CONCEPTUALIZED MODEL OF GREEN IT PURCHASING ENABLERS – AN APPLICATION OF DELPHI TECHNIQUE AND INERPRETIVE STRUCTURAL MODELING

Sania Khan, Mohammed Shahid Ahamed Khan

Abstract: Green concept which is not just being ecologically conscious however infers "attaining the sustainability" is considerable for green IT area also. Besides green issues being significant in purchasing decision, IT vendors often puzzle in understanding the determinants influencing the mainstream business consumer purchases that use IT. Currently, there does not appear to be a systematical model in investigating corporate consumer's green purchasing behavior. This paper proposes a model for ICT product consumers in Saudi Arabia, from three distinct but interrelated perspectives. It postulates the socioeconomic and environmental related variables, primarily by collecting the opinions from twelve field experts in the Green IT area through applying the Delphi technique and thereby developing these concise opinions into a strong conceptual interrelationship model for consumer green purchasing behavior in the context of ICT products using Interpretive Structural Modeling (ISM). Overall fifteen enabling factors were identified from the literature and the Delphi study was conducted in three rounds by circulating a well framed questionnaire to all the field experts. The interpretive structural model was developed by taking the maximum number of similar responses on the enabling factors. The variables are interpreted and inspected for sustainable procurement in terms of their driving and dependence powers. Possible directions for developing the present ISM model and validating it scientifically are further suggested.

Keywords: Delphi Technique, Green Consumer Purchasing Behavior, Green IT, Interpretive Structural Modeling.

INTRODUCTION

The estimated 2 percent of global CO2 emissions from ICT industry which is equal to the annual pollution of the airline industry was believed to be unsustainable for the planet [25]. IT being an integral part of each and every organization is responsible for environmental issues. Due to the increased power consumption, carbon footprints from corporate companies, early disposal of electronic items particularly IT products which contain silicon, mercury, cadmium and other toxic and non-biodegradable material causing serious health problems to mankind. Consequently global warming is becoming a major problem in the world creating lot of unsustainability and health problems for the mankind. So this Green IT concept is basically emphasized in making IT products greener in terms of socially, economically and ecologically so that to have a minimal effect from IT product usage.

Green IT apart from these basic issues has grown far beyond in making today's business. While reducing 2% of global pollution, Green IT also plays a role in tackling the remaining 98% of global CO2 emissions, and it is attracting a huge interest among IT vendors and consulting service providers mainly due to the increasing demand to power datacenters. Green IT as a potential research area opens a room for exciting research opportunities as regards the role of IT in business sustainability and low carbon economy [2]. This research is primarily conducted with the aim to have authenticated studies on consumer buying behavior of Green IT products, as they are not much so far.

The purpose of this paper is to identify the underlying factors for green purchasing behavior from literature and develop a conceptual interrelationship model with these enabling factors. Firstly a three round Delphi study was conducted among twelve field experts in the Green IT area. Later on the majority of similar responses from the experts were put together to obtain Structural Self-Interaction Matrix (SSIM) in Interpretive Structural Modeling (ISM) methodology. ISM is a well established methodology for identifying relationships among specific items which define a problem or an issue [58], [70]. The suggested variables are gathered as "enablers" from various green IT literatures (See Table I). Further the application of Delphi technique and interpretive structural model (ISM) in developing the consumer green purchasing behavior model are discussed in detail followed by the findings, conclusion and future implications.

Literature Review

A huge population all over the world accessing the Internet and business transactions online, usage of IT equipment's has grown drastically. The buying pattern of these products is unclear from the green marketing context. The study involves three distinct perspectives namely socioeconomic and environmental issues, which covers fifteen underlying factors are elucidated as follows.

Social Factors

To attain sustainable strategy, the vigor of the Kyoto Protocol is introducing new rules and regulations every time across every industry worldwide [68] [35] [59] [3]. Despite other industries, IT sector is also incorporating sustainability into their operations through corporate social responsibility (CSR) to gain the market share and image among the competitors and other market players in the market [11] [42] [47] [51] [71]. In practical, research has proved that most of the corporate sustainability executives have shown positive perception on green initiatives by practicing them in their day to day operations. Consequently corporate IT consumers are influenced psychologically (desire, attitude and intention) and demanding more for green IT products in setting up their IT infrastructure and intended to go for green purchasing which are more beneficial both economically and ecologically [50] [53] [67] [73]. So the market players begin to establish green credentials in reducing their manufacturing waste or reducing its hazardous substances, it is often a catalyst for others in the industry to follow and protect their market share and will enter the market with green products [27] [60]. On the other hand, eco labeling and certification programs such as TCO, Energy Star, Blue Angel and EPEAT are one of modest methods for consumers and corporate buyers to accurately determine the environmental features of ICT products, de-materialization like electronic invoicing can reduce carbon footprint and offers additional financial benefits such as operational efficiency and cost reduction [9] [13] [17] [52]. Consumers expect green products that are superior or at least similar with conventional products and look forward to companies to communicate through the right channels. But found most green product purchases done based on their impulse and curiosity, especially for green electronic products found 47% are currently buying and it will grow to 88% of purchases in future with organizations delivering products in line with customer demands [27] [33].

Economic Factors

The past literature states that green IT products generate financial incentives while doing business. Current studies have gone far beyond in generating new streams like Green revenue almost across every industry. Green IT practices help in meeting low operating costs, low maintenance cost, low power consumption, paying less utility bills, maximum optimization in the long run for both producers and consumers of Green IT product users [13] [16] [20] [46]. Most common green criteria found for electronic product purchases are: product environmental performance with greater energy efficiency [72]. However, new technologies are increasing IT operational performance and can reduce power usage up to 75% cost and CO2 by 56%, performance by 55%, space saving 47% [9] [45].

