

Conceptualising Green Awareness as Moderator in Technology Acceptance Model for Green IS/IT

1st Sultana Ashiq
Computing and Informatics
London South Bank University
London, UK
ashiqs@lsbu.ac.uk

2nd Dr. Christos Chrysoulas
Computing and Informatics
London South Bank University
London, UK
chrysouc@lsbu.ac.uk

3rd Prof. Ebad Banissi
Computing and Informatics
London South Bank University
London, UK
banisse@lsbu.ac.uk

Abstract—Green Information System/Technology adoption is one of the key solutions sought by organisations, policy makers and governments to promote sustainability and deal with environmental issues. Surprisingly, in the research discipline of management information systems measuring the intention of decision maker to adopt Green IS/IT is ignored while only a few studies address the issue of Green IS/IT adoption. But these studies are mostly done in organisational manner and consistently lack to conceptualise the role of Green Awareness or environmental literacy of the end user that may play the role of the facilitator to such adoption models and can significantly moderate the relationship of users' cognitive and behavioural intention factors in decision making process of adopting Green IS/IT. To fill this gap in the Green IS/IT literature, this paper conceptualise the role of Green Awareness as a facilitator by incorporating a subjective green awareness rating scale as a moderator in Technology Acceptance Model. This paper contributes to the existing knowledge in the science of information systems, mapping users' intention to adopt Green IS/IT and sustainability by conceptualising green awareness rating scale for users and a theoretical framework of incorporating the scale in Technology Acceptances model to map its role as a moderator.

Index Terms—Green Awareness, Green IS, Green IT, Adoption, Technology Acceptance Model

I. INTRODUCTION

Green IS/IT has emerged as a result of mitigating increasing climate change issues. Green is associated with the ability of a technology to be economically effective and resource efficient. Initially the concept of Green IS/IT is treated as a tool to save energy using a combination of technology and information systems [1]. However, the modern concept of Green IT/IS has expanded from merely energy saving namely (Green of IT) to (Green by IT/IS) using IT/IS to carry eco-friendly activities [2], [3]. Green of IT refers to the green characteristics of information technology that helps resource efficient usage e.g. energy saving and recycle ability of information technology throughout its life cycle, whereas Green by IT/IS means the use of technology in eco-friendly manner to facilitate the change on society to achieve a lower carbon foot print society by maximising resource efficiency and leveraging the responsiveness of technology by incorporating early desalter

response systems and real time environmental monitoring to mitigate climate change. With the outspread notion of Green IT/IS has created a need for designers and researchers to identify the factors that affluence the adoption process of Green IT/IS. There have been several studies conducted to identify the adoption factors of technology [4]–[11] and highly dominated with Technology Acceptance Model by Davis, (1985) and interpersonal network of user Unified theory of Acceptance and Usage of Technology by Venkatesh et al., (2003) but still leaving a room for these theories to be redefined with other emerging motivational factors that form user's positive attitude towards adoption green IT/IS. Attitude is identified as a strong predictor that derives intention of referent to behave in positive or negative manner towards adoption and usage [4], [9], [12]. Survey done by the European Commission (2008-2018) to measure consumers' intention towards adoption of green product consistently reported consumer's environmental awareness as one of the major influencing factors in forming positive attitude towards sustainability. Mostly studies examined user's knowledge and level of information as one single construct as part of user's motivation to measure intention to adopt green IT/IS [13] and found significantly influencing. They reported that level of information and environmental knowledge of green usage of system can build consumer trust and positive experience towards Green information systems. Treating knowledge/awareness as an objective construct may be useful for user's motivation for traditional system adoption but in case of environmental friendly IT/IS, consumer's involvement is very important to understand the green phenomenon and sustain-ably behave in persuaded manner. Organisational motivational behaviour has been given significant importance however it is essential to identify individual Element that affect Green Information Technology adoption [14], [15] because individual involvement is necessary to protect environment related to Green Information Technology e.g. eco-friendly cars, energy saving desktops, home appliance air conditioner etc. But the level of environmental phenomenon is treated as one objective factor to examine its impact whereas subjective environmental awareness is not only related to the solitude knowledge of systems' characteristics but also a combination

