Towards Low Carbon Universities in Nigeria: Agenda for Green Information Technology

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Over the years, so many efforts have been put in place towards achieving environmental sustainability. The international community has presented many models and frameworks aimed at creating sustainability awareness and cleaner productions among nations. Research concepts, policies, and technologies designed to foster the production of goods and services that conform to the standards of environmental sustainability were offered for consideration and use. However, the pace at which individuals and organisations adopt environmental sustainability policies differ across countries. Increase e-waste from the Information and Communication Technology (ICT) is becoming an important environmental issue that requires urgent attention. To control the ICT e-waste, production of environmentally friendly ICT known as Green Information Technology (Green IT) and their use among individuals and organisations should be encouraged. While the adoption of Green IT in organisations has been partly considered by researchers, its adoption among individuals has largely been overlooked. In Nigeria, the university communities represent the best place for promoting and enshrining the environmental sustainability policies being home to youth who are likely to be more conscious to issues related to sustainable environment. This paper provides a framework for understanding and explaining the individual adoption of Green IT. An extensive literature review was carried out and an Integrated Model of Green IT adoption (IMGITA) in Nigeria is presented. The paper recommends the adoption of IMGITA in Nigerian universities that will facilitate green policies to enhance the low carbon development among Nigerians.

1. Introduction

As the world continue to witness unprecedented growth in the area of information technology (IT), how it is produced, used, and disposed (IT life cycle stages) could likely affect the natural environment and eco-sustainability, as activities of each stage pose some potential environmental problems (Elliot and Binney, 2008). Waste relating to ICT use (e-waste) is fast becoming an emerging area of concern that needs to be addressed urgently. Weiss (2007) has reported that a single computer put to use up to a period of 10hrs in a day, produces 275.28 Nm^3 of CO_2 which is almost equivalent to one tenth of what a car produces a year. According to Berthon and Donnellan (2011), about 10 % of the total energy consumption in the United States was accounted by the Internet alone while 3 % of global electricity generation will be consumed by the IT sector (Ruth and Mason, 2009). Increase global use of information and communication technology (ICT) account for 2 % of the earth's CO2 emissions, equivalent to that generated by the e-aviation industry (Goasduff and Forsling, 2007). Thongmak (2012) states that the ICT industry accounts for just 2 % of the total carbon emissions, climate change resulting from carbon emissions remains among the most serious global challenges facing the environment.

As the importance of IT's role in all aspects of the businesses increases, and the fact that all stages of IT life cycle could pose environmental threat (Elliot and Binney, 2008), it is logical that IT sector adopts practice consistent with environmental sustainability. The green information technology (Green IT) concept was

introduced to the IT world. According to Dedrick (2010), Green IT is the study and practice of designing, manufacturing, using, and disposing of IT equipment such as computers, servers, monitors, printers, storage devices, and networking and communications systems in a way of more efficient and effective way with no or minimal environmental impact. Previous studies have reported that, apart from reducing carbon emissions, Green IT can also significantly save costs (Donston, 2007; Nunn, 2007). While Green IT looks attractive due the opportunities and potentials it presents, its benefits largely depend on its adoption and use by individuals and organisations (Molla, 2009). Empirical studies on the extent of Green IT adoption was reported to be scanty in the extant literature (Thomas et al., 2016). The majority of the adoption on Green IT focused on the organisational level of adoption (Chen et al., 2011), researchers have largely overlooked the factors influencing the adoption among individuals (Choon et al., 2014). Further studies are needed to investigate the factors that influence individuals' attitudes and behaviour towards Green IT initiatives (Nazari and Karim, 2012).

Universities are among the environments where ICT use is high. Part of being home to one of the highest users of ICT in a given society, the carbon emission in the universities is equally high. Often these activities results in high consumption of fossil fuel energy which also results in the emission of carbon dioxide (Abdul-Azeez and Ho, 2015) as shown in Figure 1. Again, having the highest group of daily IT users which suggest that their response toward Green IT is likely to be significant compared to other IT users within the community. According to Wesley (2011), the youth were found to be more willing to make economic sacrifices for a better environment. Studying on the behaviour of university students could help promote Green IT adoption and fill the existing gap. The aim of this study is to propose a behavioural model that would explain the individual adoption of green IT in Nigerian universities. The model is expected to provide better understanding and explanation on the reduction of CO2 through the use of green ICTs. Policies and programmes at various levels, then be implemented based on the inputs of this industry.
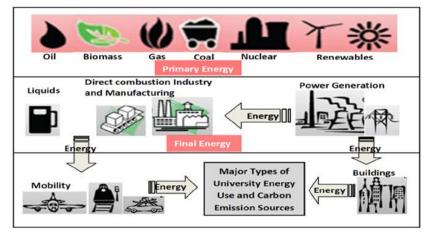

