

## Sustainability Of Environmental Programs: A Green IT Perspective

Krishnadas Nanath (Professor)  
Information Systems Area, Middlesex University, Dubai  
Email: [username.krishna@gmail.com](mailto:username.krishna@gmail.com)

R. Radhakrishna Pillai (Professor)  
Information Systems Area, Indian Institute of Management, Kozhikode  
Email: [krishna@iimk.ac.in](mailto:krishna@iimk.ac.in)

Supriya K K (Doctoral Student)  
Information Systems Area, Indian Institute of Management, Kozhikode  
Email: [supriyakk04fpm@iimk.ac.in](mailto:supriyakk04fpm@iimk.ac.in)

### Abstract

*Sustainable development programs always form an important component of strategic initiatives in modern day organizations. However, very few firms successfully implement these programs and continue the same in the long run. This article examines the sustainability of environmental programs in organizations from “program sustainability” point of view. It makes use of Resource based view and Institution theory to find out the parameters that contribute to sustainability of environmental initiatives. Green IT initiatives were chosen as ‘environmental programs’ for understanding the problem of program sustainability. These initiatives typically have low implementation levels and face the criticism of failing to continue in the long run and hence were chosen for this study.*

### Keywords

Business Process, Corporate Sustainability, Environmental Programs, Green IT, Program Sustainability

### INTRODUCTION

Sustainability is an important concern for modern day organizations owing to multiple reasons. The reasons differ across different firms and include cost savings, enhancement of business process, reduction of environmental impact, green image, corporate social responsibility and many more. Setting up of environmental programs in firms is becoming more of a core business issue than a niche peripheral issue (Walsh et al. 2003; Hoffman 1999).

Many organizations decide to go green by implementing environmental programs, but often fail to meet the overall goals of sustainability. They even result in giving up on the initiative in the long run. While some initiatives continue, they still fail to deliver the goals of reduced carbon emissions. Therefore, it is important to assess these programs longitudinally and determine the sustainability of the same. Several frameworks for sustainability assessment have been suggested in literature that varies from SWOT (strength, weakness, opportunity and threat) to Werbach’s recently developed STaR framework (Werbach 2009). However, they face a common criticism of not incorporating the longitudinal perspective in the assessment of environmental programs. Therefore, this study attempts to assess the performance of green initiatives using ‘program sustainability’ perspective. This perspective introduces important indicators for assessment of sustainability in the context of environmental programs.

While sustainability assessment demands keen attention, it is also important to explore the factors that contribute to the sustainability of environmental programs. This study leverages upon ‘program sustainability’ concepts and considers Resource based view along with Institution theory to develop a model for sustainability of environmental programs. Multiple theories and perspectives are required because sustainability and its practical applications are a) dynamic in nature because of constantly shifting background conditions (Angelsen et al. 1994; Uphoff et al. 1998) b) based on context specific and long term goals (Flora 2011) highly contested due to difference in perceptions, human values and competing political interest (Pretty 1995).

This research is backed up by empirical study on sustainability of environmental programs. The concepts of sustainability assessment are applied in the context of Green IT initiatives. These programs were chosen because they are reported to have low implementation levels worldwide (Fujitsu 2010). Green IT is a synonym for environmentally sound information technology (Murugesan 2008) and it is implemented by firms to reduce the environmental impact of computers and obtain significant power savings.

The paper starts with a literature review on Corporate Sustainability and Program Sustainability followed by assessment of environmental programs from program sustainability perspective. It then attempts to develop a model exploring factors that ensure sustainability of environmental initiatives. Later sections are devoted to application of sustainability assessment in the context of Green IT initiatives.

## **LITERATURE REVIEW: CORPORATE SUSTAINABILITY & PROGRAM SUSTAINABILITY**

There are three principles that ground sustainable development- environmental integrity, economic prosperity and social equity (Elkington 1998). The concepts of sustainability and its principles are well defined only for societal level development. However, the focus of this study lies in the environmental programs of firms and thus corporate sustainable development is an important concept to understand before exploring the sustainability of environmental initiatives. While the two principles of social equity and economic prosperity are covered through corporate social responsibility and value creation respectively, it is important to discuss the first principle of environmental integrity in firms.

Environmental integrity in firms is implemented through corporate environmental management. It is an effort to reduce the ecological footprint by reduction of power, energy, wastage and emissions. Environmental initiatives often adopt 'prevention' measures and use innovative solutions to reduce the wastage in terms of power requirements. They include cost savings from eco - efficiency initiatives, new revenue opportunities, green reputation of the firm, seeking exceptional talents and retention, and reduced risks due to emissions regulations addressing climate change (Enkvist 2007; Hoffman 1999; Baumgartner 2009). Therefore, corporate environmental management contributes strongly to firm performance and thereby constituting an important component of corporate sustainable development.

This study focuses on an important topic of sustainability of these environmental programs. It makes use of "program sustainability" point of view. This view has been referred in literature using multiple terms like incorporation, integration, survival, continuation and routinization. It forms important and integral part of organization (Goodson et al. 2001; O'Loughlin et al. 1998) and decision making in firms (Beery et al. 2005). The concept of program sustainability has never been described in literature as binary concept (either/or), but one of degree. Therefore, it becomes extremely important to conduct a longitudinal study of environmental initiatives to get a wider perspective on program sustainability.

