



## Innovative Strategy for E-Waste Management - A Model Study of Karad, Maharashtra, India

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### Key Words:

E-waste management  
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### ABSTRACT

Electronic waste is presenting a challenge for the new millennium. Almost every business organization, Institution and even educated individuals are using computers and find it essential and inevitable to conduct their day to day business activities. Rapid changes in computer technology have made it difficult for the users to restrict themselves to stick on their old machines, which are becoming obsolete, unwanted and not at all usable after a period of time. This problem of rapid obsolescence has resulted into tremendous growth of electronic waste commonly referred as E-waste. In fact, the accurate estimation of obsolete unwanted and futile computers is not possible but approximation done by the researchers has given an account of such waste material to the tune of 80% of the total computers available in the organizations of Karad, Maharashtra. Such electronic waste which contains various hazardous materials, has created an immense threat to the environment, society and the world as a whole. The E-waste incorporates various toxic metals and chemicals like lead, cadmium, selenium, arsenic, beryllium, lithium, mercury, nickel, chromium, polybromium, biphenyl chlorofluoro carbons, uranium, zinc sulphate, toner dust, chloride and many more such toxic materials, which are deadly harmful to human health and environment as a whole, if not disposed off carefully. Therefore, it is an evitable and essential requirement to study thoroughly following points in order to have effective E-waste management: 1. To understand gravity of problem created by E-Waste, 2. To find out the causes and sources of E-waste, 3. To describe health hazard created by E-waste, 4. To determine feasible and viable methodology to manage E-waste and 5. Review of the research and coming out with conclusions and suggestive measures. Thus, the paper presented stresses the significance of E-waste management in the global scenario studying Karad as an area of study, and presents the status of E-waste as on today, suggest measures for arresting the trend of increasing E-waste, and managing it effectively.

### E-WASTE: AN OVERVIEW

**Definition of E-waste:** In fact, the universally accepted definition of E-waste is not yet been clearly defined. Varied environmentalists and thinkers of the field described it in different manner. However, widely accepted definition of E-waste can be expressed in the following words: "E-waste in common connotation and informal way can be described as the electronic products which had completed their useful, fruitful, beneficial life or are at the verge of completion of their useful life." Therefore, it can cover not only computers, televisions but may incorporate microwave ovens, computerized machines, electronic machines, mobile phones, electronic ballasts, electronic lamps, fax machines, photo copiers and many more to add in the list. Keeping in view the time constraint and other resources, the study is confined to computers and its peripherals among the users of Karad, Maharashtra.

**The significance of E-waste management:** At the outset, the term electronic waste is to be well

described so as to outline the problem faced by environmentalists, users, Government organizations and the society as a whole. Therefore, the study is comprised of following aspects:

- The description of E-waste and its varied types and kinds.
- The problems presented by E-waste to the world in the scenario of global capitalism.
- The chemicals and ingredients making E-waste hazardous for health and general environment such as heavy metals, hazardous elements, and problem of disposing of E-waste.
- Present technology and methodology for reducing, reusing and recycling of E-waste.
- Suggestive measures for effective E-waste management.

### OBJECTIVES OF THE STUDY

The study will have the following objectives to be achieved:

- To determine the severity of problem created by E-waste in and around Karad.
- To identify and assess the techniques and technology adopted by the users of computers at Karad to cope up with the problem.
- To determine the level of success achieved in managing the E-waste.
- To suggest measures and viable mechanism to manage E-waste.

**Research design:** The research design adopted for analyzing and presenting the research problem and its solution is comprised of the steps like collection of data, presentation of the highlights of research conducting strength and weakness and determination of sample sources, formulating sample design analysis study, and outlining the executive discussion and conclusion with suggestions.

**Determination of the sample sources:** As the research is having large scope comprised of users, environmentalists, medical practitioners, NGOs working on environment and public as a whole, the sample sources will have varied categories. The sample design of targeted group of users is given in Table 1 and Fig. 1. It is apparent that average percentage of E-waste in educational institutions is 80.60 %. E-waste from industries, co-operative societies, nationalized and co-operative banks, and domestic and other sources is 79% averagely (Table 2, Fig. 2).

**Problems created by E-waste:** In order to understand the problem faced due to E-waste, the survey of doctors, employees, and environmentalists was conducted. The Tables 3, 4, 5 and 6 show the severity of the problem.

### METHODS OF DATA COLLECTION

Methods adopted to collect data are comprised of following.

