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## MANAGEMENT STRATEGIES FOR VARIOUS E-WASTE GENERATORS IN MYSORE - A CASE STUDY

L.Sivasubramanian  
Research Scholar

Department of Management Studies, Bharathiar University  
Coimbatore.

Dr. Jeyakumaran  
Professor

Dept of Management  
Kalasalingam University, Krishnankoil.

### *Abstract*

Solid waste management practices itself is far from satisfactory, in India. Added to the above, is another problem of recent origin i.e. E-waste handling and management which has complicated waste management due to their unique properties than other solid wastes. The generation, separation, recycling and recovery of precious metals are still in its nascent state, almost all over India. In order to assess the awareness on the various handling and management aspects of e-waste and to offer workable suggestions, Mysore region was chosen for the case study. Based on specially prepared questionnaire, a

field survey was conducted across various sectors of the above region to assess the quantity of e-waste generated and the practices that are being followed for handling and managing them. The analysed data has shown some very interesting results. Which have been highlighted based on overall assessment, it has been suggested to create general awareness and strict enforced of rules, to save the environment from further pollution.

*Keywords*— E-waste management, reuse, recovery, EPR.

## I. INTRODUCTION

The electronic industry is the world's largest and fastest growing manufacturing industry. During the last decade, it has assumed the role of providing a forceful leverage to the socio - economic and technological growth of a developing society. The consequence of its consumer - oriented growth combined with rapid product obsolescence and technological advances have posed a new environmental challenge in the form of managing the "e waste" (electronic waste) that consists of obsolete electronic devices. It is a problem of recent origin, but is posing challenges to engineers and environmentalist, for its management. Further, it has given a business opportunity of increasing significance, in terms of the volume of e-waste being generated and the content i.e. both toxic and valuable materials in them. The fraction of metals in a typical e- waste include iron, copper, aluminium, gold and other metals, is over 60%, while plastics account for about 30%. However, the hazardous pollutants comprise only about 2.70% [1].

The 450 ton waste and 150 MLD of polluted water is produced daily in Mysore city. What would have been the condition if these circumstances prevailed in our state? The dumped wastes would produce a very foul smell. Then all these wastes would have been collected and thrown in to some poor village. Then that area would become a hell with all sorts of contagious diseases. But what Mysore did is entirely different. The enchanting method of producing income from wastes! It has become sure that in recent future the waste refining scheme of Mysore Corporation would change into a tourist centre. This scheme now pervades in an area of 22 acres. The reason for this is that there are no flies, mosquitos or even a foul smell produced in this area where a huge amount of waste is dumped daily.



Figure 1: Dismantling and segregation of e-waste in the informal sector

E-waste comprises of wastes generated from used electronic devices and household appliances which are not fit for their original intended use and are destined for recovery, recycling or disposal. Such wastes encompasses wide range of electrical and electronic devices such as computers, hand held cellular phones, personal stereos, including large household appliances such as refrigerators, air conditioners etc. ewaste contain over 1000 different substances many of which are toxic and potentially hazardous to the environment and human health, if not handled in an environmentally sound manner.

For example, personal computers (PCs) contain certain components, which are highly toxic, such as: chlorinated and brominated substances, toxic gases, toxic metals, biologically active materials, acids, plastics and plastic additives. The hazardous content of these materials pose environmental and health hazards. Thus, a proper management strategy has become necessary while disposing or recycling E-wastes [2]. From a general survey conducted it seen that in India, even

management of Municipal Solid Waste (MSW) itself is very poorly managed, even in very important metropolis and cities, in India. That being a reality, management of e-waste, which is of recent origin, cannot be expected to have gained importance or operational, in India. However, it is imperative to assess the volume of e-waste generated and the disposal strategies in place, in accordance with recent enactments of Government of India, i.e. E-waste (Handling and Management) rules, 2011.

Mysore region, which is one among of the four region comprising the U.T of Mysore. It is home to a variety of electronic industries, thanks to partly due to the liberalized policies of the Government of Karnataka. In view of the above, Mysore region was chosen for the present study with the objectives to (i) identify the various e-waste generators and assess the quantity there from; (ii) assess the awareness of the various categories of e-waste generators with regard to the satisfactory provisions for the safe handling and management of E-wastes and (iii) suggest various strategies for the better management of the generated E-waste.

