

A Proposed Model for Green Practice Adoption and Implementation in Information Technology Based Organizations

Propozycja modelu określania i wprowadzania Zielonych Praktyk w przedsiębiorstwach wykorzystujących technologie informatyczne

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Abstract

Green Information technology system offers opportunity for IT based organizations to act proactively in terms of environmental preservation as well as to mitigate effects of global climate change and other environmental problems. Green Information technology system adoption and implementation is a plausible attempt for IT based organizations to resolve the current environmental issues and also enhance their economic performance and possible social benefits. Currently several models and frameworks have been developed to address sustainability in various research domain. However, there are few models that can support decision making of practitioners in adopting and implementing sustainable practices in IT based organization. Therefore there is need to develop a model to assist practitioners adopt and implement sustainable practices. The proposed model comprises of Green variables, Green process and a hybrid technique of software agents and case bases reasoning. Findings from this paper shows the model variables, process, techniques applied and derived prepositions. Ongoing work involves adopting a mixed research (case study and survey) to verify the model variables, process and validate the model prepositions.

Key words: sustainability, Green Practice, IT based organization, Case Based Reasoning, Software Agent

Streszczenie

Zielone technologie informatyczne ułatwiają firmom wykorzystującym technologie informatyczne (IT) podejmowanie działań na rzecz ochrony środowiska, a także tych prowadzących do zmniejszenia skali zagrożeń związanych ze zmianami klimatycznymi i innymi współczesnymi wyzwaniami ekologicznymi. Wdrażanie zielonych technologii informatycznych stanowi właściwe podejście dla firm IT nie tylko z uwagi na możliwość rozwiązywania bieżących problemów środowiskowych, ale także zwiększenia efektywności ekonomicznej i możliwych korzyści społecznych. Obecnie rozwija się wiele modeli odnoszących się do różnych aspektów zrównoważoności, jednak tylko nieliczne z nich nadają się do wykorzystania w procesie decyzyjnym firm IT. Z tej przyczyny istnieje potrzeba opracowania takiego modelu, wspierającego wprowadzanie zrównoważonych praktyk na tym poziomie. Zaproponowany model uwzględnia Zielone zmienne, Zielone procesy i połączenie techniki programowania agentowego z wnioskowaniem w oparciu o studium przypadku (CBR). Dzięki przyjęciu rozszerzonego podejścia (studium przypadku, ankieta) możliwa jest weryfikacja zmiennych modelu, procesów i potwierdzenie przyjętych założeń.

Słowa kluczowe: zrównoważoność, Zielone Praktyki, przedsiębiorstwa IT, CBR, programowanie agentowe

Introduction

Green relates to processes and technologies that are environmentally friendly, which have a less negative effect on the environment than conventional ones. The environmental influence of Green technologies and practices refers to the resultant effect on the ecology during product lifecycle, while the environmental effect of Green processes refers to the reduced need for resources and the reuse of materials to decreased pollution (Fabian, 2013). However due to immensely utilization of natural resources, there is insubstantial balance of the future of the ecological system and this has resulted to increased CO₂ emissions. Currently, sustainability problems are dominant and enterprise, governments, academic institutions and cross-national organizations are revolving their attention to the enquiry of how to make the world a better place, thus sustainability has been deliberated as a crucial research domain within IT based organization. Sustainability is a multi-complex term which incorporates issues associated to the environment, economy and society. In fact, sustainability refers to preservation deployment and the ethical use of resources.

According to the United Nations Report on World Commission on Environment and Development; sustainable development in enterprise is development that meets the needs of the present day without compromising the ability of future generations to meet their own needs (WCED, 1987). Lately, emphasis of environmental concerns has transformed from the local scale to global scale and has become the main concern of IT based organizations as well as non-governmental institutions, governments institutions and society (Nicky, Henning and Lutz, 2014; Mohammad, Mehrbakhsh, Azizah, Amir and Nor, 2015). There are three dimensions to sustainability; social, environmental and economic generally known as the triple bottom line. IT based organizations need to develop sustainability strategies that balance societal, environmental and commercial goals by ensuring that all three dimensions are adhere to simultaneously (Hart, 1997; Fabian, 2013; Daphne and Anol, 2014; Alemayehu, Ahmad and Vanessa, 2014). Sustainable development in IT based organizations entails a long term vision, which does not compromise the capability of future generations to meet their wants and needs (Chris, Jean and Carolyn, 2014). According to Chris et al. (2014); Fabian (2013) academic contributions to the domain of Green information technology system (ITIS) have evolved since 2008. Green ITIS continues to gain recognition as both academicians and practitioners look for pioneering ways of utilizing ITIS based systems to aid attain Sustainability goals in IT based organizations. IT based organizations is an organization that involves more than two people or group of people working together to accomplish same goal and objectives, e.g. a university planning on implementing Green technologies in their laboratories or an organization

using biodegradable materials in producing goods and services to their consumers.

Information technology (IT) usage in IT based organizations has resulted to two order effects. The first order refers to the negative effect of IT use, production and disposal on the environment. This perception sees IT as part of the problem, this however resulted to the notion of making IT product usage and disposal more environmentally friendly and Greener, termed as Green Information Technology. The second order consequence refers to the positive effect of IT on the environment which sees IT as part of the solution by utilizing IT to make business procedures and strategies Greener known as Green Information Systems (IS). Green IT and Green IS are still in their infancy and have just begun to be understood and implemented in IT based organizations (Mohammad et al., 2015; Ibrahim and Alok, 2015). IT based organizations going Green has become a main topic of concern in the modern world. Where Green IT in IT based organizations aims to decrease energy consumption and waste related with the use of both hardware and software infrastructures. Green IS in IT based organizations is the use of information systems to support environmental sustainability strategies and goals (William, Philip and Mak, 2014). In this paper, we use *Green ITIS* as a derived term covering all efforts to reduce the environmental damage initiated by the use of IT, or to use IT in ethical and positive ways to help in the accomplishment of environmental aims and goals.

It has become widely recognized that the emanation of Greenhouse gases is having a cumulative impact on the climate. Additional it is a known fact that natural resources are speedily being exhausted and the unconcerned disposal of waste poses a severe threat to human health (William et al., 2014). Decision making has long been acknowledged as an issue of great significance within IT based organizations domain and, in recent years, considerable attention has been dedicated to its impact on the adoption of Green initiatives by practitioners. William et al. (2014) argued that for enterprise to systematically incorporate environmental strategies into their business activities, they require major change of enterprise decision making process. However there are few models that support decision making of practitioners in adopting and implementing sustainable practices in IT based organization. This research study concept of decision making support is similar to research carried out by Tom (2011) who researched using case study to study how Green IS can support organizational sense-making, decision making and knowledge sharing and creation around the design and manufacture domain. However the authors did not utilize Green variables, Green process and techniques which are very important as states by Alemayehu (2009a) in his research on the reach (process) and richness (variables) of Green IT and also their research is based on design and manufacture domain, whereas this research study

is based on IT based organizations domain. Thus this research study propose a model to support practitioners in IT based organizations in making Green decisions on how to adopt and implement sustainable practices in their organizational process. The model comprises of Green variables, Green process and a hybrid techniques comprising of software agents and case bases reasoning (CBR). The Green variables comprises of independent variables (IT governance, IT practitioners, technologies and system, motivating forces, IT strategy and information availability), moderating variable (age, gender and education), control variable (timing, country, size, sector and revenue) and Green Adoption and Implementation as dependent variable which is based on pollution prevention, product stewardship and sustainable development as mention by Hart (1997). The Green process includes design, distribution, procurement, operation and end of life.

