameworks in collaborative enterprise has been undertaken. A literature review method is suitable for creating a sound groundwork for advancing knowledge and model development. A systematic literature review is mostly based on three sequential activities of input by adopting a review protocol, process of data extraction, data synthesis, data assessment and output of finding of the review based on the stated research questions. This review paper adopts the systematic literature review method suggested by Kitchenham and Charters [11], which states that completing systematic literature review involves quite a few activities such as planning the review, conducting the review, and reporting the finding from the review in relation to sustainable adoption and implementation in collaborative enterprise.

Green ITIS and sustainability is a new and emerging research domain for researchers, academicians, practitioners and industries. Kitchenham and Charters [11] suggested that authors could address an emergent issue through the medium of a review paper, which can help to create a theoretical foundation in the study area. This review paper is an answer to that call, thus we carry out this review paper to answer three related research question as mention in Section 2.1. According to Jason [97] there is need to carryout research work, which can then lead to identifying measurable variables and developing hypotheses that can be tested in quantitative studies. There is need for an approach to provide guidance to practitioners, scholars in their quest for environmental sustainability [28]. This paper follows a systematic literature review of Green ITIS and sustainability research in the domain of collaborative enterprise. A total of 143 papers were reviewed, synthesized and extracted to provide answer to the research questions Sated in Section 2.1. findings form this review papers presents the variables (independent, control, dependent, mediating and moderating variables) and their related attributes to be considered in adopting Green practices in collaborative enterprise. Green process or lifecycles to be considered in implementing Green initiatives in

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

collaborative was presented in this review. Lastly existing related model and frameworks was reviewed based on the model or framework process, variables, attributes, contributions and methodology applied in their research.

Future works involves the development of a decision support model to assist practitioners and management to adopt and implement Green practices in collaborative enterprise. The model will be based on Green ITIS variables and Green ITIS process discussed in this review paper. The attributes can be used as items to develop an instrument to carryout empirical research on the adoption of Green and sustainable practices in collaborative enterprise. The process can be used to develop a decision support tool to support practitioners and management in making decisions on how to implement a Green and sustainable practices in collaborative enterprise. Lastly it is to be noted that several research papers related to Green ITIS and sustainability in collaborative enterprise was retrieved, however only papers that were able to provide answers to our research questions were included to this review, thus the researchers declares no conflict of interest.

ACKNOWLEDGMENTS

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APPENDIX

Table 17: Green IT IS Sustainable Models and Frameworks in Collaborative Enterprise