## **II.ABOUT THE LOCATION**

Here we are talking about the Mysore city which is also the administrative headquarters of Mysore district. This is a mid sized South Indian city with a population of about 7.8 lakh (780 thousand) and spanning an area of 128 sq km (about 50 sq miles). This is the second largest city in Karnataka after Bangalore, the state capital. With about 2.5 million visitors every year, Mysore is one of the most visited cities in India. This is a modern city by any scale, yet conservative traditions are valued. The citizens are proud of its bygone status as the historic capital. The royal traditions still continues, though as ceremonies and festivals. Mysore Dasara is celebrated each year

with great pomp and fanfare. You can reach Mysore city by air, road and rail. The city has a small airport with modest connectivity to the nearby cities. The city is a major railway junction (see Mysore Railway Station) on the rail map. There are many cross country as well as intercity express trains to Mysore. Places like Mumbai, Chennai, Delhi, Bangalore are well connected by rail from Mysore. KSRTC, the state owned corporation, operate many bus services from Mysore city's central bus station. There is a bus connection to Mysore city from almost any major towns in the state and also from major cities of the neighboring states. The railway station and bus stands are located in the heart of the city. The airport is some 12km (7miles) south of the city. Kannada is the widely spoken language in Mysore. A large number of the city's population speak Urdu. Otherwise in the city you will not find it difficult to manage in English.

## **III.METHODOLOGY**

### *A. Data collection*

Efforts were made to assess the amount of e-waste generated in Mysore region and for that purpose, first the various e-waste generators were identified and then they were categorized into various sectors. Finally, from the various source sectors, the generation of e-waste was assessed product-wise. Figure 2 shows the location of the study area along with the various identified e-waste generators.



Figure 2. Location map of various e-waste generators in Mysore region.

The various sectors identified from the Mysore regions are: IT- Industries, schools, colleges, Government offices, hospitals, individual houses. To calculate the sector-wise e-waste generation, six IT companies were identified and for the remaining, five sample e-waste generators have been identified for each of the above identified sectors. From the above said sectors, the generation of e-waste was categorised product-wise, i.e. the generation of products such as: telephone, air conditioner, television, computer, printers, etc.

*B. Survey for assessing the awareness and the present procedure adopted for management of e-waste*

In order to assess the awareness regarding the handling and disposal of e-waste and the actual disposal adopted for e-waste in the various identified sectors in the Mysore region, a field

survey” was conducted. For the above, it was decided to obtain information from the owners through a “specially developed questionnaire”. The data obtained is then analysed both quantitatively and qualitatively to gain insight into the above issue.

**IV. RESULTS AND DISCUSSION**

*A. E-Waste Generation*

Based on the field survey undertaken among selected heterogeneous organisations (IT industries, schools colleges, homes etc), the quantity of E-waste generated has been assessed sector-wise and product-wise. The above details are given in Table 1 & 2 respectively.

*Field survey on awareness and management practices*

*B. IT companies*

The total E-waste generated in Mysore by IT companies is 11.060 TPA (Tones Per Annum) and the present of E-waste management practices followed in IT companies are not in good/ upto the expected mark i.e. the concerned people are aware about what is E-waste, but, they are not aware or bothered about the rules and guidelines concerning the disposal and management of E-waste. It is generally perceived from the survey that the management is not in the habit of practicing any of the procedures for identifying E-waste items including the year of manufacturing. Further, it is very clearly reflected from the survey that they are not following any of the identification procedures for hazardous content in the E- waste. Finally the survey has brought out the fact that the management of IT companies are not even aware about “E- waste Rules 2011, and hence the procedural guidelines for setting up the E-waste treatment facilities in their own places [4].

*C. Schools*

Schools are the perfect places to develop

awareness about various environmental threats that the society is exposed to, at the moment. But the schools surveyed lack the awareness, especially, with respect to E-waste generation and management. The total amount of E-waste generated by the five main schools of Mysore is 12.307 TPA. The survey reveals that the schools do not know what is E-waste, but, they believe it is one of the type of wastes generated. As expected they do not know or aware of the E-waste rules and guidelines, nor they follow any of the identification procedure for E-waste with their year of manufacturing as mandated in E-waste [4] Rules 2011. That being the ground reality, other remaining processes of the E-waste management, are not followed as mandated in the above rules. Finally, it is found that the need of the hour is to create awareness amongst the “management” and the school students, for the benefit of future generation, not only of this region, but, India as a whole.