Figure 1: Universities Energy Consumption pattern adopted by Abdul-Azeez and Ho (2015)

2. Literature Review

Different theories and models were used in the past to investigate technology adoption in the past. Theory of Reasoned Action (TRA) developed by Fishbein and Ajzen (1975), suggests that the intention leading to behaviour is determined by the individual attitude and the subjective norms. Theory of Planned Behaviour (TPB) extended TRA by incorporating perceived behavioural control (Ajzen, 1985). Technology Acceptance Model (TAM) by Davis (1989) extended TRA by incorporating perceived ease of use (PEOU) and perceived usefulness (PU) as determinants of attitude. Rogers (1995) introduced the Innovation Diffusion Theory (IDT) which states that the adoption of innovation depends on its relative advantage, compatibility, trialability, observability, and complexity. Another theory used for technology adoption is the Unified Theory of Acceptance and Use of Technology (UTAUT) which combined of TRA, TPB, TAM, IDT, motivational model, social cognition theory, and PC utilisation model Venkatesh *et al.* (2003). The Green IT Adoption Model (GITAM) by Molla (2008), propose the static Green IT contextual variables, dynamic Green IT readiness constructs and Green IT drivers could predict Green IT adoption intention. While limited studies have used these theories in assessing adoption of Green IT for example, the TAM (Dedrick, 2010), no study has integrated constructs from the TRA, TAM, and GITAM to explain adoption of Green IT among users. This is because Green IT adoption is on its emergence (Alexander and Sherwin, 2014). Accordingly, Lei and Ngai (2013) recommends for the development of research model that predicts the adoption of a specific group of Green IT users.

3. Method

The study reviews the extant literature in the field of Green IT. Specifically, empirical articles that have examined Green IT adoption, acceptance, and or intention to used were given preference while other articles were considered based on their relevance and theoretical contributions to the Green IT adoption. The review proposes the integration of TRA, TAM, and GITAM in order to explain Green IT adoption among university students as shown in Figure 2. TRA was proposed by Fishbein and Ajzen (1975) and they postulated that the beliefs people hold influence their attitude, hence leading to the formation of intention and prediction of their behaviour (Figure 2).
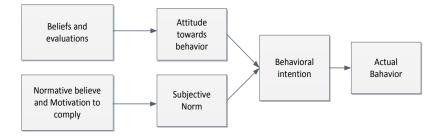

Figure 2: Theory of Reason Action (TRA) (Fishbein and Ajzen, 1975)

The TAM by Davis (1989) proposed that that PU and PEOU determine the attitudes toward using the system and these attitudes toward using the system determine the behavioural intentions, which in turn lead to the actual system use (see Figure 3.)
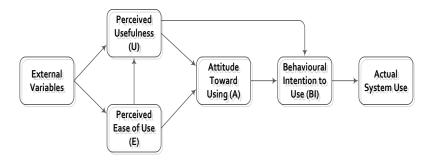

Figure 3; Technology Adoption Model (TAM) (Davis et al., 1989)

GITAM was developed by Molla (2008). The model reveals four different but interrelated perspectives on green IT. It postulates that the technological, organisational and environmental contextual variables, dynamic Green IT readiness dimensions and strong order Green IT drivers can predict the intention, breadth and depth of Green IT adoption.
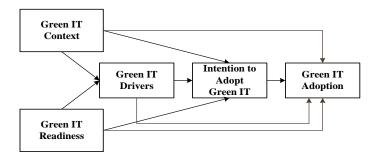

Figure 4: Green IT Adoption Model (GITAM) (Molla, 2008)

