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E-Waste Management Practices: Specific Focus on Jabalpur & Indore

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Abstract*—The electronic waste also known as e-waste is a high-risk and hazardous waste combining of unwanted, non-working and outdated electronic and electrical equipment. Developing countries are deal with the problem of e-waste management hideously which is either domestically generated or are imported from other countries. India is also confrontation the problem of e-waste management due to lack of consciousness amidst people about dangerous impact of e-waste on environment and human being via informal e-waste collection and absence of execution of rules for the process of e-waste in environment friendly manner. The project characterize the condition of e-waste in India, the case related with e-waste, the method used for e-waste management and focuses light on the legislative work done concerning e-waste in India. A study on e-waste management practices was done by conducting a survey in two cities of India i.e. Jabalpur and Indore. The respondents are classified into three categories which are computer and circular seller, mobile and accessories seller, electrical and electronic goods seller, mechanic and scrap dealer. For data collection procedure personal interview technique was used. A specimen size of ten respondents was selected for first three categories and results were received concerning awareness between people regarding e-waste, method of e-waste management and suggestions were received about e-waste management from these three categories. Some mechanic and scrap dealer were also interviewed. Based on this survey it was recommended that role and contribution of government should be enhanced for controlling the informal method of e-waste management and for encourage the formal method and magnify the awareness between people about horrible hazardous effect of e-waste and for its appropriate disposal. Also the responsibility of manufacturer should also enlarge for buy back method of e-waste management by the manufacturer. As per the study it has been found that there is an immediate requirement to address the issue related to e-waste in India in order to avoid its unhealthy, negative, harmful effect in future.*

Keywords:— *e-waste, harmful, recycle, reuse, disposal, consumer, replacement.*

1. INTRODUCTION

India is witnessing a major growth in electronic market. Due to rapid innovation in communication sector a large range of mobiles and communication equipment are available and it is developing rapidly. The present growth rate of 4.7 percent of GDP and achieved growth of 8 percent during eleventh five year plan from 2007 to 2012.[1] As per this growth rate needs and lifestyle of Indian people changes continuously. Due to a huge

revolution in technology there is advancement in every sector. The electronic and communication market is also booming in India. E-waste composes and constitutes the element used for the manufacture of electronic goods which are responsible for large environmental damage.[2] It contain multiple dangerous, high risk materials such as mercury, lead, and hexavalent chromium which are build in batteries, cathode ray tubes (CRT), liquid crystal display(LCD). Dangerous and hazardous constituent of lead, brominates flame retardants are present in all electronics equipment which contain printed circuit board. Toxic fumes emit into air if CRT is crushed and burned. Lead is reached into the ground water by the land filling of e-waste.[3] No refined machinery or personal defensive machinery is used for the ejection of different materials which have ill unhealthy impact on human health. The e-waste contains many toxics such as heavy metals, including cadmium, lead, Polychlorinated Biphenyl's (PCB), mercury, Poly Vinyl Chloride (PVC) etc in some component. The ill effect of these if disposed of in improper and non eco friendly manner is shown below.[4]

The WEEE Directive focuses on EPR, linking product disposal to design as a driver for eco-design. Article 1 of the WEEE Directive states that: "the purpose of this Directive is, as a first priority, the prevention of waste electrical and electronic equipment (WEEE) and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste". The WEEE Directive describes ten categories of WEEE (Table 6) and covers EEE used both by consumers and professionals. [5]. in 2007. The Central Pollution Control Board (CPCB) estimate India's e-waste at 1.47 lacs tones or 0.573 MT per day. Major contribution of 60% of the total e-waste originate in India is made by sixty five cities. Seventy five percent of the total e-waste is originate by the top ten states which, includes Tamil Nadu, Maharashtra, Utter Pradesh, Andhra Pradesh, West Bengal, Punjab, Gujarat, Karnataka, Madhya Pradesh and Delhi. This magnify in the amount of e-waste generation is mainly due to enhance in demand of product like TV, PC and telephones in last 5-10 years (Report, 2013). The status of e-waste in different states is shown below.