*D. Colleges*

The total amount of E-waste generated by the three colleges taken up for the survey is about 12.73 TPA. Colleges are also one of the main sources of E-waste not only in Mysore but all over the world. The survey was conducted only among well equipped institutions like Vidya Vardhaka College of Engineering, SBRR Mahajana First Grade College and CIPET Mysore where lot of electrical and electronic equipment are used for learning and for administration purposes. Every department in the chosen college has their own sophisticated laboratory, from where varieties of E-wastes are generated in a specified duration. Equipment like computer wastes, fans, CFL bulbs, printers etc., are the ones that generally contribute to E-waste. It is found that the management of colleges have absolutely no knowledge of about what constitutes E-waste: potential threat of E-wastes generated from their campus; specific identification procedure with year of manufacturing for Waste Electric and Electronic Equipment (WEEE); and rules and guidelines for handling and disposal.

Table 1: Generation of e-waste analysis in three engineering colleges

SL.No	College Name Address	No. of Computers Used	Total Weight of Computer	Computer disposed as ewaste in a 5y ears once
	Vidya Vardhaka College of Engineering	1200	26400	26400
2.	SBRR Mahajana First Grade College	850	18700	18700
3.	CIPET	120	2640	2640
	Total	2170	47740	47740
	Average	723.33	15.913.33	723.33

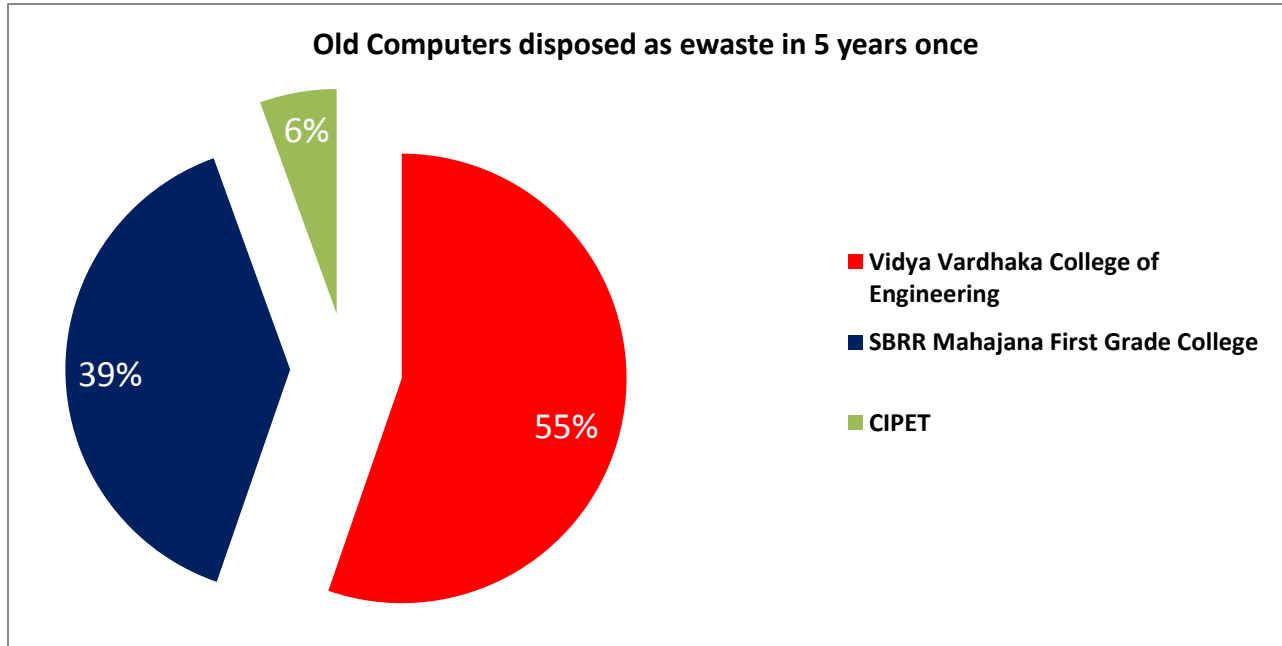


Figure 3: Old Computers Disposed as ewaste in a 5 years once

Many of the colleges have simply stored their WEEE with other kinds of waste and were accumulating them for the past several years, whereas, the time set in E-waste [4] Rules, 2011 is 180 days only. That being the reality, they are not aware and hence they do not follow any of the national policies like extended producer responsibility, take back system or buy back system. One of the surveyed college, has even dumped their E-waste with all other wastes in a open space, posing environmental threat to the society and students alike.

