

Future Forecast Sale of Electronic Devices AsE-waste

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Abstract— Electrical and electronic equipment's which become obsolete comes under the category of e-waste. The technical advancement in the society which keeps updated at greater pace creates the problem in handling any of the electronic or electrical device even before becoming an obsolete. This paper includes the predication of amount of E-waste growing trend up to 2020 year. The amount of E-waste generated is increasing at higher rate annually and if not treated properly will not only impact on environment but also on human lives. Future forecasting of sale of electronic devices indicates the amount of e waste to be generated in the upcoming years

Keywords— E-waste, ASSOCHAM, Hazards, MAIT, Forecast, Life span, Recycling.

INTRODUCTION

Waste electrical and electronic equipment (WEEE) describes discarded electrical or electronic equipment's [1]. E-waste is generic word for electrical or electronic devices which become obsolete. The device consisting of any unwanted and broken equipment or dumped by owner comes under the category of E-waste which includes mobile phones, tablets, computer, laptops, printers, ups, routers, television, refrigerators, microwave ovens, washing machines, music system, and toys.

According to the ASSOCHAM (The Associated Chambers of Commerce and Industry of India) latest report, Computer equipment accounts for almost 68% of e-waste material followed by telecommunication equipment (12%), electrical equipment (8%) and medical equipment (7%). Other equipment, including household e-crap account for the remaining 5%. More than 70 per cent of e-waste contributors are government, public and private industries, while household waste contributes about 15 per cent. Televisions, refrigerators and washing machines make up the majority of e-waste, while computers account for another 20 per cent and mobile phones 2 percent [14].

The raw materials required in making of these machines not only contains hazardous substances but also contains valuable and precious metals. The electronic and electrical equipment's uses metal, motor/ compressor, cooling, plastic, insulation, glass, liquid crystal display, rubber, wiring/ electrical, concrete, transformer, magnetron, textile, circuit board, fluorescent lamp, incandescent lamp, heating element, thermostat, FR/BFR-containing plastic, batteries, CFC/HCFC/HFC/HC, external electric cables, refractory ceramic fibres, radioactive substances and electrolyte capacitors. Typically, E-waste contains metals (40%), plastic (30%), and refractory oxides (30%). The metal scrap consists of copper (20%), iron (8%), tin (4%), nickel (2%), lead (2%), zinc (1%), silver (0.02%), gold (0.1%) and palladium (0.005%). Plastic components are polyethylene, polypropylene, polyesters and polycarbonates [2].

HAZARDS ASSOCIATED WITH E-WASTE

E-waste are hazardous to human health and to the environment if not handled properly and by means of properly, they need treatment process which follows 3R rules: Reuse, Recycle, Reduce. Recycling of the E-waste is necessary in order to reduce the E-waste generated every year. Landfill dumping of E-waste is not proper solution. Landfilling of these waste products will toxic to environment and leaching dangerous metals such as lead, cadmium and mercury into the surrounding soil, groundwater and ultimately ending up in humans.

A. Hazardous Substance

Substance	Used in	Hazards
Americium	smoke alarms	carcinogenic
BFRs	flame retardants in plastics	impaired development of the nervous system, thyroid problems, and liver problems.
Cadmium	light-sensitive resistors, corrosion resistant alloys for marine and aviation environments, and nickel-cadmium batteries	can cause severe damage to the lungs and kidney, can leach into the soil, harming microorganisms and disrupting the soil ecosystem
Lead	solder, CRT monitor glass, lead-acid batteries, some formulations of PVC.	lead exposure include impaired cognitive function, behavioural disturbances, attention deficits, hyperactivity, conduct problems and lower IQ.
Mercury	fluorescent tubes, tilt switches (mechanical doorbells, thermostats), and flat screen monitors	sensory impairment, dermatitis, memory loss, and muscle weakness. Environmental effects in animals include death, reduced fertility, slower growth and development.
Sulphur	lead-acid batteries	liver damage, kidney damage, heart damage, eye and throat irritation. When released in to the environment, can create sulphuric acid
Perfluorooctanoic acid (PFOA)	Non-stick cookware (PTFE), used as an antistatic additive in industrial applications, and found in electronics	Hepatotoxicity, developmental toxicity, immune toxicity, hormonal effects and carcinogenic effects. Studies have found increased maternal PFOA levels to be associated with an increased risk of spontaneous abortion (miscarriage) and stillbirth

Table 2. [3] Hazardous substances used in electronic & electrical equipment's.

