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RESEARCH ARTICLE

INVENTORY OF E- WASTE GENERATION IN ENGINEERING INSTITUTES: A CASE STUDY

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ABSTRACT

'Use and Throw' policy adoption by users and manufacturers, lack of awareness and poor intermingled management practices, innovations and industrialisation has led to generation of E-waste which in coming years will be a considerable component Municipal Solid Waste (MSW). One of the major contributors of E- waste is engineering institutes due to mandatory provision of different facilities according to norms after IT and electronics sector. Engineering Institutes are being funded for development under different schemes for which the major purchase is of electronic gadgets. The quantity of E- waste as per AICTE norms is calculated theoretically and practically which comes out to be 0.334 tonnes / year for 7 years life cycle and 0.262 tonnes / year till the obsolescence of 2009 at institutes. If followed the norms of AICTE, the generation rate of E –waste can be kept still to minimum as compared to present rate of generation in future. This paper gives study of quantity calculation of E- waste generated theoretically and practically in WCE, Sangli which will further led to suggestion of optimisation for E – waste generated. This study will further be extended to suitable management of E- waste through a mathematical model for Engineering Institutes.

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INTRODUCTION

E- waste is that component of the MSW which is till date not properly managed in the developing countries like India currently it is 1 % of total MSW. The major types of E- waste are categorised and classified as per the guidelines of UNEP into 10 different categories of E- waste (UNEP, 2007). The growing industrialisation from past decade, technological advancement, improvement in life style, ease of usage and availability, innovations has led to increase in the utilization of E- gadgets (Kumar et. al, 2011) and are the major reasons for the generation of E- waste (Ramesh and Joseph, 2006). Also the management of E- waste is not proper due to lack of awareness, poor practices and insufficient legislations and rules (Srivastava, 2009). Engineering institutes are one of the major contributors of E- waste. It is mandatory to provide all facilities as per the norms of All India Council for Technical Education (AICTE). Few of the engineering institutes are awarded with grants for the development under which the major purchase is observed of electronic gadgets and digital instruments. With the new purchase of electronic gadgets, old E-gadgets are either made obsolete. But if optimized properly E- waste generation can be reduced or at least kept to its present conditions.

The most traditional management practice followed at Engineering Institutes for E- waste is storage and dumping, but option of optimization is not implemented.

E –Waste Scenario

International E –Waste Scenario: In developed countries the obsolete E- gadgets from household, industry and commercial establishments are taken back by manufacturer of respective items. Also types of E- waste, collection points are established at certain locations from where E- waste recyclers pick up the waste on chargeable basis. The manufacturers send their collected E- waste to authorized E- waste recyclers for necessary actions. The recyclers process the E- waste so as to cause minimal harm to environment. For such various E-gadgets, the conceptual life cycle from its manufacturing to it disposal as waste is as shown in Fig. 1.

Indian E - Waste Scenario: In India, as there is no separate collection practices followed for E-waste, there is lack of availability of vibrant data on the generation rate, quantity generated and disposed of per year and this result into magnitude of environmental risk. Traditional E- waste flow model in India is shown in Fig. 2. The preferred management practices to get rid of obsolete E- gadgets in India are to

change them in exchange from retailers with the purchase of a new item. The business sector is estimated to produce about 78% of all installed computers in India. Obsolete computers from the business sector are sold by auctions (Joseph, 2007). It is estimated that the total number of obsolete personal computers emanating each year from business and individual households in India will be around 1.38 million. The total E-waste generated in Indian industries by obsolete or broken down EEE has been estimated to be 1, 46,000 tons per year (CII, 2006). The general flow of E – waste in developing countries which includes involvement of different sectors is as in flowchart below.

METHODOLOGY

Waste Identification: A few of the guide lines as suggested by USEP and MoEF, CPCB are used for physical identification of E waste. The methods adopted were physical survey and questionnaire survey. Physical survey was carried out at engineering institute and for other engineering institutes virtually data was assumed. From all the observations of institutes the major sources of E- waste generating at engineering institutes are as in Table 1. Since long back all technical institutes are abide by the norms laid down by the AICTE for the provision of different facilities. At the establishment of any engineering institutes, it is mandatory to provide different electronic gadgets at different laboratories. The norms for provision of gadgets are as given in below table 2. The collected data is represented in below fig 3 which shows the distribution of E- waste unit wise and as its percentage contributing in total E- waste produced in Engineering Institute.