- Review of literature available in this matter.
- Primary data through getting the well formatted questionnaire filled in by the sample respondents

### DISCUSSION

Electronic waste is presenting a great challenge for the present new millennium. The researchers have revealed a surprisingly shocking estimate that approximately 80% of old electronic equipment and their parts are lying idle, discarded and not at all in use. The uncertainty of how to manage such a huge unused electronic waste has worsened the problem (Ref: [www.hindu.com](http://www.hindu.com)).

It has been proved by the environmentalists that many components of electronic waste are highly hazardous for health of human beings, animals, and the environment as a whole. Measures of component like televisions, fax machines, computer monitors, microwave ovens, etc., ending up in level

Table 1: Sample design of educational institutions and percentage of E-waste generated.

| Types of users                                      | No. of units surveyed | Total No. computers | No. of comp. P-IV/ Laptop | No. of Comp. P-III to P-I | No. of Comp. 486 & below | Tot. No. of Comp. in use | Tot. No. of Comp. not in use | % of Waste  |
|-----------------------------------------------------|-----------------------|---------------------|---------------------------|---------------------------|--------------------------|--------------------------|------------------------------|-------------|
| a. Higher secondary and below                       | 18                    | 182                 | 16                        | 21                        | 145                      | 37                       | 145                          | 79.60       |
| b. Graduate colleges and Institutions               | 10                    | 310                 | 27                        | 30                        | 253                      | 57                       | 253                          | 81.61       |
| c. Post graduate colleges                           | 06                    | 240                 | 20                        | 23                        | 197                      | 43                       | 197                          | 82.08       |
| d. Professional colleges                            | 05                    | 300                 | 33                        | 19                        | 248                      | 52                       | 248                          | 82.66       |
| e. Private recognized and unrecognized Institutions | 05                    | 100                 | 12                        | 18                        | 70                       | 30                       | 70                           | 70          |
| <b>Total</b>                                        | <b>44</b>             | <b>1132</b>         | <b>108</b>                | <b>111</b>                | <b>913</b>               | <b>219</b>               | <b>913</b>                   | <b>80.6</b> |

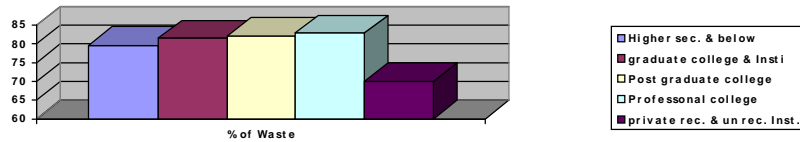


Fig. 1: Percentage of E-waste in educational institutions.

Table 2: Sample design of industries (Production and Service Industries) and percentage of E-waste generated.

| Types of users                          | No. of units surveyed | Total No. computers | No. of comp. P-IV/ Laptop | No. of Comp. P-III to P-I | No. of Comp. 486 & below | Tot. No. of Comp. in use | Tot. No. of Comp. not in use | % of Waste   |
|-----------------------------------------|-----------------------|---------------------|---------------------------|---------------------------|--------------------------|--------------------------|------------------------------|--------------|
| a. Industries                           | 12                    | 100                 | 11                        | 13                        | 76                       | 24                       | 76                           | 76.00        |
| b. Cooperative Societies                | 200                   | 400                 | 45                        | 35                        | 320                      | 80                       | 320                          | 80.00        |
| c. Banks, Nationalized and Cooperatives | 12                    | 72                  | 06                        | 08                        | 56                       | 14                       | 56                           | 79.00        |
| d. Domestic and others                  | 200                   | 1200                | 118                       | 110                       | 972                      | 228                      | 972                          | 81.00        |
| <b>Total</b>                            | <b>224</b>            | <b>572</b>          | <b>62</b>                 | <b>56</b>                 | <b>452</b>               | <b>118</b>               | <b>442</b>                   | <b>79.02</b> |

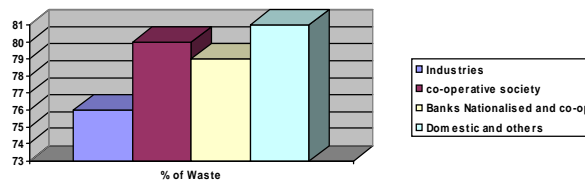


Fig. 2: Percentage of E-waste in educational institution.

fields, are creating a greater threat to the environment because these are comprised of hazardous material such as cadmium, mercury, selenium, chromium, lead, arsenic, polyvinyl chlorides and many more to add to the list. Though it is an established fact, the electronic waste will continue increasing in volume in coming years. Therefore, the problem is not only to be recognized but to be dealt with on war footing so as to save our ecology and future generations.