B. Non Hazardous Substance

Substances	Used in
Aluminum	nearly all electronic goods using more than a few watts of power (heat sinks), electrolytic capacitors
Copper	copper wire, printed circuit board tracks, component leads
Germanium	1950s–1960s transistorized electronics
Gold	connector plating, primarily in computer equipment
Iron	steel chassis, cases, and fixings
Lithium	lithium-ion batteries

Nickel	nickel-cadmium batteries
Silicon	glass, transistors, ICs, printed circuit boards.
Tin	solder, coatings on component leads
Zinc	plating for steel parts

Table 2. [3] Non- hazardous substances used in electronic & electrical equipment's.

INDIA'S E-WASTE GROWTH

The Amount of E-waste generated in India annually in the year 2007 was 3, 82,979 MT, including 50,000 MT of imports in India.[4] As per the study conducted by ASSOCHAM, India is likely to generate e-waste to an extent of 15 Lakh metric tonnes (MT) per annum by 2015 from the current level 12.5 Lakh MT per annum growing at a compound annual growth rate (CAGR) of about 25% [14]. Indian government passed the E-waste (Management & Handling) Rules, 2011 [13] which aims to channelize the E-waste generated in the country by recycling, recovering and reduce which came into effect from 1st may 2012. The reason behind the annual increase rate of e-waste is because of the higher per capita income, rate of change of technology and peer pressure contributes to increased rate of obsolescence of electronics. As the new technology comes into the market, the sale of electronic and electrical devices increases and previous technology gets affected. The rapid change in technology causes the device stability in market for a short span of time due to which the owner dumps their device even before they get obsolete.

According to the ASSOCHAM latest study conducted on E- waste which released on 22nd April, 2014, In India, about 4.5 lakhs child labours between the age group of 10-14 are observed to be engaged in various e-waste (electronic waste) activities, without adequate protection and safeguards in various yards and recycling workshops [14]. Its exposure can cause headache, irritability, nausea, vomiting and eyes pain. Unauthorised recyclers may suffer liver, kidney and neurological disorders.

The study conducted by MAIT (Manufacturers Association for information technology) organization depicts that the PC and Laptop sales has increased over the years published in their annual report 2012-13[5]. Other devices as printers, ups and server shows minor growth. The following table contains the electronic devices sold (in million units) over the past years:

Year	Desktop	Laptop	Printer	UPS	Server	Total
2006-07	5.49	0.85	1.49	2.17	0.09	10.09
2007-08	5.52	1.82	1.60	1.62	0.12	10.68
2008-09	5.28	1.52	1.62	1.52	0.12	10.06
2009-10	5.53	2.51	2.50	2.32	0.10	12.96
2010-11	6.03	3.28	3.13	2.38	0.09	14.91
2011-12	6.71	4.02	2.97	2.55	0.09	16.34
2012-13	6.77	4.40	2.93	2.53	0.09	16.72

Table 3. Previous year sales data (in million) of Desktop, Laptop, Printers, UPS & Server. [5]

LIFE SPAN OF ELECTRONICS EQUIPMENT

The average life of electronic equipment mentioned above for which the device will operate without getting obsolete is normally different for every equipment.

Device	Average Life span in Years
Desktop	5
Laptop	4
Printers	4
Server	4
UPS	5

Table 4. Device and their average life span. [6]

But in Indian scenario, the reality is different. The life time of an equipment will depend on the distribution around the equipment average lifetime because equipment are often reused or restored [7].

Equipment	Years till the device operate				
	2	3	4	5	6
Desktop[6]		25%	50%	25%	
Laptop[6]	10%	50%	20%	20%	
Printer[8]	20%	40%	30%	10%	
UPS[9]	10%	20%	50%	20%	
Server[10]		25%	40%	25%	10%

Table 5. Percentage of each device assumed which operate years before becoming obsolete.

METHOD USED FOR FUTURE PREDICTION

The method used for future prediction of sale values of electronic equipment's for the upcoming year is carried out using Forecast function provided in Microsoft Excel [11]. This method is defined to calculate, or predict, a future value by using existing values. The predicted value is a y-value for a given x-value. The known values are existing x-values and y-values, and the new value is predicted by using linear regression. Most common application of this function is to predict future sales, inventory requirements, or consumer trends.

