

INVESTIGATING THE FACTORS AFFECTING INFORMATION SYSTEMS EVALUATION WITHIN SUSTAINABLE ENVIRONMENTS

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Abstract

Currently, organizations and stakeholders are more concerned with environmental issues, thus the role of information systems (IS) and information technologies (IT) within organizations towards ecological being sustainability has changed. Environmental or Green initiatives is realized as having credibly to assist in shifting to a sustainable society. Furthermore, the elements within IS/IT evaluation including costs, benefits and risks within organizations associated with IS evaluation and sustainability are taken into account in terms of the challenges concerning green practices (Green IS/IT) leading the organizations to attempt to diminish the impact of their IS/IT operations towards the environments socially and ethically, which indirectly assist them in achieving competitive advantages competitors through adopting and implementing environmental sustainability practices. In addition, government sectors are taking a step closer in order to create awareness and incorporate green into all components of the business functions. Practitioners and scholars are motivating to use the existing frameworks and models to evaluate IS/IT initiatives with sustainability taken into perspectives. Consequently, the purpose of this paper is to critically review the normative literature associated with IS evaluation within sustainable environments and to develop a conceptual framework or model for IS evaluation within sustainable organizations that measures the impact of environmental sustainability factors and highlight a number of research gaps that need to be addressed in future research.

Keywords: IS evaluation, IS investments, Green IS/IT, environmental sustainability.

1 INTRODUCTION

Information systems evaluation is considered as one of the most fascinating of organizational discourses on information technology (Smithson and Hirschheim, 1998). Generally, the purpose of IS/IT evaluation is related to IS/IT investments, concerning the costs, benefits and risks within an organization that needed to be managed, organized and controlled effectively and efficiency. The need for IS/IT evaluation and the development of a comprehensive frameworks are still needed in organization particularly one that facing huge IT expenditures (Bjornsson and Lundegard, 1992; Bernroider et al., 2013; Gunasekaran et al., 2006; Joshi and Pant, 2008; Jukic and Jukic, 2010). However, Fernando and Okuda (2009) state that technological advancement is expected to play a major part in the amount of carbon emitted from hardware; as technology develops it is believed that emissions will diminish through energy efficiency gains and other means. In addition, Olson (2008) indicated that the latent of technology in generating business sustainability has comprehensively commenced. A global United Nations (UN) survey to establish the issue leading the future identified sustainable

economic development as an outstanding issue (Watson, 2010). Consequently, it leads to the increasing of environmental awareness in achieving sustainable development in IT/IS field amongst IT practitioners and scholars (Bengtsson and Agerfalk, 2011).

The purpose of this paper is to review the literature associated with IS evaluation within sustainable environments and to develop a conceptual framework/model for IS evaluation within sustainable organizations that measures the impact of environmental sustainability factors. To contribute to this paper, the research questions are addressed:

- What are the factors affecting the information systems evaluation in term of green initiatives and environmental sustainability within organizations?
- How are the costs, benefits and risks considered within evaluation IS/IT frameworks/model of organization pertaining to green initiatives?
- How can the concept of green initiatives encourage organizations to achieve competitive advantages?

The research aim can be achieved through the following objectives:

- To develop an understanding towards the effect of IS/IT operations on environmental sustainability.
- To identify the impact of green initiatives within organization.
- To evaluate IT/IS costs, benefits, and risks associated with the implementation on sustainable/green organizations.
- To develop and validate the conceptual framework/model.

Furthermore, this paper focuses on the first objective as part of the ongoing research in progress.

2 INFORMATION SYSTEMS EVALUATION

Song and Letch (2012) define that “IS/IT Evaluation is a process used to identify, measure, and assess the value of an object in a given context. Evaluation processes play a critical role in organizations’ efforts to assess the success and payoffs of their investments in IS/IT.” Many scholars are paying attention towards evaluation with the main concern being how to evaluate IS with different approaches, methods, frameworks, models and all knowledge interests such as arguments concerning different ways to evaluate IS, debates concerning traditional versus interpretive ways of evaluation (Hirschheim and Smithson, 1999; Lagsten and Goldkuhl, 2012) as well as evaluations aim to justify different kinds of purposes and generates different kinds of outcomes (Lagsten and Karlsson, 2006). A review of the normative literature by (Gunasekaran et al., 2001; Love et al., 2004) show that IS evaluation projects are usually evaluated using traditional financial evaluation techniques such as cost-benefits analysis, return on investment, internal rate of return, and net present value, meanwhile (Irani and Love, 2008) indicate that economic based IS/IT evaluation justifications are calculating based on economic terms of costs and benefits but they do not contain the impact of intangibles and non-financial criteria, which effect on overall project outcomes.