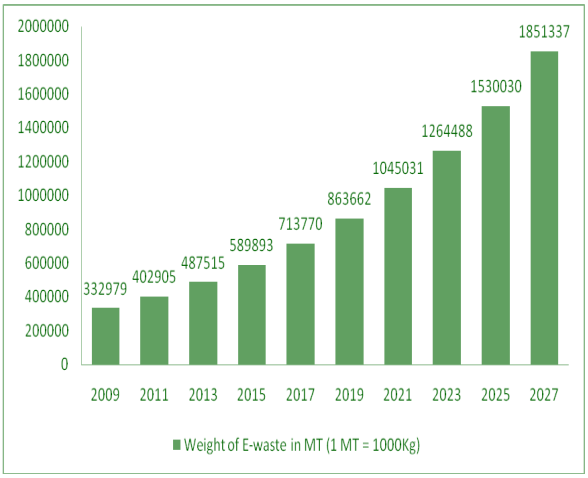

Figure 1 *Growth of e-waste in India (Source: Priyadharshini, et al., 2014)*

2. CATEGORIZATION OF E-WASTE

The e-waste are categorized into following different categories as shown in table below.

Table 1: WEEE categories according to the EU directive on WEEE(EU, 2002a)[5]

S.No.	WEEE Category	Label
1	Automatic dispensers	Dispensers
2	Small household appliances	Small HH
3	IT and telecommunication equipment	ICT
4	Monitoring and control instruments	M & C
5	Electrical and electronic tools	E & E tools
6	Lighting equipment	Lighting
7	Medical devices	Medical equipment
8	Toys, leisure and spots equipment	Toys
9	Consumer equipment	CE
10	Large household appliances	Large HH

Source: Rolf Widmera et al., (2005).

Out of the ten categories listed in above table, category 1-4 contributes for almost 95% of the WEEE generated. These categories include following products which leads to e-waste generation [5].

- Small Household Appliances- Vacuum cleaners, Coffee Machines, Irons, Toasters, etc.
- Large Household Appliances- Washing machines, Dryers, Refrigerators, Air conditioners, etc.
- Lighting Equipment- Fluorescent tubes, sodium lamps etc. (Except: Bulbs, Halogen Bulbs).
- Office, Information & Communication Equipment- PCs, Laptops, Mobiles, Telephones, Fax Machines, Copiers, Printers etc.
- Entertainment & Consumer Electronics- Televisions, VCR/DVD/ CD players, Hi-Fi sets, Radios, etc.
- Electric and Electronic Tools- Drills, Electric saws, Sewing Machines, Lawn Mowers etc. (Except: large stationary tools/machines).
- Toys, Leisure, Sports and Recreational Equipment- Electric train sets, coin slot machines, treadmills etc.

The objectives of the WEEE Directive are to divert e-waste from landfill and incinerators to environmentally sound reuse and recycling, to preserve resources, in particular energy, and to harmonize national measures on the management of WEEE. The responsibility for organizing collection of WEEE and financing its recycling has to be taken over by the producers of EEE [5].

B. Process of e-waste management :

The recycler of e-waste is extensively classified into two sectors, which are as follows.

1. Formal sector:

In this sector the e-waste is pick-up and disposed by government authorized agency or company which do the e-waste management work in environment friendly way. These organizations perform the e-waste management by using proper equipment and also provide proper safety measures to the worker and on the recycling site.

2. Informal sector:

In this sector the e-waste is pick-up and disposed by unauthorized people. They collect the e-waste from the household and market and then separate the useful and useless part by breaking the e-waste in improper way, this is very harmful to the environment because they keeps the useful part and either dump the remaining waste or burn it . They do this work in slum area of big metros and in metro cities either by making small workshop or from their home which pollute the surrounding of their living area. They also do not use any safety measures which increase the risk to the health of the worker [6].

