BYOD: A GREEN COMPUTING APPROACH TO GREENING INSTITUTIONS OF HIGHER LEARNING

[1]*Mutwiwa Petronilla Ndunge*
School of Computing and Informatics, Mount Kenya University
P.O Box 342, 01000 Thika – Kenya
Email: pndungem@gmail.com, cell: +254-720-557-568

[2]*John Wachira Kamau*
School of Computing and Informatics, Mount Kenya University
P.O Box 342, 01000 Thika – Kenya
Email: jkamau@gmail.com

[3] *Dr. Joyce Gikandi*
School of computing and informatics, mount Kenya University
Email: jgikandi@mku.ac.ke

ABSTRACT

Bring your own device (BYOD) refers to the practices of bringing personally owned device to the workplace, connecting them to the corporate network and using them for business purposes. BYOD can be considered as an approach to optimize the use of IT devices through the use of the same device for both personal and office work in various forms such as laptops or smartphones. Green computing refers to the approaches meant to reduce the carbon emission, electricity consumption and waste in lifecycle of IT devices existing within the business processes as a core value of the organization. The miniaturization of technology and growth in pervasive computing has enhanced mobility of computing devices and enabled users to carry these network enabled devices anywhere, anytime. This has made it possible for users to fully exploit the vast computing capabilities availed by these devices maximally without the barriers of time and location that characterized the traditional computing environment. These capabilities entrench the core objective of green computing. Thus, the ability of every organization to link the promise of BYOD with a desire to enhancing and building sustainable learning institution would prove beneficial from several fronts mainly because both technologies offer means of cutting costs by leveraging on the scarce resources.

Both green computing and BYOD have been touted as cost cutting approaches for any organization willing to invest in sustainable environments. This paper therefore tries to link the overall goal of BYOD to that of green computing and provide a case on how institutions of higher learning can exploit BYOD to enhance their sustainability agenda. The research is based on secondary data gathered from the practitioner community and academia and from articles and reports written within the last 6 years. The result of this research is a toolkit for exploiting and enhancing BYOD as a green computing approach for sustainable institutions of higher learning.

Keywords: green; Green computing; BYOD; Sustainability; devices.

Introduction

According to the inter-governmental panel on climate change (IPPC, 2014), sustainability involves simultaneous satisfaction of economic, environmental and social goals. Meeting environmental criteria in a society which fails to meet economic and social goals concerning justice and equity does not make for sustainability (UNEP, 2014). The Bruntland report of 1987 WCED (1987) defines sustainability with the statement that, humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. Thus, the commission defines sustainability as the ability of meeting the needs of the current generations without compromising the ability of future generations to meet their own needs. The report further argues that the concept of sustainable development does imply limits though not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. However, technology and social organization can both be managed and improved to make way for a new era of economic growth (Boudreau, Chen, & Huber, 2007).

In essence, sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both the current and future potential to meet human needs and aspirations (Drexhage & Murphy, 2010). Indeed, recent developments in information technology have come out to stamp the role of ICT in driving the sustainability agenda (OECD, 2009). On one hand, ICT has been viewed as a threat to the environment based on the vast amount of power ICT devices consume which in most cases is diesel generated and the fact that disposing obsolete computing devices is difficult as these

machines are non-biodegradable (Osch & Avital, 2010). Green IT efforts aimed at reversing this trend. The Information technology (IT) research community later opined that as much as IT contributes in the emission of greenhouse gases (GHG), rated at about 3% of the global GHG emissions, ICT can be applied to eliminate or at least significantly reduce the 97% of the GHG emissions caused by other non-IT factors. This is referred to as Green information systems (Green IS). Thus, concepts such as BYOD have continuously been analyzed as possible green IS concepts that if well-structured and adopted to address the problem of sustainability.

By definition, Bring your own device (BYOD) is the simple idea that young people and school staff are allowed to bring their own Internet-enabled device into school and use it to help them work, learn and also socialize. BYOD has become a powerful wave that hasn't yet crested for the teaching staff, school districts, and the information technology professionals who support education (Cisco Systems Inc., 2012)

Consumers today are in possession of very powerful devices that they use for their own needs. The power of these devices that have been bought by employees is often higher than the power of similar devices provided by their organizations. Therefore, many organizations are trying to leverage on this computing capability to supplement their Information Technology (IT). Leveraging on employee devices for enterprise purposes is referred to as bring your own device (BYOD) (Tata Consultancy Services, 2012). Today, many schools are shifting their focus from prohibiting the use of mobile devices on campus, to embracing BYOD as a way to enhance teaching and learning, improve student engagement, improve operational efficiencies, boost staff productivity, expand collaboration, and expand the capabilities of existing technology infrastructures(Cisco Systems Inc., 2012).