The dependent variable in this research study is based on the findings of Hart (1997) who presented the concept of environmental sustainability related to the theory of the Natural Resource-Based View. Hart (1997) identifies three goals that must be considered by practitioners to progress the environmental sustainability of IT based organizations and they includes pollution prevention, which is attained through minimization of waste and emissions, product stewardship, addressed by thoughtfulness of stakeholder optimization of product lifecycles and lastly sustainable development, accomplished through lessening of enterprise's environmental footprint and obligation to a continuing sustainability vision (Hart, 1997; Fabian, 2013). Information technology (IT) and information systems (IS) are of particular significance in realization of these three goals stated above. Thus the proposed model support practitioners in making decision to achieve each of these three goals (pollution prevention, product stewardship and sustainable development) in IT based organizations only through software agents to benchmark, assess and rate how Green the enterprise process currently is case based reasoning to provide support for making Green decisions based on past successful Green cases inputted by domain experts.

The positive social consequences of Green practices in IT based organization is complex to achieve and engages both practitioners and management to be adaptive and flexible in infusing Green initiatives and standards. Positive social consequences towards Green practice adoption and implementation requires practitioners to cultivate a sustainable IT organizational culture, set IT social-sustainability objectives, goals and transform IT services, products and processes. For implementing social-sustainability initiatives and strategies, management should follow several social-sustainability practices ac-

ording to Hart (1997) these positive social consequences can lead to be reduction of emissions, wastage of water electronic waste decline, minimizing the total environment footprint of organizational development and lastly improving efficiency. Green practice in IT based organization socially aims to diminish environmental footprint during usage by utilizing clean technologies that consumes energy from renewable power sources to decrease the use of polluting materials and improve environmentally friendly know-hows (Vanessa and Alemayehu, 2012). However for any IT based organization to benefit from the positive social impacts, they are required to invest in technologies of the future. Since such technologies can cause substantial changes in the enterprise development process with a vision to decrease the negative environmental effects derived from the design to consumption of IT organizations products and services

The outline of this paper is organized as follows: section 2 presents the materials and methods. Section 3 is the proposed Green decision support model. Section 4 is the discussion of the paper. Section 5 is the research implication and limitation of the research and the final section is the conclusion and future work of the research.

Materials and methods

This section discuss on the methodology adopted in this research paper; which is desk based research executed by utilizing secondary data source by reviewing existing industrial, practitioners and academicians publications relating to Green sustainability practices in IT based organizations in discussing the concept of Sustainability in relation to the environment. Also research publications relating to Green ITIS practice and lastly existing Green sustainable models and frameworks was reviewed.

Sustainability in IT organizations

Sustainability was defined by the (WCED, 1987) as development that meets the needs of the present without affecting the ability of future generations to meet their needs. However, this definition has been criticized by some researchers such as (Viet, Ian and Jerry, 2011; Alemayehu, 2013) as being extensive and challenging for enterprise to comprehend and apply. As a result much of the attention on sustainable development inclines toward environmental perception without considering the social and economic aspects of sustainability. More lately, a triple bottom line (TBL) viewpoint of sustainability has been embraced which considers enterprise sustainability to include three modules: society, natural environment, and economical state of enterprise.

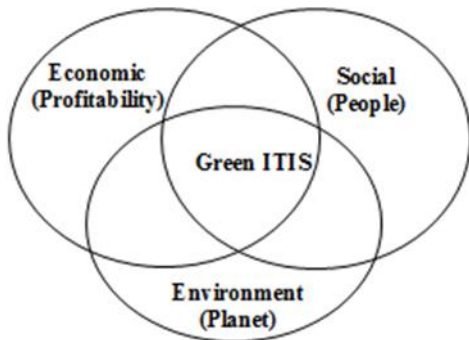


Figure 1. Triple bottom-line target in IT based organizations (Viet et al., 2011)

Figure 1 shows the dimension to be considered in attaining sustainability. The balancing of social responsibility, economic profitability and environmental obligations is commonly known as the triple bottom line (Viet et al., 2011; Alemayehu, 2013). By considering the planet (effects on the environment), people (society) in relation to enterprise profit (economic) sustainability can be attained in enterprise (Elkington, 1997).

In fact, it is maintained that long-term viability in enterprise is best accomplished by balancing it with environmental and social goals (Elkington, 2004; Hart and Milstein 2003). The Sustainability of IT based organizations is viewed as a planned shared response to address environmental issues caused by enterprise's operations and activities aimed at improving the eco-friendliness of its occupational procedures (Alemayehu, 2013).

IT based organizations can implement Green practices in attaining Sustainability. These Green practices can be support enterprise control and prevent pollution throughout its operations and production activities by incorporating eco-environmental strategies throughout the system lifecycle. This implies that while the achievement and benefit of adopting Green strategies by practitioners could contribute to enterprise's environmental as well as financial value, the accomplishment itself could be subjective by enterprise's overall Green strategy (Hart and Milstein 2003; Alemayehu, 2013).

Green IT and Green IS concept

Information Technology refers to computer software, hardware and peripheral infrastructures, whereas Information Systems is an extensive concept that involves the human activities and technology components related to the running and management process of technology across enterprise. IT conveys, processes, or stores and provides information, whereas IS is an integrated set of software utilizing IT to support practitioners, group of professional, enterprise (Stoney, Xuequn and Saonee, 2012). IS comprises of IT such as office computers, physical servers, network devices as well as shared facilities such as business applications and IT human resources in

relation to skills, knowledge and database storage. The present concern on ecological effect of human activities is ever increasing and numerous efforts have been introduced to lessen increase energy efficiency and energy consumption. Currently, Green ITIS is grounded on the first order and second order effects.

The first-order effect relates to the adverse environmental impact of IT use, design and disposal. This perception addresses IT as adversely impacting Sustainability. Thus the use, design and disposal of IT in an environmental manner is coined as Green IT. The second-order effect refers to the positive effect of using IT on economic and business processes. This perspective sees IT as part of the solutions to Sustainability. Thus utilizing IT to make enterprises Greener is known as Green IS (Murugesan, 2008).

Green ITIS aims to reducing the negative ecological impact of IT using IS to resolve ecological problems (Vanessa and Alemayehu, 2012). Green ITIS is a systematic processing of Sustainability benchmarks such as product stewardship, pollution prevention and use of clean technologies to the design, procurement, operation and disposal of the IT related infrastructure (Vanessa and Alemayehu, 2012).

