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Barriers to Implementation of Green ICT in Kenya

[1]**Franklin Wabwoba, [2]Gregory W. Wanyembi, [2]Stanley Omuterema**
[1]Kibabii University College
[2]Masinde Muliro University of Science and Technology

ABSTRACT

Information and Communication Technology (ICT) is playing an increasingly important role in both business and private undertakings. Its use in several areas in the world economy has brought about increased demand for electronic equipment. The rapid pace of technology advancement and the drop in hardware prices has led to increased demand and acquisition resulting in increased production and use of hardware. However, the increased ICT uptake has increased costs and demand for energy where electricity is the main power source. Electricity notably is a major contributor to climatic change because the coal or oil that helps generate it does releases carbon dioxide, pollutants, and sulphur into the atmosphere. With environmental degradation, rising costs of doing business and power demand and demand for social responsibility, going green is no longer an option. There are green ICT technologies in the market to mitigate the concerns but unfortunately they are not bearing fruit that calls for an understanding of barriers to implementation of the same in developing nations like Kenya. The study used multiple case study approach. The study population included ICT managerial, technical and end user human resource and public university ICT graduate students. The multiple study was conducted in one leading sugar manufacturing industry, a communication commission regulatory body and one public university offering ICT from certificate to PhD level. Respondents were either interviewed or responded to a questionnaire. The study established that green ICT technologies are available in Kenya and are not barriers to its implementation. The paper highlights the barriers to implementing green ICT in Kenya. The paper recommends alignment of ICT personnel towards enhancing green ICT implementation in the light of the barriers.

Keywords: *Green ICT, green ICT awareness, Implementation barriers, ICT personnel*

1. BACKGROUND

Everywhere in the world ICT is playing an increasingly important role in both business and private undertakings [1]. The rapid pace of technology advancement [2] and the quick drop in hardware prices has facilitated an increasing demand and acquisition leading to increased production of hardware making Information and Communication Technology (ICT) to one of the fastest growing industries in the world. However, the increased ICT uptake has increased costs and demand for energy where electricity is the main power source [3]. Electricity notably is a major contributor to climatic change because the coal or oil that helps generate it releases carbon dioxide, pollutants, and sulphur into the atmosphere.

The rapid evolution of technology is at the same time reducing the life span of ICT devices drastically accelerating their obsolescence [5] with the third world relying more on the hardware donation. The e-waste from the obsolescence is finding way into developing countries and emissions from the ICTs are endangering human life and the environment ([5]; [6]). With environmental degradation, rising costs of doing business and power demand, and demand for social responsibility, going green is no longer an option but a necessity ([7]). This has led to demand to have ICT applied sustainably hence demand for green ICT. There are green ICT technologies in the market to mitigate the concerns but unfortunately they are not bearing fruit ([8]) suggesting a lack of understanding of challenges and barriers to their applications. This study endeavoured to explore the perceived barriers towards implementation of green ICT designs by the Kenyan ICT human resource.

2. GREEN ICT

Green ICT naturally originates with IT itself ([9]). It is sometimes referred to simply as Green IT and it means different things to different people. It's important for people to understand what Green ICT is, for businesses to engage with it, and for our decision makers to be aware of its consequences and potential in helping us get to a sustainable world ([10]). Unfortunately there is disparity in the level of green ICT understanding, causing confusion within the human personnel ([11]). Hence, many do not know how or where to begin and are unwilling to implement it ([11]; [10]). The lack of completely agreed upon definition makes it difficult to measure the effectiveness or the extent of an organisation's implementation of Green ICT ([10]). The environmental impacts come in much the same way the impacts come from any equipment through the manufacture, use and disposal when one considers green ICT.

To some people green ICT is all about electricity consumption. However, there is more to Green IT than power consumption and its associated raising costs. It goes beyond the function and the ICT department. Such a definition fails to recognise that it is a central enabling technology to many aspects of sustainability. It goes beyond purchasing and usage considerations into how it can be used to lessen other aspects of our environmental impact in the other sectors it supports. This may be achieved through dematerialization and changing physical processes to virtual ones. It does enable attainment of more efficient businesses and less environmental impact. From the foregoing, it is appears like Green ICT brings together

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themes concerning the future of our current world, technology and the environment.

According to Molla (2009), it is (i) the systematic application of ecological-sustainability criteria to the design, production, sourcing, use and disposal of ICT technical infrastructure (ii) as well as within the human and managerial components of ICT infrastructure in order to reduce ICT, business process and supply chain related emissions, waste and water use; improving efficiency and generate green economic rent.

Most of the green ICT works may not have attained their goals due to implementers over concentrating on the part (i) of the definition at the expense of part (ii) of definition. From Molla's part (ii) of the definition green ICT also comprises managerial aspects to control and monitor the effectiveness of implemented measures as well as marketing measures to communicate the success towards important stakeholders ([12]). This clearly calls for concentration on the human and managerial components which forms part of ICT personnel. No wonder there are green ICT technologies in the market but unfortunately they are not bearing fruit ([8]).

Green ICT is achieved through the human personnel, hardware and software. A good definition of Green ICT has, therefore, to identify the challenges it has in the areas of how the materials in ICT equipment are mined/produced, the conditions in which they are manufactured and the energy in this process, their transport to consumers, the energy required in their use, and the disposal at the end of their life time ([10]) and how the human personnel implements and uses them.

The human personnel is an inherent part of ICT innovation and crucial for future developments [5] hence the need to be properly aligned with green ICT for its benefits to be realised. This provides the reason for paying attention to the human personnel as has been emphasized in the definition. However, hardly is there any literature to support the fact that studies into the human personnel in relation to green ICT are being undertaken. Currently there is hardly any journal concentrating on green ICT and its personnel in particular. Journals have been slow in publishing work in this area ([13]) and yet it is the people who implement the technology. In the papers surveyed, it is apparent that themes such as concept definitions and research agenda formulation are strongly present and complemented with studies on the managerial attitudes and reasons behind using Green ICT. The effects in the supply chain have been documented as well as the practical applications, for example environmental decision support systems ([13]). Green ICT research so far has focused on:

(i) Addressing the role of IT on environmental sustainability ([14])
(ii) Defining green IT ([15])
(iii) How IT can be used to develop green behaviour ([16])
(iv) Understanding the institutional forces that might influence the adoption of green IT ([17])
(v) Developing a green ICT readiness model ([9])

Hardly any study has made an effort to understand barriers to its implementation with relations to human alignment. This may be because of the disciplines newness and researchers are now just adopting it on the research agenda ([13]). The researches done so far have concentrated on themes such as definition, use and disposal of IT technical Infrastructure, impact on environment, Business process and supply chain related emissions and waste as well as improving energy efficiency ([18]).

2.1 Green ICT Implementation

Practically speaking, implementation comes after adoption has been undertaken ([19]). Green ICT implementation may be considered to be the organizational effort directed toward diffusing the appropriate environmentally sustainable Information Technology practice within the user community. This is considered to be inclusive of all activities undertaken after adoption such as adaptation, acceptance, routinization and infusion of green ICT.