Authors Year Contributions	Variables/Attributes/Process (if any)	Problem Solved	Data Collection /Analysis
1. Adela et al. [7] suggested a conceptual model and stated prepositions for organization achieving ecological sustainability	The model variables comprises of *information system, eco-efficiency, eco-equality, eco-effectiveness* as independent variables, *mimetic pressure, coercive pressure and normative pressure* as mediating variables and *adoption of eco-effective practices* as the dependent variables.	The researchers focused on how organizations are *motivated to act in an eco-friendly way* and suggested institutional theory as a lens to better understand how IS can be utilized to achieve the three indicators of ecological sustainability namely eco-efficiency, eco-equity and eco-effectiveness.	Mentioned carrying out empirical investigations in future.
2. Alemayehu et al. [22] developed a Green IT readiness framework	The developed framework comprises of *attitude (IT attitude and business attitude), policy, practice, technology and governance (IT governance and environmental governance)* as independent variables. The framework process comprises of *sourcing, operation and end of life*.	The authors claimed to introduced the concept of Green IT and defined the main pillars of the developed readiness framework *to help organizations evaluate their readiness for adopting Green IT*	No empirical data was mentioned.
3. Alemayehu [56] proposed a model titled the Green IT adoption model (GITAM).	The model comprises of *Green IT context, Green IT readiness and Green IT drivers* as independent variables, *intention to adopt Green IT* as mediating variable and *Green IT adoption* as dependent variable.	The proposed model defined Green IT from four different but interrelated perspectives. It posits that the technological, organizational and environmental contextual variables, dynamic Green IT readiness dimensions and strong order Green IT drivers *can predict the intention and the breadth and depth of Green IT adoption.*	No empirical data was mentioned.
4. Alemayehu & Vanessa [59] extended their previous research and provided a preliminary proof of concept of the Green IT readiness framework	As stated previously the framework comprises of *attitude (IT attitude and business attitude), policy, practice, technology and governance (IT governance and environmental governance)* as independent variables. The framework process comprises of *sourcing, operation and end of life*.	The authors identified five main areas of Green IT capability and describe the main pillars of a G-readiness framework *to help organizations evaluate their maturity for Green IT.*	*Desk-based* research *case study* of four organizations.
5. Alemayehu et al. [74] develop a Green IT Readiness (G-readiness) model	The model comprises of *Green IT attitude, Green IT practice (procurement and Energy audit & monitoring), Green IT policy, Green IT technology (IT technical infrastructure, data center air flow management, data center cooling systems & power delivery systems) and Green IT governance (strategic foresight, resources and metrics)* as independent variables. *G-readiness* as dependent variable.	The researchers *aimed to identify the key dimensions of Green IT* and develop a reliable and valid instrument to operationalize it. They also created an interaction between IT and eco-sustainability.	The validity of the model was tested using *structural equation modeling* (SEM) based on data collected from a cross-sectional and cross country(Australia, New Zealand and USA) *survey* of Chief Information Officers and other IT managers (More than 100 respondents).
6. Jose et al. [27] designed an IT enabled innovativeness and Green capability research model	The research model comprises of *technological IT resources, human IT resources (managerial IT resources and IT staff's technical skills)* as independent variables, *innovativeness* as a mediating variable and *Green management capabilities* as dependent variable. *Firm size, quality management practices implementation and operational agility* as control variables.	The researchers *analyzes the relationships* between two types of IT resources (human IT resources and technological IT), firms' Green management capabilities and innovativeness of the firm.	Survey conducted in Spanish firms. Partial least square (PLS) a *structural equation modeling* technique was used to analyze the data using SmartPLS 2.0. M3.
7. Richard et al. [28] presented the energy informatics framework	The framework consists of *eco goals (eco-efficiency, eco effectiveness, eco equality), stakeholders (consumers, suppliers, governments), polices & regulations, economics and corporate norms* as independent variables. *Supply and demand of*	The researchers suggested way for the IS community to engage in the improvement of environmentally sustainable practices by presenting a research agenda to establish a new area	No empirical data was mentioned.

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	information system comprising of sensor network, flow network and sensitized objects as dependent variable.	of *energy informatics, which uses IS to increase energy efficiency. (Energy + Information < Energy).*	
8. Stefan et al. [82] developed a model for adoption of sustainable IS practice	The model comprises of *strategy definition, organizational support, motivation and traceability through information systems* as independent variables and *successful adoption of sustainable practices* as dependent variables.	The researchers present variables to be considered in the development and adoption of sustainable practices.	Data was collected using *Semi-structure interview from four informants using Case study* of an IT software solution provider. *Nvivo software* was used to code and analyze the data.
Authors Year Contributions	**Variables/Attributes/Process (if any)**	**Problem Solved**	**Data Collection /Analysis**
9. Stan et al. [19] proposed a conceptual framework	The framework comprises of *institutional forces (coercive, normative and mimetic), motivation (efficiency and natural environment), ability (organizational beliefs/climate for eco-sustainability, ICT governance, Green ICT governance and resources) and expectancy (performance expectancy and effort expectancy)* as independent variable and *adoption of Green data best practices* as dependent variable.	The study *aims to identify the antecedents to the adoption* of technologies and techniques (including those that are commonly accepted to produce successful outcomes such as best practices in greening data centers. The framework also *assists in explicating the conditions that might influence the adoption* of the best practices in greening data centers.	The conceptual framework was partially explored through *two case studies*. Where data was collect using *interview* conducted with a university that has multiple data center and an organization that has a data center.
10. Ben & Geoffrey [10] developed a Green IT extent model	The model comprises of *competitive pressure (external competitive pressure and bottom lie considerations), legitimation pressure (normative, legitimation pressure and coercive legitimation pressure), social responsibility pressures, organizational pressure (management influences, organizational capabilities) and Technological constraints* as independent variables and *extends of Green IT* as dependent variable.	The researchers aimed at *understanding the factors that influence organizations towards going Green* and also *predicting future behavior and creating mechanisms to encourage more sustainable organizations*.	Utilized online *survey* (online questionnaire targeting senior IT managers) using *regression* for data analysis. Carried out content and construct validity of the instrument by checking the Cronbach's alpha for reliability and exploratory factor analysis for internal consistency (based on only 38 responses from different organizations).
11. Tracy et al. [18] developed a multi research framework	The framework comprises of *environmental sustainability motivating forces, environmental sustainability initiatives (Green information technologies and systems strategies and Green information technologies and systems)* as independent variable. *Overall environmental orientation (environmental cognition, environmental attitude, environmental behavior), organization and employee* as mediating variables. *Environmental impact* as dependent variable.	The researchers presented an agenda for Green ITIS research by setting a stage for other researchers to follow based on the framework prepositions. Thus the framework *offers a comprehensive look at Green IT/S issues in relation to enterprise environmental initiatives and their environmental effects.*	No empirical data was mentioned.
12. Adela et al [61] proposed a research model based on Green IS & IT adoption	The model comprises of *mimetic pressure (frequency based imitation and outcome–based imitation), coercive pressure and mimetic & coercive pressure (imposition-based coercion and inducement-based coercion)* as independent variables and *adoption of Green IS & IT* as dependent variable. *Industry type and revenue* of the enterprise was added to the model as control variables.	The study *examines how institutional pressures affect the adoption of green IS & IT across organizations*. From the natural-resource-based perspective, it also *examines Green IS & IT practices* in relation to pollution prevention, product stewardship, and sustainable development.	They used partial *least square method* a variance-based structural equation modeling tool was employed to analyze the *survey* replies from 75 organizations using

