The Challenge of Implementing Green ICT in Computer Colleges: Improving Initiative and Awareness

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Abstract:
Implementation of Green ICT awareness for computer college in Indonesia already initiated by Association of Computer College in 2010, to realize the Green Campus. Appeared several challenges facing the college in raising awareness in applying the activity in college. This initiation should be supported by formal policy by the leadership, to conform with the purpose of the implementation of Green ICT. This policy is continuously disseminated, Green ICT practices performed consistently, as well as in the medium or long-term need to be measured by a variety of methods of measurement. In order for the implementation of Green ICT can efficiently, there needs to be coordination between the IT Division and the person in charge of the computer laboratory which is separate from the part of IT management. So that information about IT masterplan includes laboratory can be arranged properly, so that it can be monitored clearly. This coordination will also help the college in calculating the energy consumption of electricity used by IT equipment, both of which focused on the IT Division and in the laboratory.

Keyword: Green ICT, Green ICT awareness, Green ICT Challenging, Green ICT Motivation

1. Introduction:
The fact that the Information and Communication Technology (ICT) has a direct impact on the environment can not be avoided (Agarwa & Nath, 2011) (Alena & Libor, 2012). But on the other hand, ICT systems have become part of a modern society that can not be stopped just like that. The use of ICT has become part of every business activity. ICT investments issued by companies aim to accelerate business processes, accelerate the process of communication, and deliver products and services to customers, so as to increase company profit. ICT investment in the form of the development of an information system, a collection of several system components: hardware, software, brainware, data, and procedures, which work together to produce a quality information (Shelly & Vermaat, 2010).
Beside the investment costs for building information systems, the college also has to provide a huge cost to ensure the continuity of an information system, including the cost of electrical energy consumption, in order to use ICT equipment still works. For the online system, then the system will continue to function for 24 hours a day continuously. The average electrical energy consumption for ICT systems is around 25% of overall electricity consumption in commercial enterprises (Hodges & White, 2008) (Agarwa &
Mardiana Purwaningsih / The Challenge of Implementing Green ICT in Computer Colleges: Improving Initiative and Awareness

Nath, 2011). For companies that have not been able to regulate the use of ICT systems efficiently, the amount of electrical energy used can be greater than the above figures.

The challenges of use electrical energy for ICT systems is certainly not only in terms of costs, but also its impact on the environment. The increase in the cost of electrical energy consumption were higher, supported by awareness of the company in managing the environment better, become part of the reason for companies looking for a strategy to reduce the cost of electrical energy consumption in ICT systems it uses, as well as make the system become more friendly to the environment (Hodges & White, 2008).

Impact of ICT systems is rising carbon emissions from the use of ICT equipment. Currently, the carbon emissions from ICT infrastructure and systems still accounts for about 2-3% of the causes of greenhouse gas emissions as a whole (Banerjee, 2013) (Suryawanshi & Narkhede, 2014). So there is a variety of ideas for innovation and development of various elements of ICT systems that have a minimum impact on the environment. Various ways and approach that was then known as Green ICT (Molla, Copper, & Pittayachawan, 2009) (Banerjee, 2013).

2. Literature Review:

Green ICT is consciousness in implementing a variety of technologies, techniques, and policies designed to reduce the carbon footprint of ICT equipment used by the organization, as well as the use of ICT equipment to reduce the carbon footprint of the entire organization. It is intended that the concept of Green ICT companies can reduce the 2% of carbon emissions caused directly by ICT systems (Greening of IT), but Green ICT is also a concept of how to use the ICT as an enabling technology to reduce 98% of the trail carbon caused by other activities in the overall organization (Greening by IT) (Brennan & Philipson, 2008) (Visser, 2011) (Alena & Libor, 2012) (Hankel & Lago, 2015) (Radu, 2016).

Green ICT is meeting the needs of today while considering environmental sustainability in the future, by monitoring the products, and make sure the product does not have an impact on the environment pollution or contamination during use and thereafter. Greener ICT or ICT system that is more environmentally friendly is an ICT system with better environmental performance than the previous generation (the direct impact to be expected) and using technology to improve environmental performance across the enterprise and society (systemic effects) (Alena & Libor, 2012). Originally the term Green ICT is still associated with the reduction of electrical energy consumption of ICT systems in the company, to reduce carbon emissions. But this time the concept of Green ICT becomes more widespread and improve the functioning of the ICT department. ICT departments are not just designing and using Green ICT systems, but also provide a means of measurement, data storage, reporting mechanisms, and mitigation techniques for the sustainability of the ICT system (Hankel & Lago, 2015).