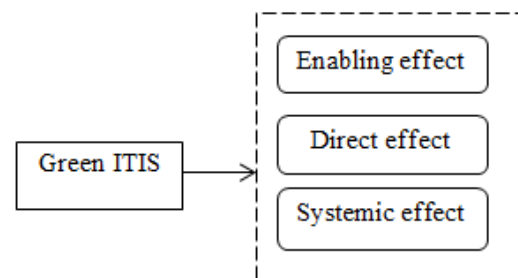


Figure 2. Green ITIS effects in IT based organizations (Yulia and Chulmo, 2012)

Likewise, Tom (2011) mentioned that Green means, least amount of harmful materials, power efficient during IT use, and proper disposal or recycling with minimum effect on human health and environment. Based on several reviewed literatures Table 1 shows a few contributions of Green IT and Green IS towards sustainability in IT based organization. Figure 2 shows that Green ITIS is anticipated to address the environmental issues and fundamentally change human behavior towards the environment by resolving global warming and producing a sustainable society based on three effects. The purposes of Green ITIS can be distinguished into enabling effect, direct effect and systemic effect. As an enabling effect, Green ITIS aids to decrease environmental effects of other economic regions such as enterprise and domestic households. As a direct effect, Green ITIS aids to reduce negative effects of technologies and systems. As a systemic effect, Green ITIS aids to develop and design innovative IS improved processes and products which can intensely changes the

Table 1. Existing Green ITIS Model and Framework in IT based organization.

| Authors, Year and Contribution | Variables/Process | Problem addressed | Research method applied |
|--|--|---|---|
| 1. Qi and Shaobo (2015) presented a theoretical framework on organizational Green IT adoption. | Independent variables comprises of external drivers which includes <i>technological context</i> and <i>institutional pressure</i> and the <i>Internal motivations</i> . The mediating variable is <i>organizational Green IT adoption and sustainable competitive advantage</i> as dependent variable. | Provides managers and policy makers with a systematic analytical framework to guide enterprise business decisions. | The researchers plan to test model with empirical data in future. |
| 2. Sulaiman, Muzamil and Shahin (2015) investigated the impact of adoption of Green IT practice in organization. | The model comprises of <i>institutional pressure, consideration of future consequences and openness</i> as independent variables and <i>adoption of Green IT practices</i> as dependent variable, where <i>the industry type and size of the enterprise</i> are the control variables. | Examined the factors that affect the adoption intensity of Green IT practices in firm's performance. | Structural equation modeling (SEM). |
| 3. Ijab and Molla (2012) studied Green IS from the theory of practice perspective. | The framework comprises of <i>top management, environmental steward, IS manager and professionals</i> as independent variables and <i>Green IS practices (pollution prevention practice, product stewardship practice and sustainable development practice)</i> as dependent variable. | Aimed at understanding how Green IS emerges and also creates an understanding of IS in organizations for Sustainability. | No empirical data was stated. |
| 4. Tracy, Webster and McShane (2011) proposed a framework for Green IT and IS research | The framework comprises of <i>motivating forces, Green IT/IS strategies, Green technologies and system as independent variable, organization and employee as mediating variable and environmental impacts as dependent variable.</i> | The researchers aimed to address environmental sustainability in management. | No empirical data was stated. |
| 5. Daqing (2011) developed a model based on the adoption of Green ITIS | The model comprises of <i>organization, business strategy, technology and environment</i> as independent variable and <i>Green IT IS adoption intention</i> as dependent variable. | Addressed the role of business strategy in the process of Green ITIS adoption. | Proposed using survey to validate model in future. |
| 6. Alemayehu and Vanessa (2009) designed a Green IT readiness framework | The framework comprises of <i>attitude, policy, practice (sourcing, operations and end of IT life), technology and governance.</i> | Helps organizations evaluate their readiness for adopting Green IT. | Case study. |
| 7. Alemayehu (2009a) introduced the reach (Green process) and richness (Green variables) of Green IT. | Therefore the researcher proposes a framework comprises of <i>Green process (creation, sourcing, operation and disposal) and Green variables (policies, practices, technologies and system).</i> | Assist in the conceptualization of Green IT and the definition of Green IT phenomenon. | Survey. |
| 8. Alemayehu (2009b) developed Green IT matrix and motivation models. | The matrix consists of <i>Green process (sourcing, operation and end of IT life management) and variables (policies, practices, technologies and system).</i> | Explore the extent of Green IT in business consciousness. Also identified the influence of institutional forces and organizational motivations in the adoption of Green IT. | Survey. |
| 9. Alemayehu et al. (2009b) suggested a Green IT Readiness Model. | The G-readiness model comprises of <i>Green IT attitude, Green IT policy, Green IT practice, Green IT technologies.</i> | Helps to identify key dimensions for Sustainability. | Structural equation modeling (SEM). |
| 10. Alemayehu and Vanessa (2009) presented a Green IT readiness framework. | The framework comprises of <i>attitude, policy, practice (sourcing, operations and end of IT life), technology and governance.</i> | Helps organizations evaluate their readiness for adopting Green IT. | Helps organizations evaluate their readiness for adopting Green IT. |

social attitude, behavior and result in restructuring of consumption deployment and behavior towards enterprise being more sustainable (Yulia and Chulmo, 2012). It can be seen that both derived concepts of *Green IT* and *Green IS* has attracted the attention of both researchers and academicians and has moved from a smaller idea and

strategy of energy efficient data center to include approaches that improve the environmental footprint of the design, creation, use and disposal of IT such as servers, computers and related subsystems that controls the actions and beliefs practitioners in preventing environmental pollution, enhancing product stewardship and supporting

sustainable development (Vanessa and Alemayehu, 2013). Green ITIS substantially ensures that enterprise products and services are environmentally sustainable (Watson, Boudreau, Chen and Huber, 2008; Tom, 2011). Green ITIS are inter related thus our research focuses on both Green IT and Green IS as seen in the research title as Green Information Technology Systems.

Related works

Numerous studies suggest the potential of Green ITIS to incorporate environmental initiatives into enterprise operations, thereby enhancing enterprise's social, economic and environmental targets. Each of the reviewed work addressed sustainability issue by addressing different issues. Table 1 briefly summaries ten previous Green ITIS studies related to this research study.

Hence Table 1 shows related works that has been carried out, aimed at achieving sustainability in enterprise.

Based on the reviewed 10 researched it is clear that Green ITIS offers opportunity for IT based organizations to act proactively in terms of environmental preservation as well as to mitigate the effects of environmental problems and other global climate change. Green ITIS adoption and implementation is a plausible attempt for IT based organizations to resolve the current environmental issues, and can also enhance the economic performance of IT based organization. Therefore practitioner's adopting and implementing sustainable practices can lead to economic, social and environmental benefits to IT based organizations and humanity. However none of the model or framework reviewed can support decision making of practitioners in adopting and implementing sustainable practices in IT based organizations utilizing Green variables, Green process and technique(s). Therefore there is need to develop a decision support model to assist practitioners in IT based organizations to adopt and implement sustainable practices in promoting sustainable IT based organization.

Proposed Green Adoption and Implementation Model

This section presents the model proposed to assist practitioners in decisions making and provides support in adopting and implementing sustainable practice in IT based organization. The model comprises of Green variables, Green process and a hybrid techniques comprising of software agents and case bases reasoning (CBR).