Different levels of sustainability have been proposed in literature: full continuation of programs, partial continuation, implementation of program in another locale, implementation of the program in modified form and full cessation of the program (Chovav and Weinstein 1997). Several authors have used variety of methods to evaluate sustainability of programs and conceptualize the same (Bracht et al. 1994; Goodman and Steckler 1989; Goodson et al. 2001; Stange et al. 2003). However, the discussion on program sustainability in literature is restricted to health and social programs; thereby calling for studies to deal with environmental programs.

This paper not only explores the problem and assessment of sustainable environmental initiatives, but also moves towards developing a model to ensure the same. Different studies have talked about factors affecting program sustainability in general, but the research on environmental initiatives is at its infancy stage. Factors identified for program sustainability relate to project design and implementation, host organization, community etc (Shediak-Rizkallah and Bone 1998; Patrizi 2006). However, environmental programs form a special component of corporate sustainability and thus should be conceptualized uniquely to identify the factors and develop a model. It is clearly evident that the factors and processes that foster sustainability of environmental programs are not sufficiently understood and addressed (Mancini and Marek 2004). Therefore, this study in an attempt to evaluate program sustainability in environmental initiatives and develop a model to find out the factors those ensure sustainability.

## **ASSESSMENT OF SUSTAINABLE ENVIRONMENTAL INITIATIVES: A PROGRAM SUSTAINABILITY PERSPECTIVE**

Several sustainability indicators have been listed in literature. These indicators are quantifiable attributes of a system that are judged to be related to sustainability (Panell and Schilizzi 1999). In general, they cover economic, social and environmental attributes of sustainability. Initial attempts were made to capture the environmental sustainability assessment with the development of Environmental Quality Index. It took into account the weighted sum of air, water, land and other indicators (Rogers et al. 1997). The assessment was further enhanced with the introduction of Pressure-State-Response framework (PSR) developed by OCED that addressed the problem of systematic identification of indicators for environmental sustainability (OCED 1993; Esty et al. 2005). It was then modified to DPSR (Driving Forces-Pressures-State-Impacts-Responses) to include broader sustainability issues including driving forces and impact.

However, the problem with these indicators is that they measure several aspects of sustainability for the entire system at the same time and thus prove ineffective in measuring the impact of environmental programs per se. Further, they present the snapshot of the system at one point of time and fail to demonstrate the longitudinal impact of sustainability initiatives. Therefore, assessment of environmental programs calls for a new perspective that can take into account the long term impact, survival and sustainability of these programs. This perspective is offered by “Program Sustainability” and it is important to understand its definition and evaluation criteria before applying it in the context of environmental programs.

A program in “program sustainability” refers to a set of resources and activities directed toward one or more common goals (Newcomer et al. 1994). In case of organizational green initiatives, the common goal is to improve environmental performance of the firm and leverage upon the business value delivered by the same. Program sustainability is often viewed in the context of life cycle perspective involving program development, implementation, evaluation, maintenance and spreading to other sites or beneficiaries (Scheirer 1990; Yin 1979).

Assessment of sustainability requires a robust framework for evaluation in the context of environmental programs. Several frameworks have been discussed in literature in the likes of Johnson et al. (2004) for interventions in substance abuse prevention field and Mancini and Marek (2004) for family support programs. However, one of the most important studies in program sustainability is the framework developed by Shediac-Rizkallah and Bone (1998). They reviewed the health intervention programs internationally and effectively brought up the literature on program sustainability. Their framework in this study was chosen as the base for developing program sustainability indicators in this study. Three measures were suggested by the framework:

- a. Continued benefits: Measuring continued benefits for individuals after the initial phase of the program ends, particularly continuing to achieve beneficial outcomes among new consumers and other stakeholders.
- b. Program continuation: Inquires about the continuation of program activities. Also known as institutionalization or routinization within an organizational focus.
- c. Community: Questions about continued capacity of community to develop and deliver similar programs.

These measures relate to different units of measurement – individual level outcomes, organizational level implementation and continued level capacity. The importance of these levels has been shown in strategic management literature focusing on environmental initiatives. In addition to the three measures of sustainability, this study adds a fourth measure that fits very well in the context of green initiatives. This measure comes from the work of Harvard Family Research project that emphasizes on: sustaining the ideas, beliefs, principles or values underlying an initiative (Weiss et al. 2002). Therefore, the four indicators used in this study are: Continued benefits, Program continuation, Community and Values.

These indicators will be used for assessment of sustainability in the context of Green IT initiatives. The performance of IT/Electronic companies (implementing Green IT initiatives) on these indicators will be recorded for consecutive years and plotted on a timeline. This will provide several insights in Sustainability and the emerging problem in this context. However, before applying program sustainability in the context of Green IT, it is important to understand the factors that contribute to sustainability of environmental initiatives. Next section attempts to develop a model for the same.

## **MOVING TOWARDS A MODEL FOR SUSTAINABILITY OF ENVIRONMENTAL INITIATIVES**

An important step in exploring the sustainability of environmental programs is to develop a model that can demonstrate factors leading to sustainability. Although many academicians and practitioners use different theories and explanations related to strengthening of sustainability, an integrated approach of incorporating program sustainability for environmental initiatives has not been explored. The extant models in literature on sustainability pay scant attention to human capital factors, culture and other organizational factors required to deploy and sustain the environmental initiatives. Organizational literature does not leverage upon human capital to develop recommendations for creating sustainable organizations that can address complex nature of environmental issues (Hoffman 2000; Bhat 1996).

