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Electronic Waste Management and Disposal methods in Addis Ababa University: Challenges and Prospects

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Abstract: ***During the last few decades, the electrical and electronics industry has experienced an enormous growth. The increase in consumption of electronic equipment has been unprecedented. Increase in the use of electronic products have resulted in increases in production of these products and hence create a new waste, or coupled with increasing consumption is the increasing accumulation and generation of Waste Electrical and Electrical Equipment / WEEE, commonly known as electronic waste / e-waste. The study was conducted to examine the management of e-waste and its disposal methods in Addis Ababa University, Addis Ababa, Ethiopia in particular the generation and status of e-waste, management practices. The networking with actors in relation to e-waste management was also observed to suggest possible recommendations for proper e-waste management in the university. The qualitative method was adopted and the research approach is a case study. The most important data collection instruments were questionnaires, interviews, observations and review of documents. The study was conducted in four campuses of Addis Ababa University. . The respondents were selected purposively based on their responsibility. Accordingly, the General Service Department officers were selected for filling the questionnaires and in-depth interviews. The study estimated that the total amount of e-waste is about 4982 in number. (Main campus 2648, science faculty 648, Institute of Technology 903, and FBE Campus 783). The most important causes of e-waste generation in AAU are rapid obsolescence rate, lack of maintenance, the demand for the new equipment and accessories. Regarding the actions taken to manage the e-waste, about 4660 of 4982 put in store, only 138 of them donated. There are about 46 rooms, which could be served as offices for academic staffs in the university that are occupied by e-waste. Recycling, reusing, donating and reselling the e-waste have not been practiced in the university. The major reasons for storing of e-waste are absence of good disposal methods, poor maintenances, upgrading and refurbishment. Awareness on e-waste is very low among the General Service Departments officers. Currently the university is not implementing any of the management options of waste materials due to the administrative, informative, economical challenges that make the implementation dormant. Making partnership with stakeholders to manage e-waste is not practiced. Therefore, there is a need to adopt specific legislations that specifically deals with e-waste and creating links with the four key actors in waste management such as the authorities, manufacturers, waste dealers and the users to design effective management system.***

Keywords: e-waste, recycle, reuse, environment, toxic

1. Introduction

Electronic products, which were once thought to be luxurious, has presently become a need. The term electronics encompasses a wide range of home and business electronic goods, including televisions, monitors, computers, audio and stereo equipment, computer peripherals, VCR, DVD players, video cameras, telephones, fax and copy machines, cellular phones, wireless devices etc. Household appliances such as washers, dryers, refrigerators and toasters can also be considered as electronics products (Ramachandra, 2004).

While other types of municipal waste are decreasing e-waste is growing by close to 5% annually. These wastes continue to be generated at alarming rate due to rapid advances in technology, drop in product prices and an ever growing demand for new features. Thousands of computers, monitors, printers, photocopiers, fax machines, and other electronic items are being replaced on an annual basis by new and advance models. Evidence of increasing storage-stockpiles and generation levels provide indicators of the limited success of reuse, refurbishment and recycling efforts in developing countries. Besides that, due to the increase in affordability of new products and technological advancements, it is easy to purchase rather than repair and dispose the out dated equipment (Arora, 2008). Management of electronic waste is a much more formidable challenge in developing countries on account of lack of proper infrastructure, poor legislation and awareness among citizens.

The main generators of electronic waste in developing countries are government institutions and public and private sectors (which includes educational institutions, agricultural development centers, health institutions, industrial zones etc. This implies the contribution from individual households is not as much higher than the institutions. Therefore, great concern has to be given for the e-waste management in the government institutions to minimize its impacts on environment and human health due to improper management and disposal of e-waste (ibid).

Electronic wastes can cause widespread environmental damage due to the use of toxic materials in the manufacture of electronic goods (Mehra, 2004). Hazardous materials such as lead, mercury and hexavalent chromium in one form or the other are present in such wastes primarily consisting of Cathode ray tubes (CRTs), Printed board assemblies, Capacitors, Mercury switches and relays, Batteries, Liquid crystal displays (LCDs), Cartridges from photocopying machines, Selenium drums (photocopier) and Electrolytes. Although it is hardly known, e-waste contains toxic substances such as Lead and Cadmium in circuit boards; lead oxide and Cadmium in monitor Cathode Ray Tubes (CRTs); Mercury in switches and flat screen monitors; Cadmium in computer batteries; polychlorinated biphenyls

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(PCBs) in older capacitors and transformers; and brominated flame retardants on printed circuit boards, plastic casings, cables and polyvinyl chloride (PVC) cable insulation that releases highly toxic dioxins and furans when burned to retrieve Copper from the wires. All electronic equipments contain printed circuit boards which are hazardous because of their content of lead (in solder), brominated flame retardants (typically 5-10 % by weight) and antimony oxide, which is also present as a flame retardant (typically 1- 2% by weight) (Devi et al, 2004).