The Green variables comprises of independent variables (IT governance, IT practitioners, technologies and system, motivating forces, IT strategy and information availability), moderating variable (age, gender and education),

control variable (timing, sector, size, country and revenue) and Green Adoption and Implementation as dependent variable. The Green process includes creation, distribution, sourcing, usage and end of life.

Figure 3 shows the proposed model which comprises of the Green process (GP), Green variables (independent variable (IV), control variable (CV), moderating variable (M) and dependent variable (DV)) and Green techniques (GT). P1 to P9 are the models' prepositions.

Model variables, process, techniques and prepositions

This section describes the proposed model in term of the model's variables, process, techniques applied and justification of each derived prepositions.

Independent variables (IV)

The independent variable (IV) is the input or the case of something in relation to Green practices in IT based organization. The independent variables identified from the literature include; IT practitioners, IT governance, motivating forces, technologies and systems, information availability and IT strategy. Also this research develops the prepositions to theoretically justify and explain the relationships in the proposed model. The prepositions were developed based on the review of literature and on-going research.

IT practitioners

These includes IT professionals, IT experts, environmental stewards and top management. IT practitioners' commitment is required for IT based organizations 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 required objectives of the enterprise. Thus IT practitioner's actions influence how Green practices are implemented and diffused to achieve sustainability in their enterprise. According to Tracy et al. (2011) IT practitioners' attitude, ethics and social culture will determine how he/she will care for the environment. Also previous researcher such as (Stan, Vanessa, Hepu, Alemayehu and Siddhi, 2010; Sachin, Pradeep, and Mukesh, 2014; Mohammad, Azizah and Nor, 2014; Qi and Shaobo, 2015) mentioned that IT practitioners' capability, beliefs, knowledge, commitment and experience are determinants which influence IT practitioners' decision to go Green in their enterprise, thus, we propose:

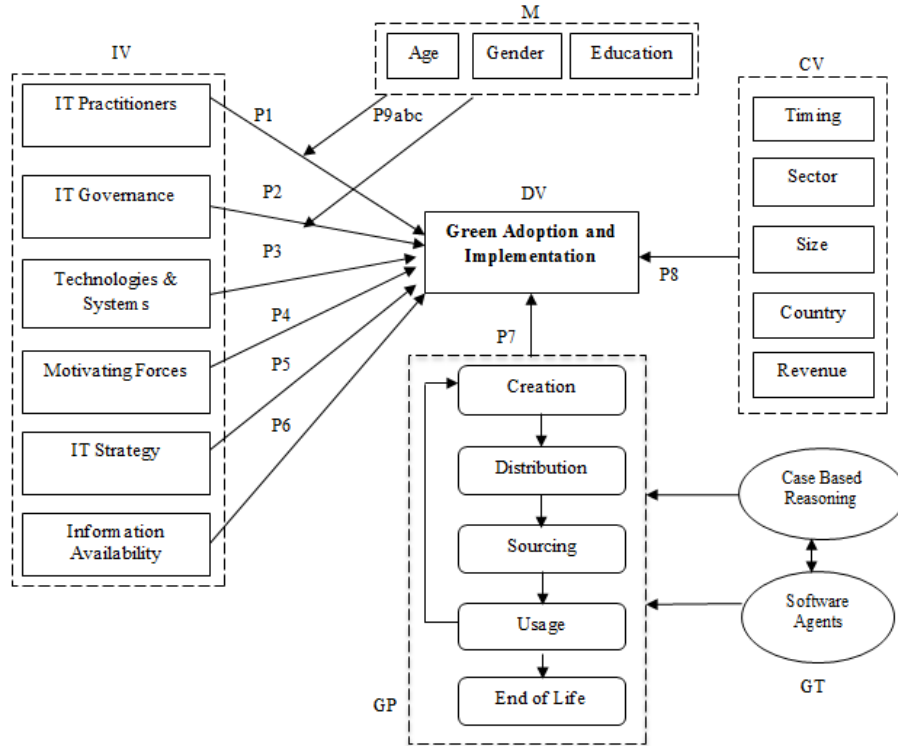


Figure 3. Proposed Green Adoption and Implementation model in IT based organization

Proposition 1 (P1). IT practitioner's personality in relation to environmental sustainability will positively influence his/her action toward the adoption and implementation of Green IT IS practice.

IT governance

Green ITIS practices can support practitioners in redesigning how enterprise advances their future Sustainability strategies. Enterprise management can work together with practitioner in order to achieve social, economic as well as environmental benefits in achieving the goals and aims of enterprise. IT governance are rules, regulations and guidance stated by management in enterprise to ensure that practitioner implement and adopt Green initiatives in their enterprise. Therefore this variable determines the rules and regulation initiated by management ensuring that practitioners in the enterprise adopt and implement Green practices in their enterprise process. IT governance is also concerned with the inspirations that affects social and enterprise policy, leadership structure, financial consideration and behavior of IT enterprise management (Alemayehu, 2008; Grant and Sam, 2012; Tracy et al., 2011; Stan et al., 2010; Sulaiman et al., 2015; Alemayehu, 2009b). IT governance offers a medium for defining the enterprise process. It is the operating pillar that defines the administration of Green initiatives in IT based organization. IT Governance is a variable that defines the management administrative decision making

(roles, responsibilities, accountability and control) of Green initiatives (Stefan, Recker, Pimmer and Vom, 2010; Adela, Richard, Marie-Claude and Elena, 2011; Stefan, Markus, Eva and Timo, 2011; Alemayehu and Ahmad, 2012; Watson et al., 2008; Katrina, Anni-Kaisa and Paavo, 2014; Jens, Roman, and Martin, 2011; Chin-Jung, Chengli and Wei-Lun, 2015; Sulaiman et al., 2015). Thus, we propose the following.

Proposition 2 (P2). IT governance structure will have a positive effect on the adoption and implementation of Green practice in enterprise.

Technologies and systems

Technologies and system defines the features of IT technical infrastructures which affect Green ITIS adoption and implementation. Therefore technology and systems refers to infrastructures that facilitate sustainable enterprise process, these technologies and systems are utilized by practitioners and management in processing the knowledge and skills required in implementing Green ITIS practices in their enterprise. Technologies and systems used in enterprise process are identified as an important variable in attaining sustainable decision making in IT based organization. These technologies and systems include hardware, software, database, network communication and infrastructures (Stan et al., 2010; Carolyn and Jean-Paul, 2014). The technologies and systems also

involve acquiring more environmentally effective Greener technologies. Thus technologies and systems are key driver of Green IT IS practice in IT based organizations (Qi and Shaobo, 2015; Deepti, Ibrahim, and Alok, 2014; Ibrahim and Alok, 2014). There is need for efficient low energy technologies and system to reduce cost and CO₂ emission. Thus, we propose:

Proposition 3 (P3). Green practice adoption and implementation is positively influenced by energy efficient, cost reduction technologies and systems.