- Some major sources of e-waste include
- Informal sector
- Dissembler/ Dismantler
- Smelter
- Recycler
- Formal sector
- Importer
- Producer/Manufacture
- Retailer (businesses/ government/ other)
- Consumer (individual household, businesses, government)
- Trader
- Scrap dealer

The main objective of the formal recyclers is that all waste electronic and electrical equipments (WEEE) is collected, stored, dismantled and recycled in an

environmentally sound manner. For observing with these objectives no chemicals, incineration processes and wet extraction processes are carried out without proper facilities. The formal recyclers also consider with commercial health and safety norms of the workers so that they are not exposed to toxic and hazardous elements present in e-waste [7].

In India, a lot of discussion and concern has now started regarding the e-waste management. A report of parliamentary standing committee on science and technology on the functioning of central pollution control board (CPCB) states that e-waste is going to be a big risk in future due to modern life style and growth in the living standards of people and rise of economic growth[8].

3. METHDOLOGY

The methodology used in this project is surveying technique. For determining the present method of e-waste management performed by different product seller a survey is conducted in two cities of Madhya Pradesh i.e. Jabalpur and Indore.

The survey was performed by field visits and collection of elementary data at various locations of the two cities and supported by secondary research and data. The tools used for the survey were structured discussions guides, open ended questions, unofficial and informal questions and discussions. . The process of survey was done in two steps which are given below:

1. Collection of secondary data
2. Primary data collection & analysis

A. Collection of Secondary Data:

The secondary data was picked-up by researching the previous work done by other author and studying the reports published related to e-waste management. The secondary data collected was shown below.

Table 2: Percentage of Household Possessing Several Products.

District	Total Household	Total Percentage of Household having		
		Television	Computer/ Laptop	Mobile phone
Jabalpur	6,15,334	75.5	18.1	62.1
Indore	7,15,029	95.4	23.4	70.7

Source: Census of India 2013,

The condition of electronic and communication products in Jabalpur and Indore could be estimated by measuring the percentage of household possessing Television, Computer/Laptop and Mobile phone which main ingredient are leading to e-waste origination.

From the above table it could be concluded that majority of household possesses television followed by computer/ laptop and mobile phone in both the cities. Therefore the percentage of e-waste originated from these household follow the same pattern [9].

Collection of Primary data:

The primary data was collected by conducting a survey in two cities of Madhya Pradesh i.e. Jabalpur and Indore. It also includes the present condition of e-waste in these two cities and analyze was done to received the results.

The survey procedure starts with recognition of various showroom owners/ retailers of different kinds of products. These showroom owners/retailers were classified in three ranges and out of each range ten showroom owner/ retailer were selected and interviewed. The ranges are shown below:

1. Electrical and Electronic product seller
2. Mobile and accessories seller
3. Computer and peripheral seller

In addition of it respondent of two more range were interviewed which are shown below:

1. Repair worker/ mechanic
2. Scrap dealer/ Vendor of e-waste

Method of communication:

For communicating to respondents of all groups interviewing technique was used and relevant proper information was received .

4. DATA COLLECTION, ANALYSIS AND RESULTS:

The survey conducted mainly has three points to be identified which are

1. Awareness about e-waste and its management among seller
2. Use of item received under exchanged from purchaser
3. Suggestion/ recommendation regarding e-waste management
4. Results of survey conducted in an IT firm regarding e-waste management

1. Result showing knowledge level of respondent of first three ranges about e-waste

The data concerning consciousness amidst seller about e-waste and its management was received by asking them questions regarding hazardous effect of e-waste, safe disposal of e-waste and knowledge of recyclers. Based on the answers given by them all the three categories seller are classified into three groups as seller having deep knowledge, shallow knowledge and no knowledge. The findings are compressed into table and result is shown in graph.

Table 3: Consciousness & Knowledge Between Businesses on e-Waste Management

Level of Knowledge About e-waste	Number of Electrical & Electronic Goods seller	Number of Computer & Peripheral seller	Number of Mobile & accessories Seller
Deep knowledge	2	3	2
Shallow knowledge	6	6	7
No knowledge	2	1	1