Syntax: FORECAST(x, known_y's, known_x's)

where, X Required. The data point for which you want to predict a value.

Known_y's Required. The dependent array or range of data.

Known_x's Required. The independent array or range of data.

Remarks:

If x is nonnumeric, FORECAST returns the #VALUE! error value. If known_y's and known_x's are empty or contain a different number of data points, FORECAST returns the #N/A error value. If the variance of known_x's equals zero, then FORECAST returns the #DIV/0! error value.

The equation for FORECAST is $a+bx$ where,

$$a = \bar{y} - b\bar{x} \text{ and:}$$

$$b = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sum(x - \bar{x})^2}$$

where x and y are the sample means AVERAGE(known_x's) and AVERAGE(known_y's).

FUTURE SALES VALUE

Using above forecast function, the sale values of some of the electronic devices are calculated. The sale forecasting of these device indicates that the rate of sale is increasing annually. But according to Toxic link report, only 5% of e- waste is recycled annually in formal sector [12] which is much lesser than the rate at which it increases. Recycling in formal sectors must be encouraged to achieve the higher recycling rate than the present status.

YEAR	Desktop	Laptop	Printer	UPS	Server	Totals
2013-14	6.798336	4.889413	3.009982	2.541475	0.097538	17.336744
2014-15	6.81991	5.362559	3.07198	2.442851	0.100206	17.797506
2015-16	6.836335	5.819978	3.120038	2.383009	0.10115	18.26051
2016-17	6.84884	6.262193	3.157291	2.346698	0.101484	18.716506
2017-18	6.858361	6.68971	3.186167	2.324666	0.101602	19.160506
2018-19	6.86561	7.103017	3.20855	2.311297	0.101644	19.590118
2019-20	6.871129	7.502587	3.2259	2.303186	0.101659	20.004461

Table 7. Future prediction of sales data of devices till 2020 year.

The above result are indicated on graph using M.S. Excel graph tool provided.

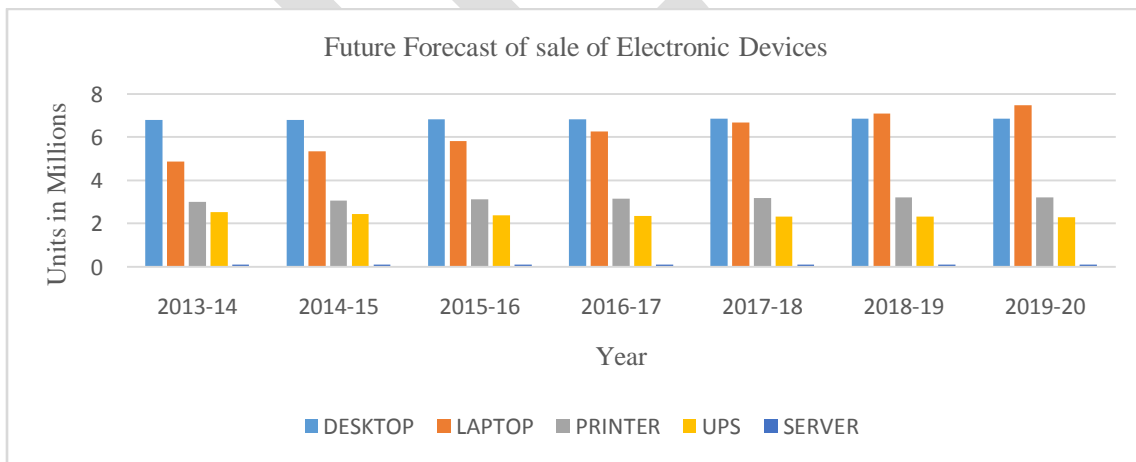


Figure 1. Graph showing the increment in sale of each device.

CONCLUSION

The future forecast of electronic equipment's such as desktop, laptop, printer, ups, and server is calculated and expected to generate 20.004461 million units to be sold out in 2020 year which will become e-waste in the years to come. As units sold in one particular year will become obsolete at the end of the average life. The need of recycling is hence required at the same rate to tackle the e-waste at right time. Local communities will also directly benefit from a clean environment and better health conditions, due to reduction or even elimination of the inadequately processed e-waste quantities. Moreover, advanced, scientific materials recovery is expected to increase employment rates, create additional markets for salvaged materials, and provide small-scale entrepreneurs with new profitable options.

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