Based on the definition and concept of experts, we can conclude a few points about Green ICT, namely: 1) that Green IT is a practice using equipment or IT infrastructure efficiently, to reduce the costs incurred; 2) the use of efficient IT equipment is used to reduce unnecessary energy use and reduce their impact on the environment; and 3) Green IT is useful to deal with the adverse effects on the environment caused by the activities of others in the company (Visser, 2011) (Murugesan, 2013).

3. Methodology:

Implementation of Green ICT awareness for computer college in Indonesia already initiated with the program "Ten Commandment to Be Greener" as a guide to begin implementing Green ICT by Association of Computer College in 2010. So that the concept Green Campus can be realized. This research was taken sample the colleges that have computer study with the consideration that the concept and technology of Green ICT more initiated by practitioners in the IT field is also partly a lecturer and leader in Computer College. Sampel is taken from the college which has a study program of Information Systems, Computer Science, or Computer Systems. The college is incorporated in the Association of Information and Computer College. This is an association which is a collaboration between universities and colleges in the field of information technology, which is expected to be a forum to increase cooperation both among universities, and between universities and the government and businesses. This association was initiated in 1983. The membership this
association includes membership and individual membership program (professors or practitioners), so that in answering this question should be included charger position and involvement in decision making. A study of 9 colleges gives a brief overview will be the implementation of Green ICT in the computer college. For more in-depth analysis selected one college is considered most concerned with awareness of green ICT. This analysis will be grouped for activities Greening to ICT and Greening by ICT (Visser, 2011).

4. Finding and Discussion:

This research conducted a survey on awareness of some of the colleges, to see the extent of awareness and implementation of Green ICT. From the results of data collection is known that all the universities to give attention to the implementation of Green ICT at different levels. Awareness of the application of ICT already started there. Awareness implementation of Green ICT has a variety of reasons. The highest priority is the reason for the implementation of Green ICT for cost savings. The average electrical energy consumption for ICT systems is around 25% of overall electricity consumption in commercial enterprises (Hodges & White, 2008) system (Hankel & Lago, 2015). One respondent even claimed leadership of the Higher Education issued a decree Rector concerning the use of electricity and air conditioning settings, which suggests that consumption of electrical energy into one of the important points in the implementation of Green ICT in Higher Education. Relating to electrical energy consumption, there is an effort to overcome or reduce the amount of electrical energy, but how their use cannot be measured clearly. It is a challenge for universities to further be able to measure the electrical energy consumption particularly evident with regard to ICT equipment.

In this research shows also that part of the college not all coordinated with faculty in relation setting ICT equipment owned by the faculty. In most universities, the laboratory directly supervised by a faculty. Because of differences in this management, the use of ICT equipment for operations and laboratories carried out respectively by the part responsible. So that the IT Division has no overall information about the master plan for the use of IT and computer laboratories. Whereas the concept of Green ICT, IT Division is becoming initiation activities that led to Green ICT. So there needs to be coordination between the IT section with computer laboratories in each faculty, so that the efficiency of the network settings, the use of electrical energy, and the customs policy of environmentally friendly behavior can be harmonized. Because the medium-term targets, the implementation of Green ICT in the campus can be measured, or even submitted for certification. Some associations in the field of IT already provides a framework for the measurement of Green ICT (Philipson, 2010). The organizational structure is applied to each university has a close relationship with the successful implementation of Green ICT, given that some universities have a separate section in managing IT respectively.

Related to the practice of environmental sustainability all universities respondents agreed to do, but have not been well documented. Good documentation will support easy in measuring the extent to which the implementation of Green ICT has been done. While the practice activities for the implementation of Green ICT in the academic faculty, needs to be done continuously, so that this practice will become a habit in their daily activities in a campus environment.

The virtue of this research is the implementation of ICT which has become part which must be maintained continuity in supporting business processes, and the serious impact on the environment, the handling of this impact should be well planned. Most universities are already aware of the impact, but mitigation is still done ad hoc. So the research must be done to see how far the Green ICT has been done in universities. In addition the output of this study will also provide recommendations for universities that will implement the Green ICT thoroughly and consistently, including any policy based on the research results.