METHODS

There are no hard and fast rules as well as fixed guide lines for such type of study. Hence a few approaches as referred have been used to meet with following objectives.

Theoretical quantity of e- waste: The E- waste generating at selected engineering institutes of Maharashtra is calculated theoretically. The theoretical calculation is based on the parameters like strength of the engineering institute and norms of AICTE for provision of facilities at engineering institutes.

Actual calculation of e- waste generation: The quantity calculation is based on the approach II followed by USEPA for the actual E- waste generated. Hence with the collected data and records, the task of quantification is done. The data is collected category wise and summed up. The average 1st life of E –waste is considered for the calculation. Thus a quantity per unit is calculated. Then from the mass of electronic gadgets (in Kg), the quantity can be calculated as Kg/ year and further in Tones/ year.

Quantity of E- Waste Generation: The unit wise generation of E- waste in engineering institutes is represent in fig below. As a case study, the results are shown for one of the renowned Engineering Institute. After counting of number of units of different types of E- waste, the quantity of E- waste generating is calculated. The result of quantity of E- waste is 6.0428 E-waste/ tone. The generation rate of E- waste is also calculated, for which an assumption is made that the strength of the students and staff remains same. Thus the generation rate of E-waste is 0.262 Tones/ year.

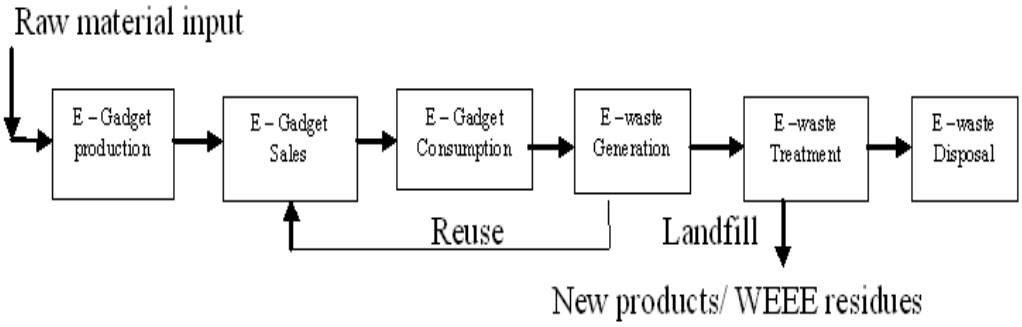

Fig. 1. E- gadgets flow in a system

