

Managing the E-waste Efficiently Through Consumer Awareness and Involvement- A Review

Vaishali Mahajan¹, K.Rajagopal², Richa Priya³, Aradhika Agarwal⁴

^{1,2,3,4}Symbiosis Centre for Management and Human Resource Development, SCMHRD, Symbiosis International (Deemed University), SIU, Hinjewadi, Pune, Maharashtra, India

ABSTRACT

Increased usage and ever-increasing demand of electronic products in daily life has led to growth in the amount of waste that is being generated from electrical and electronic equipment. The current situation in India is alarming due to the fact that along with China, it is the largest importer of E-Waste, with only 3% of it being recycled properly. Considering the volumes of E-Waste that is being generated, there is a need to understand the need for its efficient disposal and management along with the environmental and health problems that are being faced currently due to its informal recycling.

The research paper focuses on presenting an outline on E-Waste along with understanding the consumer behavior and their awareness on managing E-Waste that is being generated in Delhi through Descriptive research method. For this purpose, data was collected through questionnaire-based surveys to understand the awareness level among people regarding existing E-Waste management measures and the attitude towards the same. The target respondents for the survey included households, offices and youngsters. Different zones based on population density and socio-economic status from Delhi were selected for the survey. The paper also intends to study trend analysis of historical data on E-Waste along with analysis on the secondary data that was collected from various sources to highlight and bring forward the schemes and solutions to assist the management of increasing quantities of E-Waste.

For any study to be conclusive, the test analysis and the inferences need to be recorded systematically. The results based on statistical analyses are there is a no significant relationship between Age of the respondent and their awareness towards E-waste management, education qualification of the respondent and their willingness to learn about sustainable, safe and proper disposal of product and income level of the respondent and their willingness to spend on electronics annually.

Keywords

E-Waste, E-waste Management, Recycled products, Consumer awareness of E-waste, and E-waste Management Policies

Article Received: 10 August 2020, Revised: 25 October 2020, Accepted: 18 November 2020

Introduction

The significant rise in E-waste volumes is a critical issue in the global development paradigm. The government decided to restructure the power sector in a phased manner starting from 1991, through liberalization and inviting foreign players to infuse funds and introduce modern technology.

It was concluded that more than 50 million tons of E-waste generation will happen globally. More than half constituted of devices such as smartphones, computers, TVs and electronic tablets, while rest of it was larger in-house appliances like washing machine, air conditioner etc. Out of all this, it is a matter of huge concern that only 20% of it is recycled every year, and a big implication of this is that 40 million tons of it is disposed of in landfills, burned down or in improper and hazardous manner. This occurs in spite of the fact that around 66% world population is already regulated by e-waste legislation. Most of the governments acknowledge the fact that consumers are the key resources in the entire cycle to ensure better e-waste management. The aim must be to inspire customers to appropriately dispose the e-waste in the realm of defined recycling procedures, ensure reuse charges and develop sustainable customer behaviors to cultivate a circular economy.

India is among the top 5 in the world amongst the highest e-waste generating countries-besides China, USA, Germany and Japan. Report said, "The multitude of increase was mainly attributed to India". "Electronic Waste Management in India, an ASSOCHAM-KPMG study, has identified

computer equipment's contributing almost 70%, tailed by phones (12%), electrical electronics (8%) and medical electronics (7%) and remaining contributed by household e-waste. The increment in the amount of e-waste generated is because of large amount of consumption and uselessness. Discarding of mobiles, computers, fitness bands and other equipment has been much faster than their actual lifespan. As per the study conducted in May 2017, the E-waste volume has been increasing at growth rate of 21% annually. By 2020, e-waste from discarded mobile phones in India would be about 18 times higher; from old computers would increase by 500%; 1.5 to 2 times more from televisions.

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The Central Pollution Control Board (CPCB) has provided EPR authorization to 726 producers as on 12th October 2018. The authorization, with validity of five years from issue date, clearly specifies the assembly entities for producers for

a timeline of 5 years. However, no one is utilizing the random check provisions, as defined by the rules. There is no existence of independent mechanisms to check the claims which are made in authorizations. Improper implementation has defamed the robust set of defined rules.