#### E. Government Offices

The total amount of WEEE generated from the five government offices based on the survey is about 107.577 TPA. The awareness about E-waste and their potential hazardous threat posed to store supervisors and the head of the offices seems to be very poor. The present condition of E-waste collection and storing them at the government offices, to state simply, is not in good. However, they adopt EPR for computer waste only, but not for any of the remaining E-

wastes. One important and typical observation, made from the survey is that in many of the offices, the E-waste are dumped in one corner of open spaces, wherever they available. In governmental sector, it seems there is nobody responsible for taking care of E-waste and for its management. Even though, they do not have any collection system for E-waste, they simply stored their E-waste in their rooms.

#### F. Houses

Houses are the places where quality of the living is determined by the living space, ventilation, inner temperature. But all the above basic qualities become irrelevant, when people start to living with their own E-wastes. The total amount of E-waste that is generated from the fifty six houses survey is about 65.725 TPA. Houses are the sources of variety of E-waste like: cell phones, computer, washing machine, mixers, fans, TV., radio, refrigerators, etc. In many of the houses they do not know even what is E-waste and hence, they do not follow or practice any of the

storage procedures. E-waste occupies many places of their living area and hence the inner temperature of the houses increases considerably due to the usage of several electronic equipment. As expected, they do not adopt any national policies like EPR, take back system etc. One of the method adopted by the household members during the survey, was the disposal of their E-waste on vacant lands wherever available, along with municipal waste. From the above, it is evident that people lack even the minimum awareness about E-waste, its management rules and guidelines, and handling the E-waste in a proper manner.

Table 2: e-waste Generation details in the different sectors.

S.No	Name of Sector	e-waste Quantity in TPA
1.	IT Companies	45.577
2.	College	12.73
3.	House	65.725
4.	Government Offices	11.060
5.	Schools	12.307

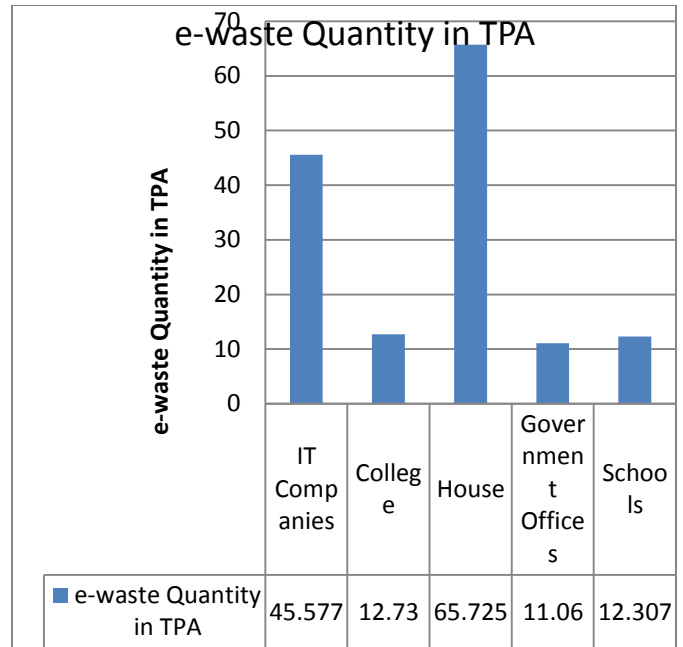


Figure 3: Comparison the e-waste quantity in Ton per Annum( Sector wise)

Table 1.1 ewaste collection from houses, hospitals

S.No	Name of the Product	Quantity (in Kg/PA)
1.	Electronic Toys	120
2.	Radio, F.M Set, VCR, VCD	50
3.	Video Camera	12
4.	Camera	10
5.	Mobile Phones	10
6.	Television	72
7.	Calculators	3
8.	Computer Waste	540
9.	Iron Box	15
10.	Fan	17
11.	Watches	2
12.	Electronic Shavings Set	1
13.	Clocks	4
14.	Torchlights, LEDs	3
15.	Mosquito Bats/Mosquito Liquid	1
16.	Washing Machine	126
17.	Refrigerator	124
18.	A/C Machine and Spares	261
19.	Hair Drier	2

20.	Bulbs, Switches	19	27.	Grinders	26
21.	Wires	158	28.	Heaters	12
22.	Stabilizers	18	29.	Vacuum Cleaners	13
23.	Remote	1			
24.	Emergency Lights	13			
25.	Mobile Phone Accessories				
26.	Mixers	14			