Motivating forces

Motivational forces control how IT based organizations carries out product and service development in relation to adopting and implementing Green practices based on standard set mostly by non-government industries and governmental institutions. These standards and regulation are enthusiastic to sustain external groups and would include responding to pressure from regulatory bodies, governmental and staffs of enterprise. Moreover, these regulations refer to supplementary actions targeting the long term sustainability, avoiding levies, penalties and also conserving the environment when mitigating environmental risk. However, these regulation and policies are put in to place to confirm practitioners and managers respond to environmental issues and integrate it into their enterprise process.

Motivating forces is thus a variable that influences sustainability decision making goal in IT based organization. These forces are mostly commercial pressure and 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 which 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 (Jens et al., 2011; Sachin et al., 2015; Mohammad et al., 2014; Qi and Shaobo, 2015). Thus pressure can also influence practitioners' integration of Green practices, such pressures includes mimetic (pressure derived when IT based organizations go Green because other enterprise go going Green), coercive (pressure from governmental and non-governmental bodies), and normative pressure (pressure from the management in the enterprise). Also Incentives from going Green and consequences from not going Green also influence Green practice adoption and implementation (Grant and Sam, 2012; Mohammad et al., 2015; Bokolo and Noraini, 2016; Tracy et al., 2011; Stan et al., 2010; Sulaiman et al., 2015). Thus we propose that.

Proposition 4 (P4). Interaction between management, governmental and non-governmental organizational pressure will have a positive effect on the adoption and implementation of Green ITIS.

IT strategy

Mainly involves depiction of IT based organizations in terms of the organizational routine, scope and management structure. This variable determines how practitioners implement their enterprise strategies. The strategy applied by IT based organizations in accomplishing their objectives is very vital in the Adoption and Implementation of Green practices. IT strategy mainly aims to support enterprise in decrease their operating expenses in product and services design and development. Thus Green ITIS can be used as a strategic decisions tool, since IT strategy is the most prominent variable of Green ITIS diffusion and implementation aimed at diminishing expenses and CO₂ emissions to achieve a sustainable strategic implementation in enterprise. Enterprise wanting to adopt Green practice must first develop a suitable IT strategy that acknowledges the importance of environmental issues by enacting environmental practices (Tracy et al., 2011; Stan et al., 2010; Sulaiman et al., 2015). Thus there is need to substitute a culture that encourages practitioners to tryout ideas about environmental issues reduction aligned with business integration. Furthermore research by Alemayehu (2008) 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 initiatives, procedure routine and services of an enterprise will determine if they intend to go Green or not (Alemayehu, 2008; Carolyn and Jean-Paul, 2014; Decio et al., 2015; Roya, Ainin and Alemayehu, 2013; Mohammad et al., 2014; Qi and Shaobo, 2015). Thus we propose that;

Proposition 5 (P5). Green ITIS practice is more likely to emerge if there exist a shared Green strategy in IT based organization.

Information availability

According to Watson et al. (2008) 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, uniqueness such as enterprise resource planning (ERP) systems to manage the transportation of developed products/services to end users. Unison, which is involved when all practitioners in a project uses corresponding schedule, and lastly universality which involves services that has more functionality such as systems that provide practitioners with the latest Green information relating to the environment and clima-

te. Sustaining these four information drives (ubiquity, uniqueness, unison and universality) is a key component in creating a successful IT based organization, which is also critical to implement sustainable systems and applications in enterprise (Watson et al., 2008; Tom, 2011). Helen, Alemayehu and Vanessa (2012) contributed by saying that information usage via ITIS can assist to moderate energy consumption, which is one of the aims of IT based organizations going Green, as there is a clear cost saving that comes with the use of less power as energy prices reduces.

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 (Watson et al., 2008; Adele et al., 2011; Albert, 2009). Lack of information, therefore, becomes a hindrance to achieving environmental outcomes and improving environmental performance in IT based organizations (Nigel and Stephen, 2010; Richard, Marie-Claude, Adele, Hector, 2011; Tom, 2011; Helen et al., 2012; Grant and Sam, 2012; Jeremy, Lisa, Kenneth and Vikram, 2013) thus we propose that;

Proposition 6 (P6). Green ITIS practice is more likely to emerge if there exist a shared enterprise Green repository in enterprise to provide Green information.

Green Practice (GP)

Practice can be defined as collections of recurrent and planned human activities. Green process is the current sustainable activities carried out by practitioners in their enterprise (Ninlawan, Seksan, Tossapol and Pilada, 2010; Khalid, Patle and Sandeep, 2012; Joseph, Chulmo and Richard, 2013; Krishnadas and Radhakrishna, 2014). Green sustainable practices in IT based organizations are implemented by practitioners carrying out Green activities in IT based organization.

The process were derived based on works by (Alemayehu and Vanessa, 2009; Alemayehu et al., 2009b; Mohamad, Alemayehu, Kassahun and Teoh, 2010; Alemayehu, 2009b; Robert, Hsu, Chen and Chang, 2012; Bokolo and Noraini, 2015; Nathalia, Minsani and Karen, 2011; Alemayehu, 2008; Xiuna and Lin, 2009; Markus, Jakob, Eva and Stefan, 2013; Biswajit, 2014; Stefan et al., 2011; Murugesan, 2008; Chandani and Anamika, 2015; Nuttapon and Gabriel, 2012; Ijab and Molla, 2012; Alemayehu et al., 2009b; Khalid et al., 2012; Ninlawan et al., 2010; Joseph et al., 2013; Krishnadas and Radhakrishna, 2014; Deepti et al., 2014).

The Green ITIS process, lifecycle or reachness as mention by (Alemayehu and Vanessa, 2009; Alemayehu et al., 2009b) involved in IT based organizations comprises of creation, distribution, sourcing, usage and end of life.

Creation

Creation also known as design in Green ITIS domain refers to the role of IT and IS in supporting enterprise's sustainability initiatives. This is implemented when practitioners utilize IT based systems for their enterprise process, carbon foot print analysis and environmental management development activities. It also encompasses IT based low CO₂ enterprise solutions such as telecommuting, IP telephony, web based business services, thin client, virtual collaboration and videoconferencing (Khalid et al., 2012; Ninlawan et al., 2010; Joseph et al., 2013; Krishnadas and Radhakrishna, 2014).

Distribution

This phase involves developing 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 that increases the competence of enterprise, thereby lowering resource consumption (Alemayehu and Vanessa, 2009; Nuttapon and Gabriel, 2011; Hong-Mei and Rick, 2012; Alemayehu and Ahmad, 2012; Alemayehu, 2013; David, 2013; Biswajit, 2014; Nadinastiti and Kridanto, 2014; Mohankumar and Anand, 2015; Chandani and Anamika, 2015).

Sourcing

Sourcing also referred to as procurement, 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, assimilating Green issues such as recyclable design and packaging in merchant assessment, enquiry of environmental foot print of IT hardware and ICT services providers and addition of social concerns such as the presence of harmful materials in IT hardware that are procured for IT based organizations usage (Alemayehu and Vanessa, 2009; Alemayehu et al., 2009b; Mohamad et al., 2010; Alemayehu, 2009b; Robert et al., 2012).