Environmental factors

Concern for the natural environment among business and consumer's is making the realization that their production and consumption has an impact on the environment, at the same time educating consumers is vital to increase their level of knowledge and concern [19] [38] [48] [65]. As IT is an integral part of each and every organization both in the public or private sector, and by the increased power consumption resulting in carbon footprints from corporate companies with data center and other IT equipment operations [22] [24] [28] [34] [36] [41]. The early disposal of electronic items particularly IT products which contain silicon, mercury, cadmium and other toxic and non bio-degradable material causing serious health problems to mankind and also to the environment [48] [56] [63] [64] [66]. Consequently global warming is becoming a major problem on the planet creating lot of unsustainability, resulting in shrinking the ice caps at North Pole, intensifying cyclones, earthquakes and other disasters on earth [1] [10] [11] [31] [40] [49]. So this Green IT concept is basically emphasized in making IT products greener in terms of economically, socially and ecologically so that to have a minimal effect of IT product usage and moving towards sustainable strategy [45].

The Authors have identified 15 enablers based on a literature review and expert opinion in this field of Green IT purchasing behavior. These enablers were listed as below in Table I with the appropriate category they fall into and with references as in literature.

Table I: Enabling factors for the Green IT product Purchasing

S. No	Enablers	Category	References
1	Environmental Consciousness	Environment	[13], [65]
2	Kyoto Protocol	Environment, Social	[14], [11], [59], [68]
3	Global warming	Environment	[11]
4	Corporate Social Responsibility	Environment, Social	[11], [48], [52]
5	Power consumption	Environment, Economic	[24], [25], [41], [45], [61]
6	E-wastage	Environment, Economic	[4], [6], [9], [49], [56]
7	Financial Incentives	Economic	[6], [10], [13]
8	Eco labeling & Certifications	Environment, Social	[9], [17], [45], [53], [72]
9	Psychological Factors	Environment, Social	[4], [67], [73]
10	Corporate perception	Social	[6], [14], [33], [53]
11	Performance	Economic, Social	[9], [45], [72]
12	Consumer Demand and Preferences	Social	[4], [27], [33]
13	Market Players	Social	[27], [60]
14	Sustainable Strategy	Environment, Social	[33], [48], [71]
15	Green Purchasing Behavior	Social, Economic, Environment	[27], [33], [67], [51]

Methodology

The methodology in this paper uses Delphi technique and interpretive structural modeling (ISM). Hence how the Delphi study leads to ISM based model development is discussed in detail.

Delphi Technique

The Delphi method was first developed in the 1950s by Olaf Helmer, Nicholas Rescher, Norman Dalkey, and others in the series of studies at the RAND Corporation [26]. The intent of the Delphi, as it was originally conceived, was to create a method using expert opinions to forecast long-range trends [26] [44]. The objective was to develop a technique to obtain the most reliable consensus of a group of experts [18].

Overview of Delphi Method

Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem. To accomplish this ''structured communication'' there is provided: some feedback of individual contributions of information and knowledge; some assessment of the group judgment or view; some opportunity for individuals to revise views; and some degree of anonymity for the individual responses. Researchers have applied the Delphi method to a wide variety of situations as a tool for expert problem solving primarily in cases where judgmental information is indispensable, and typically use a series of questionnaires interspersed with controlled opinion feedback [5] [12] [54] [7]. As this study is time consuming there is a disadvantage of panelists dropping out from the number of rounds in the study [8]. However, a key advantage of the approach is that it avoids direct confrontation of the experts. The Delphi is a flexible method built on four basic features: "structured questioning, iteration, controlled feedback, and anonymity of responses" [37].

A panel of experts in the Delphi study (Delphi Panels)

The size of Delphi panels can vary widely; [15] and [26] indicated that by rule of thumb 15 to 30 people is the norm for homogeneous groups, where [74] reported that 10 to 15 people produce good results in a homogeneous panel. For heterogeneous groups (people with expertise on a topic but from different social or professional groups), [15] reported that only 5 to 10 experts are needed. However, in two separate studies investigating the size of Delphi panels, no consistent relationship between panel size and effectiveness criteria was found [55]. Further, all things being equal, the larger the group, the more reliable their aggregate judgment will tend to be. However, beyond group sizes of 20 to 25, there were only minimal improvements in reliability [32]. In this study for the accurate opinions, the panelists are selected who are familiar about IT operations outcomes assessed and who regularly do audits on power consumption and e-wastage disposals by IT products.

In the present study, totally twelve panel members were chosen for the study, based on their familiarity, expertise in the field, interest in involvement and sincerity in answering to the questions. Out of them 2 are CIO, 3 are IT Directors, 4 are system administrators, 1 is IT consultant for IT infrastructure and 2 are network support

engineers. All these participants are from different industries viz., manufacturing, IT consulting, construction, banking, education (universities), and information technology. The details of the participants in tabular form and pictorial representation of the selected experts for Delphi study is given as in below Table II and fig. 1 respectively.

Table II: Delphi Study Panel Experts

Designations	No. of Experts
CIO	2
IT Director	3
System Administrator	4
IT Consultant	1
Network Support Engineer	2

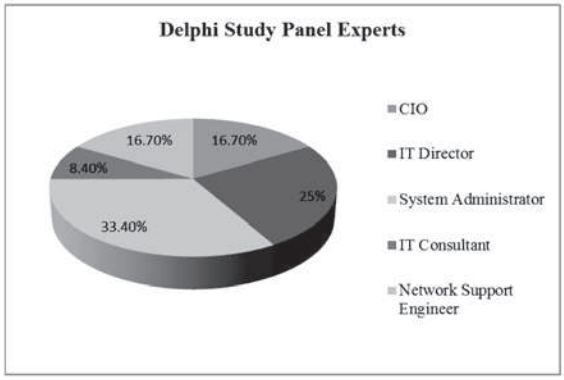

Fig. 1: Delphi Study Panel Experts

Questionnaire development

The questionnaire is developed with easiness and complete guidance to respondents, explaining how to fill it. Provide panelists with a brief account of the origin and purpose of the study [37]. The credibility of the research and the researcher was established [43]. The questionnaire development strictly followed the instructions provided by other previous researchers in making a clear statement of the questions, concise, free of ambiguities and easily understood by panelists [23] [37] [69]; providing clear written instructions to panel members [29] [74] and also pre-tested the questionnaire with three experts [37] [43].