Despite several studies drawing consensus on certain parameters like culture, values etc being important to sustainability, there is lack of proper conceptualization of the same (Ramus and Steger 2000). This calls for a model that builds itself on the theories relevant to sustainability and give insights on factors that contribute to long term sustainability of the environmental initiatives in organizations. Further, the model should be capable to provide an abstraction level limited to few dimensions which can be the focus of top management to ensure the sustainability. This section develops resource based and institutional explanations for the sustainability of environmental initiatives. These explanations were chosen because of their relevance in the context of

organizational environmental programs. The justification of selection and relevance is provided for each of the two theories.

### **Resource-Based explanations**

Resource based view claims that effective corporate strategies build rent earning resources and capabilities. Capabilities of the firm are essentially the skills that they develop over the period of time to reproduce and manage the firm resources (Barney 1995). These firm resources are concoction of tangible and intangible assets. Tangible assets include financial reserves, physical plant and equipment, raw materials etc; whereas the intangible assets include firm reputation, culture, intellectual capital etc (Grant 1991). These resources and capabilities are acquired initially and they develop over a period of time by different paths a firm takes (Barney 1986; Teece et al. 1997). Therefore, it can be concluded that the firm's resources and capabilities are shaped by previous paths taken by the firm.

Before using the explanations of resource based theory, it is important to understand how the resource based view fits into the context of sustainable environmental initiatives. This paper argues that resource based view fits in the broader context of sustainable development due to the following reasons a) sustainable development has shown to influence the firm performance (Hart and Ahuja 1996) b) environmental initiatives and sustainable development requires investment in financial and human resources (Sharma and Vrendenburg 1998) c) sustainable development creates resource based opportunities through changes in technology and market forces (Porter and van der Linde 1995). Therefore, drawing insights from resource based view added with review of literature on environmental initiatives and interviews with practitioners, few variables were identified that may influence sustainability of environmental programs.

### **Regulatory Compliance with international experience**

Regulatory compliance can be treated as the first step to ensure the sustainability of Green initiatives. It not only includes basic regulatory measures but also constitutes proactive regulations which organizations set for themselves and comply to. It has been shown in literature that international experience gives a better exposure to organizations and it helps in complying with the regulations related to environmental activities. It helps them acquire knowledge from multiple jurisdictions and develop capabilities in coordination (Roth 1995).

A knowledge base of different regulatory measures across geographical boundaries in environmental initiatives will help firms leverage the expertise and form a set of best practices for collaborative learning. Studies have emphasized the importance of third party audits and how it contributes to sustainability of green initiatives. Regulations help build capabilities in system integration that assist sustainable development practices because of wide range of areas to which sustainable development applies (Russo and Fouts 1997). Therefore, both basic and advance regulatory measures contribute to sustainability of environmental initiatives and overall sustainable development of the firm.

### **Organizational Properties-Size and Technological Resources**

These properties refer to idiosyncratic properties of an organization like physical assets, technologies, size etc. Studies have shown the importance of these capabilities to sustain the environmental efforts. Any organization implementing pollution control and prevention activities require add-ons to filter the toxins or contribute to processes that reduce waste (Russo and Fouts 1997). These add-ons typically form a part of physical assets or technological resources possessed by an organization to implement Green initiatives. Apart from physical assets, firms focusing on pollution prevention require involvement of employees and their empowerment. This is consistent with the social equity principle because it involves majority of stakeholders in decision making. This also emphasizes the importance of stakeholder relationship in ensuring success of green initiatives. Interviews with members of eco-initiatives teams in several firms further strengthened this argument as they reported that the most important aspect of Green programs was to get all the stakeholders on board and educate them. Further, these initiatives require good investment to develop precautionary measures in avoiding accidents and reducing health hazards of employees. Investment is generally in the form of technological resources required to execute the initiative (Klassen and Whybark 1999).

### **Personal Values and Individual attitude**

The resource based explanations initially focused on firm differences which formed the core of business policy and later ventured into strategic management. The decisions to expand or diversify were focused on proposing a rational process of setting objectives followed by internal and external appraisals based on level of fit between existing products/capabilities and investment prospects (Ansoff 1965). The fitness was better illustrated by the LCAG framework which was proposed a few years later (Andrews 1971; Learned et al. 1969). This framework incorporated four features which assessed the fitness. Environmental initiative in an organization is an investment project which requires proper assessment of fit between existing capabilities and the initiative. Therefore, this

assessment becomes an important factor to ensure the sustainability of environmental programs. LCAG framework not only included the strength/opportunity and weakness/threat of an organization but also the key values of the employees implementing an initiative. These personal values of employees involved in green initiatives are one of the most important factors derived from resource based view. Individual attitude and personal values play a great motivational factor in contributing to success of Green initiatives. Literature has also talked about Green Organizational culture that includes individual attitude, values and spirituality. These factors can also be derived from Theory of Reasoned Action (TRA) and Theory of planned behavior (TPB). Therefore, three factors clearly emerge in the context of implementing environmental programs and successfully sustaining them: Subjective Norm, Personal Attitude and Perceived behavior.