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			SmartPLS.
13. Jens et al. [80] developed a model for grid assimilation Green strategy	The model comprises of *pressure for environmental sustainability, mimetic pressure, coercive pressure and normative pressure* as independent variable. *Country, firm size and earliness of grid adoption* as control variable, where *grid assimilation as Green IT strategy* as dependent variable.	The model uses Grid technology *to decrease the environmental impact of IT hardware.* The study also shows the degree to which pressure for environmental sustainability as well as different types of institutional forces effect on the plan of enterprises to utilize Grid technology as a means to lessen energy usage of IT hardware.	An online survey using questionnaire in English, which was later, translated into German, French, and Dutch with a final sample of 359 valid responses. The researchers adopted an exploratory methodology, where structural equation modelling using partial *least square method* was used to analyze the data.
14. Alemayehu et al. [23] furthered their previous research and presented an exploratory Green IT readiness (G-Readiness) framework	The model comprises of *attitude, practice, policy, technology and governance* as independent variables. *G-readiness* as dependent variable.	The research explained the Green IT capabilities of enterprise and the maturity of those capabilities by capturing the input, transformational and output *capabilities that enterprises need to cultivate in sustainable administration of IT*.	Data was collected from a cross sectional and cross country *survey* of IT Managers. Data was analyzed using *structural equation modelling*.
15. Alemayehu & Ahmad [89] developed a Green IT motivation framework	The framework comprises of *eco-efficiency motive, eco-effectiveness motive, eco-responsive motive and eco-legitimacy motive* as independent variables. *Adoption of Green IT & IS for Green* as dependent variable. *Size of the enterprise and industry type* as control variable.	The research studied *the influence of enterprise eco-sustainability motivations on the adoption of Green strategies.*	Data from 176 organizations (Chief Information Officers (CIOs), IT decision maker, top IT Managers) in Australia was collected through a survey and analyzed using exploratory factor analysis *structural equation modelling*.
Authors Year Contributions	**Variables/Attributes/Process (if any)**	**Problem Solved**	**Data Collection /Analysis**
16. Jung et al. [101] recommended a model for corporation implementing Green management performance	The model consists of the company's internal *(CEO commitment and IT resources)* and external factors *(intensity of competitions and government regulations of environment)* as independent variables which are mediated by the *establishment & utilization of information systems, and building for relationships information & knowledge* as mediating variables. Where *Green management performance* is the dependent variable.	The study *examined the effects of external and internal factors of small and medium sized corporations* on Green management performances through the deployment and operation of IT.	Data was collected from 178 Korean organizations using *survey*. Confirmatory factory analysis was conducted to guarantee the validity and reliability of variable. Testing reliability with Cronbach's coefficients. Discriminant validity was assessed the model variables. The analysis of the goodness of fit indexes of the research model was used to test the