Bernroider et al. (2013) supports that organizations focus considerably on tangible benefits and neglect intangible or strategic impacts as well as the other factors associated with employees and stakeholders. Hence, Stockdale and Standing (2006) proclaim that it is a motivating task to develop generic evaluation IT/IS frameworks that are valid with a wide range of applications but adequately detailed to deliver effective guidance such as interpretive approach to IS evaluation is well founded academically and theoretically to offer potential advantages. Milis and Mercken (2004) stated that the reliance on a sole technique of IS/IT evaluation method/framework/model could cause the sub optimization or even collapse in IS/IT evaluation. Typically, there are accepted evaluation IS/IT models such as content, context and process (CCP) model and IS success Model to name a few; such models are widely used and applied as a measurement tool (Yusof et al., 2008; Bernroider et al., 2013).

2.1 The Content, Context and Process (CCP) Framework/Model

Bernroider et al. (2013) stated that the CCP is considered as a well-known generic method/framework first proposed by Pettigrew (1985) for his work on organizational change,

and later adopted in the context of IS evaluation by (Serafeimidis and Smithson, 1999; Symons, 1991; Walsham, 1999), and lately applied by Stockdale and Standing (2006) in an interpretive approach as to evaluate IS. Song and Letch (2012) support that the CCP model was the first model introduced to IT/IS evaluation research to investigate and analyze significant components in IT/IS evaluation studies by Symons (1991) and it has been successful in supporting researcher with a theoretical framework for analyzing evaluation in a specific context such as in organizational and business context (Serafeimidis and Smithson, 1996; Symons, 1991; Walsham, 1999).

The CCP framework/model consists of the following:

Content - “what” is being evaluated?.

Context - “why” and “who” evaluate IS implementation.

Process - “how” and “when” evaluation is being done.

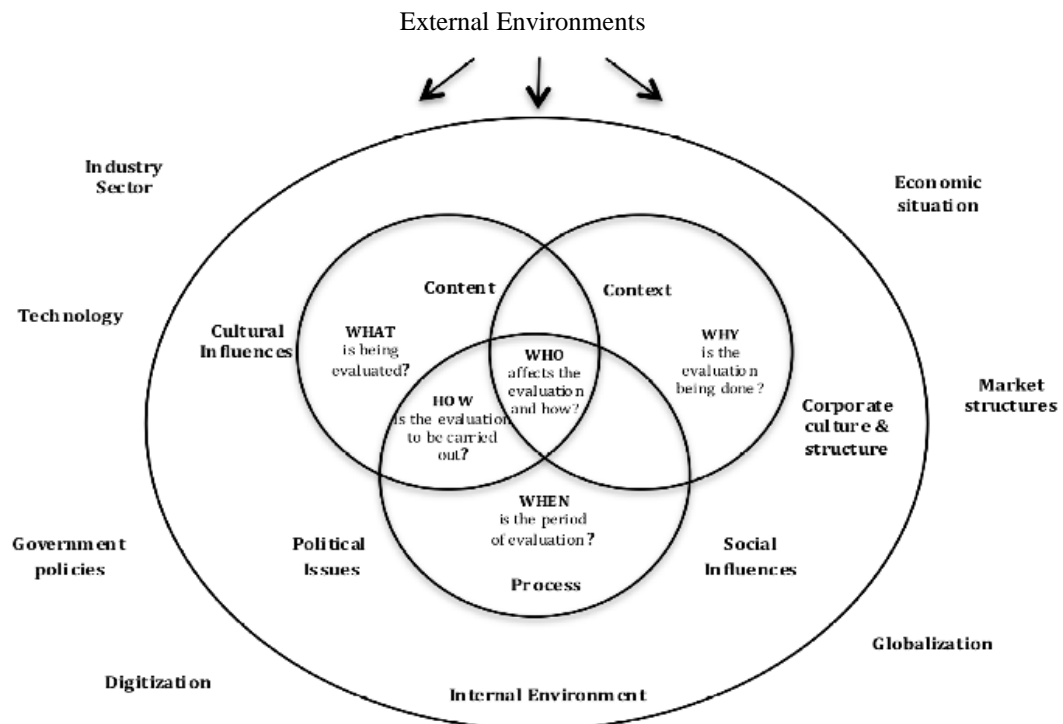


Figure 1. The Content, Context and Process Model (Stockdale and Standing, 2006)

There seems to be an extensive support in academic evaluation literature for this approach (Smithson and Serafeimidis, 2003). The CCP model is well-accepted amongst prominent IS evaluation theory in supporting the necessity for IS evaluations to be tailored to the needs of individual settings based on their environment, the context of the evaluation, what is to be evaluated and the inclusion of needed stakeholders (Stockdale and Standing, 2006).