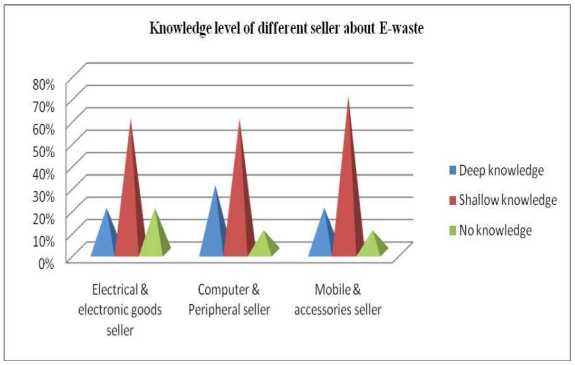

Figure 2 *Result from the level of knowledge of first three ranges product seller about e-waste:*

It was observed from graph that about 30% computer and peripheral seller, about 20% electrical and electronic goods seller and about 20% mobile and accessories seller have deep knowledge of e-waste, which means they know about how e-waste is generated, how it is passes from one customer to other and how it get disposed and recycled.

It was also found that about 60% computer and peripheral seller, about 60% electrical and electronic goods seller and about 70% mobile and accessories seller have shallow knowledge of e-waste, it means they have brief understanding about e -waste generation but lack of knowledge on the environmentally sound disposal of end of life IT/communication and electronic product, they only know about the procedure used by them to manage e-waste coming to them through exchanged process.

Further it was observed that about 10% computer and peripheral seller, about 20%

electrical and electronic goods seller and about 10% mobile and accessories seller have no knowledge of e-waste.

2. Result showing method adopted by respondent of first three ranges for e-waste management

The seller takes old product of customer in exchange of new product. The seller then manages these old product i.e. e-waste in different methods such as sell to second hand market/ mechanic, or sell to scrap dealer/ vendor.

A. Computer and Peripheral Seller

The finding received from computer and peripheral seller is comprised in table and result is shown in graph.

Table 4: Computer & Peripheral Showroom Owner/ Retailer Using Different Methods to Manage e-Waste

Retailer/ Code of Showroom	Sell to second hand market / mechanic	Sell to scrap dealer/ vendor	Company support for recycling	Whether exchange facility available
1	Y	Y	N	Y
2	Y	N	N	Y
3	Y	N	N	Y
4	Y	Y	N	Y
5	N	N	N	N
6	Y	Y	N	Y
7	N	N	N	N
8	N	Y	N	Y
9	N	N	N	N
10	Y	Y	N	Y

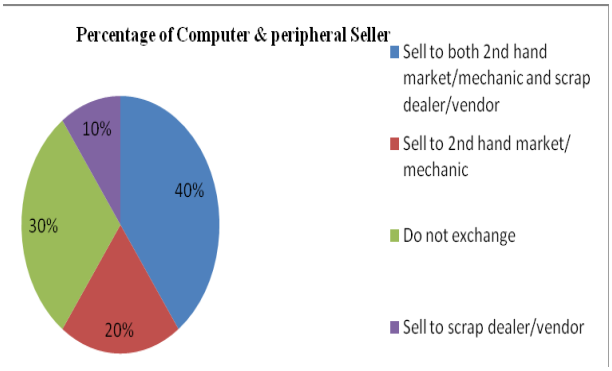

Figure 3: *Result showing percentage wise distribution of Computer and peripheral showroom owner/retailer according to method of e-waste management*

From the study it is found that about 20% computer and peripheral seller sell their old exchanged item from customer to second hand product customer or mechanic.

- About 40% computer and peripheral seller sell their old exchanged item from customer to both in second hand market and to scrap dealer.
- About 30% computer and peripheral seller who sell computer and laptops of branded company only do not offer exchange facility.
- About 10% computer and peripheral seller sell their old exchanged item from customer to scrap dealer or vendor.

Many companies like HP, Lenovo, Dell, and HCL article about e-waste program and collection facility in their website but at ground level there is no such information to the showroom owner and retailer.

B. Electrical and Electronics seller

The finding obtained from Electrical and Electronics seller is comprised in table and result is shown in graph.

As found from the survey About 80% of electronic goods seller sells their old electronic items exchanged from customer to scrap dealer or vendor.

About 10% of electronic goods seller does not provide exchange facility.

About 10% of electronic goods seller sells their old electronic items exchanged from customer to second hand market or to mechanic.