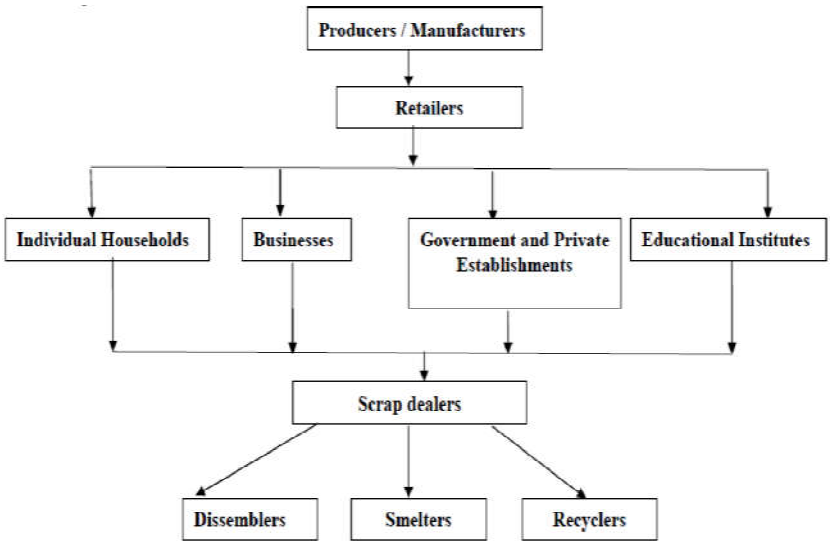

Fig. 2. E- waste flow chart in India

Table 1. Types of E- waste generating at engineering institutes

CATEGORY	NAMES OF E- GADGETS
Large Household Appliances	Fridges, Air conditioners, Electrical Oven, Coolers etc
Large Household Appliances	Fans, Water dispenser etc
IT and Telecommunication equipment	PCs, monitors (CRT/ LCD), laptops, Printers, Xerox machines, Scanners, Fax machines, Modems, Calculators, Cartridges etc
Consumer equipment	Video projector, Cameras etc
Lighting equipment	Light bulbs, Fluorescent tubes, Long life light bulbs (energy saving), Rechargeable lamps, Cells, Batteries, UV tubes etc

Table 2. AICTE norms for engineering institutes

Stream	Number of PCs to students ratio (Min 20 PCs)	Printers including Color Printer (% of total no of PC"s)
Diploma	1:6	10%
UG	1:4	10%
PG	1:2	10%

(Source: All India Council for Technical Education Approval Process Handbook (2011 – 2012), Appendix 5.1, page no. 99)

Table 3. Actual E- waste generation

Sr. No.	Gadgets	Average Mass (Kg)	E- waste (Units)	E- waste/ Kg	E- waste/ Tone
1	Desktop	11.837	111	1313.907	1.313907
2	CRT monitors	15.26	106	1617.56	1.61756
3	Flat screen monitors	5.762	56	322.672	0.322672
4	CPU	3.5	111	388.5	0.3885
5	Key boards	1.013	151	152.963	0.152963
6	Mice	0.136	155	21.08	0.02108
7	UPS	11.34	55	623.7	0.6237
8	Portables	3.17	367	1163.39	1.16339
9	Hard copy drives	8.437	44	371.228	0.371228
10	Projection devices	0.907	7	6.349	0.006349
11	Hard disk drive	0.621	99	61.479	0.061479
			Total =	6042.828	6.042828
			E- waste produced/ year =		0.262731652

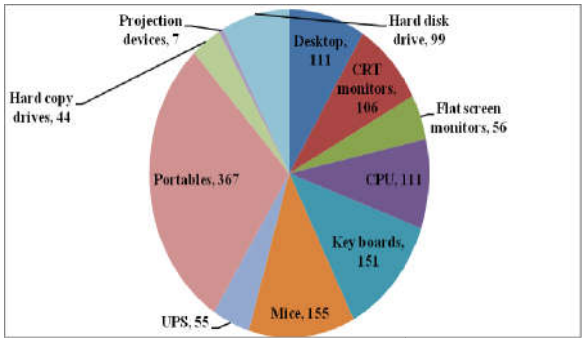

Fig 3: Unit wise E- waste generated.