The existing policies regulations and laws at national and international levels are sufficient enough to manage E-waste problem. The modern mechanism of managing E-waste comprised of following

Table 3: Problem faced due to E-waste, the survey of doctors.

| Doctors Specialization | No of samples surveyed | Patients due to E-waste hazard | Types of diseases                                                                                                         |
|------------------------|------------------------|--------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| a. Cardiologists       | 02                     | 05                             | Respiratory problem, asthmatic problem                                                                                    |
| b. Neurologists        | 01                     | 12                             | Nervous breakdown, sleeplessness, restlessness, anxiety, affected memory, change in sleeping cycle, lack of concentration |
| c. ENT Specialists     | 04                     | 02                             | Throat infection, reduced listening power, stress in eye                                                                  |
| d. Eyes Specialists    | 03                     | 04                             | Watering of eyes, reduced vision, itching in eyes                                                                         |
| e. Orthopedics         | 02                     | 05                             | Development of arthritis, stiffness of bones, reduced effectiveness of legs                                               |
| f. Others (general)    | 05                     | 03                             | Combination of varied diseases                                                                                            |

Table 4: Problems faced due to E-waste, the survey of employees (the end users of computers).

| Type of user       | No. of Units surveyed | Inventory management problem                                                                                                                                                      | Large work                                                                                       | Backbone problem                                      | Society life destroyed                                                                    |
|--------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Users of computers | 100                   | Piling of old computers, take lot of space, broken monitors and other hazardous parts create air pollution, product are getting rusted soil which result into increased pollution | Continuous seating on old computers and because of slow speed create physical and mental plaque. | Continuous sitting create backbone and other problems | Large working hours isolate users from society which result into aloneness and depression |

Table 5: Problems faced due to E-waste, the survey of environmentalists.

| Respondent        | Number | Ecological                                                                                                                                                                              | Air pollution                                                                                                                                                                                     | Water pollution                                                                                                                    |
|-------------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Environmentalists | 05     | Toxic materials are increased which create ecological problems. Cathode ray tubes create hazardous pollution elements like lead, mercury, cadmium, arsenic, etc. Creates health problem | Oxygen deficiencies, methane in air, beryllium, nitrous oxide, brominates flame retardants create air pollution, air pollution is created by polybrominated dibenzo dioxins which comes from PCBs | Oxygen deficiencies, polychrome biphenyl, polyvinyl chloride, polybrominated biphenyl ethers create groundwater and soil pollution |

pedagogy of 1. Reduce, 2. Reuse, and 3. Recycle (<http://infotrek.sysom.com>).

**Reduce:** The reduction of electronic waste by careful procurement of electronic material having least possible hazardous material is one way to reduce electronic waste. Perpetual effective maintenance of electronic equipment will also be successful method to reduce electronic waste. Dust proof environment, careful handling and avoiding rough handling of electronic equipment will further reduce E-waste.

**Reuse:** The second method, which can help in managing the electronic waste, is making reuse of the electronic equipments which are still functional or can be made functional by rectifying and by minor repairing. The reuse can be done by the present buyers. It can be reused by reselling it to the needy persons, institutions or organizations. Reuse can be incorporated by donating equipment to someone who can still use it.

Table 6: The E-waste, its ingredients and ill effects on human health and ecology as a whole (<http://mpcb.gov.in/ewaste>).