The overall intention of this research, therefore, was to assess factors that influence electronic waste management by looking at the present E-waste management structure on one hand and policy gap on the other hand. The study examined the generation, collection, segregation and the application of waste hierarchy in general to come up with some recommendations to solve the identified problems in Addis Ababa University.

2. Materials and Methods

Addis Ababa University – Main campus, Institute of Technology, Science Faculty and FBE campuses were selected for the present study. The five elements that were considered were the research methodology, research approach, data collection methods (including ethical consideration and valid analysis techniques). Having analyzed the main qualitative methods, we decided to adopt all the methods to address the research questions, with interviewing being used as the main research tool. In order to gather critical information four General Service Department heads and two storekeepers and two purchasers from the selected institutions were included in the study using purposive sampling technique.

3. Results and Discussions

According to questionnaires and interviews the causes for rapid e-waste increase (generation) in all campuses are due to rapid change in technological advancement, the demand for new and additional products, the incompatibility issues and the existence of irreparable electronic products. Technological advancement is a responsible factor for the occurrence of high obsolesce rate.

The other important factor as the causes of e-waste generation is the existence of unserviceable electronic equipment and incompatibility of the old electronic equipment with the newly purchased (imported) accessories. Electronic products that were produced (manufactured) currently have features that the older equipment does not have. Therefore, this condition made some electronic products incompatible.

The information gathered on the quantity of e-waste that are caused by the technological change, the demand for new products, irreparable products and the incompatibility issues reveals that
main campus (6 kilo) accounts the largest coverage with 53.1% of the total e-waste in AAU followed by Institute of Technology (18.1%). Science faculty and FBE campuses accounts, 15.7% and 13% of e-waste items respectively.