Literature review

Green computing

Green computing in organizations has become the trend in usage of information technology (IT) to reduce the carbon emission, electricity consumption and waste in the lifecycle of IT

devices. Researchers in the field of computing and sustainability recognize that organizational information communication technology infrastructure and devices are a core value to the business process and should thus support the goals of the organization in every way (Loeser, Erek, & Zarnekow, 2012). IT infrastructure is rapidly moving towards lower energy consumption and lesser cooling cost. Innovations are happening on two fronts. First, on the front of ICT infrastructure, making them to consume lesser power and cooling requirements (ACM, 2008). These technologies including virtualization, Cloud computing etc. are very popular among CIOs (CDW, 2007). Adoption of these technologies helps in saving power and reducing carbon emission. Similarly, technologies are being developed which can monitor and manage power consumption. These smart and intelligent technologies help an organization to map power consumption of each and every device (IBM, 2012). Such technologies could help industry verticals such as telecommunication companies and the hospitality industry as well as schools and other learning institutions whose electricity bills constitute a large part of their operational cost lower their energy bills.

One area that has been proposed for enhancing sustainability is Green Computing which both practitioners and researchers have discussed into the topics: Green IT and Green IS (Boudreau et al., 2007). These areas are as a result of the role that ICT play as an integrating and enabling technology in organizations. In the last eight years, the role of ICT in enhancing sustainability has received closer focus from the research community, environmental organizations, practitioners as well as governments.

The continued rise in ICT equipment acquisition and usage costs has surpassed global predictions. In the year 2014 alone, an estimated 351 million Personal computers (PCs) were sold globally. [1]During the first three months of 2015, an estimated 51 million tablets were sold globally. [2]This continued growth in the usage of computing devices presents a challenge to environmental management and protection efforts especially in the reduction of global greenhouse gas (GHG) emissions as ICT is considered to contribute between 2-3% of the GHG emissions (Brooks et al., 2012). However, the adoption of mobile devices and energy efficient computing devices (energy star) presents a new area where personal devices in the hands of individual users can be assimilated in the sustainability matrix by employing them to perform organizational duties.

[1] www.gartner.com

Information systems researchers have therefore focused their efforts on finding ways in which IT can be made more environmental friendly and at the same time identify innovative techniques in which IT/IS can be applied to reduce the global GHG emissions caused by other non-IT factors. Green IT thus focuses on how to reduce the negative ecological impact of information technologies (Osch & Avital, 2010); this, according to Boudreau et al (2007) is also referred to as greening IT. ICT permeates every level of an organization's management, this broad application creates an environment where the innovative capability of IS can be harnessed to reduce the environmental footprint of other non-IT related GHG emissions, this is referred to as green IS or greening with IT.

There has been concern that focus has been more on green IT which offers softer benefits, thus, the research community has continued to encourage firms to consider green IS which offers more benefits for both the environment and industry (Boudreau, Chen, & Huber, Green IS: Building Sustainable Business Practices, 2007). ,BYOD can be considered to be a green IS approach to sustainability because it facilitates the reduction of emissions that could have been caused by other non-IT factors. For example, use of BYOD would eliminate the need to travel from work hence saving on the emissions that could otherwise have been caused due to travel. In the same way, students can do their assignments on their personal devices and submit it via email hence eliminating the need to print it.

Green BYOD

The need for adoption of BYOD by organizations is explained best by Jisc (2013) who opines that company and institutional computers are left to run idle for long durations. In the case of schools, institutional computers remain idle overnight; much of the time during the day and for over 3 months annually when schools are on holiday. These devices therefore are underutilized. Use of personal devices for work and educational purposes hence optimizes the usage of these devices and ensures that the vast computing power is put into better use all year round (Jisc, 2013). Over the last few years, laptops and handheld mobile devices have become affordable and provide users with 24/7 access to ideas, resources, people and communities (Alberta Education, 2012). You can imagine the benefits of allowing students to use the powerful computing devices that they are already so much familiar with; that they are always carrying in their pockets. These devices include laptops, smart phones, tablets and other portable digital assistants (PDAs). Not only does this allow schools to tap onto this

power and keep students engaged, it also ensures that the creativity of students can be tapped as the accessibility of these devices is with the students on a 24/7 basis (Miron, Urschel, Mathis, & Tornquist, 2010).