### **Business Process Factors**

This section focuses on set of variables that help an organization integrate sustainability in their business process. This helps organizations generate business value from Green initiatives rather than considering it as corporate social responsibility. Business Process factors derive itself from natural resource based view of the firm. It was suggested by Hart (1995), that recognizing natural environment is an important source of competitive advantage. Therefore, he proposed natural resource based view of the firm by integrating natural environment into resource based view. This paper focuses on one of the three strategies proposed by Hart (1995)- Product Stewardship. The goal according to this strategy is to reduce the overall life cycle environmental costs of a product by disciplining the design and development process (Shrivastava et al. 1995). The focus is on mitigating the environmental footprint of activities at each step of the value chain and achieving system transformation from cradle to grave and cradle to cradle. Business Process factors include variables like Organizational systems, Green service adoption and Green process innovation.

Organizational systems basically refer to the organizational process designed to enhance the environmental performance. They include environmental mission statements, environmental audit programs, offering environmental compensation incentives to employees/managers and the staff involvement in environmental programs. Green Service Adoption, in similar lines could be seen as environmental initiatives from a services perspective which includes policies concerning the use of technology in environmental initiative for overall business sustainability. This is particularly relevant in context of Green IT and has been explored by Molla (2009). Green Process innovation on the other hand deals with innovation that is related to energy-saving, pollution-prevention, waste recycling or no toxicity (Chen et al. 2006)

### **Institutional Theory**

Institutional theory explanations are used to emphasize the social context within which firms operate. It provides an enhanced and complicated view on how organizations become homogeneous in institutional environment due to external and internal sources. Firms respond strategically to institutional norms in order to gain improved access to resources (Oliver 1999, Suchman 1995). These institutions could be government, public opinion, media, professional associations etc. Institutional theory has been used to explore environmental behavior of organizations (Chen et al. 2008; Jennings et al. 1995). This study makes use of institutional theory to find out the factors that contribute to sustainability of Green initiatives.

It is relevant to sustainability and environmental programs in particular because of multiple reasons a) individual value and belief systems assess a firms commitment to sustainable development (Bansal and Roth 2000) and green initiative requires commitment and individual motivation to implement and continue over a period of time. b) due to diversity in the technologies involved in environmental programs, stakeholders will have differences of opinion. This will result in dialogue and debate to establish norms and beliefs uniformly (Hoffman 1999). c) Components of sustainable development are already being institutionalized through regulations and international commitments (Frank et al. 2000). Different types of institutional pressures-coercive, mimetic or normative have shown potential influence on sustainable development practices (Jennings and Zandbergen 1995). They have also been shown as significant predictors of adoption and diffusion of Information Systems products and practices (Liang et al. 2007; Orlikowski et al. 2001; Teo et al. 2003). Therefore, this study makes use of institutional theory to understand the program sustainability of Green initiatives.

### **Industry Structure**

This component derives from the mimetic pressure described in institutional theory. It is considered as standard response by firms when they face uncertainty and the course of action is not clear. They reduce environmental uncertainty by imitating the structure and activity of similar firms (DiMaggio and Powell 1983). This concept is also quoted as industry macro culture in literature which talks about how industry practices could motivate/force organizations to implement sustainable practices and continue it over a period of time.

The advantage of adopting green initiatives from industry practices is that firms may capitalize on the success of their peers. They stand a chance to adopt the best practices and suitable Green Technologies in their organization

with established business value and positive environmental impact. This would result in better Organizational Systems that basically reflects the set of practices followed by organization to integrate the concepts of Green initiatives in their business.

### **Stakeholder Relationship**

This factor derives itself from coercive isomorphism. They mostly refer to the pressures imposed by institutions that directly influence the firms. Institutions in this context refer to bodies like resource dominant organization, funding agencies, regulatory institutions etc. Literature has shown that firms failing to comply with such pressures especially in the case of powerful stakeholders face the danger of damaged reputation, loss in earnings and problem of unsustainable operations (Oliver 1991, Pfeffer and Salancik 1978). Therefore, it becomes extremely important to share important information related to environmental programs with the stakeholders and develop a strong relationship with them.

The exchange between firm and institutions govern the success of firm's green initiatives. A resource dependent organization complies with resource dominant organization to sustain the relation and secure its survival (Pfeffer and Salancik 1978). Sustaining the relation and the environmental initiative in general is the concern of many organizations and hence stakeholder relationship is considered an important factor for sustainability of Green initiatives.

## **ASSESSMENT OF PROGRAM SUSTAINABILITY IN GREEN IT INITIATIVES**

This section provides empirical evidence for the sustainability issue in the context of Green IT initiatives. Green IT is a synonym to environmentally sound Information Technology (Murugesan 2008). It includes multiple aspects like environmental sustainability, energy efficiency economics, cost of disposal/recycling etc. Broadly, there are two sides of Green IT; one dealing with IT being the cause of environmental problem and the other using IT/IS to solve the environmental problems.

Green computing initiatives have a great potential for reducing carbon emissions, making process more efficient and reducing power cum energy requirements. However, several reports claim the implementation levels of Green IT remain very low on a global platform (Fujitsu 2010). The technologies associated with Green IT also fade away at a very early stage and fail to deliver the promised results. Therefore, it makes Green IT an interesting and apt initiative to consider for program sustainability.

The application of the proposed concept in Green IT is divided into two parts. First part deals with the assessment of sustainability in Green IT initiatives using the indicators of program sustainability. While second part looks upon the trend of carbon emissions in IT companies to investigate the issue of sustained environmental performance in IT sector.