According to Lagsten and Goldkuhl (2012), the framework of the CCP has been widely used in wide range of case studies such as (Huerta and Sánchez, 1999; Serafeimidis and Smithson, 1999; Piotrowicz and Irani, 2008) in examining IS evaluation processes in practice.

According to Song and Letch (2012)'s study, after reviewing 176 papers in five leading IT/IS research journals over the last 25 years; they concluded that the concepts of evaluation in all papers were explored based on the CCP model. The stakeholders involved in evaluation are vital to an effective evaluation and diverse stakeholders' involvements strategies and their effects on the evaluation process and consequences should be investigated for future IT/IS evaluation research (Seddon and Kiew, 1996; Song and Letch, 2012).

All in all, the CCP model has represented positive outcomes as the generic model that can be tailored in IS/IT evaluation studies, thus it is significant to be able to identify the factors of

the CCP model that can be utilized as a part of conceptual framework/model at a later stage of this research.

2.2 IS Success Model

Delone and McLean (1992, 2003) developed the IS Success Model (D&M model) because there was a demand to be able to measure the IS success implementation and the efficiency of business performance. In addition, D&M model is the most tried and tested model because of its wide acceptance in the IS research field especially on the focus of questions of what is being evaluated. Yusof et al. (2008b) described that the model consists of six success categories; they are linked temporally as success is viewed as a dynamic process instead of a static state. The measures are included in the six system dimensions:

- System Quality (the measures of the information processing system itself)
- Information Quality (the measures of IS output)
- Service Quality (the measures of technical support or service)
- Information Use (recipient consumption of the output of IS)
- User Satisfaction (the important means of measuring our customers)
- Net Benefits (the overall IS impact)

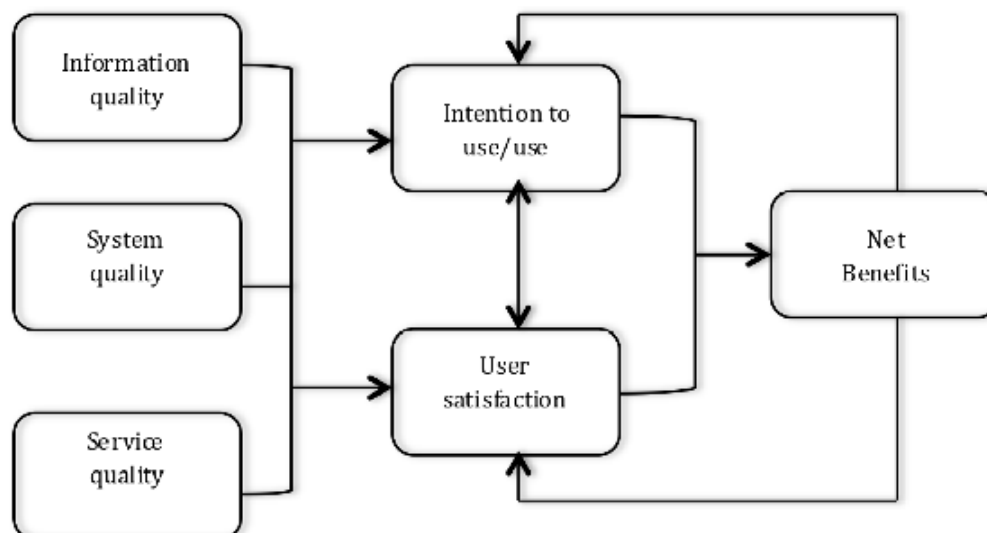


Figure 2. IS success Model (Adopted from DeLone and McLean, 2003)

According to IS Success Model, the model has grouped into three stages; each stage has an effect to the next one. The first stage, the magnitudes of introducing an IS are seen in the quality specific dimensions (Information Quality, System Quality and Service Quality). DeLone and McLean (2003) mention that each element should be measured or controlled for independently because singularly or mutually, they will affect subsequent 'use' and 'user satisfaction' in the next stage. Then, changes that occur in terms of quality dimension would impact the middle user dimension, which establishes the second stage (Intention to use/use and User Satisfaction). The users affect the organization, and thereby, Net Benefits linked with the initial investment are expected (Bernroeder *et al.*, 2013). For instance, a high-quality system will be related with more use, more user satisfaction, and positive net benefits and vice versa (DeLone and McLean, 2003).