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of consumers knowledge or information of environmental issues, attitude towards local global view point of saving the environment at individual level, necessary skills to carry the activities that lead to achieve sustainable goals [16]–[18] and therefore user’s demography can be different based on their level of green awareness and may play a significant role as facilitator if conceptualised by augmenting as a demographic measure in Technology Acceptance Model to measure user intention to adopt and use Green IS/IT. This study emphasises on the role of Green Awareness as a demographic measure in technology acceptance model and identifies the key factors that contribute towards user’s overall green awareness to help designing a scale naming GARS Green Awareness Rating Scale to measure users’ level of green awareness. Further the study conceptualise GARS visualisation as stack bar chart to ease the beneficiaries to dynamically view and differentiate the population with higher and lower level of green awareness for market segments and strategic decision. Further in this paper critical literature is reviewed to build the insights of green awareness and its role in user’s decision making process of technology adoption and usage. Further the key factors are identified based on existing literature of user’s environmental awareness or consciousness models and theories to design proposed Green Awareness Rating Scale (GARS) and question items selection.

II. LITERATURE REVIEW

In this section theoretical relation between green awareness and green technology adoption/usage is reviewed to identify the importance of green awareness role as a moderator in technology acceptance model.

A. Information Technology/Systems and Green indicator

Green in term of sustainable product does not refer to colour but the sense of a product to be efficient in conserving resources. Several studies used “green” to refer products, businesses, and production processes that are designed to use resources e.g. energy, water, recycle materials, less pollution etc. and save natural resources[14], [19], [20]. Green in terms of IT is defined as usage practice of designing, manufacturing, using and disposing it to reduce environmental impact [21], [22]. Rapid expansion in individual’s IT usage e.g. smart phones, wearable, laptops, desktops etc. has increased electronic waste causing environmental crisis that mankind must address now. Green IT/IS are proclaimed with green indicator called eco-labels e.g. energy efficiency, recyclability, upgradeability and reparability. Manufacturers are bound by law in many countries e.g. Europe to indicate electric product with eco-labels to inform users about the efficiency of the products to facilitate users to take an informed decision at the time of purchase. Some of the green indicators examples in figure below:



Figure 1. Example of Green Indicators.

B. Green Awareness and Technology Acceptance Model

Technology adoption is referred as how one acknowledges any new or existing technology and embraces the change [23]. Several studies identified and classified the processes of adoption from the stage of introduction of new information system to the actual response stage [4], [12]. Technology Acceptance Model (TAM) was introduced by Fred Davis in 1985 to measure user motivation towards adoption and use of information systems. TAM was developed on the foundation of well-established theory of Reasoned Action and Planned Behaviour by [9], [10], [24], [25]. TAM established a relationship between system characteristics and human factors to empirically test intention towards adoption and usage. TAM was conceptualised based on three stages of user adoption; the first stage is System Stimulus and referred as features and characteristic of information system that can represent ‘n’ number of objective features, the second stage is Organism that refers to ‘k’ number of factors that motivate users to form an attitude and likelihood of accepting a technology and the third stage is Response that is referred as actual use of system that can be predicted from user’s intention to use a system. These stages further supported by communication theories literature of success of information systems [26]. TAM referred the paradigm of Theory of Planned behaviour [25]. Original TAM concluded user’s cognitive and effective response as user’s motivation. Referent’s cognition was measured as Perceived ease of Use and Perceived Usefulness of a system that further influence user’s effective response that is referred as user’s Attitude that one develops by examining the IT product to the degree to which it is useful for one’s performance expectations. The limitation with the model is that model does not address the cognitive response extensively and keep it limited to system’s features whereas there are many other factors involved e.g. socio-economic, personal norms, public policies etc. that influence user motivation towards system adoption. In case of Green IS/IT adoption the agenda of stimulus stage of TAM in this study is not only about systems’ features but also but it includes consumer’s intellectual ability of understanding the usage purpose of system and carry the behaviour accordingly. Like any other model TAM is also limited in its application and offers opportunity to extend and alternatively designed for different context [27]. Despite of being highly adopted model, there is no environmental literacy scale that measures user’s overall green awareness ratings and acts as a moderating variable in technology acceptance theories. Thus, TAM needs subject specific revision for green IS/IT. Therefore, this study design and conceptualise Green Awareness Rating Scale and incorporate it as a moderating variable in TAM.