Awareness of Green ICT in the college is realized by making the policy implementation of Green ICT in the academic and non academic activities. This realization arises because there are some motivations. Some of the things that motivates the implementation of green ICT awareness in the schools is to improve employee productivity and cost savings organizations. These motivations are internal motivations appears to improve the quality of business processes in the college (Molla, Copper, & Pittayachawan, 2009). Another motivations are to reduce environmental impact and improve the
image of the college. These motivations are motivation that is driven from an external party, because now customers have been very critical. Often, organizations that implement good environmental management policies, into consideration in choosing a product or service to be used.

However, The motivations that encourages the implementation of Green ICT in the College has not done measurements, ie, how much money can be saved with the implementation of green ICT, how improving employee performance with the implementation of Green ICT systems that support this (Agarwal & Nath, 2011).

Motivation is realized by making an informal policy to be realized effectively. This policy is supported by developing various information systems that can be accessed online for all academic faculty; lecturers, students, and employees. The system built is e-learning and e-library. For administrative personnel, both faculty and staff, the school is also setting up an online information systems.

Leader of this college feel the need informal policies that have been implemented this will soon be strengthened by a formal policy, so that awareness of Green ICT can be further increased among the academic community of the college. Implementation is also in accordance with the expected goals, and the expected benefits can be obtained. Some things that will be included in this policy includes everyday operations, and strategic activities of both short and long term. Things to be realized is the selection and arrangement of communication media for internal and external communication. This includes paper usage policies for internal and external communication, because the use of paper coupled with the use of printer ink into a direct impact on the environment.

1) Greening to ICT:

To support informal green ICT policies above, colleges seek to use new technologies that are environmentally friendly. Besides green ICT policies have also had a direct impact by reducing paper usage, as well as triggering the initiation of a recycling program. Some online system applied in this college should be supported by adequate server performance, both in terms of quantity and quality. Increasing the number of servers it will increase the burden of the electric usage. So there needs to be action to address this, one of which is with server virtualization. Server virtualization into one of the actions undertaken in the implementation of Green ICT. In the area of network management, Green ICT policies followed by the use of server virtualization to reduce the number of servers, and installing power management software, to be more efficient in the use of electrical energy.

The role of IT in improving the understanding part of the Green ICT and the success of the implementation of Green ICT is enormous. Policies that have been made by management will be followed by the procedure set up by the IT department for the use of ICT equipment, as well as everyday users of ICT, such as turning on and turning off computers and other ICT equipment correctly. Deadly ICT equipment that is not used, and set each computer with the power management setup, can maximize computer work, as well as efficient use of electrical energy.

Relating to the management server, the IT department is also responsible for setting the server, including optimizing the number of servers that exist to meet the needs of the network by using virtualization and consolidation. IT section is also responsible for regulating the use of power on the server and PC. In this case the IT department will coordinate with the laboratory part, because the server and PC in addition to back office support schools, as well as to support activities in the computer laboratory.

In the field of procurement, this policy followed by the procurement section that is always in coordination with the IT department at the time of purchase of ICT equipment. IT section will provide recommendations to the procurement of ICT equipment that is certified environmentally friendly, one of which is ENERGY STAR.

Another thing to be regulated is the procedure of disposal of hardware and other electronic devices. Technological developments are often also requires adjustments to the hardware used, so it makes a lot of hardware expired. Litter of hardware and other electronic devices is not easy to be recycled, and has the potential to pollute the environment. Often this physical hardware was also meets the storage warehouse.

2) Greening by ICT:

This policy is realized by developing various information systems that can be accessed online, for all academic faculty: faculty, students, and
employees. The system built is e-learning. On learning system using e-learning, the lecturer has prepared the material and evaluation of learning that can be accessed by students at any time. E-learning system is still used in parallel with classical lectures, but modules and materials can be downloaded and accessed at any time so as to minimize the material that needs to be printed. On learning system using e-learning, the lecturer has prepared the material and evaluation of learning that can be accessed by students at any time. E-learning system is still used in parallel with classical lectures, but modules and materials can be downloaded and accessed at any time so as to minimize the material that needs to be printed. It also built e-library. Various references in the form of e-books and online references, stored in a database library that can be accessed online. It also built e-library. Various references in the form of e-books and online references, stored in a database library that can be accessed online. Students who require a wide range of reference for the purposes of lectures and thesis, does not have to always visit the library, but can access it online. This policy is in addition to facilitate students in obtaining the reference, it also improves the access time to study the various sources of reference. Because of the time used to travel from home to the campus when visiting the library, will be used to increase access time references are available in the e-library. Students who require a wide range of reference for the purposes of lectures and thesis, does not have to always visit the library, but can access it online. This policy is in addition to facilitate students in obtaining the reference, it also improves the access time to study the various sources of reference. Because of the time used to travel from home to the campus when visiting the library, will be used to increase access time references are available in the e-library. E-learning and e-library also facilitate faculty in updating the references in preparing the material for lectures, gather references to research, write articles, and to collaborate more active. This is possible because some of the features provided in the e-learning and e-library. The system also supports the ease of communication between faculty and students, because the system also provides features discussion forums. Because the system can also be accessed by mobile devices, then th