The issue of e-waste has been discussed to some of the levels; however, it has not been addressed at a large, in-order to bring a substantial and big impact, especially in the sectors which are unorganized in nature. Biggest proper lies in the improper handling of E-waste. Unfortunately, India is in no way equipped in proper skilled labor to manage e-waste and the recycling processes which accompanies with them.

The issue of e-waste has been discussed to some of the levels; however, it has not been addressed on a large scale to bring a substantial and big impact, particularly in the sectors which are unorganized in nature. Biggest proper lies in the improper handling of E-waste. Unfortunately, India is in no way equipped in proper skilled labor to manage e-waste and the recycling process which accompanies with them. The elements which can be reused like the base metals are lost and it also leads to soil contamination which is caused by crude and unorganized dismantling. Consumers of electronic or electric devices are not educated about the end of the product value chain. Information should be provided with the product package about the responsibility of the consumer or the e-collection center for the product. Our country do not provide any new schemes around refunds on reprocessing of the product. It should be adopted as one of the methods to incentivize consumers.

With yearly generation of 1.8 metric tons electronic waste in 2016 and forecasted value of 5.2 million metric tons by 2020, India is racing ahead. Mumbai ranks top in the list of top 10 Indian e-waste generating cities, followed by other cities. The primary source of E-waste is the government, private and public sectors accounting nearly 70%. Individual households are contributing around 15%. The remaining 15% is contributed by various electronics manufacturers. Such a situation of e-waste generation in India, highlights the fact that it is right time the government address to the concern and assumes responsibility to prevent health hazards and environmental damages. To tackle this, it is necessary to educate the consumers about E-waste. Electrical and electronic equipment which have crossed their expiry date or have become inadequate for their initially planned use are described as "e-waste". Computers, monitors, mainframes, servers, CDs, scanners, printers, calculators, battery, transceivers, phones, copiers, TVs, iPods, machines for washing and cleaning, air-coolers, medical apparatus, and refrigerators are few examples of e-waste. Precious metals such as gold, silver, platinum and copper can be obtained from e-waste if it is processed scientifically. However, substances like polychlorinated biphenyls (PCBs), liquid crystal, mercury, lithium, nickel, selenium, brominated flame proofing agent, arsenic, barium, cadmium, copper, chrome, lead and cobalt, which form an intrinsic fragment of various electronic and electrical equipment's, are carcinogenic and toxic. However, if the processing and dismantled of E-waste is done in a simple manner, the various toxic components can be dangerous to the humans. The cathode ray tubes (CRTs) attached to computer

monitors, contains dangerous metals like cadmium, lead and barium may be harmful during their improper processing and cause an adverse impact on the human respiratory and nervous systems. Similarly, cadmium and lead in printed circuit boards, mercury in flat-screen monitors and switches, beryllium in motherboards, polyvinyl chloride (PVC) in cable insulation, cadmium in computer batteries and bromine used in creation of plastic housing damages human body parts such as the nervous system, lungs and skin, kidney and liver, heart, brain and skin, liver and muscles, kidney and liver, endocrine system and immune system.

Around 90% of the disposal and recycling of E-waste is carried out by the unorganized or informal sector. Such sectors constitute of unskilled workers who work without any safeguards or protection measures, but dwelling in slums near landfills and e-waste dumps which are untreated. For instance, they do not wear any mask or glove while utilizing nitric acid to remove platinum and gold soldered in the electronic circuit boards. Small kids are majorly engaged in disintegrating the circuit boards without any protection of any kind. The public and private sectors mainly sell their e-waste to informal labor since they are able to draw more price as the expenditure for recycling through the unorganized sector is less.

Literature Review

Bhaskar, K., & Turaga, R. M. R. (2018), suggested to check the status of the ecosystem for the management of e-waste. The research also focuses on the various challenges faced by this sector, such as insufficient resources to keep check on the guidelines, lack of knowledge and awareness among the people regarding the rules and how to achieve the e-waste. Researchers have also tried to identify the various methods of improvements for the better management of the e-waste discarding system.

A research conducted in the city of pune, maharashtra by Borthakur, A. (2014), involved four different stakeholders: - a) Information Technology Sector b) Banking Sector C) Education Sector d) Household Sector. These four sector are major providers of the e-wastes as listed by Indian Ministry of Environment and Forest.