III. MODEL DEVELOPMENT

In this section theoretical relation between green awareness and green technology adoption/usage is reviewed to identify the importance of green awareness role as a moderator in technology acceptance model.

A. Methodology

Technology acceptance model is most widely adopted management information system theory that refers to the significant relationship between user's motivational factors "Perceived Ease of Use", "Perceived Usefulness" and "Behavioural Intention" to adopt information systems. To construct Green Technology Acceptance Model, factors are adopted from original TAM to extend and examine collective socio-technical and sustainable psychological factors of users while analysing the role of subjective green awareness ratings in this complex network of human computer interaction. Secondary data from relative literature is collected to supplement the conceptual model referred as Green-Technology Acceptance Model. Further, the design of Green Awareness Rating Scale is conceptualised based on existing socio-psychological theories and models designed to measure environmental awareness and consciousness. Human involvement categorisation and its different results are conceptualised. In order to create a model; the Green IS/IT adoption stages should be separated, the stages of adoption are adopted from original TAM [4].

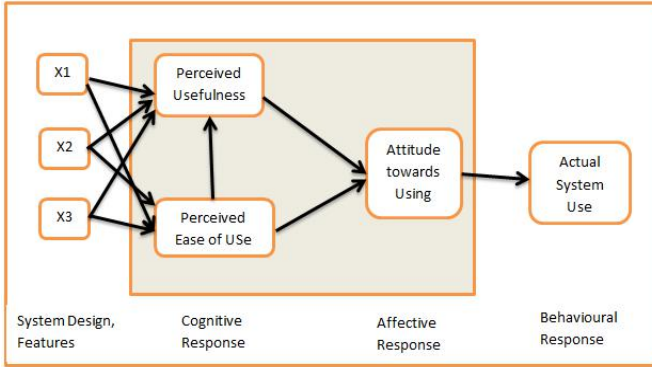


Figure 2. Technology Acceptance Model (Davis, 1985).

In original TAM Davis conceptualised the model on four stages as the part of decision making process of adoption and usage of information system. Such stages are also supported in model of success of information system (Shannon and Weaver 1949; Mason 1978; DeLone and McLean's 1992, 2003) [26]. The first stage of system feature and design in this agenda is treated as the stage of IT introduction to users as a stimulus. At this stage user's knowledge and experience is triggered by examining the information and system quality. In communication theories it is treated as transmitting and receiving messages from system's design and features stimulation [21]. At Green IT introduction stage a user is introduced with a technology that has environmental benefits as a part of product features and competences. In TAM this stages addresses the external

variable as features of information system that directly impacts user's cognition response that one generates by examining the quality and information of system by processing one's knowledge and skills that may potentially be sourced through other elements e.g. social stakeholder [4], [7], [8], [12]. In TAM cognition response is related to one's understanding and performance expectation from a system described as ease of use and usefulness of a system that a user perceives. in Green IS/IT acceptance literature the cognitive dimension is examined as individual's information and knowledge related to environment that one processes and form a negative or positive attitude known as Affective response regarding pro-environmental view, belief of environmental threats and seeking Green IT/IS as a solution to environmental problems [16], [18]. An Affective response of a user is a potential predictor of behavioural response that how a user will actually use a system. In case of Green IT/IS acceptance a subjective level of environmental awareness that is determined by user's motivation, attitude, environmental value, knowledge/information of environmental problems, skills and ability to act, interfere at every stage of decision making process to adoption and usage. Phases of green awareness triggers in decision making process are designed for this study.