### **Assessment of Sustainability**

Sustainability of Green IT could be viewed from the context of four indicators listed in earlier sections. In order to gain insights on program sustainability, it was decided to find out the status of IT/Electronic companies that implemented Green IT in the view of four indicators. With the review of present rankings available including ComputerWorld, Global 100 rankings (<http://www.global100.org>), Carbon Disclosure Project etc, it was found that Greenpeace rankings covered three out the four indicators suggested by this paper. These indicators were continued benefits, community and values. The only indicator missing was the continuity of program initiatives. It was therefore decided to look upon secondary data (websites of Green IT initiatives) to find out if the continuity of the program is maintained.

Sixteen firms that featured frequently in the rankings of Greenpeace were selected for this study. These firms were mostly IT/ITeS or Electronic companies, the summary of which has been provided in Table-1. The score of these firms on three indicators were calculated from the Greenpeace database while the fourth indicator was looked upon in the web-sites of these firms (program continuation). Since these firms frequently featured in the top rankings, the "program continuation" indicator was the same for all the sixteen firms. They were still continuing with the Green IT initiative.

Therefore, the aggregate score of these companies were collected over a timeframe (five years, longitudinal) and plotted on a timeline to observe the phenomenon of program sustainability. It was ensured that all the evaluation parameters in Greenpeace rankings were consistent over the years for an unbiased evaluation of program sustainability. It was also decided to plot the final score rather than the rankings to provide an absolute scale to the assessment of sustainable performance over years. The scores had a range from zero to ten and this remained consistent over the time period selected for this study. Therefore, the overall score of the firm per year would represent its yearly performance on three indicators of program sustainability.

The graph plots of sixteen firms gave a fair idea about the consistent and the non-consistent performers. However, a two step process was followed to distinguish between the two groups. Step 1-The graph was shown to academicians and practitioners in the field of sustainability and Green IT to classify the given set into sustainers and non-sustainers. On a consensus reached after several rounds of discussions, three companies were termed as sustainers, while the others as non-sustainers. Step-2 on the other hand, involved calculation of statistic parameters and trend analysis of aggregate sustainable scores obtained by sixteen firms. In order to test for any trend in the sustainability scores of the sixteen firms, Mann-Kendall's trend test was conducted. This test was first proposed by Mann (1945) and refined by Kendall (1975). Since the first introduction the test has been revised and extended several times. It has been used in environmental studies owing to the fact that it is simple, robust and can cope up with missing values. The null hypothesis of no trend is given by:

H<sub>0</sub>: Prob (Y<sub>j</sub> > Y<sub>i</sub>)=0.5, where time T<sub>j</sub>>T<sub>i</sub>

H<sub>a</sub>: Prob (Y<sub>j</sub> > Y<sub>i</sub>) ≠0.5, ( 2 tailed test)

Y is the random response variable in the trend test (Score on Green IT performance), and T is expressed in years. The null hypothesis of no change is rejected when Kendall's  $\tau$  of Y<sub>j</sub> - Y<sub>i</sub> versus T<sub>i</sub> is significantly different from zero. One of the major advantages of using this method is that the assumption of normality is not required in the data set. The test compares the relative magnitudes of the sample data rather than the data points.

The test coefficients and significance levels are listed in Table-1. Results indicate that eight companies out of the sixteen firms (50%) demonstrated significant downward/negative trend. This result is of particular interest because the sixteen firms were featured in top Green IT rankings over the years. It was also surprising to see just one firm having a significant positive trend in the dataset. In order to distinguish sustainers and non-sustainers using the results of trend analysis, firms with minimum standard deviation and no-trend were chosen as Sustainers. Therefore, three firms (F, D and E) emerged as sustainers from this exercise (Step-2) and the results were consistent with Step-1.

The firms under consideration were top Green IT firms, the data for which was obtained on consistent scales over a period of time. Owing to the nature of data collection, the resulting sample set is very small in number and hence taken on a case to case basis. However, to view the broader picture of longitudinal environmental performance in IT industry, a trend analysis of carbon emissions in IT firms was carried out.

As a part of deeper examination on sustainability of environmental programs, it was decided to find out the trend of carbon emissions in IT firms over the period of time. Epstein and Roy (2001) mentioned about CO<sub>2</sub> emissions as one of the important parameters of evaluating environmental performance. The famous Global 100 rankings (<http://www.global100.org>) also included CO<sub>2</sub> emissions as one of the key indicators of environmental performance. However, there is a need for control the variables like production level and industry size that could feature in the carbon emissions. In order to control the variables, firm sales or cost of revenue was chosen. The control mechanism was consistent with some studies that included emissions and toxic releases from Investor Responsibility Research Council (IRRC). Therefore, the ratio of Carbon Emissions/Sales was chosen as the evaluation parameter for conducting a trend analysis on IT firms. A rising trend (positive) would indicate serious concerns on the sustainability of environmental performance over the period of time.

The best source of carbon emissions data should ideally be a database that not only stores the carbon emission data of these organizations but also verifies the same on common grounds. Several databases were explored for the same and Carbon Disclosure Project (CDP) was chosen for collection. The data was collected over the period of seven years for a clear view on sustainability of environmental performance. Emerging Market Information Service database (EMIS-product of ISI emerging market) was chosen to find the list of IT Services and Manufacturing firms and their contacts owing to the comprehensive collection and details provided in the database. This database breaks the IT industry into two parts: 1) Part-A: 'Computer and Electronic Product manufacturing' (375 firms) and 2) Part-B: 'IT Services' that includes- Data Processing, Hosting and Related Services, Other Information Services, Software Publishers (672 firms). Therefore, there were 1047 firms listed in the database. The web-sites of the firms given in the database were used to find out if any Green IT initiatives existed. Only those firms were retained in the data set for which such initiatives could be tracked. Further, the firms not listed in CDP were excluded and the missing data records were eliminated. Therefore, the resulting dataset had the ratio of Carbon Emission to Sales for 144 firms over the period of seven years. The summary statistics of firms is given in Table-2.