The research by Needhidasan, S., M. Samuel, and R. Chidambaram (2014), gives the impression on hoe the e-waste has increased rapidly in India. The research give us the true scenario of how the e-waste management system in India works. It also lay emphasis on the extent of problem, health and environmental hazards, current plans of e-waste disposal, various recycling operations, and various other instruments to improve the health and environmental conditions. The absence of infrastructural facility and the proper guideline for the discarding of e-waste play significant role for the increased amount of e-waste in the country.

E - Waste Management in India

Considerable growth has been witnessed in E-waste and a major factor has been multifold in nature. Some of the factors which stand out are IT revolution, socio-economic

development, innovations in technology, rise in consumer demand, rapid technological changes resulting in short product life cycles and large discounts for consumption. E-waste greater than 6.8 kg of is being produced for each living human being, which means minimum of 6 billion phones(mobile) are currently being operated in the world; as per The United Nations Environmental Program. One can understand the gravity of the E-Waste crisis.

The growing Indian economy has transformed in the past two decades. One of the beneficiaries has been the electronics industry which has emerged fast growing sector in terms of production, internal consumption and export. This has resulted in an increment in terms of electronics usage in the country. Considering the fact that electronics have a very limited lifespan; it is inadvertent that there will be a major contribution towards E-waste.

Importance of E-waste in India in regards to volume and toxicity can be estimated in terms of a growing rate of 7-10% pa. With such drastic growth rates, current generation of Indians are under a great threat as it can be detrimental to their lifespan and can also create great environmental changes which can be detrimental to the future of this planet. This estimation of growth rate is definitely on the higher side when compared to many developing nations in the world. These estimations are very important in nature and should not be taken lightly as they are a true indicator of the seriousness of the condition of E-waste in India and all other nations. Many of the world leaders are simply ignoring this facet of E-waste and concentrating on improving their economies in the form of single way thrust of technology. Around 400,000 tons of E-waste is being produced in India alone on an annual basis. Along with Africa, India is listed as one of the largest dumping grounds, as many factors like cheap labor and non-existence of stringent regulations have made it easier of India to be marked among the top in the list. It is a matter of few years that we start to see the adverse effects of this major ignorance around the world.

Current E-Waste Management Practices

One of the biggest challenges to human society will be the sustainable management of the ever-growing E-waste around the world. Management of E-waste is for sure a difficult task and reason for it being difficult include various factors such as its management, socio-environmental repercussions, cultural changes and monetary factors, etc. Along with the quantity of E-waste, the volume of toxicity is also a pertinent cause of concern. Majority of E-waste consists of heavy metals (for e.g., mercury, lead, and cadmium and hexavalent chromium) and organics pollutants (e.g., polychlorinated biphenyls, brominated flame retardants and diphenyl ether). Hence, E-waste management is a major challenge, both in regards to amount and poisonousness.

A great challenge lies in front of developing countries in managing of E-waste, as the burden of domestic generation and illegal imports from developed countries is too large for them. A great amount of pollution and hazardous health techniques are currently adopted by such countries to tackle E-waste. Authorized recycling institutions are collecting only 3% of the actual E-waste

being generated in the country. Collection of E-waste accompanied by various other processes like transportation, separation, disintegration and extraction of crucial metals are being carried out by these sectors. All these processes are being carried out through cheap labor with no skill levels and in addition to that they are exposed to hazardous elements of this process which contributes no less to the pollution around us.

E- Waste Management Policies in India

'The E-waste (handling and management) Rules, 2018' have constituted EPR model for making sure sustainable E-waste management practices. As per the 'E-waste (Management) Rules, 2019', "Extended Producer Responsibility means responsibility of any producer of electrical or electronic equipment, for channelization of e-waste to ensure environmentally sound management of such waste." Still, proper regulation of EPR has remained a major challenge which is due to certain unique nature of E-waste management system in India. For example, Indian consumers believe it is better to sell obsolete and broken electronics to the nearest scrap dealers for a certain amount instead of following EPR principles defined by the country. No one wants to pay for E-waste management in India; be it consumers or the producers. Major players have been the nearest scrap dealers in the vicinity, who are ready to pay something in this process of E-waste management. In developed countries the behavior has been vice versa where both consumers and producers are equal stakeholders in this process in terms of the payment. Certain recycling fees is charged from them which is kind of a tax or a fee which is in turn used for the treatment of E-waste in proper manner as defined by the regulatory authorities.