It therefore points to that, combined with the right pedagogy, and if used responsibly, technology in education can be a major transformative tool in the delivery of content; ensuring the 'one device per student' is achieved; enabling learners to collaborate with teachers and peers as well as act as a vehicle for personalized learning by ensuring that each student is fully engaged in learning and is successful in fully attaining established learning standards (Gaines & Martin, 2014). with the same breadth, adoption of BYOD within institutions of learning can greatly influence the drive towards sustainable development. This is compounded not just by the direct results that are achieved but the creation of a sustainability driven citizen considering the large number of individuals who pass through these institutions.

BYOD is defined as the practices of bringing personally owned device to the workplace, connecting them to the corporate network and using them for business purposes. BYOD is a new approach to optimize the use of IT devices through the use of the same device for both personal and office work in various forms such as laptops or smartphones. The implementation of BYOD practices support green initiative by reducing the IT hardware in a working environment that will help to reduce carbon emission. IT hardware is the major contribution to the disposal and IT usage that give negative impact to the environment.

Link Between BYOD and sustainability

According to (WCED, 1987), Ecological economists recognize four distinct "capitals" which are necessary to support the real, human welfare producing economy: ***Natural*** (the land, sea, air and ecosystems from which the human economy derives its materials and energy and to which it ultimately returns its wastes); ***Built*** (buildings and cities, the physical infrastructure which produces economic outputs and the human artifacts thus obtained); ***Human*** (the health, skills, knowledge and values of the human population); and ***Social*** (the web of formal and informal interpersonal connections and institutional arrangements which facilitate human interactions) (UNEP, 2014). Of importance here is to identify the position of BYOD within the ecological cycle.

End-users play an important role in green attitudes and behavior of the organization's workforce towards environment. However, the different end-user need different IT hardware based on usage pattern, location requirement that including job specification, time, value derived from mobility, data access and system access(Njeru et al., 2016). It is still not clear what the main components of BYOD that must be considered to support green computing. However, one important requirement for any organization is to establish frameworks to support BYOD adoption. This will involve essential strategies to ensure the security of organizational information as well as controlling who can access what and what device can be allowed to access institutional resources. This is important because, sustainable measures must not threaten the core existence of the same institution.

By adopting BYOD, TVET institutions are saved on the costly investments required in assembling effective ICT facilities. This includes mainly the cost of hardware and the associated costs of maintaining the same. It is important to note that BYOD devices are acquired and managed by the individual users.

Potentials of BYOD for students

Web-based tools have transformed the learning environment and process. Students now have at their fingertips unlimited access to digital content, resources, experts, databases and communities of interest. By effectively leveraging such resources, school authorities not only have the opportunity to deepen student learning, but they can also develop digital literacy, fluency and citizenship in students that will prepare them for the high tech world in which they will live, learn and work(Alberta Education, 2012). The potential of BYOD therefore in transforming of just the education practice but also the learners is therefore immense. Hence, exploiting BYOD as a green technology holds better promises for institutions and society. Its basic tenets cut through all the core demands of building a just and environmentally stable society. Like every other green technology, Green BYOD presents several benefits as highlighted above. And it is also prove that all green approaches pay not just in ensuring resource efficiency and a better cleaner ecosystem but also guarantees a more resource intensive society.

Both academia and practitioners have intensively investigated the benefits of adopting green IT as well as BYOD. Placing a link between these two technologies offers a unique

opportunity to merge these benefits for the benefits of all stakeholders, that is, the society, ecosystem, individuals and organizations. Several frameworks have been developed that seek to provide structures for adoption of each of these technologies within organizations(Njeru et al, 2016).

Institutional requirements for green BYOD

The desire for considering a Green BYOD model would often include the potential for cost savings. Faced with the lack of budgetary capacity to provide adequate numbers of up-to-date devices to meet teaching and learning needs, school authorities have an opportunity to consider BYOD models. However, most institutions management have found that initially, their costs may not be reduced, but rather initial costs are redirected to network reconfigurations and the increased bandwidth required to support the BYOD model with latter costs being directed to maintenance of the BYOD infrastructure. Thus, it is not a wonder for the institutions to realize that for the same investment, student access can be substantially increased.

The shift from investments in devices to investments in network infrastructure and bandwidth, combined with the increased number of devices available to students for learning, translates into increased access. But the reality is that, as students realign their mindsets to increasingly joining the BYOD networks, benefits begin to trickle in for the learning institutions. The need to purchase and service their own computers is eliminated and the associated costs of power that could otherwise have been consumed by standalone organizational computers drastically reduce; the need for replacement of obsolete systems also fades translating into improved financial savings for institutions. This directly translates not just to better financial benefits for these institutions but reduced GHG emissions translating into a more cleaner and vibrant ecosystem.