Here instead of direct questions, a grid form of questions are developed to fill in with V, A, X, O appropriately. However the experts were contacted on telephone and in person if necessary at the beginning of the Delphi survey. Later on interactions were done by email till the successful completion of a Delphi study. Enough time was maintained between rounds to prepare and distribute feedback, but did not allow so much time that panelist loses interest [69]. Proper precautions were taken by the research in acknowledging the divergence of opinions if any [26] [37] [69]. The questionnaire is presented at the bottom of this report as Appendix I survey instrument.

Application, Analysis and Aggregating Panelists' Opinions in a Three round Delphi Study

The purpose of the Delphi technique in this study was the fifteen enabling factors mentioned above; generate a consensus on the part of the respondent group regarding consumer purchasing behavior of green IT products.

A three phase process was used, where the first round of the Delphi method asked the participants to respond to the questions on virtual teams by comparing and analyze if factor 'i' enables the factor 'j' or vice versa. The first round resulted six experts answering similar in a favorable way to all questions and other six experts answered differently. The second round used questions developed from responses to the first round of the study. The participants were again asked to go through the same process to find if they would like to change their opinion or fix with the same like before to a particular question which matches with other majority respondents. If they remain

with the same answers, they were requested to explain why it is so. Consequently in the second round one respondent changed some of his opinions and resulted in eight experts answering in similar ways and rest four with other opinions. The third round used the same statements as the second round and asked the participants if they would like to still modify or stick to their opinion based on the responses of the other participants. In the third round, the respondents whose answers were not matching with other majority of respondents were being explained the reasons of defending to set of particular questions. The third round of Delphi nine panelists' opinions found to be similar and three panelists' opinions in a different way. It appeared that the most change in panelists' responses occurs within the first two rounds and that not much is gained in further iterations [43]. When using a rating scale "the reliability of ratings can be greatly improved by pooling the results from several judges who have made their ratings independently" [30]. In this study the ratings are not numerical, rather given for comparison using V, A, X, O as per the guidance given in the questionnaire. The Delphi method is based on panelists achieving consensus; however, there is no standard method for determining consensus [29] [43]. Finally the most improved and similar opinions are considered and summarized as final opinions, which is used as a basic self-structural Interaction Matrix (SSIM) in developing ISM (Interpretive Structural Model) based model for consumer green purchasing behavior of green IT products.Table III shows the summarized opinions of experts in all the three rounds.

Table III: Tabular Form of Summarized Opinions

Rounds in Delphi Study	Total No. of Panelists	Similar Opinions	Different Opinions
First Round	12	6	6
Second Round	12	8	4
Third Round	12	9	3

Criteria for Truth

Delphi is a method for structuring a group communication process to systematically explore and gain insight into a problem [44] [57]. It is founded on the belief that collecting data precedes the development of the theory [44]. To develop a framework for evaluating qualitative research Spencer, Richie, Lewis, and Dillon (2003) stated that one form of truth in research is "agreement that it is true (a consensus view of truth)". This is the case for a Delphi. Truth is experimental, derived inductively, and based on "sufficient widespread agreement … by a group of experts" [44]. Scheele (1975) explained that in the Delphi process, reality is negotiated by the group. It is constructed through the perceptions of the participants bringing to the discussion.

The final responses are collected and summarized based on the identical responses of the majority of experts among who all participated in the Delphi study. The results are displayed in a single matrix form called Self Structured Interaction Matrix (SSIM) as below shown Table IV in Interpretive Structural Modeling (ISM) section.

Interpretive Structural Modeling

Interpretive structural modeling is an interactive learning process in which a set of different and directly related elements is structured into a comprehensive systematic model [2] [58] [70]. This methodology helps to develop the direction of complex relationships among elements in a system [21] [58]. The model thus obtained by applying this methodology presents a structure of a complex issue or problem, a system or a field of study, in a carefully designed pattern implying graphics as well as words [21]. Hence it is said ISM modeling not only provides insights into relationships between the various enablers but also helps develop the hierarchy based on the importance of each enabler and provides a visual representation of the scenario. It is a modeling technique as the specific relationships and overall structure is portrayed in a digraph model. The steps to develop ISM are as follows:

Identifying Elements

The Table I represents the set of fifteen elements/enablers which are recognized from a review of past literature.

This procedure can also be done by survey method if the area of study is new to the research field.

Structural Self-Interaction Matrix (SSIM)

The SSIM which has to be developed for the study has involved set of green IT experts, from various industries in both public and private sectors of Riyadh, the capital city of Saudi Arabia were referred and involved in the Delphi study for understanding the contextual relationships among the enablers (Table IV). To study the enablers in emerging SSIM, the below four symbols have been used to symbolize and track the relationship between enablers (i and j):

V – Enabler i will help to achieve Enabler j; A - Enabler j will help to achieve Enabler i; X - Enablers i and j will help to achieve each other; O - Enablers i and j are unrelated.