expected response can be obtained more quickly. Outside of lectures activities, academic information system is also built and continue to be developed to support the activities of academic administration and finance. In this system, the curriculum of each program of study, the distribution of courses, course schedule, selection of courses each semester start can be made online. In addition to quicker and easier to get information, then print materials for academic administration activities can be reduced. In addition to supporting the system of lectures for faculty and students, as well sisem built to handle personnel administration, finance, both faculty and staff. This system is also provided online. In addition it was made policy in the field of non-academic supports green ICT policies, for example with the establishment of a remote working policy. This policy is supported also by the development of e-learning and e-library. So that the lecturer conditions cannot be physically present on campus, it can be replaced by online lectures. Similarly, research activities can still be continued, because the reference needed can be accessed using the e-library. So this policy remains based on the quality of teaching and research.

3) Challenges:

Some of the challenges in increasing awareness and implementation of green ICT primarily is the cost of implementation and maintenance program. Environmentally friendly hardware equipment is expensive, of course, the purchase of equipment with environmentally friendly technologies will be the focus at the time of acquisition, and of course the cost of care. The next challenge is the lack of support by the leadership of the government. Although the existing regulations regarding environmental sustainability issued by the government, the government is expected to also follow up with ICT equipment procurement policies are environmentally friendly. In this case the government is expected to set the price of ICT equipment environmentally friendly, so it can be reached. Because one of the challenges is the implementation of green ICT procurement of environmentally friendly equipment that is still expensive. The next challenge is that the application of green ICT requires commitment from management. This commitment is necessary so that the implementation
can be done consistently, so that the expected goals can be realized.

Next is the challenge of the limited understanding of the concept of Green ICT among academicians. Thus the policy and real actions carried out in the application of green ICT is, needs to be disseminated continuous and examples of concrete actions in their daily academic activities. These challenges arise from the opportunities that high school can apply green ICT more effectively, since they have the same science, organizational structure more simple, so that coordination between sections can be easily done.

The organizational structure is applied to each university has a close relationship with the successful implementation of Green ICT, given that some universities have a separate section in charge of managing IT respectively. In order for the implementation of Green ICT can efficiently, there needs to be coordination between the IT Unit and the person in charge of the computer laboratory which is separate from the part of IT management. So that information about IT masterplan includes laboratory can be arranged properly, so that it can be monitored clearly.

4) Policies:

a) Selection of technology and equipment. This step includes the purchase of ICT equipment that is certified environmentally friendly or replacement of ICT equipment that uses less electricity. Universities also need to consider the purchase of ICT equipment that can be recycled. Initiation of Green ICT is already starting to be used by a wide range of ICT hardware industry in developing the Personal Computer (PC) using the Energy Star specifications on a PC that was released in the 1990’s by the US Environmental Protection Energy (Hodges & White, 2008). Electronics one of which is a monitor, is designed using environmentally friendly technologies and energy saving. Then through the testing phase, and if it passes it will receive the Energy Star label. Interest in the design, build, and implement Green ICT solutions is growing very rapidly in recent years. Backed by the research areas of Green ICT very progressive, into a guide for hardware developers to create products that are more environmentally friendly. As well as being a guide for the company in designing the overall ICT system and implement Green IT strategy.

b) Setting the technology and equipment. Including an efficient server management, one is to use server virtualization. Regulating the use of the printer using printer sharing together, as well as for fax machines and photocopiers.

c) Optimization and network architecture design. Given that the network design using a lot of equipment, the design of the network needs to be made clear that the network equipment can be monitored clearly. Especially for networks that provide access for students. To ease the mobility of students many universities which provide outlet in various places for students in need. This has an impact on the amount of electricity consumption, given the students often use more than one mobile device (mobile).

d) Reengineering processes and software algorithms. In designing a program, using an efficient algorithm. Due to inefficient processing algorithms will also use a lot of electricity, at the time the program is executed. The concept of Green ICT made also a classification known as green software, which is divided into four categories, namely: 1) the software which is more environmentally friendly by consuming less energy; 2) integrated software that helps other work being environmentally friendly; 3) Carbon Management Software (CMS); and 4) software that can adapt to changes in the weather, estimates the implications and provide thoughtful responses (Murugesan, 2013).

e) Setting data centers and facilities. Given that the amount of data stored will be more and more, the PT needs to perform efficient data storage settings, so that data when it needs to be easy, and saves the data search process.

