E-Waste Management: A Review

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Abstract-E-waste is described as the rejected electronics devices, those are no longer in use due to functionality failure or obsolescence in their technology. It includes retired desktops, laptops, mobile phones televisions, IC's, etc. 4R's concept, i.e.-Reduce, Recover, Reuse, Recycle is use to manage e-waste. In this paper we have discussed the problem created by e-waste and it's management.

Keywords- *E-waste, E-waste generation, E-waste management, 4R's concept.*

I. INTRODUCTION

Waste is nothing but something which is unwanted or rejected or defected or not useful. But we can extract the useful things from it.eg-plastic has been converted into petroleum. Similarly E-waste is the waste, which is not in use or retired due to various reasons discussed in this paper. Like any other waste, it also creates many problems and required to be managed by adopting e-waste management methodologies. In this paper we have discussed the problems created by e-waste and best possible solution for its management. We have introduced 4R's concept i.e.Reduce,Reuse,Recover,Recycle for the E-waste management and sustainable product design to reduce the growth of e-waste generation.

II. E-WASTE

"Electronic waste" may be defined as discarded computers, office electronic equipment like(fax machine, security system), entertainment device electronics, mobile phones, television sets, refrigerators, A.C, which are no longer in use due to functionality failure ,obsolescence in their technology or are at the end of their life cycle[2].

III. GENERATION OF E-WASTE

Generation of e-waste can be categorised as follows-

A. E-waste generated by retirement of electronic items due to partial functionality failure.

Many times an electronic device stops working due to failure in its one or more sub-components. This may result complete retirement of the electronic items if either the sub-components are not available or their replacement cost is almost equivalent to the original cost of the electronic device itself. Ultimately the device will be converted into e-waste[3]. For example-Television's costliest item is CRT and if it stops working, the better option will be, to go for a new television rather than replacing or repairing the CRT.

B. E-waste generated by retirement of electronic items due to complete functionality failure

This may be the reason of unfair use or accidental damage to the device of such a manner that the repairing of the device is not at all possible, and entire device is converted in e-waste.

C. Retirement of electronic items due to their obsolete technology

Due to rapidly exceeding technology, life span of an electronic item, based on a particular technology is reduced .An electronic device may be functioning properly, but might be forced to be retired, if a better device based on advanced technology is available in the market. For example-Cell phones working on an old operating platform like Symbian were forced to be scraped ,when new and better cell phones working on IOS and android were launched in the market.

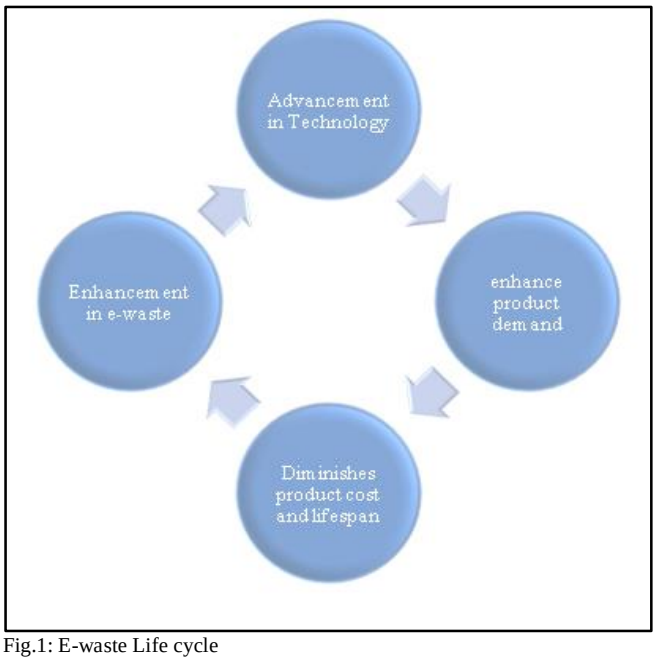

Fig.1: E-waste Life cycle

IV. EXPONENTIAL GROWTH OF E-WASTE GENERATION WITH TIME

Rate of technology advancement has been increased rapidly, due to which number of electronic items, those are being converted into e-waste, has been increased exponentially. Reliability of electronic devices has been increased with the advancement of technology, but at the same time, the life span of product is reduced, the reason behind

this is increased purchasing capacity of customer. No customer would like to use an e-devices which is based on obsolete technology, while new and better device is available in the market. This is how a properly working e- device may be converted in e-waste.For example- Earlier in 80's, life of typical television set is use to be almost 15 years, although the reliability of electronic sub-component was not much better. But in the present scenario,the life of the television set has been reduced to 4-5 years or even lesser than that, although it uses much better and reliable sub-component. The real cause of this short life span is the rapidly growing technology, which is easily available in affordable price to the customer.Development of economy coupled with exponential increase in population, has contributed in the increase of demand of electronic devices, due to which the volume of e-waste is increasing at an average rate of almost 15% per year.