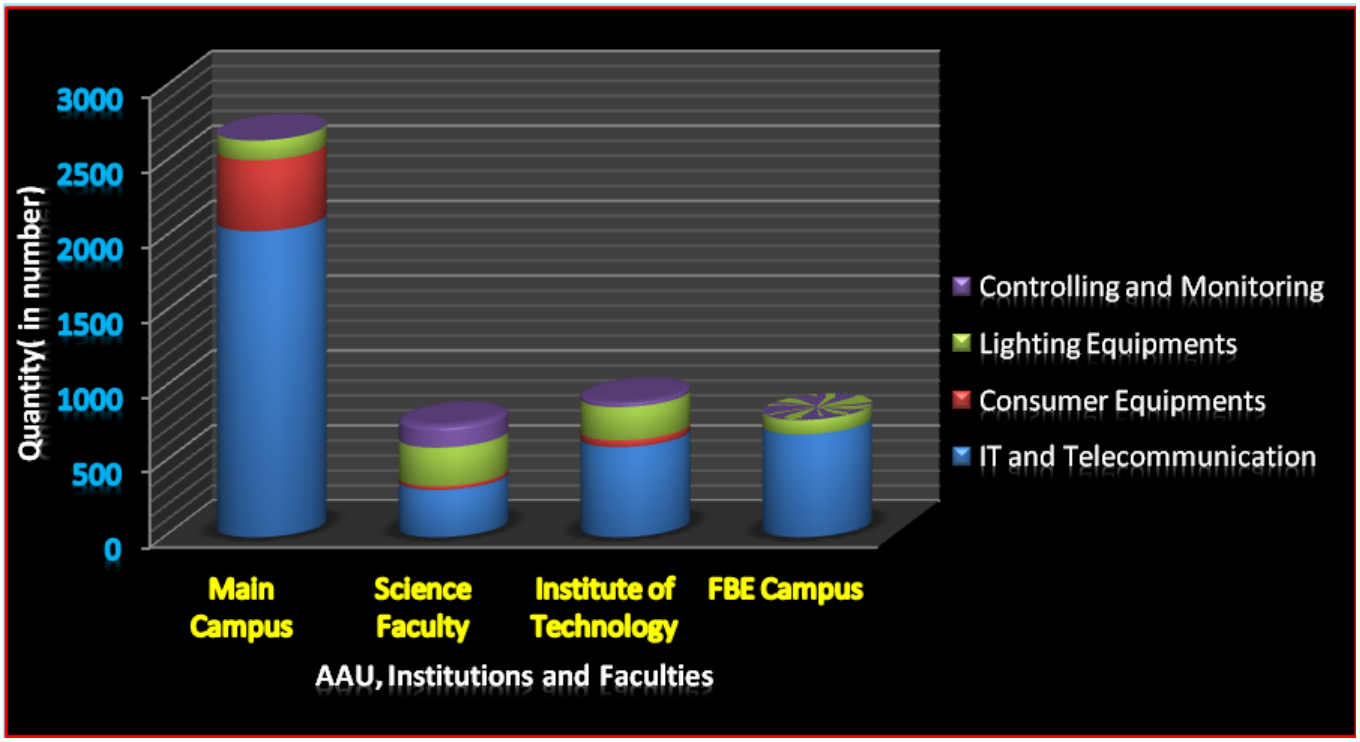

Figure 1: Categories of Electronic Waste in Addis Ababa University
Source: General Service and Property administration Department of AAU

Inevitably with the expansion of educational institutions and rapid technological advancements, purchasing of electronic equipment increases annually. They are purchasing the electronic equipment from general distributors or whole sales, second hand market or retail shops and not directly from the manufacturer.

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E-waste contains precious and special metals, including gold, silver, palladium and platinum, as well as potentially toxic substances such as lead, mercury, cadmium and beryllium. Therefore, responsible end-of-life management of e-waste is imperative in order to recover valuable components and properly manage hazardous and toxic components. End-of-life management of e-waste includes reuse of functional electronics, refurbishment and repair of electronics, recovery of electronic components, recycling e-waste, and disposal. Reuse, refurbishment or repair of electronic products is most desirable since this option increases the life span of the electronic product and higher resource efficiency. (Jennifer Namias, 2013).

There are several reasons for an organization to accumulate /store unused electronic equipment annually. They do not consider it appropriate to throw as garbage or lack of awareness regarding disposal while others have not found good disposal methods or recycler to reuse and recycle the electronic wastes. In addition, some of them want to donate / sell it to other organizations. The respondents (100%) reported that the unused electronic equipment are because they want to donate them to other organizations that are in a need of the discarded items. Besides, they don't found good disposal methods to dispose/recycle the equipment properly and about 50% of the respondents replied that they do not consider it appropriate to throw them in garbage. Regarding reasons for replacement of electronic products respondents reported several reasons. Old electronic equipment is too slow in performance which consumes greater time; they want newer technology and features or capabilities not available on old electronic equipment. In addition to this, the newly produced one replaces old and dysfunctional electronic equipment because the institution needs additional electronic equipment for the existing offices and departments.

The electronic equipment which are old and unserviceable or non-operational (as 75 % respondents), obsolete products (50% respondents) are categorized as e-waste. Concerning the characteristics of e-waste, as depicted on table 1, IT and Telecommunication equipment accounts the highest value with 73.2%, while the remaining contributes 26.8% of the total e-waste equipment in AAU.

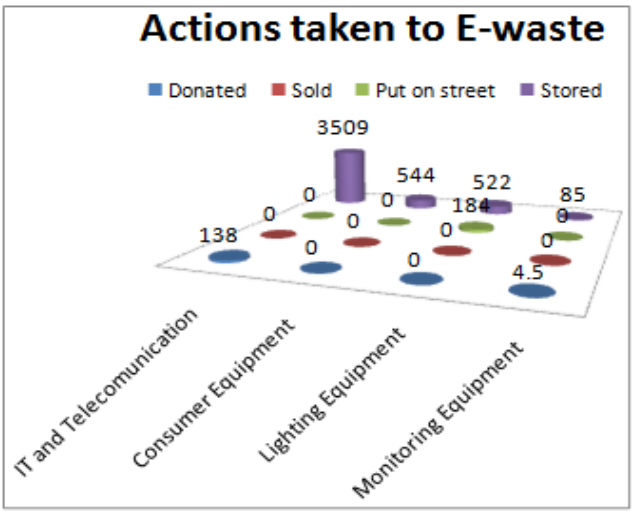

Figure 2: Actions taken to E-waste (in number)
Source: General Service and Property Administration Department of AAU

The conclusion drawn from the response shows that all of the respondents reported storing is the action taken to old, broken and unserviceable electronic products. Of the total amounts of e-waste 93.5% of them are stored while only 2.7% is donated to other organizations. In addition to this, about 3.7% that is totally lighting equipment are put on open spaces in the campus.