Objective Of The Study

The key objective of conducting this survey is to present the level of customer attitude and awareness towards E Waste Management through a representation of data collected. Based on the data collected, a pattern has been tried to be established among the consumers which can be targeted by the Government or respective regulatory bodies and in turn, improve the policies and practices of the E Waste management.

Hence, to attain this main objective, following are the sub-objectives which can be formulated.

1. To examine the consumer awareness and knowledge towards E-Waste management.
2. Highlight the customer attitude towards E-Waste management.

Research Methodology

A survey approach was applied to analysis this descriptive research. A questionnaire was designed with 10 major parameters which focuses on the respondent's awareness on various arguments for the e-waste management. The primary data was collected from 300 respondents. Convenience sampling technique was used for the available

sample. SPSS was used to analyze the data obtained. Chi-square test and co-relation were used to find out the results.

Hypothesis:

To study the consumer awareness and attitude towards E-waste management, the following hypothesis are developed:
 H1: There is a significant relationship between Age of the respondent and their awareness towards E-waste management
 H2: There is a significant relationship between Education qualification of the respondent and their willingness to learn about sustainable, safe and proper disposal of product.
 H3: There is a significant relationship between income level of the respondent and their willingness to spent on electronics annually.

Data Analysis And Interpretation

Hypothesis 1

H0: There is no significant relationship between Age of the respondent and their awareness towards E-waste management.

H1: There is a significant relationship between Age of the respondent and their awareness towards E-waste management.

Observation

Figure 1. Age of Respondents

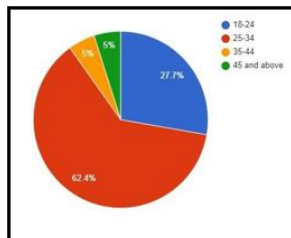


Figure 2 – Most Used Electronics in Delhi

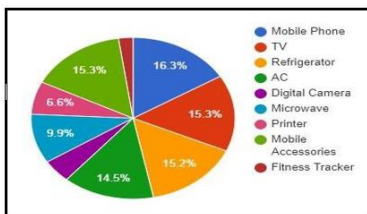


Figure 3 – Replacement Rate of Electronics

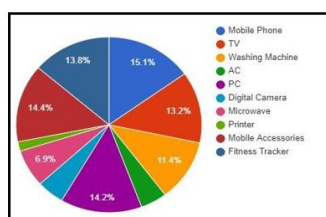


Figure 4 – Results from SPSS and Survey

Correlations

Dependent Variable	Age	Education Qualification	Annual Income	Willingness to learn about sustainable, safe and proper disposal of product	Willingness to spend on electronics annually
Age	1.000	-.173*	-.146*	-.142*	-.124*
Education Qualification	.339	1.000	.297	.173	.249
Annual Income	.117*	.399	1.000	.292	.284
Willingness to learn about sustainable, safe and proper disposal of product	.339	.297	.292	1.000	.287
Willingness to spend on electronics annually	.124*	.249	.284	.287	1.000

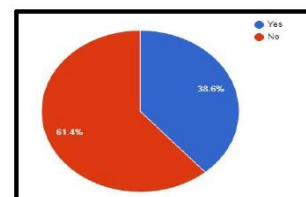
*. Correlation is significant at the 0.05 level (2-tailed).

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	13.165 ^a	3	.004
Likelihood Ratio	11.793	3	.008
Linear-by-Linear Association	3.988	1	.049
N of Valid Cases	300		

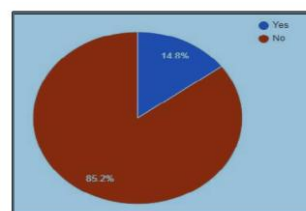
- From the product utilization mapping, it is clearly visible that most used electronics by Delhi citizens are mobile phones, accessories, television and refrigerator. Other electronic items like fitness tracker, printer and digital camera are the least used.
- From the survey conducted, it has been clear that the rate of replacement among Delhi citizens is highest for mobile phones, which stands around 15.1% among all the electronic items included in the survey. Mobile accessories are the next most replaced at around 14.4%. The least replaced electronic items in Delhi households are personal computer hardware's like printers, which stand at 1.7%.