Most of the electronic goods manufacturer does not provide any support to retailer and showroom owner for management of exchanged items. Company like Voltas mention in its website about establishment of collection centre for e-waste but there is no such information to retailer or showroom owner.

Table 5: Electrical & Electronic Showroom Owner/ Retailer using Different Methods to Manage e-Waste

Retailer / Code of showroom	Sell to second hand market/ mechanic	Sell to scrap dealer/ vendor	Company support for recycling	Whether exchange facility available
1	Y	N	N	Y
2	N	N	N	N
3	Y	N	N	Y
4	N	Y	N	Y
5	N	N	N	N
6	N	Y	N	Y
7	N	Y	N	Y
8	N	Y	N	Y
9	N	Y	N	Y
10	N	Y	N	Y

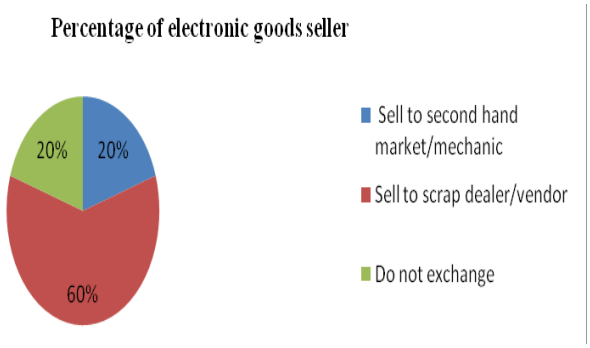

Figure 4: Result showing percentage wise distribution of Electrical & Electronics showroom owner/retailer according to method of e-waste management

C. Mobile and accessories seller

The finding obtained from Mobile and accessories seller is comprised in table and result is shown in graph.

Table 6: For Mobile Company/ Private Showroom Owner/ Retailer using Different Methods to Manage e-Waste

Retailer / Code of Showroom	Sell to second hand market/ mechanic	Sell to scrap dealer/ vendor	Company support for recycling	Whether exchange facility available
1	Y	N	N	Y
2	N	Y	N	Y
3	N	Y	N	Y
4	N	Y	N	Y
5	N	Y	N	Y
6	N	Y	N	Y
7	N	Y	N	Y
8	N	Y	N	Y
9	N	Y	N	Y
10	N	Y	N	Y

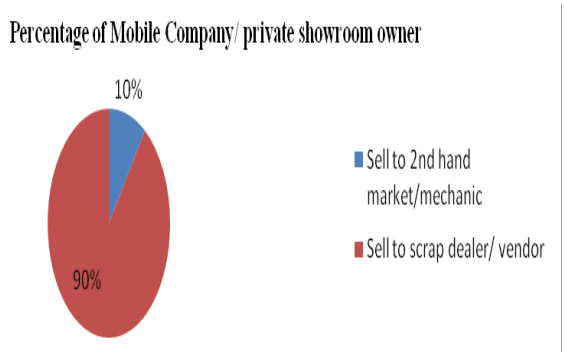

Figure 5: *Result showing percentage wise distribution of mobile and accessories showroom owner/retailer according to method of e-waste management*

About 90% of the mobile phone seller sells old mobile phones exchanged from customer to scrap dealer or vendor. About 10% of mobile phone seller sells the old mobile phones exchanged from customer in second hand market or to mechanic.

3. Result on suggestion given by different product seller:

During the survey, different product seller provides different suggestion and recommendation based on their knowledge of e -waste. Based on these suggestions a table comprising different suggestions is formed as shown below.