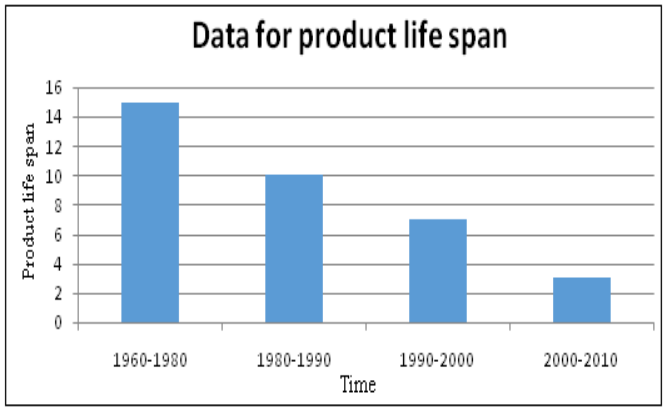

Fig.2: Data for product life span

V. PROBLEMS CREATED BY E-WASTE

A. *Environmental problem*

The processes of dismantling and disposing of electronicwaste lead to a number of environmental impact[1]. Liquid and atmospheric releases end up in bodies of water, groundwater, soil and air and therefore in land and sea animals - both domesticated and wild, in crops eaten by both animals and human, and in drinking water. One study of environmental effects in Guiyu, China found the following:

- Airborne dioxins- one type found at 100 times levels previously measured.
- Levels of carcinogens in duck ponds and rice paddies exceeded international standards for agricultural areas and cadmium, copper, nickel, and lead levels in rice paddies were above international standards
- Heavy metal found in road dust - lead over 300 times that of a control village's road dust and copper over 100 times.

B. *Information security problem*

E-waste presents a security threat to individuals and exporting countries. Hard drives that are not properly erased before the computer is dismantled, can be reopened, exposing sensitive information. Credit card numbers, private financial data, account information and records of online transactions can be accessed by most willing individuals. Organized criminals in Ghana commonly search the drives for information to use in local scams.

C. *Health hazard problems*

- Guiyu in the Shantou region of China is a huge electronic waste processing area .It is often referred to as the "e-waste capital of the world." The city employs over 150,000 e-waste workers that work through 16-hour a day's disassembling old computers and recapturing whatever metals and parts they can reuse or sell.

- An investigation has been carried out by Professor HuoXia, of the Shantou University Medical College. She tested 165 children for concentrations of lead in their blood. 82% of the Guiyu children had blood/lead levels of more than 100. Anything above that figure is considered unsafe by international health experts. The average reading for the group was 149.

- There are many health hazard problems created by e-wastages due to different components.

VI. METHODS OF E-WASTE MANAGEMENT

A. *Sustainable Product Design*

- With the advancement of technology in society, people begin to pay more attention to the adverse effects of resources and energy on social environment. So there should be the requirement of Sustainable product design that links society, economy and environment as a whole[9].

- Green design process is introduce to address wasted resources in production to increase productivity, drive down costs and deducts impact on environment and socio-economy[10].

- The highest criterions of green design are as follows: consider recycling fully, reduce the waste, increase product durability, the material's fitness, be easy to decompose and assemble, save energy source and select the least polluting material, guarantee' staff safety and so on.

B. *4R's concept for E-waste management[8]*

1. *Reduce*

Manufacturing something, to reach the same or an improved final quality, while using less direct and indirect materials[6]. For instance, laptops are much lighter now than years ago, because of the use of lighter components, more efficient and lighter batteries, etc. By adopting this method, amount of e-waste generated can be controlled very effectively.

2. Reuse

It includes reusing the retired device as a whole, if it is in working condition. Retired devices those are retired due to obsolete technology can be reused in the countries where new technology is either not available or much costlier then the presently available technology.

- Some e-devices retire due to partial functionality failure. These devices can be repaired and can be reused at the place of converting them in to e-waste.

- Developed countries like USA spends lakhs of dollars on e-waste management by just scraping out their e-waste to underdeveloped countries like Ghana. Alternatively the same money can be used to repair, repairable devices, and those devices can be donated to the underdeveloped countries[5].

3. *Recover*

This e-waste management technique includes extraction of useful sub components from e-waste[7]. This way of e-waste management can be used more effectively for the devices those are retired due to partially or fully functionality failure and not possible to be reused in total. Although we cannot use the device in total, but we can recover its sub-components, those are in 100% working condition and can be reused in a device, which is based on better and advanced technology.

4. Recycle

Recycling waste materials from end-of-life electronics devices is an effective solution to the growing e-waste problem. Most electronic devices contain a variety of materials, including metals that can be recovered for future uses. By dismantling and providing reuse possibilities, intact natural resources are conserved and air and water pollution caused by hazardous disposal is avoided[4]. Additionally, recycling reduces the amount of greenhouse gas emissions caused by the manufacturing of new products.This type of e-waste management is best suited for developed countries.

VII. CONCLUSION

Finally we concluded that E-waste is a waste, which is being generated due to various reasons, also the rate of generation of e-waste is exponentially increased with span of time. There are various problems related to e-waste and solution of all those problems is e-waste management. We discussed the various ways of e-waste management by using 4R's concept. All 4R's may not be applicable to a particular country. So we can say that e-waste management varies from country to country.

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