Study	Phases			
TAM, Davis (1985)	Systems Features/Design	Cognitive Response	Affective Response	Behavioural Response
	Product at technical and Semantic level	Perceived Ease of Use Perceived Usefulness	Attitude	Intention/Actual Use
This Project (Green Awareness triggers and interference)	Green Awareness interference to assess	User's expectancy related to Performance, Recourse conservation Personal (monetary, temporal) and environmental (energy, waste etc.)	Influence of level of Green Awareness to form negative of positive attitude towards object	Green or non-green system usage influenced by level of green awareness
	Green System Features			
	Green IT/IS introduction	Green User Adoption/Acceptance Level		Usage Level

Table I
CONCEPTUALISED ROLE OF GREEN AWARENESS AT EVERY STAGE OF TECHNOLOGY ACCEPTANCE MODEL.

B. Green Awareness and Perceived Green Usefulness

It is not very easy for designers to convince users to buy green IT/IS in persuaded manner. Technology acceptance models help designers to identify potential difficulties that users can face in order to practice certain behaviour. Therefore, designers try to communicate with consumers using different communication methods to inform users about green benefits of systems. In order for a user to perceive green benefits of information system one must be able to comprehend green benefit information given by manufacturers. In theory of Diffusion of Innovation (DOI), Perceived Green Benefits construct is referred as relative advantage [5], which means perceived benefits of an innovation is better than what it claims [5], [28], [29]. The idea of perceived more benefit of green is related to one's level of green awareness because, a traditional consumer will perceived a green systems to be only energy

saving technology. Whereas, green benefits are not limited to physical benefits but also to psychological level referred as Hedonic Motivation “a pleasure derived from using an IT” in Unified theory of Acceptance and Use of Technology 2 (UTAUT2) [7]. Hedonic Motivation was reported to be having influence on technology usage intention with moderating effects of Age, Gender and Experience. That arises a concern of difference between psychological benefits of green and non-green IS/IT usage. If the appearance of green or non-green smartphone or computers is not distinguished then their usage cannot be distinct unless the consumers are different based on their level of green awareness to perceive more moral psychological [30]. if the value of psychological and physical benefits that one perceived from green IT/IS usage can be influenced by consumer’s level of environmental literacy then Environmental/Green Awareness can be a factor that may play a role of moderator between user’s motivational factors and intention to adopt and use of system.

C. Green Awareness and Resource Conservation

Consumers are faced with choices between green and traditional counterpart of IT/IS due to increased substantiality of Green IT/IS marketplace. Users are reluctant towards green products as they perceived to be less effective or costly [31]. In further extension of TAM monetary value of IT/IS is considered as Price Value in UTAUT [12]. In UTAUT model Price value is found moderating factors, age, gender experience there must be moderating influence of green consume in case of Green IS/IT adoption. In line with Roger’s theory of Diffusion of Innovation, innovators adopted the technology faster than other types because of financial stability however all innovators with financial stability may not be able to perceive similar benefits of green IS/IT [23]. Since Price identified as a significant factor therefore in order for innovators to adopt green IS/IT and perceived same level of benefits it is very important that user’s recognition of green benefits and finance sacrifice should occur simultaneously at the time of purchase. For a consumer’s ability to identify green and performance related benefits one must be environmentally literate and concerned. Along with monetary and functional resource sacrifice, consumer’s temporal resources cannot be neglected and must be given more attention because if a consumer has to spend more time to understand green system design to perceive green benefits then they are more likely to lose their interest in green IT/IS [21], [32]. Therefore, the moderating effect of green awareness cannot be neglected as this can play a role of barricade in acceptance of green IT/IS in user’s evaluation of monetary and temporal resource sacrifice.

D. Green Awareness and Eco-Labels Noticeability

In case of Green IS/IT acceptance, Notice-ability is referred as perceptibility, recognition and understand ability of eco-friendly labels. A regular consumer perceives green products abstractly. Many consumers are not able to utilise the green product at its optimum level as they are not aware of full breadth of green product capability) [33]. A study observed