Green ICT implementation hence terminates when it has been successfully integrated within the operations of the organization. For implementation to stand higher chances of success an organisation has to take into consideration the resources needed for the implementation, user involvement during the implementation, analyses of the organization, anticipated changes in the environment, solutions to potential resistance during the implementation, information technology to be implemented, the innovation's relevance to the business, responsibility for the implementation and management support for the implementation.

Implementation, therefore, has to take into consideration the economic, Technological, cultural, and political/ regulatory environments. This puts more demand on the people involved in the implementation than the technology. It is the people who have to ensure that there is an understanding of the "Buy-in" of the organization where all users must clearly see the need for the change if they are to support it and factors affecting Information Technology implementation. The people who act as local champions in green ICT implementation have to be actively and enthusiastically promote the system, build support, overcome resistance, and ensure that the system is actually installed and used. It is the people who identify and design strategies to overcome the barriers towards green ICT implementation. The use of accepted traditional methodologies for technology implementation has failed to guarantee successful implementation of green ICT. There are still weaknesses in the traditional methodologies as they hardly recognize to important role played by the human resource and the need for its proper alignment.

Despite the fact that technology has improved over the past years there are still too many examples of failed Information Technology implementations. There is need to critically appraise the way IT innovations implementation has been done. It should not be seen as purely a series of formalized technical processes. Information technology design appears to be structured and formalized leading to a problem-solving

philosophy accepted approach uncritically by information technology and computer professionals. IT systems implementation process has generally been perceived to be a purely technical process aimed at solving problems which are defined in largely technical terms. This partial and mechanistic biased approach takes little care of human resource alignment to the technology being implemented and the role in understanding and overcoming barriers. This may be a major factor leading to implementation failure of IT innovations.

2.2 Barriers to IT Implementation

Some of the barriers to IT adoption may include affordable and accessible green ICT hardware, human personnel skills and qualification, consultancy, training of managers and users, lack of awareness, education systems review policy, its funding, legal framework, lack of consumer demand, and poor decision-making process in organisations.

The cost of purchasing hardware is generally high despite the general trend of fall in prices for hardware compared with that of software. When considering the element of cost in terms of green ICT a number of factors are considered in addition. It does include costs of equipment and networks, software and re-organization, as well as ongoing costs. With limited technical skills available in the human personnel in the category of managerial capability with regard to green ICT coupled with scarcity of funding and funds, many organisations opt for donations or low priced refurbished ones from the developed nations. A number of such donations are actual e-waste. Owing to high costs of e-waste disposal, old products are being shipped to developing countries of origin with most being unsuitable for re-use. Many may also not be meeting the requirements of the origin countries with regard to legislation on environment tags. Compared to other waste streams world over, e-waste is accumulating very rapidly in developing nations. With non-complying hardware little can be done towards green ICT status. Even where the right human resources are on ground, they may be forced by the hardware to lay systems that are not ecologically friendly.

The human personnel need to have appropriate ICT skills and qualification in order to be able to deliver quality service. Organisations usually concentrate on day-to-day operations and as a result do not have time to think about the benefits that might be accrued by implementing new technologies. When they do, then they need knowhow and suitable qualified employees which are not available. Skilled and qualified human personnel are important for the development and utilisation of technology [5]. Naturally it is the humans and not machines who advance and control the spread of a technology ([20]). Unfortunately, the human personnel for IT have been in short supply.

The way IT is accepted in an organisation mainly depends on previous training and experience of the managers and users. If the training of employers and employees is insufficient, the chance of them having skeptical attitude towards IT innovations is high ([21]). Negative attitude hampers its application.

Technology is changing very rapidly. This necessitates proportionate adaptation of the education system and training policy to the technological changes, otherwise it would result in skills deficiency. The lack of IT innovations use is influenced by the lack of awareness and skills among the human infrastructure.

Some organisations do not have skilled human personnel and hence rely on external consultants. Many a time the role of such a consultant is not fully understood which leads to a number of mutual misunderstandings during specification, purchase and implementation of IT applications ([21]). The problem is connected to a missing information strategy and insufficient knowledge of ICT on the part of the organisation. In many countries, there is hardly any legal framework to guide the user of IT, leave alone steering it towards green ICT.

Another barrier to green IT acceptance is resistance to organisational changes, especially in connection with older human personnel ([21]). This does hamper decision making towards implementing given technologies. Also in such circumstances decision making is geared more towards short term solution than long term hence limiting possibilities.

2.3 Benefits of Green ICT to Organisations

The solution to averting the disaster is likely to occur since the climatic change and increased costs of doing business lie in green ICT ([22]) and its application within itself and in other sectors. Green ICT extends other less commonly considered aspects of the entire life cycle. This includes eco-friendly procurement, employee behaviour, running data centres on sustainably generated power, and environmentally sound disposal of used ICT equipment ([1]). According to Herman et al (2010), ICT is not intrinsically green because it consumes energy and raw materials; however, it can be leveraged to make business processes more energy-efficient. The greatest benefit of green ICT to the universe and any nation is the reduced environmental impact and costs of doing business ([1]). This is so when seen against the background of energy consumption in developing countries.

The value of green ICT to the society is so great and can be best summarized as illustrated in Fig. 1. The benefits can be realised at environmental / society level, organisations / company level, capital market level, employees level, customer level and public citizenry level.

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Environment/society	Lower carbon emissions Reduced resource consumption Compliance with legal requirements		
Companies	Reduced energy costs Reduced operating costs of data centres Less hardware needed		
Employees	Capital market	Customers	Public
• Increased employee satisfaction • Greater loyalty • Easier recruitment	• Improved ratings • Higher share price • Greater company value	• Greater customer loyalty • Appeal to new customer groups • Greater customer satisfaction	• Improved image • Rounded-out CSR strategy • Greater brand value

Figure 1: How different stakeholder groups benefit from Green ICT

Source: Herman, Shalaby, & Bundgen (2010)

3. RESEARCH METHOD

The study used a multiple case survey involving three different cases. The cases selected were done using purposive sampling based on their involvement with ICT use. Then thereafter the respondents were selected through the use of stratified random sampling to ensure that the respondents of all cadres were represented. In each category random sampling was used to select the respondents to ensure that possible respondents had equal chances of being selected. Questionnaires and interviews were used to collect data from 360 respondents out of 2088 eligible ones. The respondents consisted of 33 from an ICT regulatory board, 224 from a leading sugar factory and 103 from a public university offering ICT programmes ranging from certificate to PhD level. Fifteen respondents came from top management, 31 from ICT technical human resource, 294 were end users, 10 were Masters Students in IT (MSc (IT)) and 10 were Doctorate candidates in IT (PhD (IT)). The respondents were required to respond to items of the tool without having any knowledge of the case studies a part from theirs. The PhD and Masters in Information Technology students consisted of those who were working in the industry.