Activities of printer usage and habits. Use the printer sharing arrangements should also be supported by habits that support, for example, simply print the document for things that are important. For example, in the drafting process can be done using softcopy first. The use of paper back
and forth when possible, and internal and external communication is maximized using email.

h) The use of outsourcing. Still relating to points data settings, the current cloud technology helped universities in organizing data storage with easy and cheap, since universities do not need to provide their own data storage equipment. Concerns about data security can be circumvented with the selection of a trusted vendor.

i) Adjustment of lifestyle and culture based on Information Technology. However, the application of Green ICT in the campus still has obstacles that need to be addressed. The main challenges of this application is the lack of human resources who understand the concept of Green ICT. Given these constraints, the leaders need to strive to continue to socialize the concept of Green ICT, and ensure that programs initiated Green ICT done consistently. The policy needs to continue informal nature in the form of a formal policy. And habits that led to the initiation of Green ICT needs to be legalized. This is the so-called Regulatory Compliance Motive is a motivational approach by using some rules that force companies to run, even though the company does not have its own desire to do so (Molla & Abareshi, 2011).

Cultivate the habit of using IT in everyday activities on campus, such as digital libraries, information systems that can be accessed 24 by students, including announcement of the routine, as well as other learning activities. This is done by one of the respondents stated that all activities including the administration perkulihan for faculty and students already done electronically. Awareness of the implementation of Green ICT needs to be supported by the leadership of the universities were officially enforced on campus. Formal policy has been carried out on one of the respondents, in term of using electricity and air conditioning settings. While other respondents perform informal policy that is to replace all electronic-based information systems.

j) Conduct promotion, dissemination, and teaching the effective use of ICT. Class e-learning is one form of this commitment. One respondent expressed a gradual and consistent use of this technology, starting from the academic year 2014/2015 for regular classes, and will gradually be implemented in the employee class, intensive, and graduate programs. Another emphasis of this step is to use motivation eco-efficiency approach is the motivation for the company to prepare the products or services at competitive prices on the one hand, and on the other hand also engage in activities that progressively reducing ecological impacts on the environment (Chen, Boudreau, & Watson, 2008).

5. Conclusion

The concept of Green IT has long been thought by experts, and urgent to be implemented. However, for the implementation of Green ICT can be directed and in accordance with the purpose of the company or organization can use ICT Framework as a reference, through measures more concrete based on pillars and action formulated in the framework. In principle, all the activities that lead to the approach Green ICT is to reduce carbon emissions which are directly generated by the equipment or the ICT system itself (Greening of IT), and the use of equipment or systems of ICT to help reduce the carbon emissions released by other activities in the company overall (Greening by IT). Two things can happen if the framework that has been applied in the organization suaru always be measured, monitored and regulated, in order to provide consistent results as the main goal the implementation of Green ICT.

However, this needs to be supported by the initiation of a formal policy by the leadership of the universities, to suit the purpose of the implementation of Green ICT. This policy is disseminated on an ongoing basis, consistent practice activities are also carried out, as well as in the medium or long-term need to measure the extent to which the implementation of Green ICT with various methods of measurement.

In order for the implementation of Green ICT can be efficient, hence the need for coordination between IT and the responsible section computer laboratory that separate management of IT Division. So that information about IT masterplan including the laboratory can be arranged properly, so that their use can be monitored clearly. This coordination also will help universities in calculating the energy consumption of electricity used by IT equipment, both of which focused on the IT Division and in the laboratory. An organizational structure that is applied to each university has a close relationship with the successful implementation of Green ICT, given that some universities has a separate section in managing IT respectively.
6. Recommendations:

Universities also felt that in order for the application of green ICT to be controlled well, the next university needs to make the documentation of the application of green ICT. Overall leaders stated that sustainability will be the commitment and will always be disseminated to all academic faculties, so it is expected that green ICT will become a lifestyle among academic faculty.

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