how tourist behave towards eco-friendly travel products and identified that referents were not aware of how green travel products look like despite of being interested in saving the environment [33]. Sometimes consumer assume that they want to save the environment but cannot identify and distinct between green and non-green products merely because of lack of environmental awareness an unknowingly they substitute green products with non-green products. Therefore it is very important for designers to educate their users with effective communication to increase their ability to identify and comprehend green indicators. Level of education has been reported to be positive factor in notice-ability and understand ability of eco-labels [34]. Consumer may have monetary and temporal resources stability but still unwilling to buy green product because one does not understand and can comprehend green indicators. Therefore this research proposes that at the level of Green IT/IS introduction if a consumer, 1. acknowledges the importance of saving the environment and its benefits by perceiving green benefits of Green IT (Positive Attitude towards environment as part of green awareness 2. willing to sacrifice more money to adopt green IT/IS (willingness to act as part of green awareness), 3. understands the information given on eco-labels (knowledge/information as part of Green awareness, that user will have more likelihood of purchasing and using green IT/IS.

Proposition: Individual’s Green Awareness (Positive Green Attitude to perceive green benefits of IT, Willingness to sacrifice resources time and money, Green Knowledge/information to understand the meaning of green indicators e.g. eco labels) has an influence on user’s green intention to purchase or use IT products.

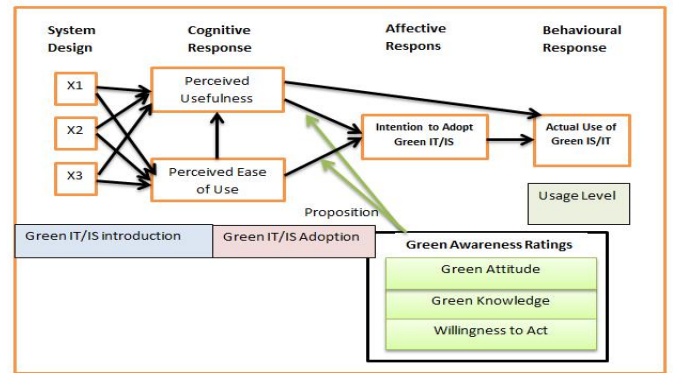


Figure 3. Conceptual Framework for Green Technology Acceptance Model.

IV. CONCLUSION

A critical literature is reviewed on factors affecting consumer’s adoption for Green IS/IT. It is not very easy for designers to convince users to adopt however they take the approach of identifying the potential barriers influencing consumer adoption of green technology that can be subject or object related. It is identified that many factors has been explored and examined by several acceptance theories but in green specific case subjective green literacy rate cannot

be ignored and should be examined for its significance role as consumer's demography in Technology Acceptance Model (TAM). Focusing on the adoption of such technology that is positioned as sustainable or can be perceived with sustainable benefits, we propose that consumer's intention towards green IT/IS acceptance may be increased or decreased depending on the level of subjective green awareness rate. This research touches the study areas of environment, user behaviour and IS/IT adoption. Two potential contribution of research framework are expected.

- 1) Understanding Green Awareness Level of users for IS/IT acceptance, usage and societal degree of green awareness.
- 2) Understanding user's overall green literacy including attitude towards environmental situation, environmental knowledge to understand green indicators, and willingness or active to sacrifice personal and financial resources in their purchase decision for technology.

A. Comparative Analysis and Validation

The proposed Green-Technology Acceptance Model (G-TAM) has a wider validity compare to other existing models in this regard. G-TAM is not limited to test the technology that is positioned as Green IS/IT but also to persuasively designed technology that may be not positioned as green IS/IT but can influence consumer's attitude towards sustainable behaviour e.g. smartphones, wearable, AI voice assistance (smart speakers), health related information systems and technologies etc. We further identify the method of designing the elements to measure proposed moderator "Green Awareness" with existing literature review as a scale to rate users based on their environmental literacy with combination of social and psychological dimensions. The study offers future opportunity to empirically test the role of green awareness as moderator and if the moderation role is significantly proven then this study can be used in many applications of sustainability, technology acceptance and environmental literacy. To empirically test the model, primary data can be supplemented using questionnaire tool. Confirmatory factor analysis, linear regression can be used to analyse the significance value of factors and combine variance of proposed key factors. Practitioners can utilise the study to measure and rate referents based on their level of environmental education hence concluding their green interests to adopt green IS/IT.

B. Limitation

The proposed study is limited because of no empirical evidence of conceptual framework. The identified constructs can or cannot be equally important in different subject areas.

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