4. FINDINGS, DISCUSSION AND INTERPRETATION

The study started with an interview of respondents with regard to barriers towards implementing green ICT. The identified barriers were then converted into a questionnaire items and respondents asked to respond to them. The barriers cited to be contributing lack of green ICT implementation in Kenya were thereafter subjected to none management and end user respondents to rank them. They were ranked from the one perceived to be a strong barrier to that perceived to be the least within the cases. The two categories were isolated in the ranking because of their limited knowledge in ICT. The results of the questionnaire responses to each of the identified barriers from the interview are presented first and then thereafter the results of the ranking.

4.1 Perceived barriers to green ICT implementation in Kenya

The first suspected barrier that was presented to respondents to give the opinion with regard to skills and training in the field of green ICT. Figure 2 gives the responses to lack of technical skills and training in green ICT.
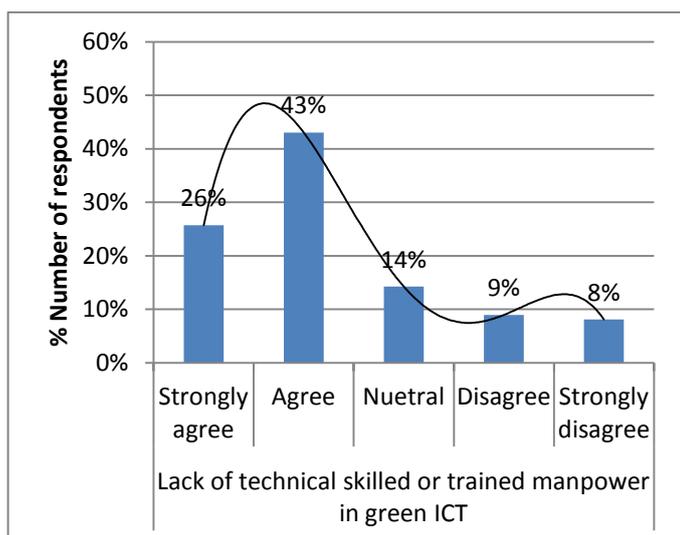
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Figure 2: Lack of technical skilled or trained manpower in green ICT

The trend line observed in figure 2 shows that the responses were strongly skewed to the agreement that there is lack of technical skilled or trained manpower in green ICT. According to the findings presented in figure 2, 26% of the respondents strongly agreed to the statement that lack of skilled or trained manpower in green ICT contributed to barriers towards its enhanced implementation. Forty three percent agreed to the statement while 14% were neutral in their response. Nine percent of the respondents disagreed with the statement and 8% strongly disagreed with it. Most of the respondents (69 %) indicated that lack of technical green ICT skills were a major contributor to lack green ICT implementation. The findings of this study seem to be in agreement with Enfield et al. (2011) [23] findings that suggested that people will support adoption hence implementation of emerging technologies for as long as the technologies are well understood. According to Info-Tech (2008) [24], lack of appropriate skills leads to IT staff not to be able to support implementation and use of emerging technologies. Lack of technical skills can significantly hinder implementation of any given technology ([19]; [25]; [26]) and lead to failure of innovations implementation ([27]). Lack of skills among top management affects the ability of an organisation to make decisions to adopt technologies hence their implementation since adoption leads to implementation ([19]). Lack of technical skills arises out of lack of training or limited training opportunities or having inappropriate training being undertaken. Training for this study is considered to mean providing all the necessary training to the ICT personnel about the technology, the use, the purpose and its benefits. Other studies have established that education and training is important for any organization to incorporate any kind of change, modification, innovation or process improvement ([28]). Training on new structure is therefore vital for any organization and its lack may lead towards hindering implementation of green ICT. Lack of appropriate abilities and skills can limit workers' productivity which would in turn limit the application of a given technology and it does also result in organisations having challenges in implementing new technologies ([29]). These call for planned training that will involve all personnel

who are or will be involved in green ICT implementation at all levels, including management . The findings of this study are in agreement with those of other studies that also found out that developing countries lack ICT technical skills making it a major inhibitor to technology implementation ([19]; [30]). The implications of limited availability of technical skills leads to implementation of green ICT on a trial and error approach resulting in minimal implementation.
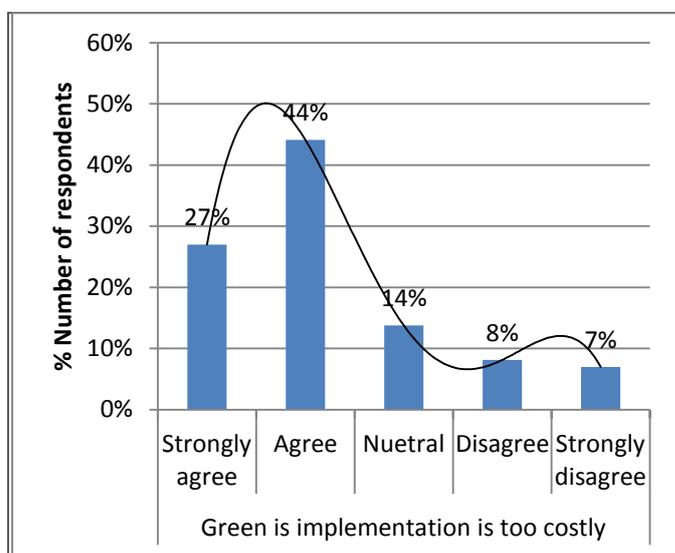

Figure 3: Green ICT implementation is too costly

The trend line observed in figure 3 shows that the responses were strongly skewed towards the agreement with the statement that green ICT implementation was too costly. From figure 3 findings, 27% of the respondents strongly indicated that green ICT implementation is a costly undertaking hence making it a barrier to its implementation with 44% indicating that it was costly to implement the same. 14% were neutral in their response to the item with 8% disagreeing. Only 7% of the respondents to the item strongly disagreed to the item. 71% of the respondents therefore indicated that the implementation of green ICT is a costly affair. Cost has been reported to be a hindrance to implementation of new innovations in other studies ([31]). When the costs of implementing a technology are too high in comparison to the benefits it offers, ICT personnel are less likely to consider its implementation. When the implementation costs are within the ability of organisations they are likely to implement the technology. When the costs of implementing a technology are high organisations are encouraged to use the traditional approach rather than employ it. The cost factor affects the technologies an organisation goes for but it is apparent that there will be no time when an organisation will have enough resources to satisfy all technology demands. It is therefore best to apply green ICT practices to save on the costs.