Table IV: Structural Self Interaction matrix (Result of Delphi Study)

Enablers	Description	15	14	13	12	11	10	9	8	7	6	5	4	3	2
1	Environmental Consciousness	V	V	X	V	O	O	V	X	O	A	A	X	A	X
2	Kyoto Protocol	V	V	V	V	O	O	O	V	O	A	A	V	A	
3	Global warming	V	O	V	V	O	O	V	V	O	A	A	V		
4	Corporate Social Responsibility	V	V	X	V	O	O	V	V	O	A	A			
5	Increased Power consumption	V	O	V	V	V	O	V	V	O	V				
6	Increased E-wastage	V	O	V	V	A	V	V	V	O					
7	Financial Incentives	A	V	X	V	A	V	V	X						
8	Eco labeling & Certifications	V	V	X	V	A	V	V							
9	Psychological Factors	V	V	X	V	O	O								
10	Corporate perception	V	A	X	V	A									
11	Performance	V	V	V	V										
12	Consumer Demand & Preferences	V	X	X											
13	Market Players	X	A												
14	Sustainable Strategy	X													
15	Green Purchasing Behavior														

Reachability Matrix

The SSIM is transformed into an Initial Reachability Matrix (Table V), which is a binary matrix representation consisting of 1's and 0's. The rules for substitution of 1's and 0's are as mentioned below:

- If (i, j) entry in the SSIM is V, then (i,j) entry in the Reachability matrix turns into 1 and (j, i) entry denoted as 0.
- If (i, j) entry in the SSIM is A, then (i,j) entry in the Reachability matrix turns into 0 and the (j, i) entry denoted as 1.
- If the (i,j) entry in the SSIM is X, then (i, j) entry in the Reachability matrix turns into 1 and the (j, i) entry denoted as 1.
- If the (i, j) entry in the SSIM is O, then (i, j) entry in the Reachability matrix turns into 0 and the (j, i) entry denoted as 0.

Table V: Initial Reachability Matrix

Enabler	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Driving Power
1	1	1	0	1	0	0	0	1	1	0	0	1	0	1	1	8
2	1	1	0	1	0	0	0	1	0	0	0	1	1	1	1	8
3	1	1	1	1	0	0	0	1	1	0	0	1	1	0	1	9
4	1	0	0	1	0	0	0	1	1	0	0	1	1	1	1	8
5	1	1	1	1	1	1	0	1	1	0	1	1	1	0	1	12
6	1	1	1	1	0	1	0	1	1	1	0	1	1	0	1	11
7	0	0	0	0	0	0	1	1	1	1	0	1	1	1	0	7
8	1	0	0	0	0	0	1	1	1	1	0	1	1	1	1	9
9	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	5
10	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	4
11	0	0	0	0	0	1	1	1	0	1	1	1	1	1	1	9
12	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	4
13	1	0	0	1	0	0	1	1	1	1	0	1	1	0	1	9
14	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	5
15	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	4
Dependency Power	8	5	3	7	1	3	5	10	9	7	2	14	14	10	14	

In this case the transitivity test is satisfied and final reachability matrix is obtained. Final reachability matrix along with driving power and dependence power for each enabler is shown (Table VI) will be used for further calculations.

Table VI: Final Reachability Matrix

Enabler	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Driving Power	
1	1	1	0	1	0	0	1	1	1	1	0	1	1	1	1	11	
2	1	1	0	1	0	0	1	1	1	1	0	1	1	1	1	11	
3	1	1	1	1	0	0	1	1	1	1	0	1	1	1	1	12	
4	1	1	0	1	0	0	1	1	1	1	0	1	1	1	1	11	
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	
6	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	13	
7	1	1	0	1	0	0	1	1	1	1	0	1	1	1	1	11	
8	1	1	0	1	0	0	1	1	1	1	0	1	1	1	1	11	
9	1	1	0	1	0	0	1	1	1	1	0	1	1	1	1	11	
10	1	1	0	1	0	0	1	1	1	1	0	1	1	1	1	11	
11	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	14	
12	1	1	0	1	0	0	1	1	1	1	0	1	1	1	1	11	
13	1	1	0	1	0	0	1	1	1	1	0	1	1	1	1	11	
14	1	1	0	1	0	0	1	1	1	1	0	1	1	1	1	11	
15	1	1	0	1	0	0	1	1	1	1	0	1	1	1	1	11	
Dependency Power	15	15	4	15	1	3	15	15	15	15	2	15	15	15	15		175
																175	

The driving power for each enabler is the sum of all enablers (including itself) row wise and dependency power is the sum of all the enablers (including itself) column wise, which may help achieve it.

Level Partitioning the Reachability Matrix

The final Reachability matrix is subjected to access the reachability and antecedent sets for each variable [70]. The reachability set contains the element itself and other elements in its row, on the other hand antecedent set consists of the element itself and other elements in its column. Then the elements which are common in both of these sets are derived as intersection for all elements [21]. The elements which are same for the reachability and intersection sets are determined as the top level elements in the ISM hierarchy. The top level hierarchical elements will not support to achieve any other element above its own level [21]. As soon as the top level elements are identified they are ignored from other elements (shown in Table VII). This process is repeated till the level of each element is identified.

Table VII: Partition of Reachability Matrix

Enabler	Reachability Set	Antecedent Set	Intersection	Level
1	1,2,4,7,8,9,10,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,4,7,8,9,10,12,13,14,15	I
2	1,2,4,7,8,9,10,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,4,7,8,9,10,12,13,14,15	I
3	1,2,3,4,7,8,9,10,12,13,14,15	3,5,6,11	3	II
4	1,2,4,7,8,9,10,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,4,7,8,9,10,12,13,14,15	I
5	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	5	5	V
6	1,2,3,4,6,7,8,9,10,12,13,14,15	5,6,11	6	III
7	1,2,4,7,8,9,10,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,4,7,8,9,10,12,13,14,15	I
8	1,2,4,7,8,9,10,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,4,7,8,9,10,12,13,14,15	I
9	1,2,4,7,8,9,10,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,4,7,8,9,10,12,13,14,15	I
10	1,2,4,7,8,9,10,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,4,7,8,9,10,12,13,14,15	I
11	1,2,3,4,6,7,8,9,10,11,12,13,14,15	5,11	11	IV
12	1,2,4,7,8,9,10,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,4,7,8,9,10,12,13,14,15	I
13	1,2,4,7,8,9,10,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,4,7,8,9,10,12,13,14,15	I
14	1,2,4,7,8,9,10,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,4,7,8,9,10,12,13,14,15	I
15	1,2,4,7,8,9,10,12,13,14,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,2,4,7,8,9,10,12,13,14,15	I