In order to test for any trends in the environmental performance of the IT firms in the dataset, Mann-Kendall's trend test was conducted. A positive trend (increasing) for a firm would indicate a problem with its environmental performance in the long run. It was found that 76 firms demonstrated increasing carbon emission trend accounting for 52.78 % of the firms in the dataset. These firms demonstrated the trend at three significance levels- 0.05, 0.01 and 0.001 (Refer Table-2). Though many other firms demonstrated degraded environmental

performance over the years, they were excluded from the results because of the strict criteria of using three significance levels. On the other hand, only 18 firms (12.5%) demonstrated significant negative trend (improving environmental performance), indicating only a small proportion of firms being able to sustain their environmental efforts. These results empirically demonstrate the problem of sustainability and environmental performance, when environmental programs are concerned. This justifies the need for a model to understand the sustainability of environmental programs and calls for new research dimensions to explore the area of program sustainability.

Table-1: Summary of Aggregate Scores								
Company	Sector	Mean Score	Max Score	Min Score	Standard Deviation	Trend test (Coeff.)	Significance Level	Trend
(*p<0.05; **p<0.01; ***p<0.001)								
Company A	ITeS/Manuf.	5.22	7	3.7	1.65	-0.74	NS	
Company B	IT	3.56	6	2.4	1.45	-0.40	NS	
Company C	Comp Manuf.	3.38	7.3	1.3	2.40	-0.20	NS	
<b>Company D</b>	<b>ITeS/Manuf.</b>	<b>2.74</b>	<b>3.3</b>	<b>2.2</b>	<b>0.40</b>	<b>0.60</b>	<b>*</b>	<b>Positive</b>
<b>Company E</b>	<b>Electronics</b>	<b>4.96</b>	<b>6.7</b>	<b>3.7</b>	<b>1.29</b>	<b>-0.20</b>	<b>NS</b>	
<b>Company F</b>	<b>Electronics</b>	<b>7.34</b>	<b>7.5</b>	<b>7.3</b>	<b>0.09</b>	<b>0.316</b>	<b>NS</b>	
Company G	Electronics	4.6	7	3.3	1.49	-0.20	NS	
Company H	IT	4.64	6.7	3	1.37	-0.89	***	Negative
Company I	Comp Manuf.	4.36	6.1	2.2	1.50	-0.73	*	Negative
Company J	ITeS	5.2	7.3	3.9	1.59	-0.71	*	Negative
Company K	Electronics	4.52	6	2.5	1.36	-0.83	**	Negative
Company L	Electronics	5.5	7.5	4.2	1.38	-0.79	**	Negative
Company M	ITeS/Manuf.	4.35	5.45	2.5	1.33	-0.37	NS	
Company N	IT/ITeS	5.36	7.4	4	1.51	-0.68	*	Negative
Company O	IT/ITeS	4.92	6.5	3.1	1.45	-0.74	*	Negative
Company P	IT/ITeS	3.52	5.3	2.2	1.34	-0.65	*	Negative

Table-2: Summary statistics of the sample (n=144)				
Category	Frequency	Percentage (%)	Improving Trend (#) (*, **, ***)	Declining Trend (#) (*, **, ***)
<b>Sector</b>	(*p<0.05; **p<0.01; ***p<0.001)			
Part-A: Computer and Electronic Product manufacturing	38	26.4	5	29
Part-B: IT Services	106	73.6	13	47
B.1 Data Processing	20		2	8
B.2 Hosting and Services	36		6	13
B.3 Other Information Services	38		4	17
B.4 Software Publishers	12		1	9
<b>No. of employees</b>				
<1000	41	28.5		
1000-5000	32	22.9		

5000-10000	22	15.3		
10,000-50,000	32	22.2		
>50,000	16	11.1		

## CONCLUSION

This paper addresses an important issue of sustainability of environmental programs. It has implications for both academicians and practitioners, thereby enhancing the field of environmental research with a special focus on Green Computing initiatives. This paper uses the concept of Program Sustainability and applies it in the assessment of environmental initiatives. Several firms were analyzed from program sustainability point of view and it turned out that only few firms could sustain their Green initiatives in terms of performance and continuity. Therefore, the problem is an important issue organizations face today and it becomes extremely important to address the issue by finding out important factors that could enhance the sustainability of environmental initiatives. From multiple perspectives of program sustainability, resource based view and institution theory, three sets of factors were evident- factors that promote sustainable culture, business process factors and organizational properties.