Usage

Usage also known as operation includes reducing IT induced CO₂ emissions, structural avoidance results in reducing 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 of power utilization without decreasing the installed power base (Xiuna and Lin, 2009;

Markus et al., 2013; Biswajit, 2014; Stefan et al., 2011; Murugesan, 2008; Chandani and Anamika, 2015; Nuttapon and Gabriel, 2012; Ijab and Molla, 2012; Khalid et al., 2012; Ninlawan et al., 2010; Joseph et al., 2013; Krishnadas and Radhakrishna, 2014; Deepti et al., 2014).

End of life

This is the most common process implemented in IT based organization. Based on finding from Alemayehu et al. (2009b), most organization dispose or recycle their enterprise redundant or obsolete IT hardware. Thus End of life also called disposal denotes practices in reusing, recycling and disposing of IT hardware in an ethical ecological environmental manner (Alemayehu et al., 2008; Alemayehu and Vanessa, 2009; Alemayehu et al., 2009b; Alemayehu, 2009b; Xiuna and Lin, 2009; Mohamad et al., 2010; Nathalia et al., 2011; Robert et al., 2012; Markus et al., 2013; Bokolo and Noraini, 2015).

Albert (2009) contributed by saying that it is important for practitioners to carry out each process in order to achieve sustainable enterprise, because some enterprise only practice one or two process and claim they adopt Green process which is wrong, thus we propose that;

Preposition 7 (P7). Interaction between creation, distribution, sourcing, usage, end of life practice will have a positive effect on the adoption and implementation of a Green practice in IT based organization.

Control variables (CV)

The control variables are variables that are constant in the enterprise over a period of time. The control variables identified from the literature include sector, timing, size, country and revenue.

Enterprise size

This variable was mentioned by (Chin-Jung et al., 2015; Jens et al., 2011; Katrina et al., 2014; Sulaiman et al., 2015; Alemayehu and Ahmad, 2012; Schmidt and Kolbe, 2011; Savita, Dominic and Ramayah, 2014; Sachin et al., 2014; Mohammad et al., 2014; Jack and Lucky, 2015; Oriana and Elena, 2014). 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. (2015) sustainable enterprise strategic adoption varies according to the size of the enterprise. Smaller enterprise have less sophisticated understanding of technical issues while larger enterprise are usually in possession of more infrastructure, finance and human resources. Although, bigger enterprises are also disadvantaged as they tend to be less agile and flexible than smaller enterprise. In contrast, smaller enterprise are anticipated to be more innovative, they require less of communication, organization and external impact to make decisions.

Enterprise sectors

This variable was suggested by (Chin-Jung et al., 2015; Katrina et al., 2014; Adela et al., 2011; Sulaiman et al., 2015; Alemayehu and Ahmad, 2012, Chris et al., 2014; Krishnadas and Radhakrishna, 2014; Savita et al., 2014; Sachin et al., 2015; Mohammad et al., 2014; Carolyn and Jean-Paul, 2014; Deepti et al., 2014; Jack and Lucky, 2015; Oriana and Elena, 2014). IT based organizations in diverse industry sectors may accomplish differently in terms of Green sustainable practice adoption and implementation. As enterprise in different industry sectors have different needs, it appears that those in more information intensive sectors are more likely to adopt Green initiatives than those in less IT intensive sectors. Enterprise such as industries such as banking, courier services, airlines, etc. which tend to have more information content in their products and services are more likely to shift to a more sustainable enterprise than those in engineering sector. Current adopters of e-commerce from the industrial sector tend to face more setbacks than other sectors. Enterprise type could affect how practitioners adopts and implements sustainable practices (Sulaiman et al., 2015).

Timing

This variable was mentioned by (Chin-Jung et al., 2015; Jens et al., 2011; Sachin et al., 2015; Mohammad et al., 2014; Jack and Lucky, 2015; Oriana and Elena, 2014). The time an enterprise first adopt Green initiatives may affect its implementation due to first mover benefit. Thus this research includes timing as a control variable to recognize when the enterprise starts to adopt and implement Green sustainable practices.

Country

Jens et al. (2011) proposed this control variable in their research 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.

Revenue

This variable was mentioned by (Adela et al., 2011; Schmidt and Kolbe, 2011; Fabian, Koray, Felix and Ruediger, 2012; Daqing, 2011) as a control variable in their research asserting that enterprise with suitable financial resources are able to examine new practices and cope with implementation failures. Hence, 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.

Therefore IT based organizations supporting Green practices in their business process is based on several varia-

bles, known as control variables which comprises of the time duration the enterprise originated, the sector of the enterprise such as educational sector, telecommunication sector, etc. The size of the enterprise also influence if practitioners will go Green or not. The location of the country is also a control variable since different county has different policies and lastly the revenue or profit generated by the enterprise will determine if the management will encourages and promotes Green initiatives or not.

An enterprise that makes more income will easily go Green unlike an enterprise that makes less income (Chin-Jung et al., 2015; Jens et al., 2011; Katrina et al., 2014; Sulaiman et al., 2015; Alemayehu and Ahmad, 2012; Bokolo and Noraini, 2015; Schmidt and Kolbe, 2011; Oriana and Elena, 2014). Thus we propose that;

Proposition 8 (P8). The adoption and implementation of a Green IT/IS varies due to how long the enterprise has existed, enterprise sector, enterprise size, location of the enterprise and revenue made by the enterprise.

Moderating variables (M)

Moderating variables are variables that regulate certain independent variables. The moderating variables identified from the literature include age, sector, gender and education. The moderating variables in this research are derived from (Alemayehu, Vanessa, Hepu and Stasys, 2009d; Alemayehu et al., 2014; Deepti et al., 2014; Mohammad and Azizah, 2015). These sociodemographic variables (age, gender, and education) are critical in understanding how practitioners and management make decisions about adopting and implementing Green practices. This implies that, in attempting to understand how practitioners in IT based organizations make Green decisions, it is important to consider how the demographic variables moderate practitioners and management decisions in adopting and implementing Green initiatives.

Gender

The relationship between gender and practitioners and management Adoption and Implementation of Green practices has produced diversified results. For example, Alemayehu et al. (2014); Deepti et al. (2014) reported that practitioner and management's gender does forecast Green attitude. Further, gender differences have been found not to have an effect on practitioners implementing and adopting Green practices in their enterprise. However, other researcher such as Alemayehu et al. (2009d) has detected substantial differences in environmentally responsible behaviors because of gender differences. Alemayehu et al. (2009d) reported that women have more favorable attitudes toward the environment and are more involved in recycling activities. Thus the researcher believes that females are more likely to be engage in environmentally friendly and recycling behaviors than men. In

addition, Mohammad and Azizah (2015) indicated that men pay meaningfully less attention to greenhouse gas (GHG) reduction activities other than women. Women are also more likely to characterize global climate change as the most significant environmental concern than men (Alemayehu et al., 2009d).