The respondents' opinion to provision of workshops and seminars on green ICT training are presented in figure 4.
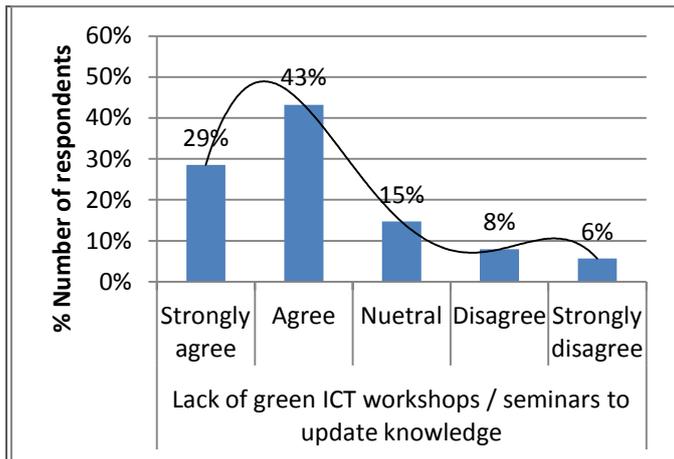
Figure 4: Lack of green ICT workshops / seminars to update knowledge

The trend line observed in figure 4 shows that the responses were highly skewed to the agreement with the statement that there is lack of green ICT workshops / seminars to enable personnel update knowledge with regard to green ICT. From figure 4 findings it can be observed that 29% of the respondents hold a strong opinion that there are no workshops or seminars to enable them update their skills in green ICT. 43% of the respondents have the opinion that there are no green ICT workshops or seminars in the country while 15% were neutral in their response to the item. 8% believe that there are green ICT workshops and seminars with 6% of the respondents strongly indicating that are workshops and seminars on the same. 72% of the respondents indicated that lack of green ICT workshops and seminars is a barrier to its implementation as there are no places to upgrade the skills. This is a training related factor. Training through workshops and seminars can be good means of increasing expertise levels and skills for ICT personnel on green ICT. They are also of means creating awareness and improving employees productivity in implemented ICT innovations ([32])

The respondents' views on reliance on donations for acquisition of hardware as a barrier to green ICT implementation is presented by figure 5.
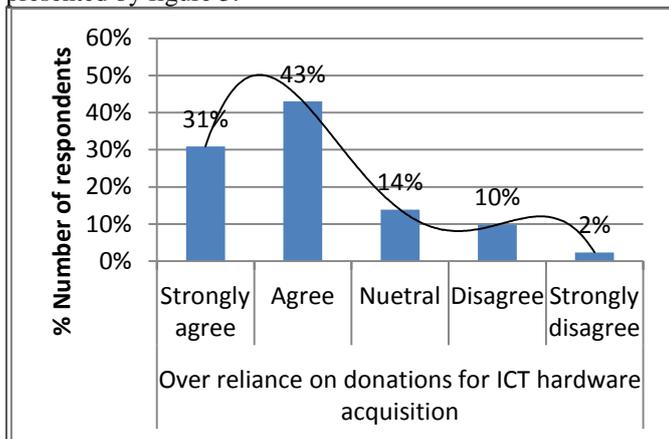

Figure 5: Over Reliance on Donations for ICT Hardware Acquisition

The trend line observed in figure 5 indicates that the responses were strongly skewed to the agreement with the statement over reliance on donations for ICT hardware acquisition within organisations. From figure 5 findings, 31% of the respondents strongly indicated that organisations rely on donations to acquire hardware with 43% indicating agreement to the same. 14% of the respondents were neutral the item. 12% of respondents did not subscribe to the idea that organisations rely on donations to acquire hardware with 2% strongly disagreeing. 74% of the respondents were in agreement to the fact that organisations relied on donations as a means of acquiring hardware by indicating strongly agree to or agree to. Overreliance on donations for ICT hardware acquisition with limit technical skills has contributed to lack of green ICT implementation. When donations are given out, it is possible that the donors do it with little considerations of the skills available to manage it within the recipient.

The next suspected barrier that was presented to respondents to give the opinion about was with regard to top management's support for green ICT implementation. The findings of the study are as presented in figure 6.
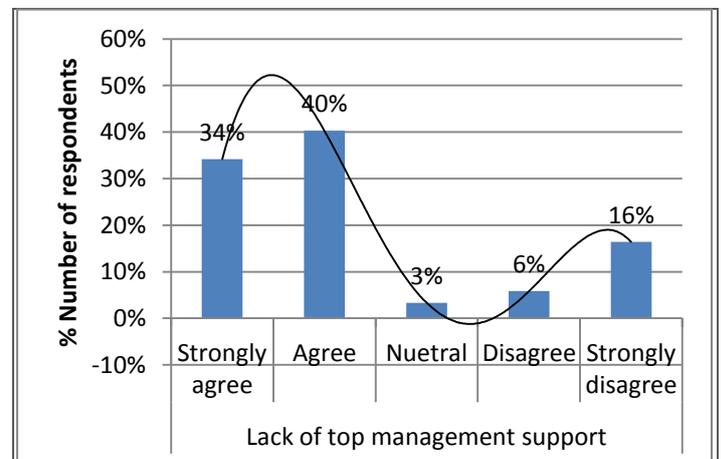

Figure 6: Lack of top Management Support

The trend line observed in figure 6 shows that the responses were strongly skewed towards the agreement with the statement of lack of top management support for green ICT implementation with some reasonable skewed towards disagreement of the same. Based on the findings presented in figure 6, 34% of the respondents are of the strongly opinion and 40 % of respondents are of the opinion that there is lack of top management for green ICT implementation. 3% were neutral in their responses to their item. 6% of the respondents indicated that these top management support of green ICT implementation while 16% were strongly in agreement to the same. Seventy four percent of the respondents believe that there is lack of support from top management towards green ICT. Top management provides the forward motion for initiation of technology implementation ([33]). Without such support from top management not much can be realised ([25]; [34]; [31]). It is these ICT managerial personnel that has found and motivate the employees of an organisation towards taking up and

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implementing the technology. It is this same cadre of ICT personnel that make the policies of organisations and hence may make those that would or would support green ICT. Top management's commitment is very crucial to successful implementation of technology ([35]) that is a prerequisite for implementation of green ICT. Top management makes decisions towards adoption and implementation of IT innovations ([36]) such as green ICT. Lack of top managements top support of an innovation leads to failure of its implementation ([37]). Employees normally take the lead of the direction that top management propagates. If it is positive, it encourages commitment from employees and if it's negative, it de-motivates employees and encourages indifference by employees to the technology and resistance ([28]). Resistance can easily lead to an excellent project to fail.

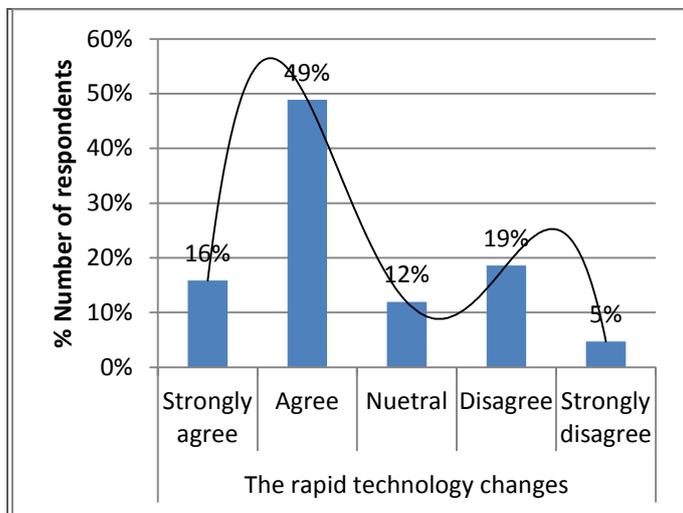The respondents' views rapid change of technology as a barrier is presented in figure 7.