D&M model illustrated a clear, specific dimension of IS success or effectiveness and the relationships between them. However, Yusof et al. (2008b) claimed that the model does not include an organizational factor (such as organization structure and environment) that is pertinent to IS evaluation. Additionally, Stockdale and Standing (2006) also discuss that financial measures are not included in the model. The literature suggests that D&M model is

relevant to public sectors (Gable et al., 2002; Thomas, 2006). Bernroider et al. (2013) states that D&M model is aimed at ex-post evaluation but with appropriate measures and methods, also an ex-ante can be conducted.

However, D&M model has shown its wide acceptance in the IS research field especially on the focus of questions of what is being evaluated. Practicably, the metrics of this model could be used and utilized to measure the IS success implementation as a part for developing the conceptual framework/model at a later stage of this research.

3 GREEN IS/IT AND ENVIRONMENTAL SUSTAINABILITY

Global warming and climate change are the major threats that challenge sustainability of business and society such as the rising energy cost, scared resources and the increased power consumption (Molla et al., 2009). Many organizations consider environmental initiatives as a feasible way to achieve sustainable competitive advantage over competitors (Franklin, 2008; Sharma and Vredenbug, 1998). Nevertheless, Webber and Wallace (2009) claim that IT manager perceives that greening IT operations is costly, and difficult to measure and value the intangible benefit. Sarkar and Young (2009) mention that current organizations around the world pay more attention towards the area of Green IT because of the instability of current environment and the stability of organizations' profit margins through an increasing in energy costs.

Definition of Green IT	Authors, Year
1) The optimal use of information and communication technology for managing the environmental sustainability of enterprise operations and the supply chain, as well as that of its products, services, and resources, throughout their life cycles.	Mingay, 2007
2) Green IT is the systematic application of criteria related to environmental sustainability to the design, production, sourcing, use and disposal of IT within an organization.	Molla et al., 2009
3) The study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems—such as monitors, printers, storage devices, and networking and communications systems—efficiently and effectively with minimal or no impact on the environment. Green IT also strives to achieve economic viability and improved system performance and use, while abiding by our social and ethical responsibilities.	Marugesan (2008, p. 25-26)

Table 1. Definition of Green IT

However, Brooks *et al.* (2012) suggested that in term of understanding sustainability systematically, it is also needed to consider Green IS.

Definition of Green IS	Authors, Year
1) Green IS refers to the design and implementation of information systems that contribute to sustainable business processes.	Watson et al., 2008; Watson et al., 2010
2) Green IS incorporates the concept of Green IT and compromises a greater variety of possible initiatives to support sustainable business processes. In addition, it is the systematic application of practices that enable the minimization of the environmental impact of IT, maximize efficiency and allow for company-wide emission reductions based on technology innovations.	

Table 2. Definition of Green IS

As referred to by Melville (2010), Green IS has more potential and capable in offering more inclusive solutions for environmental sustainability by integrating the possibility of entire systems and viewing holistically. Currently, researchers pay more attention in the benefits associated with Green IS initiatives as it is one of the main reasons for organization's adoption but it is not the only reason (Brook *et al.*, 2012).

3.1 Environmental Sustainability Frameworks

Environmental sustainability is growing as an importance concept among both practitioners and academics. Business directors expect environmental premises to become central issues and they have already begun to follow green IT strategies and associated with aspect of economic, environmental, and social impact of organizations (Ijab, 2012; Ozturk *et al.*, 2011). United Nations and national governments globally have been the motivated behind sustainable development, most generic sustainable frameworks namely: Global Reporting Initiative (GRI), United Nations Commission on Sustainable Development Framework (CSD), Sustainability Metrics of the Institution of Chemical Engineers (IchemE) and Wuppertal Sustainability (Labuschagne *et al.*, 2005; GRI, 2002; Spangenberg and Bonniot, 1998).

Social, economic and environment dimensions are typically included in the generic sustainability frameworks, while some frameworks included a fourth dimension, which is “Institutional” for assessing sustainability. Labuschagne *et al.* (2005) stated that the generic sustainability frameworks could be used to measure the sustainability of the projects, technologies, as well as the overall company sustainability particularly within a developing country context, and focusing more on operational initiatives and the frameworks use for evaluating sustainability nationally, internationally, and locally (organization focused).