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			model hypothesis.
17. Tom [31] designed a comprehensive practice oriented Green IS framework	The framework comprises of *business and IS strategy, which, in turn influences the energy efficiency people, waste and recycling, dematerialization and Green operations.*	The author argued that the designed framework can comprehensively address and lower organizational Greenhouse Gas (GHG) emission.	No empirical data was mentioned.
18. Maryam et al. [32] designed a new framework for organizations to apply Green technologies and process	The new framework consists of *information quality, system quality, service quality, environmental concern and knowledge* as independent variables. *Users' satisfaction in term of using Green technology* as mediating variable and *individual performance* as dependent variable.	The new framework aims to enhance the performance of individuals in applying Green technologies and process in their business.	Case study of university.
19. Vanessa & Alemayehu [33] developed a Green IT capability model	The model comprises of *stakeholder pressure for Green, social integration mechanism, Green IT exposure & experience, industry norms as regimes of appropriability, Green IT knowledge acquisition and assimilation, Green IT knowledge transformation, Green IT knowledge exploitation, Green IT attitude, Green IT policy & governance and Green IT practice & technology*.	This researchers utilized the theory of absorptive capacity to represents the capability of the IT organization to recognize the value of recognizing new and external information, transform, assimilate *to classify the processes of, and the elements that influence, an IT organization's Green IT capability*.	*Case studies* comprising of four organizations and one university.
20. Mohamad et al. [67] suggested a conceptual framework showing the emergence and recurrent use of Green IS practice	The framework consists of *external influences (regulative, normative & cultural-cognition); Green IS field (organizational actor (resources &disposition) and lastly Green IS practice (eco-sustainability practice).*	The researchers' mainly *discusses the advent and the intermittent use of Green IS practice in organizations*.	The researchers employed a *single case study* in this study.
21. Yulia & Chulmo [109] developed a model of Green IS adoption by investigating the motivational factors of Green IS usage behavior	The model variables comprises of *Intrinsic Motivation (Perceived Pleasurability), eco-technological knowledge, Integrated Regulation (Perceived Usefulness), Integrated Regulation (Perceived Altruism), Identified Regulation (Perceived Importance), Introjected Regulation (Ego Involvement), attitude toward Green IS use behavior, social influence, Green IS use intention, facilitating conditions and actual Green IS use*.	The authors' studied *the predictors of Green technology adoption behavior and established Green technology foundation* mainly from motivational perspective.	*Web based survey* comprising of 100 respondents. Used *partial least squares* to validate the model.
22. Chun & Ngai [91] recommended a Norm activation model for organization adopting Green IT	The model comprises of *discretionary slack, personal norm, managerial interpretation, and competitive advantage of Green IT as* independent variable, *mimetic, normative and coercive pressure* as control variables. *Intention to Green IT adoption* as dependent variable.	The study *investigated how an intention to adopt Green IT is formed* based on the Norm of the practitioners which influence their intention to go Green.	Mentioned collecting data through survey in future.
23. Alemayehu & Ahmad [68] presented a Green IT adoption model based on motivational perspective in organizations	The model comprises of *eco-efficiency motive, eco-effectiveness motive, eco-responsiveness motive and eco-legitimacy motive* as independent variables, *sector, size and corporate citizenship* as control variables. *Adoption of Green IT* as dependent variable.	The research studied the *factors that influence the adoption of Green practices in organization.*	Conducted survey from 176 organizations in Australia. Data was analyzed using exploratory factor analysis and analytical *structural equation modeling* (SEM).
24. Ming et al. [85] proposed a residential energy information system framework	The framework involves the framework use enabled by intervention strategies which in turns results to *norm activation, motivation, evaluation, action and outcome* based on *habitual behavior*.	The authors aimed *to promote energy efficient behavior* in residential energy end users.	No empirical data was mentioned.