Figure 7: The Rapid Technology Changes

From the trend line observed in figure 7, it can be observed that the responses are strongly skewed towards the agreement that rapid technology changes have contribute to lack of green ICT implementation within organisations although there is some small skew towards the disagreement with the same. According to the respondents' responses in figure 7, 16% strongly indicated that rapid change of technology was a barrier to implementation of green ICT while 49% indicated the same. 12% were neutral to it while 19% did not perceive the rapid change of technology to be a barrier at all. Five percent strongly disagreed with considering rapid change as a barrier to the implementation of green ICT. On the overall therefore more than half of the respondents (65%) indicated that rapid technology changes may be a barrier towards green ICT implementation. There is need for organisation to equal respondent rapidly to the changes in technology. In most cases the planning systems do take a long time to be actualised hence by the time the planned technologies are introduced, they may have become obsolete. Aside from the hardware impact, this does also affect the ICT human resource as it challenges their

expertise levels. This may easily lead to resistance from the people to advance it. However, as much as the rapid technology change may an impact on both hardware and software and ICT personnel, it important to acknowledge that there will be no time when an organisation and users will have means of knowing what they will need in future. This does call for provision of continuing learning opportunities in order for the user to keep abreast with what is available and best put it to use.

The study also sought to find out if there was supportive legislation for green ICT implementation in the country. The findings were as presented in figure 8 and figure 9.
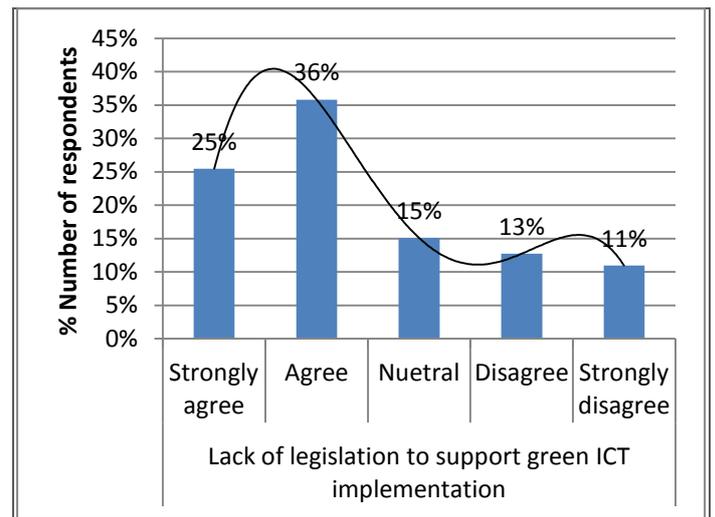

Figure 8: Lack of Legislation that Support Green ICT Implementation

According to the findings of figure 8, 25% of the respondents indicated strongly that there was no legislation that supports green ICT implementation. 36% did indicate that there was no supportive legislation as 15% were neutral. 13% were of the opinion that there was legislation that supports green ICT implementation while 11% more strongly indicated that there was supportive legislation. It is the belief of 61% of the respondents that lack of legislation to support implementation of green ICT is contributing to its lack of application. The trend line observed in figure 8 shows that the responses were skewed towards the agreement with the statement of there being no legislation to support green ICT implementation within organisations. Legislation plays an important role in technology innovations being implemented ([25])

Figure 9 presents the respondents opinion with regard to whether existing legislation and policies hinder green ICT implementation.
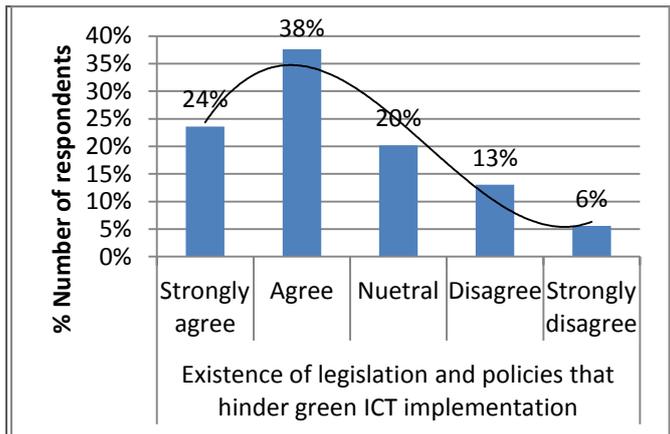
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Figure 9: Existence of Legislation and Policies that Limit green ICT Implementation

The trend line observed in figure 9 shows that the responses were skewed to the agreement with the statement existing legislation and policies within organisations contribute to hindrance towards green ICT implementation. From figure 9 findings, 61% of the respondents (24% strongly agreeing and 38% agreeing) were in agreement with there being legislation and policies that may be limiting the implementation of green ICT. 20% were neutral to the item while 13% believe there were no hindering policies or legislation in place. 6% strongly did indicate that there were no policies or legislation that may be hindering to green ICT implementation in the country. Comparing the findings of figure 8 and figure 9, they seem to be in agreement. However the lack of total agreement to both legislation and policies being supportive or not may point to the fact that respondents may not be aware of the existing policies and legislations on the matter. Where there is legislation and policies at the national level and organisation level supportive of implementation of a technology is likely to have the technology quickly put in place as compared to where there is none. Organisations need to have policies that support implementation of technologies ([29]) to facilitate green ICT implementation.

The respondents' view their understanding the starting point on implementing green ICT is presented in figure 10.
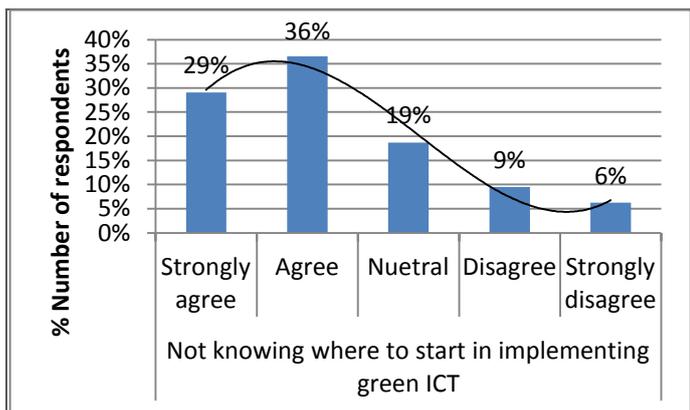

Figure 10: Lack of understanding to where to start in implementing green ICT

The trend line observed in figure 10 shows that the responses were strongly skewed to the agreement with the statement that staff do not know where to start when it comes to green ICT implementation within organisations. Based on the findings of figure 10, 6% of the respondents indicated strongly that they knew the starting point while 9% more indicate they knew where to start. 19% were neutral hence were not sure whether they knew the starting point or not. 36% indicated they did not know and 29% strongly indicated that they did not know where to start in green ICT implementation. On the overall therefore 65% of the respondents did not know where to start with regard to implementation of green ICT. The lack of identifying where to start may be as a result of lack of awareness about green ICT or even lack of training on the same. One possible explanation behind limited implementation of green ICT might be the lack of awareness. This is in agreement with the findings of a study in Malaysia that found out that contractors were not using ICT due to their lack of awareness to the benefits in ICT implementation ([37]). Lack of awareness can hinder technology implementation ([33]) Naturally one cannot implement what he or she does not know how to do it. If the technology is imposed to such an individual, the person is likely to respond by resisting it. For technologies to be implemented successfully, the recipients need to be prepared for it. The best technology may not succeed if the receivers are not prepared for it [38] as it calls for changes in the organisational capabilities.