- In addition, the Balance Scorecard (BSC) is a strategic management framework for aligning business objectives with the vision of an organization to improve internal and external situations and govern performance (Kaplan and Norton, 1992). The BSC is considered as a performance management framework that allows organization to holistically evaluate their success along the four perspectives of learning and growth, internal business processes, customers and financial measurements (Kaplan and Norton, 1992). Researcher such as (Wati and Koo, 2011) proposes the Green IT balance scorecard, which aims for the arrangement of technologies and business with the natural environment in order to measure the performance of IT with environmental aspects. According to Figge *et al.*, (2002) considers BSC as an effective tool to balance environmental and social management systems with business economic performance thus addressing the three pillars of sustainability: planet, people and profit (Elkington, 1994).
- The three pillars referred as Triple Bottom Line (TBL) perspective of sustainability is a framework that incorporates three dimensions of performance: financial, social, and environment assisting in the measurement of the impact of an organization’s activities including both its profitability and shareholder values and its social, human and environmental capital and it turns out to be a more sustainable outcome (Elkington 1994, 1998; Savitz, 2006).
- Piotrowicz and Cuthbertson (2009) claimed that the current IS/IT evaluation frameworks and approaches do not cover sustainability issues adequately particularly the environmental and social factors. The framework was designed to be as generic as possible in order to be able to apply each dimension various metrics categories to confirm the impact in, it was created from literatures in operations management, operational research and logistics disciplines and existing literature related to supply chain measurement and evaluation (Bestlog, 2007) and supported by Cuthbertson and Piotrowicz (2008). Furthermore, the framework has built upon three main dimensions: social (Health and safety, noise and employees), economic (Quality, efficiency and responsiveness) and environmental (Emissions, natural resources utilization and waste/recycling) by using a company as a case study (Piotrowicz and Cuthbertson, 2009). Thus, this framework was a starting point to develop sustainability-oriented IS/IT evaluation for overall industry, society and policymakers.
- Moreover, Jenkin *et al.* (2011) proposes and draws on a framework that brings together sustainability research from both management and IT/IS and offers a comprehending platform by which to combine the extant literature. The framework

provides mechanism to assess Green IT/IS as a critical that often ignored component of corporate environmental initiatives. The Green IT/IS research framework identifies a number of environmental sustainability motivating forces driving corporate environmental initiatives including ecological, technological, organizational, regulatory-marketing, and sociocultural factors (Starik and Rands, 1995). These forces can be group in varying degrees to motivate an organization to adopt particular environmental strategies and practices (Starik and Rands, 1995). Thus, successful organization needs to balance all three dimensions to be sustainable (Ijab, 2011).

As seen in the aforementioned attempts, it is obviously that there are many research scholars trying to develop the frameworks and models that associated with IS/IT evaluation and environmental sustainability and Green IS/IT initiatives. Therefore, it is obviously that there are needed to develop the conceptual framework/model within these research areas for future research.

4. RESEARCH GAPS & CONCLUDING REMARKS

There are growing opportunities for organizations to exploit on “Green” IT/IS initiatives (e.g. initiatives that efficiently use IT and IS to either directly or indirectly reduce environmental impact (Watson et al., 2008). Su and Al-Hakim (2010) stated the fact that IT/IS are drivers to create of the green economy, thus future research in this area would be crucial for both academicians and practitioners. IS literature also began to realize the importance of sustainability, and proposed the concept of green IS to better understand the role of IS in dealing with sustainability (Melville, 2010; Watson et al., 2010; Brooks et al., 2012) and more research in Green IS area (Ijab, 2011). For instance, Elliot and Binney (2008) stated that Green IT/IS concept is lacking from all recognizable management information systems (MIS) journals.

Therefore, it is vital to examine IS/IT from an environmental perspective, organizations will find it challenging to move toward sustainable practices, thus the future research should aim to develop a richer understanding of the current barriers that prevent organizations from adoption Green IT/IS practices as well as to evaluate the degree to which organizations have the essential knowledge and understanding of the benefits and costs associated with Green practices (Jenkin et al, 2011). Besides, the existing IS/IT evaluation frameworks/models lacking of metrics on environmental sustainability, as well as some missing elements (such as environment, organization, financial factors) that are deemed crucial to enhance such models themselves (Yusof et al., 2008; Bernroider et al., 2013). This paper presents research in progress whereby a conceptual framework/model will be developed, as there is a needed for these growing research areas to respond to environmental sustainability and IS/IT issue within organization, so as to understand the effect of IS/IT operations on environmental sustainability and to identify the impact of green initiatives within organization in order to address the literature gaps.

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