25. Ijab & Molla [36] presented a conceptual framework and preposition that can be used for future IS research	The model comprises of *(resources, economics, knowledge & technological), disposition (eco-sustainability & roles of IS)* as independent variables and *Green IS practices (pollution prevention practice, product stewardship practice & sustainable development practice)* as dependent variable.	Their study was mainly apprehensive *with understanding the practice of using IS for eco-sustainability* which is now known as Green IS.	Mentioned carrying out empirical investigations in future.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Authors Year Contributions	Variables/Attributes/Process (if any)	Problem Solved	Data Collection /Analysis
26. David [93] presented a Green IT value model	The model comprises of *awareness, translation, Green IT, comprehension and value* as the variables which are influence by risk control.	The presented model *described the process and mechanism of achieving Green IT and environmental sustainability in enterprise* which focuses on various risk factors that influences the models' variables.	No empirical data was mentioned.
27. Chun & Ngai [84] extended their previous research and presented a Green IT adoption research model based on managerial perspective	The model comprises of *discretionary slack, strategic orientations (organizational innovation orientation, organizational futurity orientation & environmental orientation)* as independent variable. *Management perception (managerial interpretation & relative advantage)* as the mediating variable and lastly *intention to adopt Green IT* as dependent variable.	The authors *investigated how organizational elements disturb the formation of an enterprise decision maker's intention to adopt Green IT through the mediation of managerial opinions.*	Plans to collected data from private and public companies using hard copy questionnaire which will be delivered by post to respective respondents.
28. Vanessa & Alemayehu [77] developed a duo models comprising of a context based Green IS assimilation model and a Green IT assimilation capability based model	The context based Green IS assimilation model comprises of *organizational context & environmental context* as independent variable. Green IT assimilation as dependent variable. The Green IT assimilation capability based model comprises of *Green IT knowledge acquisition, Green IT knowledge assimilation* as independent variables. *Green IT knowledge exploitation & Green IT knowledge transformation* as mediating variables. *Green IT assimilation* as dependent variable.	The authors researched beyond the initial adoption of Green IT and *investigated on the assimilation of Green IT* in enterprise.	Previously adopted case study and later carried out an international *survey* of 148 large organizations. The psychometric property (reliability and validity) of the instrument was tested using Partial Least Square (PLS). *Structural equation modelling* (SEM) and Partial Least Square was also used to validate the models.
29. Alemayehu et al. [39] developed a research framework that is based on belief-action-outcome (BAO) framework which consisted of 11 hypotheses	The framework variables include *Green IT beliefs, Green IT attitudes, pro-environmental IT practice, organizational context, information acquisition capability, and demographic characteristics (gender, age and education).*	The authors *analyzed the attitudinal factors and beliefs that affect the private sphere pro-environmental behavior* of IT professionals in using personal computers.	Data was collected using a web link of *survey* questions from respondents comprising of 322 IT professionals in Australia and analyzed using *structural equation modeling.*
30. Vanessa & Alemayehu [70] proposed a duo models similar to their previous work, comprising of a context based Green IS assimilation model and a Green IS assimilation absorptive capacity-based model	The context based Green IS assimilation model comprises of *organizational context, technological context & environmental context* as independent variable. The Green IS assimilation absorptive capacity-based model comprises of *potential Green IT absorptive capacity & realized Green IT absorptive capacity* as independent variable and *Green IT assimilation* as dependent variable.	The authors *investigated the factors that influence Green IT assimilation in organizations*.	Data was collected from an international survey of 148 large organizations. *Structural equation modelling* (SEM) and Partial Least Square was also used to validate the models.
31. Deepti et al. [40] suggested a conceptual model based on theory of reasoned action for the application of Green IT	The model variables include *subjective norms, attitude towards behavior and behavioral intention* as mediating variables. *Actual behavior* is the dependent variable. *Person related beliefs, sector of respondent, experience of respondent and level of awareness* are the independent variables. *Sector, age and working experience* were included as demography variables.	Their *study investigated the behavior for the adoption of Green IT* in organizations.	*Survey* was used to conduct data among IT professionals from major private and public sector establishments. 157 samples were used for the validation of the model. *Structural equation modelling* (SEM) was used for data