The other suspected barrier that was presented to respondents to give the opinion on was with regard to general resistance change. Responses to organisation resistance to change as a barrier to green ICT implementation is as presented in figure 11.
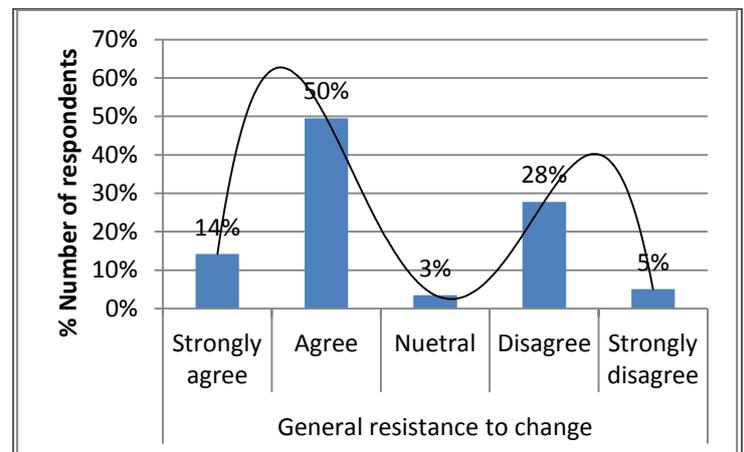

Figure 11: The general resistance to change by the organisation

Out of the findings of figure 11, 64% of the respondents with 14% strongly agreeing and 50% agreeing that general resistance to change is such a barrier to green ICT implementation. 3% of the respondents were neutral to the item. 28% to not believe that resistance to change was a barrier to implementation of green ICT while 5% strongly indicated that it is not a barrier. Successful adoption and by extension implementation of technologies is dependent on people ([39]).

People may resist the implementation for various reasons ([40]; [41]). According to Othman et al (2011), new innovations bring with them resistance to change as result of necessitating changes to existing work practices. People always exhibit resistance to implementation of new technologies ([19]). Resistance can be destructive if it results in ill will. This can easily lead personnel's attention to be directed in the direction away from the implementation. Owing to the high percentage indicating that it is a barrier, there is need to plan for mitigation against resistance in implementing green ICT. Doing so will increase the chances of enhancing its implementation and would also encourage the culture of planning for the implementation that is critical to successful implementation of any technology. Resistance may influence an organisations accepting or rejecting of a technology ([19]). Such resistance has to be managed to ensure enhanced green ICT implementation. Resistance to implementation of innovations may be attributed to lack of awareness ([25]). Resistance also arises out of perceived feeling of lack needed skills to implement and support the technologies ([42]; [24]) and perceived risk associated with the innovations ([43]; [39]).

Figure 12 presents the respondents' opinion with regard to whether there are plans or strategy to guide implementation of green ICT in their respective organisations.
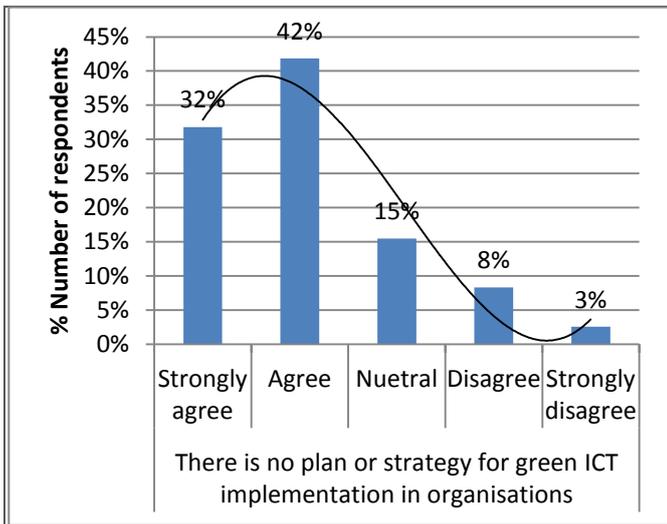

Figure 12: Lack of plan or strategy for green ICT implementation

 The trend line observed in figure 12 shows that the responses were strongly skewed to the agreement with the statement of there being no plan or strategy for green ICT implementation within organisations. From figure 12, 32% of the respondents strongly indicated that there was no plan or strategy in their organisation towards implementation of green ICT. A further 42% indicated that the same is not there. 15% were neutral in their response. 8% indicated that it is not true that there organisations did not have a plan or strategy for green ICT implementation while 3% strongly indicated the same. Accordingly, 74% of the respondents are of the opinion that there organisations have no plans or strategies for implementing green ICT which makes it a barrier to its implementation. This percentage is fairly high calling for steps

to be taken to mitigate the state. It is very important to design a proper plan to be executed ([28]). Without a plan or strategy to perform a given tasks, chances of it being performed successfully get minimised. Naturally policies and strategy provide guidelines for action. Unfavorable and ambiguous policies or strategy may affect the functioning of the individuals and their being productive to implement tasks especially new technologies. This may experience stress that may lead to developing resistance towards implementing green ICT. Organisations that have strategic plans for emerging technologies adoption facilitated their implementation ([44]). Strategic planning, for example for green ICT, ensures adequate planning of technologies hence implementations ([36]). Strategic planning for IT innovations plays a big role in delivering them to ensure rapid improvement realization ([45]).