Figure 5 – Consumer attitude towards recyclable nature of electronics.



Only around 38.6% of respondent's care about the electronics they purchase to be recyclable in nature, rest 61.4% of respondents do not care whether the electronics they are purchasing are recyclable in nature or not.

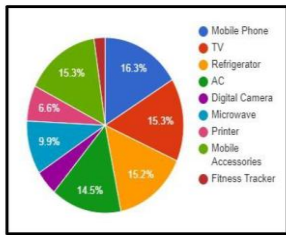
Figure 6 – Consumer awareness about recyclers



- This shows the attitude of consumers towards the electronic items they buy and signifies the fact that great deal of importance is not given to the necessity of the product being recyclable in nature. This can be stemming from the non-awareness of importance of the issue of E-waste management.
- Survey results have revealed that only 14.8% of the respondents are aware about scrap dealers who are performing recycling procedures and rest 85.2% are not aware. This clearly shows that the majority of consumers are not having much awareness regarding how scrap.

Figure 7 – Consumer awareness about e-waste startups

Figure 14 – Most Used Electronics in Delhi

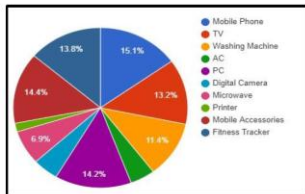


Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	58.304*	6	<.001
Likelihood Ratio	64.063	6	<.001
Linear-by-Linear Association	.263	1	.608
N of Valid Cases	300		

Observations:

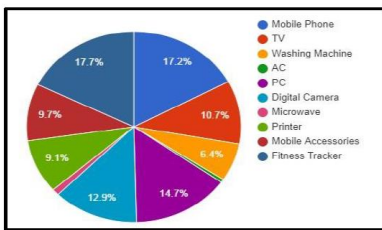
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Figure 15 – Replacement Rate of Electronics



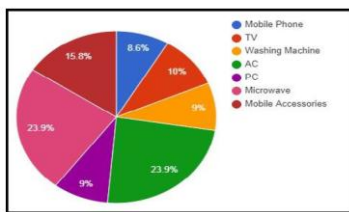
The eagerness to replace on a scale of 5 is the most for mobile phones and fitness trackers, which is around 17.3% and 17.2% respectively. They are followed by computers, digital cameras and television at 14.7%, 12.9% and 10.7%. The least eagerness to replace was shown for Microwave which was at 1.1%.

Figure 16 – Eagerness to Replace Electronics



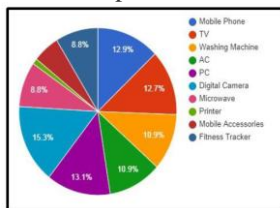
The survey mapped the products which will remain with customers for the least amount of time by classifying the years for which they intend to keep as 1-3 years, 4-10 years and more than 10 years. As per the survey results it has been found that the mobile phone accessories and mobile phones are the electronic items intended to be kept for the least amount of time with the respondents among all the electronic items listed in the survey.

Figure 17 – Electronics Used for Least Years



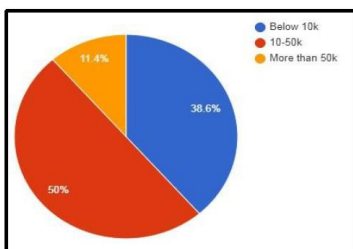
Almost 25% of the consumers intend to keep the mobile phones and accessories for a period of 1-3 years only. As per survey results, 20.4% respondents intend to keep using fitness trackers for a period of 1-3 years only. Washing machine is the only electronic item which falls the least in the bracket of 1-3 years.

Figure 18 – Products disposed off in working condition



From SPSS results, People have high income likely to spend more on buying electronics either due to necessity or new advanced feature. The Chi-square test result revealed that the relationship between income level of the respondent and their willingness to spent on electronics annually is statistically significant at a probability level of 0.05.