Age

A number of researchers have explored the relationship between practitioners and management age toward Green practices adoption and implementation in IT based organization. Some have reported the relationship between age and the environmental attitudes of practitioners and management (Alemayehu et al., 2009d; Deepti et al., 2014). However environmental issues awareness is higher and more stable among practitioners and management members aged 55-60 years, those aged between 25-35 years have strong but unstable concern, and middle-aged citizens manifest a stable subset of concerns for the environment (Alemayehu et al., 2014). As the age of individuals 'increases, their engagement with reuse, reduce; recycle activities increases, although others have found an important and negative relationship between age and practitioners and management going Green (Mohammad and Azizah, 2015).

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, researchers such as Alemayehu et al. (2009d); Alemayehu et al. (2014) found significant positive relationships between education level and ecological environmental 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 such as in the reuse, recycle, refurbish, reduces, also increases. Alemayehu et al. (2014) Mohammad and Azizah (2014) reported that there is a significant correlation between age and Green ITIS practicing, and they found that young practitioners and management members are more towards practicing Green ITIS.

Based on the gender of practitioners and management, it is reported by Alemayehu et al. (2009d) that gender is not forecasting the attitude towards the environment. Further, it has reported that there is no difference between males and females concerning sustainable practice in enterprise (Alemayehu et al., 2014; Mohammad and Azizah, 2014). The correlation among Green practice adoption and implementation in relation to the educational level of IT practitioners and management members has been researched by Alemayehu et al. (2009d); Alemayehu et al.

(2014); Mohammad and Azizah (2014). The results regarding the influence of education level on Green practice adoption and implementation is mixed which some scholars such as Alemayehu et al. (2014) reported the significant influence of educational level while others argue the insignificant impact of educational level on Green practice adoption and implementation. Based on the preceding arguments the following propositions are made:

Proposition 9a (P9a). The age of IT practitioners and IT governance management member moderates the Adoption and Implementation of Green IT/IS in enterprise.

Proposition 9b (P9b). The gender of IT practitioners and IT governance management member moderates the Adoption and Implementation of Green IT/IS in enterprise.

Proposition 9c (P9c). The educational level of IT practitioners and IT governance management member moderates the Adoption and Implementation of Green IT/IS in enterprise.

Dependent Variables (DV)

The dependent variable (DV) is the output or the effect of something in IT based organizations implementing and adopting Green practices. The dependent variable (DV) is based on the independent variables and the control variables (Siti and Ruziah, 2012), thus DV depends on IV, while IV influences DV. Therefore the dependent variable is *Green Adoption and Implementation*. This is the dependent variable as previously stated; this variable depends on other variables. This research aims to provide a decision making support model for adoption and implementation of Green ITIS practices in IT based organization. According to Hart (1997); Watson et al. (2008); Tracy et al. (2011); Adela et al. (2011) IT based organizations pursue sustainability based on the three phases of Sustainability practices namely; pollution prevention, product stewardship and clean technology.

Pollution prevention practice

Mostly concerns the control and mitigation of contaminating emissions wastes during and after development procedures. In IT based organizations pollution prevention practice involves innovative use of IS to lessening pollution produced by enterprise processes. In mitigating pollution, practitioners use IS technology such as innovative carbon energy assessment and control application or telematics systems to reduce enterprise's carbon footprint (Hart, 1997; Watson, 2010; Tracy et al. 2011, Adela et al., 2011).

Service steward practice

This phase requires environmental effects to be considered all through IT based organizations processes. This phase is generally based on the ethics of the practitioners

and management. In IT based organization, service stewardship practice includes advance use of system such as innovative digital platforms, conference and collaboration system that improve the eco-friendly of product and service Adoption and Implementation. Service steward practice also involves the utilization of diagnostic applications such as the life cycle control program in the product and service policy that can assist practitioners attain product and service ethics strategy (Hart, 1997; Watson, 2008; Tracy et al. 2011, Adela et al., 2011).

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 IT based organizations involves usage of sustainable data and learning controlling systems that change enterprise operations. This phase also involves usage of compliance application software that is used by practitioners in product and service development for supporting enterprise decision making and creation of knowledge for ecological sustainability. This can be seen as a Green clean technology or sustainable development practice (Hart, 1997; Watson, 2008; Tracy et al. 2011, Adela et al., 2011).

Techniques for Green ITIS practices in IT based organizations (GT)

Software agents and case based reasoning is used as techniques to facilitate Green ITIS Adoption and Implementation of practitioners carrying out Green process in IT based organization. Case Based Reasoning (CBR) is one of the evolving paradigms for developing intelligent systems. It shows important potential for enhancing the efficiency of unstructured and complex decision making. It resolves new issues by adopting previously successful solutions to similar problems.

In CBR technique a set of Green cases stored in the case base is used as main source of knowledge. CBR support practitioners to use experience from past and chooses the most similar case to the current problem, based on the concept that similar problems would have similar solutions (Jack and Lucky, 2015). This research will contributes to Green ITIS research in the domain of IT based organizations by utilizing case based reasoning approach to support practitioners in decision making on how to implement and diffuse Green practices in IT based organizations process. Thus caring for the environment and reducing climatic changes. Data from the case-base library can support practitioners in decreasing energy cost and lessen CO₂ emission.

Software agents can assist practitioners and management in making Green decisions to support sustainability in IT based organization. Multi software agents are software that performs specific task on behalf of practitioner, independently or with little control. These agents are useful in automating monotonous tasks, discovering and explicatory information (Mazlina and Tutut, 2013).

The characteristic of the multi agents in the model includes; autonomy in which multi software agents are aware of their environment operating without human interference to some extent in order to assist in decision making. With autonomous behavior, software agents can take control over Green activities and work without practitioners' interference. The reactivity of multi software agents can observe their environment and respond to specific Green activities changes. Software agents identify the context in which Green practices are carried out and react to it appropriately. Pro-activeness of multi-software agents makes agents initiate Green practice suggestions.

Whereas the persistence of multi-software agents are not implemented on demand but run continuously and decide for themselves when it should assist in Green implementation. Interactivity is the ability of an agent to maintain communication between different Green processes. Multi-software agents establish dialogue and share Green resources and services spanning across different practitioners. Due to the mentioned features of software agents and case based reasoning, we decided to utilize software agents assisted by case based reasoning to facilitate the Green process carried out in IT based organization.

Discussion

The role of energy in IT based organizations is being transformed. It is moving from being an item towards becoming a service. As such, Green ITIS can assist manage energy usage efficiently and effectively, it is predicted that there will be almost 100 % rise in the ICT division's footprint by 2020, but approximates that the operational use of ITIS within IT based organizations could cut CO₂ emissions by up to 5 times this quantity. IT based organizations are progressively realizing the significance of sustainability, and many are attempting to design or redesign their enterprise processes so that their activities are more ecologically friendly.

Even though IS literature has studied how IS can support several enterprise processes and improve the effectiveness and efficiency in enterprise, few studies have focused on how Green ITIS strategies and initiatives can improve and support practitioners decision making in relation to adopting and implementing sustainable practices.

Sustainability is a multi-dimensional objective that requires action from practitioners, societies and enterprise. This study focuses on supporting decision making of practitioners and management in adopting and implement-

ing Green sustainable practices in IT based organizations domain. However, variables and process can also come into play and affect enterprise Green decision making. Presently more enterprise embraces Green initiatives. In order to stay competitive, IT based organizations needs to be prepared for strategic Green decision making. This research explores the roles of ITIS in developing ecological sustainability in IT based organization.