## REFERENCES

- Andrews, K. R. 1971. *The Concept of Corporate Strategy*. New York: DowJones-Irwin.
- Angelsen, A., Fjeldstad, O., and Sumaila, U. R. 1994. *Project appraisal and sustainability in less developed countries*. Bergen, Norway: Chr. Michelsen Institute.
- Ansoff, I. 1965. *Corporate Strategy*. New York: McGraw-Hill.
- Bansal, P., and Roth, K. 2000. "Why companies go green: a model of ecological responsiveness," *Academy of Management Journal* (43:4), pp. 717-736.
- Barney J. B. 1986. "Strategic factor markets: expectations, luck and business strategy," *Management Science* (32:10), pp. 1231-1241.
- Barney, J. B. 1995. "Looking inside for competitive advantage," *Academy of Management Executive* (9:4), pp. 49-61.
- Baumgartner, R. J. 2009. "Organizational culture and leadership: Preconditions for the development of a sustainable corporation," *Sustainable Development*, (17:2) pp. 102-113.
- Beery, W. L., Senter, S., Cheadle, A., Greenwald, H. P., Pearson, D., and Brousseau, R. 2005. "Evaluation of the legacy of community health initiatives," *American Journal of Evaluation* (26), pp. 150-165.
- Bhat, V. 1996. *The green corporation: The next competitive advantage*. Westport, CT: Quorum Books.
- Bracht, N., Finnegan, J. R., Jr., Rissel, C., Weisbrod, R., Gleason, J., Corbett, J., et al. 1994. "Community ownership and program continuation following a health demonstration project," *Health Education Research* (9:1), pp. 243-255.
- Chen, A., Boudreau, M., and Watson, R. 2008. "Information systems and ecological sustainability," *Journal of Systems and Information Technology* (10) pp. 186-201.
- Chovav, H., & Weinstein, T. 1997. *Continuation or cessation? A follow-up study of projects in neighborhoods where Project Renewal has ended*. Jerusalem, Israel: Ministry of Housing, Department of Neighborhood Social Rehabilitation.
- Diamond, C. P. 1996. *Environmental management system demonstration project: final report*. National Science Foundation. <http://www.epa.gov.owm/iso14001/findemo.pdf> [21 July 2004].
- Dierkes, M., and Coppock, R. 1978. "Europe Tries the Corporate Social Report," *Business and Society*, (25), pp. 21-24.
- DiMaggio, P. J., and Powell, W. W. 1983. "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields," *American Sociological Review* (48:2), pp.147-160.
- Elkington, J. 1998. *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*. New Society: Stony Creek, CT.
- Enkvist, P., Naucler, T., and Rosander, J. 2007. "A cost curve for greenhouse gas reduction," *The McKinsey Quarterly* (1), pp. 35-45.
- Epstein, M. J., and Roy., M.J. 2001. "Sustainability in Action: Identifying and Measuring the Key Performance Drivers," *Long Range Planning Journal* (34:5), pp. 585-604.
- Esty, D. C., Levy, M., Srebotnjak, T., and de Sherbinin, A. 2005. *Environmental sustainability index: benchmarking national environmental stewardship*. Yale Center for Environmental Law & Policy, New Haven.
- Flora, C. B. 2001. *Interactions between agro-ecosystems and rural communities*. Boca Raton, FL: CRC Press.
- Frank, D. J., Hironaka, A., Schofer, E. 2000. "The nation-state and the natural environment over the twentieth century" *American Sociological Review* (56:1), pp. 96-116.
- Fujitsu. 2010. "Green IT: The Global Benchmark Report, 2010", Available at [http://www.icliteracy.info/rf.pdf/green\\_IT\\_global\\_benchmark.pdf](http://www.icliteracy.info/rf.pdf/green_IT_global_benchmark.pdf) (accessed 1 January 1 2012).
- Goodman, R. M., & Steckler, A. (1989). A model for the institutionalization of health promotion programs. *Family and Community Health*, 11, 63-78.
- Goodson, P., Smith, M. M., Evans, A., Meyer, B., & Gottlieb, N. H. 2001. "Maintaining prevention in practice: Survival of PPIP in primary care settings," *American Journal of Preventive Medicine* (20), pp. 184-189.
- Grant, R. M. 1991. "The resource-based theory of competitive advantage," *California Management Review*, 33(3), pp. 114-135.
- Hart, S. L. & Ahuja, G. 1996. "Does it pay to be green? An empirical examination of the relationship between pollution prevention and firm performance," *Business Strategy and the Environment* (5), pp. 30-37.