About 50% of the respondents replied that the electronic waste is stored separately and other 50% replied as they put e-waste with functional electronic equipment. Therefore, one can easily understand from the above discussion that the condition under which electronic waste are accumulated/stored and the overall facilities such as the storage area/size, shelves and containers to manage/handle all electronic waste is very poor. Moreover, it can be concluded that the current facility under which e-waste stored is in a very risky condition, which can affect the human health and the environment in the near future if no significant measures are taken by the management bodies.

Figure 3: E-waste Storage
Source: Survey Data, 2012

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According to the data obtained on the efforts to reduce waste before generation, it indicates that there is no effort to minimize electronic waste at the institution level. Concerning awareness creation, both the results obtained from the Main and FBE campuses showed that there is no awareness creation whether some hazardous contents of electronic waste need a special treatment in order to disposed of. Thus, lack of awareness on the hazardous friction of e-waste will be resulted in poor management of electronic waste that is caused by improper disposal of the items like other wastes.

Among the respondents from the four institutions of Addis Ababa University, the General Service Department workers reported that they are not aware that some electronic parts profitably sold to other organization or recyclers. Rather they simply know about computer that it can be sold to any organization or individuals that require it after the maintaining of the item.

The study revealed that there is no unit/department that is established to handle electronic waste in the university and currently it is handled by the storekeepers under the control of General Service and Property Administration of the university. In addition, the respondents reported that there is no training or knowledge provided to them in relation to electronic waste management. Rather they simply collect; transport and store electronic waste as any other type of wastes. Moreover, the organizational structure of property administration of AAU has proven the absence of any unit that handle e-waste.

Concerning the current programmes and activities implemented by the university's management in relation to e-waste management, all the respondents reported that the only activities performed currently in relation to e-waste is e-waste inventory. Even this is not fully practiced because major activities in inventory of e-waste are not yet touched with mentioned e-waste activities.

Making partnership with other stakeholders is pivotal if e-waste management problem is to be handled sustainably. This is essential to purchase the most qualified equipment required by the university. Moreover, in order to send the unused equipment back to the industry /company that has been producing the equipment, the presence of links with these companies is vital. According to the report from the respondents, the institution does not make partnership with concerned stakeholders regarding the purchasing, consuming and management of waste resources.

Waste needs proper management. The first priority should be to segregate wastes, preferably at the point of generation, into re-usable and non-reusable for waste reduction and changing in to financially viable material; hazardous and non-hazardous components for avoidance of hazardous/ containing products and waste worker safety. Some wastes are highly hazardous, e.g. hospital and industrial wastes, requires careful collection and storage, and can be expensive to treat. Nevertheless, minimization and raw material substitution options should be preferred in dealing with this waste (Nigatu et. al., 2011))

4. Conclusions

Addis Ababa University is the largest academic institution of Ethiopia, using various electronic equipments for educational purposes. As a result, it has been found that there is tons of e-waste stored in the campuses where this study was conducted. E-waste items such as IT and telecommunications equipment, consumer equipment, lighting equipment and monitoring equipment are widely available in this university. Legislation that specifically deals with e-waste management, lack of e-waste facilities and skilled man power as well as a community with low awareness on the issue are found to be major problems. When the university is purchasing electronic products, there is no any network creation with the manufacturer, distributors and retailers.

There are no systems that allow the practice of electronic waste management by independent unit as independent issue. Because the current organizational structure of facility management does not encompasses e-waste management. Poor collection and availability of tones of e-waste items in storerooms are some of the implication of inefficient management. The current e-waste management facilities like storerooms, wheels, containers, shelves and recycling facilities are insufficient. Moreover, the way the e-waste stored is not good at all. In all storerooms there are many scratched equipment falling down on the grounds. Thick dust is covering the waste items. In addition, it is very difficult to identify some of the equipment due to the poor handling of e-waste. Even the construction materials from which the storerooms are built up is steel and the ground is not concretized.