V. Classification of Enablers: Each enabler is classified depending on their driving power and dependence power. Hence all the elements are organized in four categories as autonomous enablers, dependent enablers, linkage enablers and independent enablers. The elements with same driving and dependency powers are segregated in one cell. The driving power and dependence power diagram for enablers is shown in Fig.2. Usually the elements are explained in four clusters. The first cluster is of autonomous enablers who have a weak driving power and weak dependence power. In this case, there are no autonomous enablers. The second cluster contains of dependent enablers who have low driving power and high dependence power. In the present case, there are no dependent enablers. The third group contains of linkage enablers that have robust driving and dependence power. The effect on these enablers will have an effect on the other enablers and also a significant effect on it. In this case, enablers 1, 2, 4, 7, 8, 9, 10, 12, 13, 14 and 15 are in this category of linkage enablers. The fourth cluster comprises independent enablers that have strong driving power and weak dependence power. In this case enablers 3, 5, 6 and 11 are in the category of independent enablers. Here the total elements fall only into two clusters.

DRIVING POWER															
15	5														
14		11													
13			6												
12				3											
11			Cluster IV								Cluster III				1,2,4,7, 8 , 9, 10,12, 13, 14,15
10			Independent								Linking				
9															
8															
7															
6															
5			Cluster I								Cluster II				
4			Autonomous								Dependent				
3															
2															
1															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	DEPENDENCE POWER														

Fig. 2: Cluster of Green IT product buying enablers

VI. ISM based digraph and model

Fig.3 represents the proposed digraph with dependent and independent enablers. The independent enablers occupy the bottom position and the dependent enablers in the top position of the structural model. Directed arrows are used in digraph to depict the relationship. The bi-directional arrows represent the relation among the mentioned enablers 'i' and 'j' and the single headed arrow represents the cause of another enabler they are pointed to.

This digraph is called as an initial directed graph, or initial digraph. This process is carried out till the last level is reached and transitivity's are removed. The final digraph is converted into an ISM based model, shown in Fig. 4 with list of activities illustrating the relation among each activity.

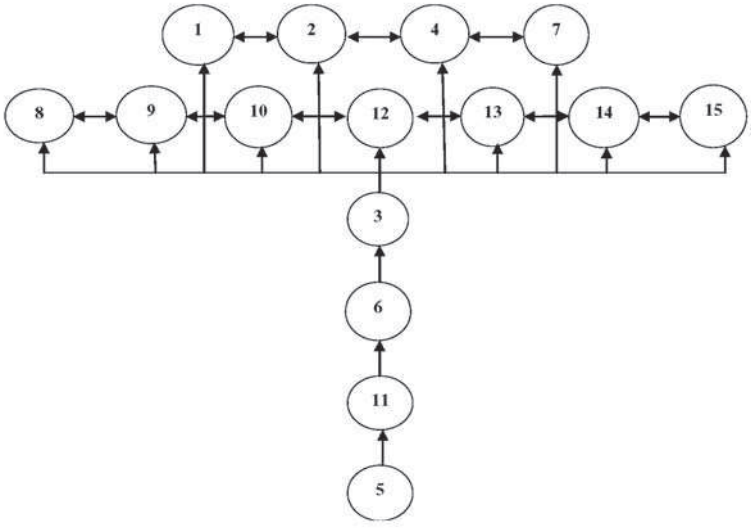

Fig. 3: Final digraph depicting relationship between Green IT product buying enablers

DISCUSSION AND FINDINGS

The levels of Green IT product buying enablers in the grid (fig. 2) are necessary to understand. Enabler "Increased power consumption" with high driving power and low dependence among other identified enablers is positioned at lowest level in the hierarchy of ISM based models. Eleven enablers as shown in digraph are with high dependence and low driving power, hence they are placed on the top level in the hierarchy which is depending on the rest of all the enablers. The enablers in middle layers with high driving power are called "strategic enablers", which need greater consideration from the corporate IT sector. As autonomous variables have low driving power and low dependence power and does not exist in this case, play less role in driving the green IT product purchasing. Other enablers have a vital role in green IT product purchasing and hence need to concentrate on all the suggested enablers.

CONCLUSION AND FUTURE IMPLICATIONS

Although all the fifteen enablers in the ISM based model have their own importance towards green IT product purchasing, after the enablers increased power consumption, e-wastage, IT product performance and global warming has highest driving power and less dependence power. So these four enablers are key enablers for Green IT product purchasing. In this study, only the key variables as enablers are identified and the interrelationship model (Fig.4) was developed and there is no scientific validation of the model. Therefore further research studies can identify other related underlying enablers and develop the present model of green IT product purchasing using ISM and to test the validation of the current model, structural equation model (SEM) which sometimes referred as linear structural relationship approach can be used as a tool.