- Hart, S. L. 1995. "A natural-resource-based view of the firm," *Academy of Management Journal* (37:2), pp. 986-1014.
- Hoffman, A. 1999. The importance of organizational change management for environmental decision making. In K. Sexton, & A. Marcus (Eds.), *Better environmental decisions*.pp. 245-266. Washington, D.C.: Island Press.
- Hoffman, A. 2000. *Competitive environmental strategy*. Washington, D.C.: Island Press.
- Jennings, P. D., and Zandbergen, P. A. 1995. "Ecologically Sustainable Organizations: An Institutional Approach," *Academy of Management Review* (20:4), pp. 1015-1052.
- Johnson, K., Hays, C., Center, H., and Daley, C. 2004. "Building capacity and sustainable prevention innovations: A sustainability planning model," *Evaluation and Program Planning* (27), pp. 135-149.
- Kendall, M.G. 1975. "Rank correlation methods". Charles Griffin, London.
- Klassen, R. D., & Whybark, D. C. 1999. "The impact of environmental technologies on manufacturing performance," *Academy of Management Journal* (42:6), pp. 599-615.
- Learned, E.P., Christensen, C.R., Andrews, K. R., and Guth, W. D. 1969. *BusinessPolicy*. Irwin, Homewood, IL.
- Liang, H., Saraf, N., Hu, Q., and Xue, Y. 2007. "Assimilation of enterprise systems: The effect of institutional pressures and the mediating role of top management," *MIS Quarterly* (31:1), pp. 59.
- Mancini, J. A., and Marek, L. I. 1998. Patterns of project survival and organizational support: The national youth at risk program sustainability study. Retrieved September 7, 2003, from <http://www.ext.vt.edu/pubs/family/350-800/350-800.html>
- Mancini, J. A., and Marek, L. I. 2004. "Sustaining community-based programs for families: Conceptualization and measurement," *Family Relations* 53, pp. 339-347.
- Mann, H. B., 1945. "Non-parametric tests against trend". *Econometrica* 13, 245-259.
- Molla, A. 2009. "The extent of green IT adoption and its drivers and inhibiting factors: an exploratory study," *Journal of Information Science and Technology* (6:4), pp. 1-21.
- Murugesan, S. 2008. Harnessing Green IT: Principles and Practices. *IT Professional*, 10(1), 24-33.
- Newcomer, K. E., Hatry, H. P., and Wholey, J. S. 1994. Meeting the need for practical evaluation approaches: An introduction. In J. S. Wholey, H. P. Hatry, & K. E. Newcomer (Eds.), *Handbook of practical program evaluation* (pp. 1-10). San Francisco: Jossey-Bass
- O'Loughlin, J., Renaud, L., Richard, L., Gomez, L. S., & Paradis, G. 1998. "Correlates of the sustainability of community-based heart health promotion intervention," *Preventive Medicine*, 27 , pp. 702-712.
- Oliver, C. 1991. "Strategic responses to institutional processes," *Academy of Management Review* (16: 1), pp. 145-179.
- Panell, D. J., & Schilizzi, S. 1999. Sustainable agriculture: a matter of ecology, equity, economic efficiency or expedience. *Journal of Sustainable Agriculture* (13), pp. 57-66.
- Patrizi, P. A., Gross, E. K., and Freedman, S. 2006. Strength in flexibility: Lessons from a cluster of capacity building grants in the juvenile justice field. *Evaluation and Program Planning* (29:1), pp. 162-170.
- Pfeffer, J., and Salancik, G. 1978). *The external control of organizations: A resource dependence perspective*. Harper & Row, New York.
- Poduska, R., Forbes, R., and Bober, M. 1992. "The Challenge of Sustainable Development: Kodak's Response," *Columbia Journal of World Business* (27), pp. 286-291.
- Porter, M. E, and van der Linde, C. 1995. "Green and competitive: ending the stalemate," *Harvard Business Review* (73:5), pp. 120-134.
- Pretty, J. N. 1995. Participatory learning for sustainable agriculture. *World Development*, (23:8), pp. 1247-1263.
- Ramus, C. A., and Steger, U. 2000. "The roles of supervisory support behaviors and environmental policy in employee" ecoinitiatives" at leading-edge European companies," *The Academy of Management Journal*, (43:4), pp. 605-626.
- Reilly, W. 1992. Environment, Inc. *Business Horizons*, 35, pp. 9-11.
- Rogers, P.P., Jalal, K.F., Lohani, B.N., Owens, G.M., Yu, C.C., Dufournand, C.M., and Bi, J. (1997). *Measuring Environmental Quality in Asia*. Harvard University Press, Cambridge, MA.
- Roth, K. 1995. Managing international interdependence: CEO characteristics in a resource-based framework. *Academy of Management Journal*, (38:1), pp. 200-231.
- Russo, M. V, Fouts, P. A. 1997. A resource-based perspective on corporate environmental performance and profitability. *Academy of Management Journal*, (40:3), pp. 534-559.
- Scheirer, M. A. 1990. "The life cycle of an innovation: Adoption versus discontinuation of the Fluoride Mouth Rinse Program in schools," *Journal of Health and Social Behavior*, 31, pp. 203-215
- Sharma, S., Vredenburg, H. 1998. "Proactive corporate environmental strategy and the development of competitively valuable organizational capabilities," *Strategic Management Journal*, (19:8), pp. 729-752
- Shediac-Rizkallah, M. C., & Bone, L. R. 1998. "Planning for the sustainability of community-based health programs: Conceptual frameworks and future directions for research, practice and policy," *Health Education Research*, 13, pp. 87-108
- Shrivastava, P. 1995. "Ecocentric management for a risk society," *Academy of Management Review*, (20:1), pp. 118-37.
- Stange, K. C., Goodwin, M. A., Zyzanski, S. J., and Dietrich, A. J. 2003. "Sustainability of a practice-individualized preventive service delivery intervention," *American Journal of Preventive Medicine*, 25, pp. 296-300.
- Suchman, M. C. 1995. "Managing legitimacy: strategic and institutional approaches," *Academy of Management Review* (20:3), pp. 571-610
- Teece, D.J., Pisano, G., & Shuen, A. 1997. "Dynamic capabilities and strategic management," *Strategic Management Journal*, (18:7), pp. 509-533.
- Uphoff, N., Esmann, M. J., & Krishna, A. 1998. *Reasons for success: Learning from instructive experiences in rural development*. West Hartford, CT: Kumarian Press
- Walsh, J. P., Weber, K., and Margolis, J. D. 2003. Social issues and management: Our lost cause found. *Journal of Management* (29: 6), pp. 859-881.