The GSD officers have not aware on the nature of e-waste, (the valuable parts and the hazardous contents in e-waste) management of e-waste (recycle and reuse) and the impacts on human and environmental health if treated improperly. It is very difficult task for them, firstly, to measure the costs of the waste items if the need arises to sell the items to e-waste markets. Secondly, lack of proper handling makes the management of e-waste more complex in the environment where there is no e-waste management structure as factors like increasing demand for electronic equipment, rapid change in technology and breaking of electronic items are inevitable in this technocratic world. Absence of independent policy that deals with e-waste provided from the central government that the university is aware of is another concern. The General Service Department workers are acting as property administrators who are responsible to control the properties of the university starting from the purchasing phase throughout consumption and disposal of the products having little or no knowledge of e-waste management.

Among the factors that hinder donation, disposal or recycling of these wastes is poor government intervention in e-waste management hence e-waste management is a complex task that requires joint efforts. Because they already have informed to take no action with the equipment discarded from the university until, the government itself is permitting to do so. Nevertheless, the government does not collect or allow any agency to make partnership with

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university to deal on the issue of e-waste management. Due to this fact, several e-waste items are stored in the university.

In e-waste management, the challenges are administrative, informative and economical. Administrative challenges include absence of legislation and organizational structure, and backward system for collecting and categorizing waste. Whereas the problems in relation to informative challenges are lack of awareness on why the need for handling e-waste properly, how effective management is realized, who is responsible in the management, the implications of ineffective management and absence of computerized data. Lastly, but not least, economical challenges are of financial constraints, absence of skilled work force, lack of facilities for maintenance and recycling of e-waste.

The accumulation of tones of e-waste in the storerooms and departments of the university are implications of absence of redesigning, reusing, recycling, selling and donating of e-waste of the waste items.

5. Future Implications of the Present Management

E-waste has been put on the priority waste streams list and is among the fastest growing waste streams (Philliber et al. 1980). In the environment where there is lack of assembly and maintenance of permanently broken electronic equipment, rapid obsolescence rate and increasing consumption of e-waste, there will be increasing generation and accumulation of e-waste. Unless the university's management bodies plan to design a system that allows proper handling and management of e-waste with responsible stakeholders in the near future, within short period of time large number of discarded equipment will be scattered along the streets and open spaces of the university.

Lack of networking with responsible stakeholders in the management of e-waste will be resulted in various problems. Activities like reuse, redesign, and recycling of the waste items may not be implemented effectively.

Absence of legislation/policy that specifically deals with e-waste is another challenge that contributes a lot for ineffective management of e-waste. The government is not intervening in e-waste management by establishing agencies that deals with e-waste, by making/enforcing rules, encouraging formal and informal waste collectors to play their pivotal role. The university has no full right to take any actions to the outdated, broken and irreparable electronic equipment stored in the storerooms without the permission of authorities.

The departments and offices of the university is ordering the electronic equipment they wanted with clear specifications to the General Service Departments. When the newly purchased equipment is arrived, they throw away the old equipment even if the equipment is functioning. This implies that many of the electronic equipment, which still is functioning properly, shall be thrown to storerooms and categorized as e-waste.

Appropriate storage areas and facilities like containers and shelves are not fulfilled. This implies that emphasis has never been given to the fulfillment of facilities indispensible for proper handling of e-waste. Hierarchy of e-waste management is not practiced in AAU. Prevention, which is the first step to reduce (minimizes) the generation of e-waste products is not implemented. Departments and offices in the university have been throwing functional electronic equipment to the storerooms when they are provided with new electronic equipment.

In the near future, among the major challenges of the university in designing of a system for effective management of e-waste, firstly, is establishing of organizational structures that combine e-waste management as independent unit. The GSD workers need provision of courses, trainings and information on e-waste management. Secondly, fulfilling e-waste management facilities require allocation of huge costs. Because the management requires standardized storage, within the storage appropriate shelves and containers, adequate recycling facilities should be fulfilled. Thirdly, computerizing information and data management system on electronic waste types, characteristics, number of years used, label of e-waste etc will require knowledge and money.

Finally, preparing storage areas and supply of e-waste management facilities demands huge financial resources. Because the current management strategy the university promoting dominantly is storing, though it is not the best management strategies to handle e-waste.

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