4. Result

Using TRA, TAM, and GITAM models, the paper presents an integrated framework called Integrated Model of Green Information Technology Adoption (IMGITA) that seeks to understand and explain Green IT adoption

behaviour in Nigerian universities. The model posits that SN, Organisational Support (OS), and Green Readiness (GR) explain Green IT adoption through PU and PEOU as presented in Figure 5.
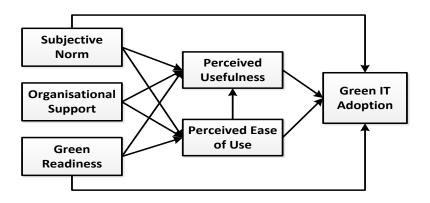

Figure 5: Proposed Framework Green IT adoption

Factors influencing individual's adoption to Green IT

Previous studies conducted different forms, fields, and contexts, to establish the influence of some factors on user's intention to adopt certain technologies. Among these factors included; readiness (Hung et al., 2010), perceived enjoyment (Liu et al., 2016), internet self-efficacy (Tsai et al., 2016), computer self-efficacy, organisational support (Liang et al., 2007), interaction (Wang, 2011), perceived risk (Bashir and Madhavaiah, 2014), and social norms (Okumus et al., 2016). In this study, the three key factor expected to influence human behaviors are further described hereafter. The three key factors are then related to PU or PEOU as shown in Figure 5. Both PU and PEOU factor will then influence GITA.

4.1.1 Subjective Norm (SN)

According to Fishbein and Ajzen (1975), subjective norm refers to the person's perception that most people who are important to him/her think he or she should or should not perform the behaviour. It is a major construct in the TRA. IT was reported that subjective norms had impact on Green IT adoption intention among Malaysian students (Choon *et al.*, 2014). While investigating the behaviour for the adoption of Green IT, Mishra *et al.* (2014) found subjective norm to significantly affected the intention to use Green IT professionals in public and private sector.

4.1.2 Organisational Support

According to Anandarajan *et al.* (2002) organisational support is the endorsement, encouragement of employees and positive attitude of the organisation in the provision of training information, system development and operations. It was reported that the strong believe regarding organisation's ability to provide required support the more likely it will influence its adoption (Venkatesh and Bala, 2008). Sánchez and Hueros (2010) have demonstrated that organizational support stimulates positive attitude.

4.1.3 Green Readiness

Green readiness has been defined as a dynamic assessment of an organisation's own and environment preparation to accept Green IT (Molla, 2008). According to Molla and Licker (2005), presented three dimensions of Green IT readiness. These include:
1. Perceived organisational Green IT readiness describes the awareness, commitment and resources of a firm relevant to Green IT.
2. Perceived value network Green IT readiness refers to the readiness of a firm's suppliers, competitors, investors, partners and customers of green IT
3. Perceived Institutional Green IT Readiness. Institutions refer to both formal entities such as government and professional associations and informal norms and practices.

4.1.4 Perceived Ease of Use (PEOU)

Perceived ease of use has been defined as the degree to which a person believes that using a particular system would be free from effort (Davis, 1989). It is one of the constructs of TAM. Drawing from the literature review in the field of information technology, perceived ease of use has been recognised as one of the major factors that have been used to investigate user behaviour towards technology use. Previous studies have established PEOU

as a direct determinant of attitude (Šumak *et al.*, 2011) and indirectly impacted upon intention to use (Lee *et al.*, 2011). Similarly, PEOU was reported to have to have had significant and direct effects on PU (Joo *et al.*, 2016).

4.1.5   Perceived Usefulness (PU)

Perceived usefulness is one of the constructs of TAM (Davis, 1989), which has been widely used by researchers in measuring individual's adoption or acceptance of a technology (Tarhini *et al.*, 2014). PU refers to the degree to which a person believes that using a particular system would enhance his or her job performance. PU was reported to have positively affected the users' behavioural intention to use the systems and actual use of Web 2.0 tools in the classroom (Sadaf *et al.*, 2016) as well as attitude towards behaviour (Lai, 2016).

5. Summary

Through an extensive literature review this paper proposed an integrated framework termed integrated framework called Integrated Model of Green Information Technology Adoption (IMGITA) that would assist Nigerian universities to adopt green IT for low carbon consideration. SN, OS, GR, PU and PEOU derived from TRA, TAM, and GITAM models formed the basis of IMGITA. The paper recommends the empirical validation of the proposed IMGITA which go a long way in improving empirical literature in Green IT adoption among individuals.

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