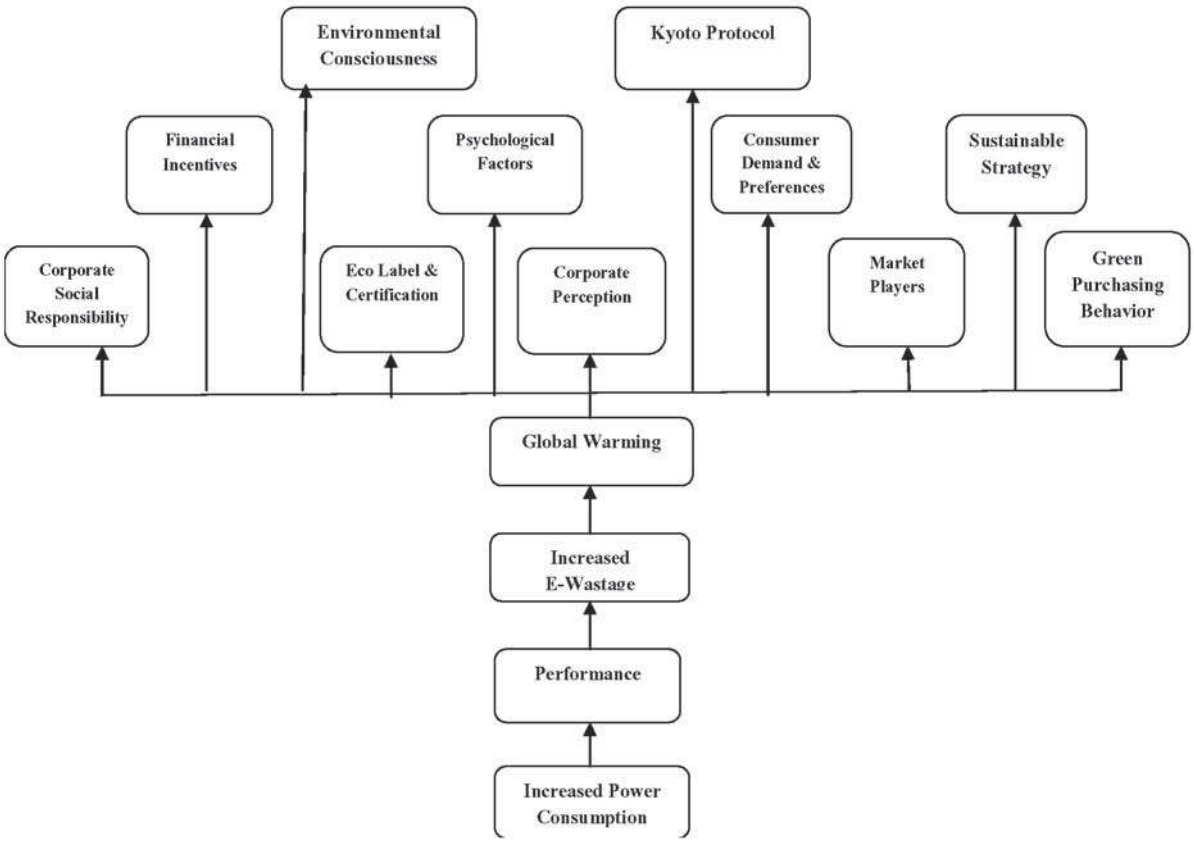

Fig. 4: Proposed Consumer Green Purchasing Model for Green ICT products

APPENDIX I: Delphi Questionnaire
A Self-Structured Interaction Matrix Opinion on Green IT Products

Date: _____

Guidelines:

(i) Variables 'i' are given 1 --15 in the Description column

(j) Variables 'j' are given in reverse order of 'i' Varies from 15-2 in the row shown by arrow mark

Place V, A, X, O in respective cells after proper comparison of (i, j)

V: variable (i) will help/enable to achieve variable (j)

A: variable (j) will help/enable to achieve variable (i)

X: variable (i) and (j) will help/enable each other to achieve

O: variable (i) and (j) are unrelated

Name: Gender: Education:

Age: Phone No: Email id:

Role in Organization: Private / Public Sector: Industry Type:

Enablers	Description (i) (j) -------->	15	14	13	12	11	10	9	8	7	6	5	4	3	2
1	Environmental Consciousness														
2	Kyoto Protocol (Government Regulations)														
3	Global warming														
4	Corporate Social Responsibility														
5	Increased Power consumption														
6	Increased E-wastage														
7	Financial Incentives														
8	Eco labeling & Certifications														
9	Psychological Factors														
10	Corporate perception														
11	Performance														
12	Consumer Demand and Preferences														
13	Market Players														
14	Sustainable Strategy														
15	Green Purchasing Behavior														

Explanations / suggestions by experts if any:

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REFERENCES

1. A. O'Flynn, Aug.2010, "Green IT: The Global Benchmark," white paper, Fujitsu.
2. Agarwal Ashish, Shankar, Ravi, M. K. Tiwari 2007. "Modeling agility of supply chain Industrial Marketing Management", Vol. 36 (4), pp. 443-457.
3. Alemayehu Molla, 2008, "GITAM: A Model for the Adoption of Green IT", 19th Australasian Conference on Information System.
4. Alemayehu Molla, Vanessa Cooper, Siddhi Pittayachawan, 2009, "IT and eco-sustainability: Developing and validating a green IT readiness model", Conference Proceedings: 13th International Conference on Information Systems, Phoenix, Accessible at: http://rmit.academia.edu/siddhi/Papers/433109/IT_and_eco-sustainability_Developing_and_validating_a_green_IT_readiness_model
5. K. Amal Ali, 2005, "Using the Delphi Technique to Search for Empirical Measures to Local Planning Agency Power", The Qualitative Report, Vol. 10 (4), pp. 718-744.
6. Anand Siva Subramaniam, 2009, White Paper, TCS, "Making IT Green – The TCS Way".
7. R. Anthony Romano, November 2010, "Malleable Delphi: Delphi Research Technique, its Evolution and Business Applications", International Review of Business Research Papers, Vol. 6 (5), pp. 235 – 243.
8. W. R. Borg, & M. D. Gall, 1983, Educational research: An introduction (4th Ed.). New York: Longman.
9. C. Hobby, N. Rydal, E. Sjogren, W. Williams, 2009, "IT products – Going Beyond Green – Can High performance and Sustainability Co-exist", Sustainable Systems and Technology. ISST IEEE International symposium pp. 1-4.
10. D. Castro, 2009, "Learning from the Korean Green IT Strategy," The Information Technology & Innovation Foundation Web Memo, [Online]. Available: http://www.greenbiz.com/research/report/2009/08/11/learning-korean-green-it-stratey. [Accessed: Oct, 4, 2009].
11. Chandrasekhar Rama Sastry, 2009, "Green IT Matters at Wipro LTD", Asia Case Research Centre, The University of Hong Kong.
12. Chitu Okoli & D. Suzanne Pawlowski, 2004, "The Delphi method as a research tool: an example, design considerations and applications", Journal of Information & Management, Vol. 42 pp. 15 – 29.
13. Christopher Gan., Han Yen Wee, Lucie Ozanne, TzuHui Kao., 2008, "Consumers' purchasing behavior towards green products in New Zealand". Innovative Marketing, Vol. 4, Issue 1.
14. Clare D'Souza, Mehdi, Peter, 2006, "An empirical study on the influence of environmental labels on consumers", An International Journal, Vol.11, No.2, pp. 162-173.
15. M. J. Clayton, 1997, Delphi: A technique to harness expert opinion for critical decision-making tasks in education. Educational Psychology, Vol.17 (4), pp. 373-384.
16. A. Clifford, 2009, "Sustainable IT," it.toolbox.com: Project Management Community, 2009, Retrieved February 25. Available at: http://it.toolbox.com/blogs/minimalit/sustainable-it-30157.
17. Consumer Electronics Association, 2008. "Environmental Sustainability and Innovation in the Consumer Electronics Industry" report-. www.ce.org.
18. N. Dalkey, O. Helmer, 1963, "An experimental application of the Delphi method to the use of experts", Management Science Vol. 9 (3), pp. 458–467.
19. Donaton, Scott and Kate Fitzgerald, 1992, "Polls Show Ecological Concerns is Strong," Advertising Age, Vol.63, pp.49.
20. D. Dubie, 26 January, 2009, "How to Cut IT Costs with Less Pain," Network World, pp. 11- 40.
21. M. N. Faisal, D. K. Banwet, R. Shankar, 2006, Supply chain risk migration: modeling the enablers. Business Process Management, Vol. 12 (4), pp. 535-552.
22. W. Forrest, J. M. Kaplan and Kindler, 2008, "Data Centers: How to Cut Carbon Emissions and Costs, The McKinsey Quarterly, Number 14.
23. B. Garrod, 2004, Lecture notes on the Delphi technique. Retrieved December 12, 2004, from http://users.aber.ac.uk/bgg/rm.htm
24. Gartner Inc, 2008, Sustainable IT, A Gartner Briefing, Gartner, Dublin
25. Gartner Inc, 2007, Press release, Gartner Estimates ICT Industry Accounts for 2 Percent of Global CO2 Emissions. Available at: http://www.gartner.com/it/page.jsp?id=503867
26. T. J. Gordon, 1994, The Delphi method. Washington, DC: American Council for the United Nations University.

27. Grail Research, September, 2009, "The Green Revolution", Available at: http://grailresearch.com/pdf/ContenPodsPdf/The_Green_Revolution.pdf
28. Hamm Steve 2008, "It's too darn hot", Business Week, http://www.businessweek.com/magazine/content/-8_13/b4077060400752.htm
29. F. Hasson, S. Keeney, & H. McKenna, 2000, Research guidelines for the Delphi survey technique. Journal of Advanced Nursing, Vol. 32 (4), pp. 1008-1015.
30. G. C. Helmstadter, 1964, Principles of psychological measurement. New York: Appleton-Century-Crofts.
31. S. Heng, 2009, Green-IT: IT is not green and never ever will be! http://www.dbresearch.de/PROD/DBR_INTERNET_DEPROD/PROD0000000000238000.pdf. Accessed May 26, 2009.
32. R. M. Hogarth, 1978, A note on aggregating opinions. Organizational Behavior and Human Performance, Vol. 21, pp. 40-46.
33. Hugh Wareham, August 2009, CEO – ECO Buy, "Green Purchasing in Australia", http://www.ecobuy.org.au/uploads/documents/Green%20Purchasing%20Australia%20Report%20Summary%20Document.pdf
34. J. Koomey, 2010, "Estimating total power consumption by servers in the U.S. and the world", Analytics Press, Oakland. http://enterprise.amd.com/Downloads/svrpwrusecompletefinal.pdf
35. W. Kirk Cameron, 2011, "Trading in Green IT", Virginia Tech, IEEE Computer Society.
36. R. Kumar, 2008, Media Relations, Gartner, available at: www.gartner.com/it/page.jsp?id=781012 (accessed January 2009)
37. T. Lang, 1995, An overview of four futures methodologies, from http://www.futures.hawaii.edu/jrnls.html
38. M. Laroche, J. Bergon, M. Tomiul, and G. Barbaro-Forleo 2001, "Targeting consumers who are willing to pay more for environmentally friendly products", Journal of Consumer Marketing, Vol.18 (6), pp.503-520.
39. H. A. Linstone, & M. Turoff, (Eds.). 1975, The Delphi method: Techniques and applications. Boston, MA: Addison-Wesley.
40. Luis Neves 2008, "Smart 2020: Enabling the low carbon economy in the information age", The Climate Group for the Global e-Sustainability Initiative.
41. H. L. McKeefry, 2008, "A high-energy Problem", eweek.
42. Ministry of Communications and Information Technology, annual report 2009, http://www.mit.gov.in/sites/upload_files/dit/files/annualreport2009-10(1).pdf
43. V. W. Mitchell, 1991, The Delphi technique: An exposition and application. Technology Analysis & Strategic Management, Vol. 3 (4), 333-358.
44. I. I. Mitroff & M. Turoff, 1975, Philosophical and methodological foundations of Delphi. In H. A. Linstone & M. Turoff (Eds.), The Delphi method: Techniques and applications (pp. 17-34). Boston, MA: Addison-Wesley.
45. S. Murugesan, 2008, "Harnessing Green IT: Principles and Practices", IT Professional, IEEE Computer Society, pp. 24-33.
46. S. Nagata, and O. Shoji 2005, Green Process Aiming at Reduction of Environmental Burden. Fujitsu Science and Technology Journal, Vol. 41(2), pp. 251 - 258
47. Nathalie Bachour and Larry Chasteen, 2010, "Optimizing the Value of Green IT Projects within Organizations", IEEE.
48. Noushin Laila Ansari, Mahfuz Ashraf, BushraTahseen Malik and Helena Grunfeld, 2009, "Green IT awareness and Practices: result from a field study on mobile phone related e-waste in Bangladesh", IEEE International Symposium on Technology and Society.
49. Paul Budde, 3rd March, 2010, "ICT solutions for Global Warming and Energy Saving", http://www.reportbuyer.com/blog/ict-solutions-for-global-warming-and-energy-saving/
50. Y. K. Ricky Chan, 2001, "Determinants of Chinese Consumers Green Purchase Behavior", Journal of psychology Marketing, Vol. 18 (4), pp. 389-413
51. RMIT University (Royal Melbourne Institute of Technology University) (September 14, 2009). Green IT Observatory. http://greenit.bf.rmit.edu.au/index.php.
52. R. Robert Harmon and Nora Auseklis, (2009). "Sustainable IT Services: Assessing the Impact of Green Computing Practices", PICMET Proceedings.
53. J. A. Roberts, 1996, "Green Consumers in the 1990s: Profile and implications for advertising", Journal of Business Research, Vol. 36, pp.217-231.
54. G. Rowe, G. Wright, F. Bolger, 1991, Delphi: a re-evaluation of research and theory, Technological Forecasting and Social Change 39, pp. 235–251.
55. G. Rowe, & G. Wright, 1999, The Delphi technique as a forecasting tool: Issues and analysis. International Journal of Forecasting, 15, pp. 353-375.
56. S. Ruth, July 2009, "Green IT-More than a Three Percent Solution?" IEEE Internet Computing, Vol. 13, no.4. P. p. 74-78.
57. H.Sackman, 1974, Delphi assessment: Expert opinion, forecasting and group process. Santa Monica, CA: Rand Corporation.