The respondents' opinion about the availability of technologies to implement green ICT is presented in figure 13.
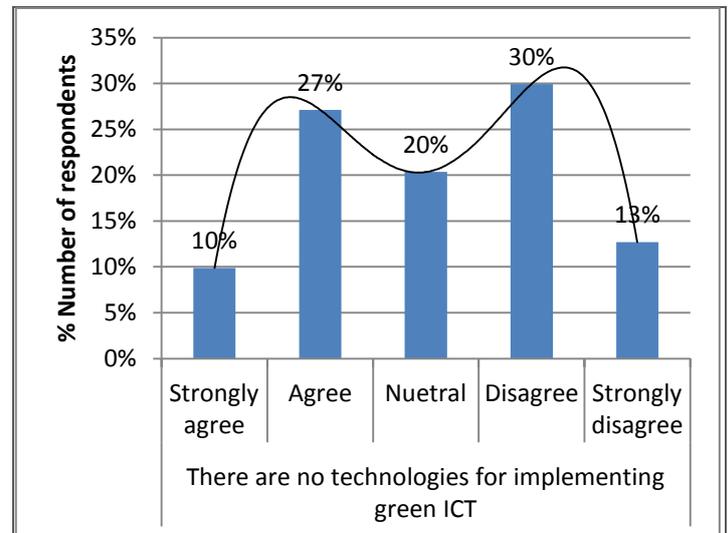

Figure 13: Lack of Technologies to Implement Green ICT

 According to the trend line in figure 13, the findings seem to be equally skewed to both sides of disagreeing and agreeing with the statement that there are no technologies for implementing green ICT. From the findings of figure 13, 10% of the respondents strongly indicated that there were no technologies to implement green ICT with another 27% indicating that there were the same. 20% were neutral in their response. This can be attributed to lack of awareness. 30% indicated a disagreement to the fact that technologies for implementing green ICT being unavailable with a further 13% strongly being of the same view. While 37% of the respondents indicated that lack of technologies were a barrier, 63% do not find it to be a barrier.

Fear of failure to realise a significant environmental impact had the respondents' opinion as presented in figure 14.
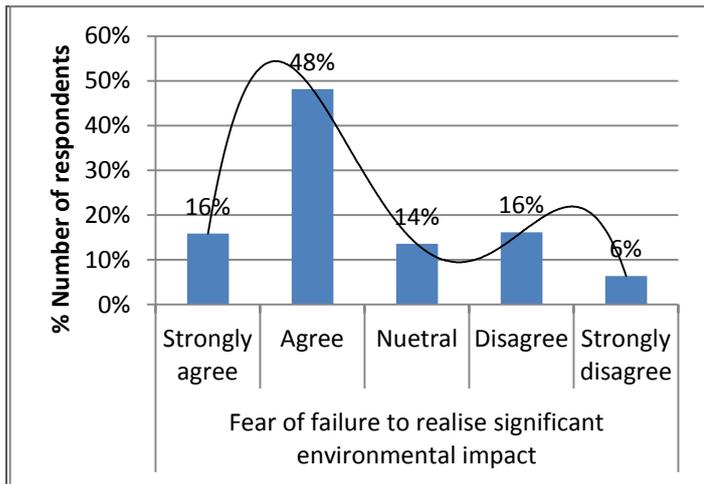
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Figure 14: Fear of Failure to realise Significant Environmental Impact

The trend line in figure 14 shows that the responses were heavily skewed towards agreement with the statement that there is fear of failure to realise significant environmental impact. However there is some sizeable skew towards the disagreement to the same. According to the findings of figure 14, 16% of the respondents strongly indicated their agreement to fear of failure to realise significant environmental impact, 48% indicated their agreement. 14% were neutral in their response. 16% indicated disagreement to fear of realising significant environmental a further 6% strongly disagreement to the same. According to the respondents (64%), fear of failure to realise significant environmental impact is most likely to hamper implementation of green ICT.

The respondents' opinion in line with budgetary allocation for green ICT implementation was as presented in figure 15.
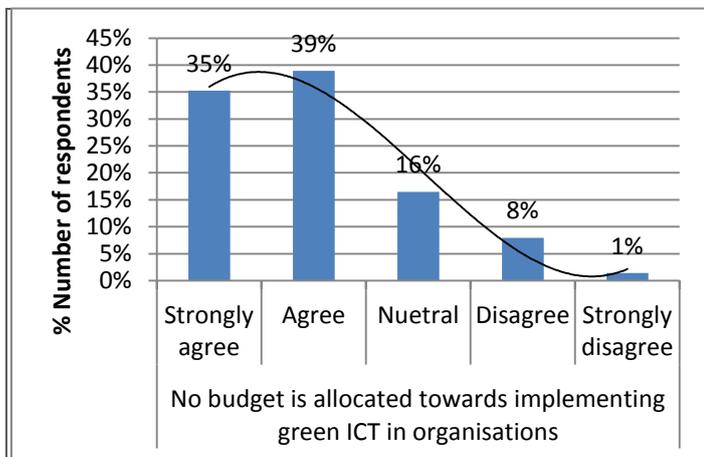

Figure 15: Lack of Budget Allocation towards implementing Green ICT

According to the findings of figure 15, the responses are highly skewed to the agreeing with the statement that no budget is allocated towards implementing green ICT as can be observed from the trend line. Accordingly 74% of the respondents

indicated that no budgets are set aside for the implementation of green ICT. Without a budget some of the tasks involved in implementing green ICT may not be realised easily. The findings are in agreement with Molla's (2009) study findings where it was established that most organisations in Australia were yet to set aside a budget for green IT.

4.2 Ranking of Barriers to Green ICT Implementation

From the study responses the following were identified to be the barriers towards implementing green ICT:- lack of technical skilled or trained manpower in green ICT, implementation is too costly, lack of green ICT workshops / seminars to update knowledge, over reliance on donations for ICT hardware acquisition, lack of top management support, rapid technology changes, lack of legislation to support green ICT implementation, existence of legislation that hinder green ICT implementation, not knowing where to start in implementing green ICT, general resistance to change, no budget is allocated towards implementing green ICT in organisations, there is no plan or strategy for green ICT implementation in organisations and the fear of failure to realise significant environmental impact. Technologies for implementing green ICT were not perceived to be barriers to its implementation in Kenya. However, within these barriers the respondents did not identify their weighting as barriers.

To obtain how strongly the barriers were perceived by the respondents, the initial findings were subject to 10 PhD in Information Technology candidates, 10 Masters in Science in Information Technology students and 31 ICT personnel from the three cases to rank them from the greatest barrier being ranked 1 to the least being ranked 14. The resultant ranking is given in table 3 below. The results of the task were as given in table 3.

Table 3: Ranking of Barriers to Green ICT Implementation

Barrier to implementing green ICT	PhD cand (IT)	MSC stud (IT)	ICT person	Mean wgt	Rank
Lack of technical skilled or trained manpower in green ICT	1	1	1	1	1
Green is implementation is too costly	10	12	12	11.33	11
Lack of green ICT workshops / seminars to update knowledge	6	7	6	6.33	5
Over reliance on donations for ICT hardware acquisition	8	5	8	7	7

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Over reliance on donations for ICT hardware acquisition	8	5	8	7	7
Lack of top management support	4	4	5	4.33	4
The rapid technology changes	7	10	7	8	8
Lack of legislation to support green ICT implementation	5	6	9	6.67	6
Existence of legislation and policies that hinder green ICT implementation	9	8	10	9	10
Not knowing where to start in implementing green ICT	11	9	4	8	8
General resistance to change	12	11	11	11.33	11
No budget is allocated towards implementing	3	2	2	2.33	2

Source: field data

The spearman Rank Correlation Coefficient (R) using the formula $R = 1 - \frac{6 \sum d^2}{n(n^2-1)}$ was calculated to establish the relationship between the responses of the strata. The R value for responses between the PhD (IT) candidates and the MSc (IT) students was obtained to be 0.925275, while that of the PhD (IT) candidates and ICT personnel was obtained to be 0.832967 and that of the ICT personnel and the MSc (IT) students was obtained to be 0.872527. In all cases the values obtained indicate there is a high degree of reasonable agreement in the responses of all the groups with regard to the barriers to green ICT implementation ranking.