Table 7: Suggestions Given by Different Seller

S. No.	Seller → Suggestions ↓	Computer & Peripheral seller	Electrical & electronic goods seller	Mobile & accessories seller
1.	Increase in awareness among people about e-waste and its ill effect	1	-	5
2.	Increase in govt responsibility by providing training to scrap dealer and increasing e-waste collection/ recycling centre	4	2	1
3.	Company should establish buy back channel for old used product	1	3	-
4.	Not willing to give any suggestion	4	5	4

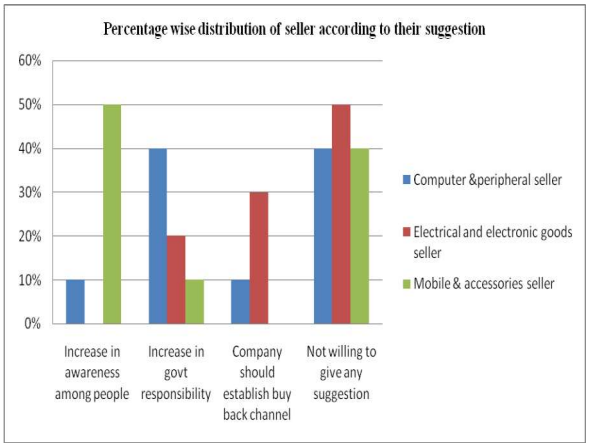

Figure 6: *Result showing percentage wise distribution of different product seller according to suggestion given by them.*

It was observed from graph that about 10% mobile and accessories seller about 40% computer and peripheral seller and about 20% electrical and electronic goods seller suggest increasing the government responsibility by establishing more collection centre and recycling facility and by encouraging door-to-door collection.

It was also found that about 50% mobile and accessories seller and about 10% computer and peripheral seller suggest increasing the consciousness about e-waste between people by organizing awareness camp in school, collages, offices, market place and in other public places. Consciousness could also be increases by highlighting the unhealthy effect of e-waste on human being and environment.

Further it was observed that about 30% electrical and electronic seller and about 10% computers and peripheral seller suggest installing buy back facility by the manufacture. The manufacture should install the process of taking back old and outdated product from customer and from retailers.

It was also observed from graph that about 40% computer and peripheral seller, about 40% mobile and accessories seller and about 50% electrical and electronic goods seller are not willing to give any suggestion as most of them are company employees and are not authorized to give any such suggestion which have opposite effect on their company.

4. Results of survey conducted in an IT firm regarding e-waste management

When an interview was conducted with an employee of an Information Technology firm following findings are obtained:

1. The main reason for product becoming out-dated is change in technology. For example the launch of newer version of operating system. The working machine could be upgraded to newer operating system but sometimes it does not support it and it became out-dated.

2. Big firms are use to sell their old electronic product (mainly computer) by publishing tender. But the company never sold their hard drive, in spite of it destroy it by itself due to risk of data stealing.

3. Recently Microsoft had announced that it stop supporting the Microsoft XP operating system. Due to it the Reserve Bank asked all the Government banks to upgrade its computer operating system. Due to it many banks have to change its whole computers due to not supporting newer version which leads to e-waste generation.

The medium level company commonly do not sold its machine rather passes it from one department to other. Like most advanced computer systems are used by technical department and when it becomes outdated in terms of technology, the firms passes it to other department which do not perform any high tech work such as sales finance and HR department.

Most of the companies in Jabalpur received the old computer as scrap and uses its parts when required. Even when the computer becomes totally out-dated then company sell it by publishing tender in public notice but do not sell its hard drive.

The recycler of e-waste in Indore is Unique Eco Recycler. It is the only authorized recycler of Madhya Pradesh registered under Hazardous waste (Management, Handling and Tran boundary, Movement) Rules, 2010.

5. CONCLUSION & RECOMMENDATIONS

From the above result it is concluded that the responsibility and accountability should be decided at various levels. The government should develop a model through which the informal recycler could also get involved in environment friendly recycling of e-waste. The government should also make planes to increase the awareness and semblance between people concerning the hazardous effect of e-waste and force them to give their e-waste to collector who recycles it in environment friendly manner. The government should allow only those recyclers for taking part in auction of e-waste who execution recycling in environment friendly manner. The company should also promote buy back facility for proper disposal of e-waste by the end user. The companies should also disperse awareness between end user about the hazardous effect of e-waste and provide proper information about disposal of products. For this collection and dropping centre should be open by company for customer other then the already available dealer location. The provision and principle concerning e-waste should be made strong and appropriately implemented so that unhealthy and negative effects of e-waste could be prohibited.

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