58. A. P. Sage, 1977, "Interpretive structural modeling: Methodology for large scale systems". New York, NY: McGraw-Hill.
59. Sania Khan, H. Abdul Razak and V. Krishna Kumar, 2011, "Prioritization of Green IT Parameters for Indian IT Industry: Using Analytical Hierarchy Process", World Journal of Social Sciences, Vol.1, No.4, pp. 179-194 http://www.wbiaus.org/14.%20Sania.pdf
60. N. H. Schmidt, Schmidtchen, Timo, ErekKoray, Kolbe, M. Lutz and Zarneow, Ruediger, (2010). "Influence of Green IT on Consumers' Buying Behavior of Personal Computers: Implications from a Conjoint Analysis", 18th European Conference on Information Systems.
61. N. H. Schmidt, K. Erek, L. M. Kolbe, and R. Zarnekow, 2009, Towards a Procedural Model for Sustainable Information Systems Management. In Proceedings of the 42th Hawaii International Conference on System Sciences 2009 (HICSS-42) (Sprague, R.H.Ed.). USA, Hawaii.
62. L. Spencer, J. Ritchie, J. Lewis, & L. Dillion, 2003, Quality in qualitative evaluation: A framework for assessing research evidence. Retrieved April 22, 2006, from http://www.policyhub.gov.uk/docs/qqe_rep.pdf
63. Stephen Swoyer, November 14, 2006, "The Greening of IT: Cutting Power Consumption is Just the Beginning", Enterprise Systems.
64. T. J Velte, A. T. Velte, and R. Elsenpeter, 2008, Green IT: Reduce Your Information System's Environmental Impact While Adding to Bottom Line. New York: McGraw Hill Companies.
65. T. S. Chan, 1996, "Concerns for environmental issues and consumer purchase preferences: A two-country study", Journal of International Consumer Marketing; Vol. 9(1): ABI/INFORM Pg.43.
66. T. Vetter, and H. Creech, 2008, "The ICT Sector and the Global Connectivity System: A sustainable development overview," The International Institute for Sustainable Development, IISD, Winnipeg. [Online]. Available: http://www.iisd.org/pdf/2008/ict_global_con_sd.pdf. [Accessed: Dec, 10, 2009].
67. Tim Flannery, Faculty of Business and Economics, October 2010, "The gap between consumer attitude and purchase behavior of eco-friendly products", Macquarie University, Sydney, Australia. http://blogs.panasonic.com.au/consumer/wp-content/uploads/2011/03/Panasonic-booklet.pdf
68. Tugrul Daim, Jay Justice., Mark Kraits, Matthew Letts., Ganesh Subramanian & Mukundam Thirumalai, 2009, "An energy efficiency model for information technology managers", Management of Environmental Quality, Vol. 20 No.6.
69. N. P. Uhl, 1983, "Using the Delphi technique in institutional planning", In N. P. Uhl (Ed.), Using research for strategic planning (p.p. 81-94). San Francisco, CA: Jossey-Bass.
70. J. W. Warfield 1974, "Developing interconnected matrices in structural modeling". IEEE transcript on systems, Men and Cybernetics, Vol. 4 (1), p.p. 51-81.
71. White Paper 102. 2011, "Enabling the Green Data Center: Drivers, Benefits and Technology Enablers", nlyte software.
72. William Young, Kumju Hwang, Seonaidh McDonald and J. Caroline Oates, 2010, "Sustainable Consumption: Green Consumer Behavior When Purchasing Products", Journal of Sustainable Development, Vol. 18, pp. 20-31.
73. E. P. Y. Yam-Tang, and R. Y. K. Chan, 1998, "Purchasing behaviors and perceptions of environmentally harmful products", Marketing Intelligence & Planning, Vol. 16 (6), pp. 356-362.
74. E. Ziglio, 1996, The Delphi method and its contribution to decision-making. In M. Adler & E. Ziglio (Eds.), Gazing into the oracle: The Delphi and its application to social policy and public health. London, England: Jessica Kingsley.

* * *

Sania Khan, Ph.D Scholar,
GSIB, GITAM University, India
Saniakhan05@gmail.com

Mohammed Shahid Ahamed Khan,
IT Product - Sales Manager,
MIEL e-Security Pvt. Ltd. Pune, India
Sansha06@gmail.com