| S.N. | Parts creating E-waste                                                     | Hazardous chemicals or materials                      | Effect on the human health and ecology                                                                                                   |
|------|----------------------------------------------------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Front panel CRT                                                            | Barium, cathode rays and other chemicals              | Liver damage, weakened muscles, heart problem                                                                                            |
| 2    | Chip resistors                                                             | Cadmium, lead, arsenic and other chemicals            | Affect functioning of kidney, damages liver, genetic effects, nervous system is also affected                                            |
| 3    | Printed circuit board                                                      | Mercury, hazardous chemical coatings                  | Damages respiratory system, creates skin disease, damages functioning of brain, in case of inhaling high dose of mercury may cause death |
| 4.   | Relays, switches and semiconductors                                        | Cadmium, mercury, arsenic                             | Affect kidney, toxic effect on health, damage nervous system, affect liver and kidney                                                    |
| 5.   | Motherboards                                                               | Beryllium, mercury and cadmium                        | Creates beryllicosis, skin diseases, lung cancer, affect functioning of brain, asthmatic problem can be created                          |
| 6    | Semiconductors                                                             | Mainly cadmium and other hazardous chemicals          | Affect kidney, damages nervous system, genetic effect                                                                                    |
| 7.   | Relays and switches                                                        | Mercury, lead                                         | Brain damages, respiratory system affected, skin diseases                                                                                |
| 8.   | Solders and printing circuit board (PCB), Glass panel, gas kiting monitors | Lead                                                  | Nervous system is affected, blood system is affected, kidney is affected, affects brain development of children                          |
| 9    | Cabling in computer housing                                                | Polyurethane, polyvinyl chloride, polyvinyl acetate   | Affect immune system and damages it very badly, regulatory hormones are disturbed, reproductive and development problems created         |
| 10   | Plastic housing of electronic equipment and circuit boards                 | Brominates, frames, methane and other hazardous gases | Disturb endocrines system functioning                                                                                                    |

**Recycle:** Recycling is a process of using the component in new electronic equipment or repairing the same for original equipment itself. There are certain recycling units which can be connected for such purpose which will defiantly help in reducing the E-waste that can be enlisted as under:

1. Computer equipment manufacturer may offer take back program.
2. There are certain businesses, which except obsolete or unwanted electronic equipment for refurbishing and other purposes and using old component for varied other purposes.
3. Certain nonprofit making organizations are also accepting obsolete electronic equipment with social objectives.

E-waste can be managed by enhancing the alternative products such as LCD panels, plasma screens and other material which contain almost negligible or no hazardous material.

**CONCLUSIONS**

It can be concluded that electronic waste will be the most significant problem of society and place serious challenge before the environmentalists, Government and society as a whole to manage the e-waste. The potential harm of E-waste will be the materials such as lead, mercury, cadmium and arsenic which will contaminant of groundwaters and environment which will create health risk to the population by causing brain damage, affecting blood system, kidney and liver failures, diseases of nervous system, affecting adversely the respiratory system and many more. Therefore, the E-waste management process of reduce, reuse and recycle and byback are to be extended to a very great extent.

## SUGGESTIONS

1. Presently, no comprehensive national or international legislation has been effectively implemented to manage the E-waste. Therefore, researchers are of the opinion that such legislations should be evolved and implemented immediately to arrest the problem.
2. Use of hazardous materials such as lead, arsenic and cadmium should be banned in the production of all electronic goods including computers. Materials in place of such harmful materials should be used and if they are costly, then the production cost should be subsidized by the Government.
3. The product life cycle of electronic products should be enhancing extensively so that the E-waste can be minimized. Netherlands is the first country which is encouraging the collection of old electronic products for recycling and such process is encountered by rewarding the manufacturer. European Union laws have been passed in 2005 which emphasise that the manufacturer of electronic equipment is bound to take old equipment and implement recycling process. U.S. also passed in July 2000 to ban the disposal of CRT in landfill, and in addition to this a Federal Bill has also been introduced which states that a small fee should be added in the purchase price of electronic equipment so as to help funding the recycling programs of electronic equipment. Australians are also not far behind in managing E-waste and implemented a law which explains that how and where to dispose off your electronic waste. Such laws, legislation and guidelines should be implemented immediately so that the manufacturer and users are educated to manage E-waste properly.
4. The manufacturer of E-waste should be responsible and accountable for enumerated impact of their electronic product and should guide customers that how to manage their obsolete electronic products brought from these manufacturers.
5. In Karad, the electronic waste has been assessed and the disposal process was found to be very poor and alarming. This electronic waste is spoiling the health of people and is of the great concern. Therefore, the authors are of the opinion that the producers' responsibility is to be enhanced, and the main principles are educated and inculcated among the users so as to arrest the gravity of the E-waste management problem.

## SCOPE FOR FURTHER STUDY

The E-waste management places a great challenge before the Government, NGOs and environmentalists. IT hubs coming up at varied cities are to be carefully studied and a model solution can be evolved and implemented to capture the problem of E-waste. A further study can be carried out to find out possibilities of avoiding the dependence on electronic equipment. A brain storming exercise can be carried out for adopting holistic approach, reducing the human needs and stressing upon noble deeds so as to avoid excessive use of electronic equipment and thereby eliminating electronic waste. This approach can be termed as spiritual development

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