The responses of the groups indicated in agreement that the main hindrance to green ICT implementation was lack of training and skilled manpower in the area. This was followed by lack of budget allocation and lack of a plan or strategy in organisations for green ICT implementation respectively. Lack of top management support came in at the fourth position. This is followed by lack of green ICT workshops and seminars in the country. The lack of legislation to enforce green ICT implementation was ranked sixth as over reliance on donations for acquisition of ICT hardware was ranked seventh. Rapid technology change and not knowing where to start with regard to green ICT implementation as barriers shared the eighth position. Ranked in the tenth position was the existence of legislation and policies that hinder implementation of green ICT. The eleventh position was shared by green ICT implementation being considered to be too costly and the belief that there is general resistance to change towards the same. From the study responses, there being no technologies for implementing green ICT is ranked last interestingly with fear of failure to realise significant environmental impact being ranked above it in the second last position.

Out of the 14 ranked barriers, among the top ten, eight of them are apparently people depend thus if the personnel are

influenced positively towards green ICT through appropriate alignment, it is likely to have more impact towards enhancing green ICT implementation in developing nations like Kenya.

5. SUMMARY OF FINDINGS

The costs of purchasing ICT hardware is generally high in developing nations based on their gross GDP though they may appear to be cheap in developed nations. This is so despite the general trend of fall in prices for hardware with that of software being on the rise. This being the case when the cost is looked at wholesomely to include costs of ICT equipment and networks, other overhead costs, software and re-engineering, as well as ongoing costs to realise green ICT. There is a limited technical skill available in the human resource.

Many organisations opt for donations or low priced refurbished hardware from the developed nations as a means of acquiring hardware. A number of such are actually e-waste. Owing to high costs of e-waste disposal, old products are being shipped to developing countries with most being unsuitable for re-use [6]. Many may also not be meeting the requirements of the countries of origin with regard to legislation on environment tags. Compared to other waste streams world over, e-waste is accumulating very rapidly in developing nations. With non-complying hardware little can be done towards green ICT status.

Lack of green ICT skilled human resource is the main barrier to implementation of green ICT. Even where the adequate human resources exist, they may be forced by the hardware availed to lay systems that are not ecologically friendly due to lack of awareness and support at top level management. The human resource need to have appropriate green ICT skills, training and qualification in order to be able to deliver quality service. Organisations seem to concentrate on day-to-day operations leaving no time to think about the benefits that might be accrued out of implementing green ICT technologies. This is as a result of the lack of the knowhow and skilled employees. Skilled and qualified human resource is an important component to the development and utilization of technology [5]. Naturally it is the humans and not machines who advance and control the spread of a technology ([20]). Unfortunately, the human personnel for green ICT is in short supply.

The way green ICT is accepted in an organisation mainly depends on previous training and experience of the managers and users. Lack of appropriate abilities and skills in green ICT is likely to limit the ICT personnel productivity. If the training of employers and employees is insufficient, then chances of having skeptical attitude are high ([21]). Training therefore is very critical to implementation of green ICT. The training has to be continuous in order to encourage green ICT personnel to implement it. The lack of provision for green ICT skills avenues such as seminars and workshops has limited implementation of green ICT. This may also be arising out of lack of awareness and lacking skills among the human resource. Implementation of green ICT will take longer and can easily be a frustrating undertaking and problematic where there is no training. This contributes a lot to lack of planning for the

technology and hence making of policies supportive of the technology.

Technology is changing very rapidly. This necessitates for commensurate adaptation of the education system and training policy to the technological changes, otherwise it results in skills deficiency. The deficiency arises from the education system producing graduates whose skills are already obsolete. This greatly contributes to the lack of the knowledge necessary to select the right technology. The problem leads to missing information strategy and insufficient knowledge of green ICT on the part of the organisation. In Kenya, there is hardly any legal framework to guide towards green ICT. Some policies in place do hamper the implementation all together.

The developing nations like any other nations are in short supply of resources as compared to demand. Hardly does ICT have an adequate budget assigned to it. In many organisations, ICT sections are just a subsection of another department. The study found that there is no budget provision for green ICT. Worse still many respondents indicated that they depend on donations for the ICT hardware acquisition. Some of the donations are indeed e-waste being done away by developed nations skillfully to avoid the expenses of lawfully disposing it.

6. CONCLUSION

The study established that green ICT technologies are available in Kenya. Most of the ICT human resources lack the necessary green ICT skills and training. This has been ranked as the number one barrier to green ICT implementation in Kenya. The other barriers to green ICT implementation established from the study include lack of budget allocation to green ICT, lack of plans or strategy for green ICT, lack of top management support, lack of skills upgrade avenues such as workshops and seminars, lack of legislation to support green ICT implementation, over reliance on donations for ICT hardware acquisition, rapid technology changes, not knowing where to start, existence of legislation that hinders implementation of green ICT, general organisation resistance to change, fear of failure to realise significant environmental gains, and lack of easily affordable and accessible green ICT hardware starting from the perceived to be the main barrier to the least barriers respectively.

In any technology implementation education and training is critical for its success. Most of the barriers identified are people dependent hence for green ICT implementation to be accelerated, it will call for more of improving on the quality of the ICT personnel towards it. The study recommends aligning of ICT human resource towards enhancing green ICT implementation in the light of the perceived barriers after establishing the work place's green ICT preparedness in Kenya.

7. RECOMMENDATIONS

The study recommends the inclusion of green ICT into the curriculum of ICT personnel. There is need organise workshops and seminar on the same to provide an avenue for ICT personnel already in the field to acquire the skills and increase awareness. This would also provide a forum of sharing experiences on the subject within the country. This will make

them confident to implement green ICT and push for policies and legislation that would facilitate for organisations need to provide for green ICT in their budgets for it to be implemented. This may contribute to the organisation realizing green ICT benefits in both the long term and short term.

There is need for development of legislation and policies to guide the implementation of green ICT. This may make management and ICT personnel to consider green ICT as a serious agenda which in turn may make the country realise benefits of lowered costs of doing business, reduced demand on power and environmental pollution. The legislation should provide guidance on donations being received in the country. This may help make top management to be committed to green ICT agenda.

On the overall, there is great need to align the ICT human resources in order enhance green ICT implementation. However, before this is undertaken, there is need to establish how ready the organisations in Kenya are towards green ICT implementation.

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