Conclusion

Green IT and BYOD stand out as technologies of the present and the future. IT investments have been vast in the last decade with billions of computing devices being sold. The recognition of the role of IT as both a challenge to sustainability and as an agent to a cleaner

and sustainable environment has presented researchers in the field of computing with an ideal opportunity to contribute positively to efforts on sustainability. TVET institutions and other institutions of higher learning too have a unique chance of molding more sustainability conscious citizens by integrating green technologies into their daily educational practices. A lot of research seems to have been done within each of these technologies (Green IT and BYOD); however, little seems to have been done on developing structures and frameworks for integrating these technologies for optimum benefits. In the case of learning institutions, the potential of these technologies in transforming the attitude of young citizens on sustainability are many. These opportunities need to be exploited by developing better structures to support the adoption.

References

ACM. (2008). *Green Computing*. Communication of the association for computing machinery. united states: Communication of the ACM.

Boudreau, M.-C., Chen, A., & Huber, M. (2007). Green IS: Building Sustainable Business Practices. *University of Georgia: A Global text Project*, 1-17.

Boudreau, M.-C., Chen, A., & Huber, M. (2008). Green IS: Building Sustainable Business Practices. *Ceport Report: Global text*, 1-17.

CDW. (2007). *Implementing Green I.T. Eleven Ways I.T. Can Lower Power Consumption, Reduce Costs & Eliminate Waste*. CDW-G, Illinois.

Drexhage, J., & Murphy, D. (2010). *Sustainable Development: From Bruntland to Rio 2012*. New York: United Nations.

IBM. (2012). Aligning IT with strategic business goals. *IBM Global Technology Services*, 1-12.

IPPC. (2014). *Summary for Policy Makers in climate change 2014. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Intergovernmental policy on climate change (IPCC). Cambridge, United Kingdom and New York, NY, USA.: Intergovernmental Panel on Climate Change.

Karen, Anderton; Subaskar, Sitsabeshan;. (2013). *ICTs for Sustainable Energy Partnership. GREENING GOVERNMENT THROUGH ICT: INSIGHTS FROM EUROPE*. THE CLIMATE GROUP DESSC, LONDON.

Loeser, F., Erek, K., & Zarnekow, R. (2012). TOWARDS A TYPOLOGY OF GREEN IS STRATEGIES: INSIGHTS FROM CASE STUDIES. *Thirty Third International Conference on Information Systems, Orlando 2012* (pp. 1-19). ORLANDO: International Conference on Information System.

OECD. (2009). *TOWARDS GREEN ICT STRATEGIES: ASSESSING POLICIES AND PROGRAMMES ON ICT AND THE ENVIRONMENT*. Inter-Government report, ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD), Denmark.

Osch, W. v., & Avital, M. (2010). From Green IT to Sustainable Innovation. *Association for Information Systems* (pp. 1-9). peru: AIS Electronic Librar y (AISeL).

UNDP. (2015). *Sustainable Development Goals*. Geneva: United Nations Development Programme.

UNEP. (2014). *GREENING UNIVERSITIES TOOLKIT V2.0. TRANSFORMING UNIVERSITIES INTO GREEN AND SUSTAINABLE CAMPUSES : A TOOLKIT FOR*

IMPLEMENTERS. NAIROBI, KENYA: United Nations Environmental Programme (UNEP).

WCED. (1987). *Our common future.* Oxford: Oxford University Press.

Alberta Education. (2012). *Bring Your Own Device: A Guide for Schools*. Retrieved from http://education.alberta.ca/admin/technology/research.aspx

Cisco Systems Inc. (2012). *BYOD in Education*. *Cisco systems Inc*.

Gaines, J., & Martin, E. (2014). Bring your own Device (BYOD) for Learning. *PDST Technology in Education*, (November), 1–8.

Jisc. (2013). Bring Your Own Device Policy Template for Further Education. *JISC Legal Information*, (May), 1–6.

Miron, G., Urschel, J. L., Mathis, W. J., & Tornquist, E. (2010). Schools without diversity: Education management organizations, charter schools, and the demographic stratification of the American school system. *Boulder and Tempe: Education and the Public Interest Center & Education Policy Research Unit. Retrieved February*, *16*, 805–829. Retrieved from http://ea.niusileadscape.org/docs/FINAL_PRODUCTS/LearningCarousel/SchoolsWODiversity.pdf

Njeru, K. M., & Kamau, J. W. (2016). A GOVERNMENT DRIVEN APPROACH, *1*(1), 1–15.

Njeru, K., & Muchiri, P. G. (2016). Green Economy : Integrating Green Technological Innovations for Sustainable Economic Development, *1*(1), 1–14.

Tata Consultancy Services. (2012). *Bring Your Own Device (BYOD)*.