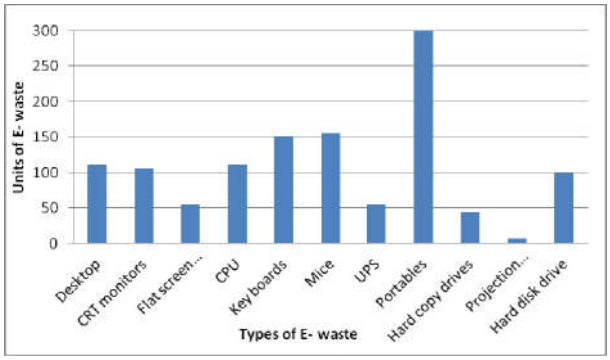

Fig. 4. Units of E- waste generated

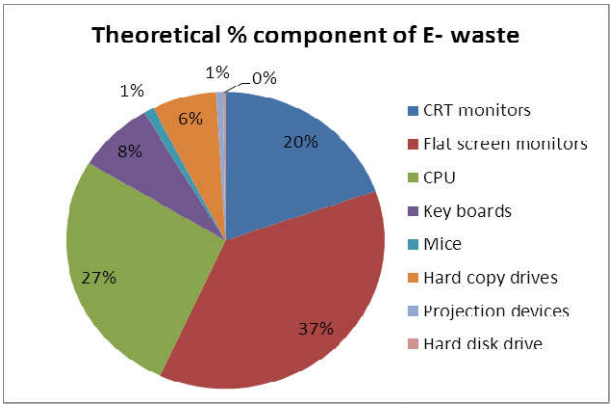

Fig 5. Theoretical E- waste Contribution as % component

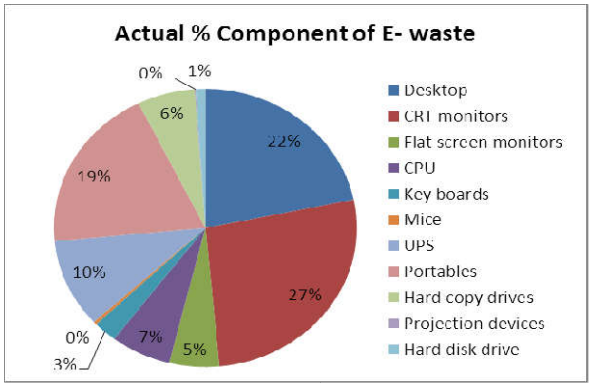

Fig 6. Actual E- waste Contribution as % component

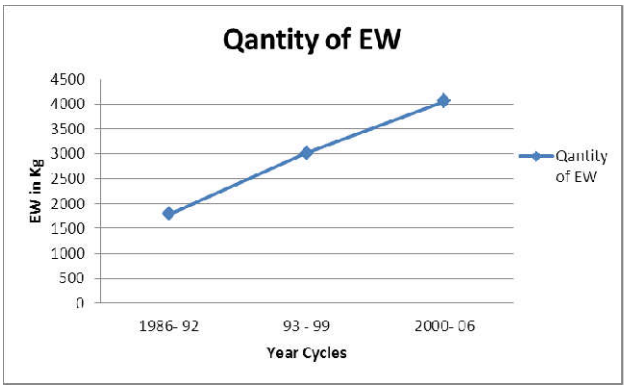

Fig 7. Increase in the rate of E- waste

RESULTS AND DISCUSSION

Calculation of quantity of e -waste generation at wce, sangli

A specimen calculation for Theoretical of E- waste generation shows the Quantity of E – waste to be 0.334 Kg/ year. The quantity of E-waste is calculated for the period of maximum first use i.e. 7 years for all gadgets selected. The unit wise contribution of gadgets is shown in fig 5. The data was collected for the obsolescence carried out at one of the renowned Engineering institute. For which a purchase data records were used during the years 1986 to 2009 as the procedure of obsolescence was carried out in that duration of 23 years. The actual units made obsolete are shown in below fig 6. From this data actual Quantity of E- waste generated at an engineering institute for selected gadgets is 0.2627 Kg/ year. Thus from the calculated results, it can be seen that with change in technology and advancements, the use of CRT monitors has reduces and thus they are accordingly replaced by flat screen monitors. The use of UPS has almost seen to be negligible now a days. Need of optimisation: As per the data analysis, if the life cycle of 7 years is followed, total 3 life cycles are complited upto year 2009.The results showed that with completion of cycles, the rate of generation of E – waste is increasing linearly. the pattern is observed as shown in below Fig 7.

Conclusion

The above study of quantification of E- waste in an engineering institute reflects in general the type and generation of E- waste in all engineering institutes is similar. It also depends upon mainly the intake capacity of institutes and the guidelines of AICTE. Presently the availability of e gadgets has found to be exceeded than that mentioned in the norms of AICTE. Thus in future while purchasing new e gadgets for institutes, previous gadgets should be disposed off properly or if they are working at least those gadgets should be donated or resold. The purchase of new gadgets should be carried out as per norms of AICTE. This will lead to the least generation of E- waste in the institutes and it will help to minimise the E-waste generating. This practice of optimisation is needed to be implemented so as to minimise the load on treatment and tedious disposal practices of E- waste.

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