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

			analysis.
32. Ibrahim & Alok [41] proposed a Green IT model based on the theory of planned behavior perspective	The model variables include *behavioral beliefs, subjective norms, and perceived behavioral control* as independent variables. *Behavioral intention to use* as a mediating variable and *actual use* as dependent variable.	Their study *explained IT professionals' intentions for implementing Green IT practices.*	They conducted a survey among IT professionals from and private and public sector organizations. ANOVA technique was used to analyze the data.
33. Nicky et al. [71] developed a contingency model for Green IT governance	The model variables comprise of *competitive strategy, firm size, organization structure, performance strategy, environmental impact of industry, environmental strategy, IT infusion and IT diffusion* as independent variable. *Green IT governance* is the dependent variable.	The authors *showed the fit between incidents and the enterprise-specific outline of Green IT*. The model provides *possibility factors for determining the ideal type of Green IT governance*. Thus the model can *assist enterprise to select the most efficacious Green IT governance outline to adopt*.	The model was first tested using case study and later validated by a *questionnaire* using *factor and regression analysis* method.
Authors Year Contributions	**Variables/Attributes/Process (if any)**	**Problem Solved**	**Data Collection /Analysis**
34. Mohammad et al. [48] proposed a research model to determine the factors that influences the practicing Green IT processes	The model variables include *job relevance, user experience* as moderating variables. *Argument quality, source credibility, Green IT beliefs, Green IT attitude* as independent variables and *Green IT practice intention* as dependent variable.	The researchers aimed *to examine how process of external influences affects the practicing of Green IT among potential practitioners* in organizations.	The researchers mentioned planning to develop a measurement instrument in future.
35. Molla & Cooper [87] developed a model to assist data centers go Green	The model variables include *ability, effort expectancy, performance, expectancy, institutional mimetic, institutional normative and institutional regulative* as independent variable. *Best Practice implementation* as dependent variable.	Their study aimed *at investigating the motivation, expectancy and ability drivers for organizations implementing and greening their data centers.*	The authors collect data form 96 data centers using *survey*. The data analysis progressed in two steps of verifying the psychometric properties of the measurement model followed by the structural model test. Smart PLS and SPSS tools were later used.
36. Bokolo & Noraini [5] proposed a framework for adoption and implementation of Green IT/IS practice in IT governance	The framework variables includes *environmental sustainability initiatives (motivational forces, business strategies & technologies & systems)* as independent variable, *environmental orientation (organization & employee)* as mediating variable, *environmental impact (pollution prevention practice, service steward practice & sustainable development practice)* as dependent variable.	Their study aimed to *develop a framework to assist practitioners and enterprise in the adoption of Green IT/IS practices mainly in IT governance.*	The researchers plan to validation of the framework based on a survey.
37. Sulaiman et al. [44] developed a Green IT practice adoption model	The model variables comprise of *institutional pressure, consideration of future consequences, openness, economic performance, environment performance and customers satisfaction* as independent variable. *Industry type and size of the enterprise* are the control variables. *Adoption intensity of Green IT practice* is the dependent variable.	The authors *examined the factors that affect the adoption intensity of Green IT strategies and their consequent influence on the enterprise's performance* in the perspective of a developing country (Iran).	Data was collected using an online *survey* through a questionnaires administered to 277 managers in Tehran Stock Exchange. Data analysis was carried out using *structural equation modeling*.
38. Mueen et al. [72] suggested a knowledge management framework using Green IT to implement	The framework variables includes knowledge management *(renewal & update, sharing, evaluation, creation), eco-system (knowledge sharing culture, infrastructure & design of entrepreneur eco-system, information communication & technology network & interaction between business entrepreneurs & stakeholders) and Green IT (Green IT attitude,*	The framework *perceives the relationship between eco-system and Green IT to produce a sustainable entrepreneur eco-system.*	No empirical data was mentioned.

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sustainable entrepreneur eco-system	*Green IT practice, Green IT policy, Green IT technology and Green IT governance).*		
39. Mohammad & Azizah [50] designed an integrated framework to understand the influence of morality on Green IS adoption	The framework variables include *norm activation model (awareness of consequences, personal norms, ascription of responsibility, Green IS attitude & environmental attitude), upper echelon values (self-transcendence & self-enhancement)* as independent variable. *Upper echelon characteristics (age, gender & education level)* as mediating variable and *intention to adopt Green IS* as dependent variable.	The study *identified and examined the factors that influence the pro-environmental behaviors of managers to adopt Green IS strategies*. Their study is also *useful to assess the influence of moral behavior on practicing of Green IS strategies* by the managers of enterprises.	No empirical data was mentioned.
40. Chin-Jung et al. [45] carried out an empirical study on the impact of Green activities on enterprise performance	The variables from the study consist of *Green activities and performance* as dependent variables. *Degree of research & development, degree of internationalization* are the independent variable. *Firm size, timing and industry sector* are the control variables.	The study aims to *distinguish an arrangement of Green activities* (Green processes, ISO 14000, Green certifications and pollution prevention) and *analyzed their relationships with enterprise performance.*	They collected data from Taiwan Economic Journal (TEJ) and official websites of the sampled firms. With a sample size 599 for examining Hypothesis 1 and the sample size 627 for examining Hypothesis 2. Descriptive statistics analysis and correlation matrix using multiple logistic regressions was used to analyze the data.
41. Qi & Shaobo [46] proposed a theoretical framework on organizational Green IT adoption	The framework variables includes *external drivers which comprises of technological context institutional pressure (coercive pressure, mimetic pressure & normative pressure) and internal motivations (top management support, Greening of organizational culture, strategic intent)* as independent variables. *Organizational IT adoption* as mediating variable. *Sustainable competitive advantage* as dependent variable.	The research study *provides a general review and description of why enterprises adopt Green IT*. The study also *provides policy makers and managers with a systematic investigative framework in managing their business decisions*.	The authors plan to examine the correlation between and internal motivation and external drivers & test the model with empirical data.