Figure 19 – Average annual expenditure spent on electronics



Inferences through statistical analysis:

In conclusion to the present study the test analysis and the inferences deduced can be stated as follows:-

- There is a no significant relationship between Age of the respondent and their awareness towards E-waste management.
- There is a significant relationship between Education qualification of the respondent and their willingness to learn about sustainable, safe and proper disposal of product.
- There is a significant relationship between income level of the respondent and their willingness to spent on electronics annually.

Figure 20 – SPSS Test results

Conclusion And Discussion

The above survey results aim to showcase the consumer awareness and attitude towards the major issue of E-waste management in Delhi through demographic profiling of the respondents, product utilization mapping and consumer awareness about the E-waste initiatives by the government or any private firms. The empirical analysis also highlights the gaps and areas where the government and the concerned authorities can work in order to increase the awareness among the consumers

and the attitude of the consumers. Some of the highlights of the survey are as follows -

- 60% of users don't care about recycling.
- More than 75% of users are not aware of the initiatives. More than 75% of users are not aware of E-waste rules.
- Nearly 90% of users are not aware of recycling agents nearby.

Awareness program should be conducted in such a way that all the segments of consumer should understand the importance of E-waste management.

Recommendation And Future Scope

The issue of E-waste is an immediate concern as it can lead to big environmental issues which can endanger human health. It is no less an issue that India is currently lagging behind in managing its e-waste management problems.

Indian citizen is not at all aware of the hazardous nature and the calamities associated with E-waste. Hence, the most important matter of concern is the awareness among the consumers. Only awareness is not enough, the attitude needs to be changed as well through various possible incentives as it is very inherent to Indians to be motivated through the various discounts and incentives on offer. If reasonable prices are provided to the consumers for used electronics, there can be a major shift in the attitude of the consumers. The unskilled workers of the unorganized sector need to be trained and made aware of the hazardous proportions of the E-waste. Proper collection procedures will establish the process of the reverse cycle from consumers to ultimate goal of recycled goods.

Incentives can be formulated for the recyclers as well to ensure that they become pro-active in their attempts to collect the E-waste. A dedicated media team can be established to make the young and old consumers aware about E-waste through social media like Facebook and other media options like a dedicated website for propagating the information regarding the E-waste across the regions. Tax rebate policies must be formulated to encourage consumers and producers alike. A concept of value on return must be encouraged in kirana stores which sell plastic items as is the case in European countries; wherein customers stand a chance to earn something on returning plastic products.

5 R's can be followed to improve the entire process even further -

- Recognize – The awareness among the consumers must be spread regarding the unnecessary storage of electronics being on no use. Hence, they must be encouraged to sort it

out as soon as possible.

- Reduce – Consumers must be encouraged to reduce the purchase of unnecessary products; rather ensure upgradation of the existing products.
- Refurbish – Encourage the consumers to use refurbished product or to refurbish their products, which can be sold to those who need it more.
- Reuse – Obsolete products must be donated to those who need it more through a network of NGOs.
- Recycle – Producers must be encouraged to use a good percentage of recycled materials in producing new products.
- Focus should be on building environment friendly products which can be easily recycled and upgraded whenever needed. Building such easy modular designs can go a long way in achieving the goal of reusing the commodity. The ability to upgrade to new technology in the same device can help change consumers attitude and make them think twice before discarding them. Campaigns must be run in schools and colleges to make the next generation aware of the importance of E-waste management. A circular economy where a reverse flow exists from the consumers to producers to recyclers can go a long way in restoring the damage done to environment due to E-waste.
- Social media must be utilized to spread awareness about the issue of E-waste. Influencer marketing and smart marketing strategies must be adopted to fuel the information spread across as many eyes and ears as possible.
- Youngsters and kids must be taught about this from young age and should be earmarked to be the trendsetters in the society which can bring in a massive shift in the consumer awareness and attitude towards the process of E-waste management.

Limitations Of Research

The scope of this research can be limited in to the following

- Geography - The survey was conducted within Delhi. The respondents have been classified, as per residential location, into North Delhi, South Delhi, East Delhi, West Delhi and Central Delhi.
- Sample Size - The sample size of population is 300. The survey was conducted with limited resources in which population was profiled on the basis of Age, Residential location, Marital status, Family type, Education qualification, Nature of accommodation, Employment type and Annual income.

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