Based on sustainability research, we proposed a model and propositions to be further investigated through empirical research. The proposed model shows that implementing Green practices in enterprise is carried out based on the Green process, from creation, distribution, sourcing, usage and end of life is useful in implementing and adopting sustainable knowledge to practitioners in attaining environmental goals.

Green ITIS has recently gained increasing prevalent consideration in IT based organization. Besides concentrating on economic gains of enterprise activities, management and practitioners also need to consider the environmental and social impacts of their enterprise activities (Elkington, 2004). Green ITIS can actually support enterprise increase profitability, reduce cost, sustain their corporate sales, competitive gain among other firms, and become sustainable contributors to the humanity and enterprise business process in the long term.

Additionally, this research states the importance of sustainability research and practice in IT based organizations and consider all three factors of sustainability profit, planet, people, concurrently, if practitioners considers each of the independent variables and implement each of the model process assisted by case based reasoning and software agents they can contribute towards making profit for their enterprise. Practitioners can also care for the planet by reducing CO₂ emission, thus contributing to a cleaner environment for people and future generations to come.

Research implication and limitation

Theoretical implication

The proposed Green ITIS model represents an original contribution to the information systems literature. The models' variables and process together with case based reasoning and software agents will be useful in Green IT and Green IS research. However the theoretical implication of this research is based on the fact that the research is basically related to IT based organizations only. Green practices in IT based organization, institutions, companies and universities are implemented and diffused to ensure that IT infrastructures (hardware, software and network communications) are utilized and disposed-off properly. The research concern IT practitioners among Malaysian institution, similar to research done by (Matti, Bukaza and Joy, 2009; Maryam, Mahmood, Neginsadat and Mohammad, 2012; Carolyn and Jean-Paul, 2014; Ibrahim and Alok, 2014; Alemayehu et al., 2014; Nana, Amevi and

Nii, 2016) where their research was carried out in institutions and Malaysian enterprise similar to research done by (Watson et al. 2008; Alemayehu, 2008; Jason, 2010; Edward et al., 2011; Robert et al., 2012; Tom, 2011; Bokolo and Noraini, 2015; Grant and Sam, 2012; Sulaiman et al, 2015) where the research was carried out in IT based organization.

Thus the scope of research considers only Green practices in university institution and enterprise. Also this research considers only IT practitioners in IT based organizations only. There are other Green ITIS model and frameworks that were searched and reviewed from the literatures developed by other researchers that was not considered in this paper because the researcher did not outline their variables or/and process in their proposed approaches. Other research works was not considered because the research is not related to IT based organizations domain.

Practical implication

This proposed model comprising of Green process, variables and techniques which are software agents and case based reasoning (CBR). The model shows how Green ITIS can be implemented and diffused in IT based organization. Practitioners can use the identified process and variables as a guideline in making decision for attaining sustainability in their enterprise. The model also supports practitioners to implement Green initiatives not only from the human and managerial perspectives but also the IT technical infrastructure.

In addition, the model, rather than viewing Green ITIS from one domain of IT strategies, is based on Green process comprising of creation, distribution, sourcing, usage and end of life and variables. The proposed model can also offers a common platform for practitioners to make decision to benchmark and assess their current Green IT initiatives and strategies only.

Limitation

We recognize the following limitations of the study. First, the field of Green ITIS and the enterprise abilities to transform toward Green ITIS practices are evolving. We utilized both academic and practitioner literature using desk based research to identify the model variables, process and suitable techniques to develop the model. However, we haven't conducted an in-depth case studies based on interviews to confirm and pool additional variables and process if any.

Although the approach suggested is suitable to ensure content validity, there is need for further improvement, especially one that is based on in depth case studies to derive any potential variable or process that are missed from the present model.

Conclusion and future works

The adverse side effects of IT combined with the higher dependency on IT have elevated the importance of practitioners going Green. This has resulted to IT based organizations utilizing IS to achieve sustainability in the enterprise business process. Practitioners' adoption and implementation of Green practice is essential to limit the negative effects of the fast universal growth of domestic energy demand. Therefore, understanding the variables influencing Green ITIS adoption and process involved in implementing Green ITIS is both an enterprise asset and a social benefit to the environment.

But presently practitioners find it hard to make decisions on how to implement and adopt Green sustainable practices in IT based organizations. Thus this research study proposes a Green ITIS model that assists practitioners in adopting and implementation of Green initiatives in IT based organization. The significant impact of decision making support on Green practice adoption has already been reported in the literature and findings of this study outline the proposed model variables, process and techniques that are based on previous scholar works.

The proposed models' independent, moderating, control and dependent variables supports the findings from previous studies shown in Table 2 of this research paper. The model process is similar to previous works by (Alemayehu, 2009b; Alemayehu, 2009a; Alemayehu et al., 2009a; Alemayehu and Vanessa, 2009).

This study provides practitioners with guidance regarding the adopting and implementation of Green initiatives and strategies in their enterprise. IT based organizations can use the proposed model's comprehensive set of variables and process to measure their current enterprise process. The study offers a basis for benchmarking current enterprise process against the models'. The model processes are critical drivers to generate sustainability value in IT based organization. The models' process and variables represent both tangible and intangible assets and infrastructures in the enterprise.

Thus the process serve as strong performance measure components for strategic initiatives and provide practitioners and management with a means to reflect on Green actions taken through the enterprise sustainability development procedures. Researchers investigating the variables and process involved in making decision on how IT based organizations can fully go Green can refer to the proposed model as a support oriented model. The model can be used by other researchers to institute a cause and effect relationship. It can also be used by practitioners as a Green decision support model to assess how Green their enterprise process is based on the Green process. Thus the proposed model enriches the Green ITIS body of knowledge.

Future work/Ongoing work involves the adoption of a mixed research methodology (qualitative and quantitative approach) will be adopted, similar to Nicky, Henning and Lutz (2014) research. Presently interview and questionnaire instrument are being developed based on previous measurement items from relevant literatures.

The model process and variables will be verified using case study by interview carried out in different Malaysian based enterprises similar to work carried out by (Alemayehu and Vanessa, 2009; Schmidt and Kolbe, 2011; Stefan et al., 2010; Stan et al., 2010; Savita et al., 2014; Nicky et al., 2014; Decio et al., 2015). The case study data will be analyzed using descriptive and narrative analyses. After which Green sustainable documents will be collected to verify the model also.

Data will be collected using online survey (questionnaire) among various ITIS practitioners in enterprise which is in line with research implemented by (Alemayehu, 2009b; Alemayehu, 2009a; Alemayehu et al., 2009a) who used surveys to validate their developed model. Structural Equation Modelling (SEM) will be used to analyses the data to refine and validate the model relationships similar to work carried out by (Sulaiman et al., 2015; Alemayehu et al., 2009b; Alemayehu, 2009a; Adela et al., 2011; Jens et al., 2011; Alemayehu et al., 2014; Sulaiman et al., 2015).

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