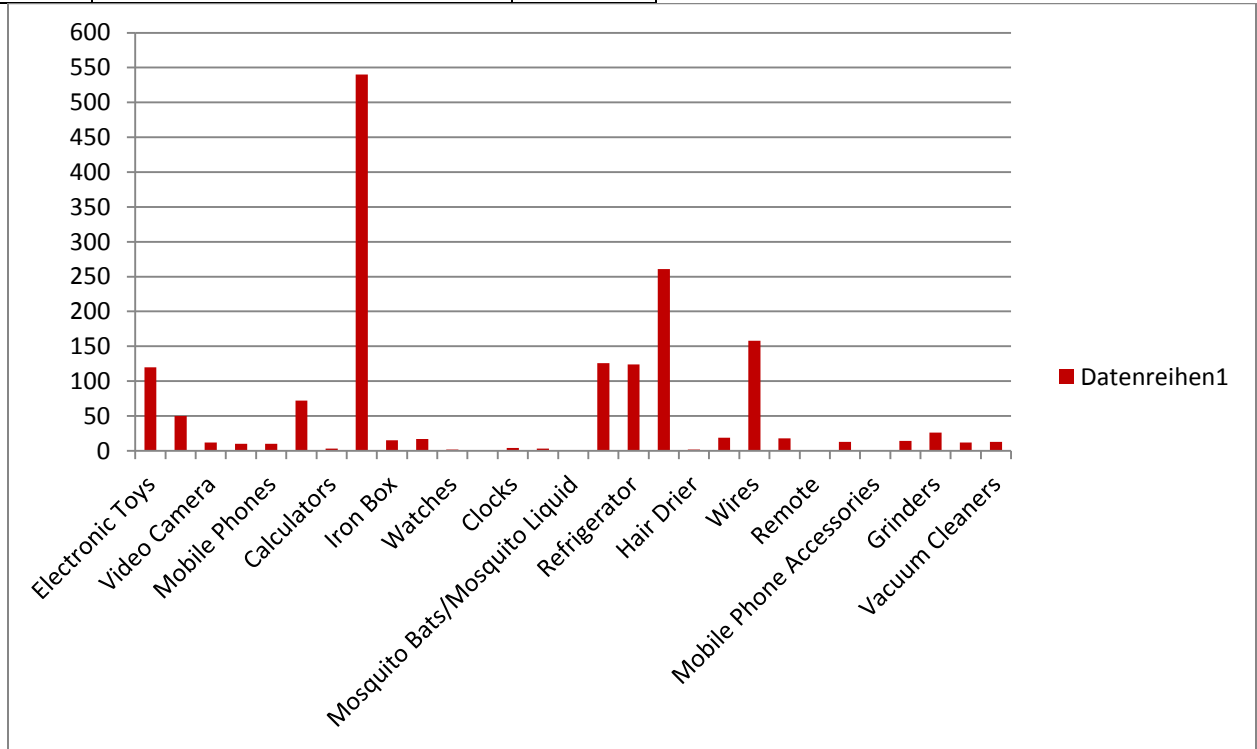


Figure 4. ewaste collection from houses, Hospitals and IT Companies in a year

#### IV. CONCLUSIONS

Based on the field survey conducted on selected heterogeneous organization, and the analysis carried out following are the salient conclusions:

- Awareness about E-waste and its potential hazardous nature have to be created among all stake holders. The Government should set up regulatory agencies in each district and encourage beneficial reuse of "e-waste" and
- business activities; enforcement of strict regulations and impose penalty/fine on the industries based on the principle polluter should pay; and

extended producer responsibility should be adopted. Waste minimization techniques and sustainable product design have to be adopted mainly for IT companies.

- Schools, colleges, hospitals, Government offices, houses, must be encouraged to collect their E-waste in separate places and it should not be allowed to be dumped in open places. Policies like "Take back policy or Buy back policy" and "Extended Producer Responsibilities" system should be enforced in the above organizations, strictly.
- From the five sectors of the E-



waste generators, houses are in the first place (about 66 TPA) followed by IT Companies which are in the second place (about 45.577 TPA), in terms of quantity of E-waste generated.

- Toys, clocks, watches, fans, CFL bulbs, cell phones, even though are very high in terms of numbers, but, their contribution to the weight of E-waste generated seems to be less. Televisions, refrigerators, computers, grinders, mixers, washing machines are less in numbers but according to their weight they contribute more to E-waste generated.

- Houses are in a “vulnerable condition” as they lack awareness and lack of management of E-waste. Further houses are also the sources for a variety of E-waste.

- On overall assessment, general awareness and strict enforcement of rules are the need of the hour, to save the environment from pollution and to prevent the future generation from the various environmental hazardous that may arise, due to willful and indiscriminate pollution, by the present generation of people.

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