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E-Waste Prediction and Disposal Model using Analytics

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Abstract - *The technology revolution upgrades the life style of common people with more electronic instruments. More and more electronic gadgets / equipments occupy domestic as well as industrial areas. The word 'technology stabilization' is far from reach as technology changes rapidly. Innovations and renovations are progressing fast, leaving the 'under use' items to 'no use' status ie. Obsolete. When these items reach the stage of non-usable, these cannot be disposed by our traditional ways, like other items because of the hazardous component in-built. These items tend to contain one or other, lower or higher percentage of hazardous substance which may effect the environment heavily in case of disposal by traditional methods. Hence, the developing concern and focus is on the disposal of electronic items / waste without effecting the environment. This article focuses on analytical approach to device a model to predict the disposal strategy.*

Key Words: e-Waste, WEEE, toxic, hazard, electronic equipments, data analytics, big data

1. INTRODUCTION

Any electronic item that reached its life time is termed as Electronic Waste or e-Waste. "Electronic waste or e-waste describes discarded electrical or electronic devices. Used electronics which are destined for refurbishment, reuse, resale, salvage recycling through material recovery, or disposal are also considered e-waste."[1]. Any device / appliance, which works on electricity, once ending up its life time is called Waste Electrical and Electronic Equipment (WEEE). The scope of WEEE has been expanded in a big way due to the multi-fold developments across the globe. Though there is no firm definition of e-waste, in most cases, e-waste comprises of all products used for entertainment, telecommunication, data processing etc utilized in household and business sectors. Unlike other wastes, e-waste cannot be treated without concern, due to its composition of toxic contents. Example for such products are Household appliances, Information Technology and telecommunication equipments, consumer equipments, electrical and electronic tools, programmable Toys, sports equipment, medical and control instruments. In the world of fast growing technology, e-waste accumulation is getting geared faster due to one or other factors, such as changes happing at Industries, Trends, user choices, obsolescence of equipments, non usable state, ignored or damaged state or end of its life. "Annual global production of e-waste is estimated to surpass 50 million tons in 2020. India is among the top five e-waste producing countries in the world with estimated annual production of 2 million tons. Like some of the other developing countries, e-waste management in India is dominated by the informal sector with estimates of more than 90 per cent of the waste being processed in this sector"[3].

1.1. GROWTH OF RISKS, HAZARDS BY e-WASTE

Electrical and electronic equipment are made up of components, some containing toxic substances which can have an adverse impact on human health and the environment if not handled properly at disposal. e-Waste is of concern largely due to the toxicity and carcinogenicity of some of the substances if processed improperly. Toxic substances in electronic waste may include lead, mercury, cadmium. Carcinogenic substances in electronic waste may include polychlorinated biphenyls (PCBs). The traditional methods disposal like land filling, breaking or burning, if practiced on e-wastes, it may result very high risks and hazards to the health and environment. Breaking or recycling or disposing e-waste in an uncontrolled environment, give off toxins into the soil, air and groundwater. Land filling of e-waste prone to hazards because of leachate which often contains heavy water resources. Landfill sites and dumps release hazardous emissions which spoils the environment slowly. Landfills are also prone to fires which can release toxic fumes. "E-waste Handling is a concern currently, which is affecting the environment and life. Due to the pandemic and Work-From Home situation, consumers are buying new electronic products, thereby putting extra load on E-Waste by adding more obsolete products to it"[2].

1.2. ROADBLOCK OF e-WASTE MANAGEMENT

Managing e-waste in our country is turned out to be a big challenge because of various reasons including geography, nature and type of e-waste and economic disparities. Considering the importance of special treatment needed for e-Wastes, government, corporate, even consumers are taking precaution in disposal. "E-Waste, if not managed well, can pollute ground water, acidification of soil and add to air pollution; Need to bring GreenCo Standards for E-Waste Recycling Process"[2]. However, there are major challenges included, but not limited to Volume of e-Waste, uncontrolled e-Waste sources, low level of awareness, non-standard / no proper disposal methods, shortage in disposal units and their limited serving, logistical issues, , protective measures in disposal workshops. The challenges do grow faster as the contribution to e-Waste move faster new developments / innovations grow or due to faster change in existing technologies. The successful implementation of e-waste management is possible only if these practices have

economic and social viability and support along with the coordination from various stakeholders and government"[4].

2. MATERIALS AND METHODS

2.1Data Analytics to facilitate e-Waste Management

Various researches provide approaches to address the growing scenarios of e-waste management. "Waste management, recycling, raw material recovery, elemental analysis, and material flow analysis were considered the main emerging topics in the scientific literature and in e-waste statistics"[7]. However, aggressive growth of Information Technology, extends analytical way using data on the e-waste and disposals. "These approaches aim to achieve proper waste management by reducing the environmental impact and associated costs and improving the social acceptability of waste management and also appropriate management system can be established by combining environmental friendly and economically-viable alternatives"[6]. Industry 4.0 framework facilitates the high data driven-ness in address disposal strategies. Big data is the ideal supportive technology as it considers all types of data to get the insights by horizontal and vertical analysis of e-waste data. "According to the three Vs (i.e., volume, velocity, and variety), this Construction Waste Management CWM dataset qualifies as big data. By mining it, it is anticipated that cases of illegal dumping can be identified."[9].

2.2 Big Data Analytics

Big Data analytics is widely used in major critical and complex application areas, where huge data high precision information are gathered, organized, stored and processed to discover insights of information. It is capable of handing large size of data and hold any type of data like structured, unstructured and semi-structured. Lots of tools are available in Big data, to support business specific approaches in processing. Large number of library functions, in build in Big Data components, enables to designers to utilize, by reference, instead of coding those functions. The success factor lies with the quality of data gathered, curated, process designing from business perspective and storing formats, volume, analytical means and computability from technical perspective.

2.3 Prediction of the volume of e-Waste & Disposal Strategies

Under this proposed prediction model of the e-Waste management, it has multiple steps under which data are collected and processed to arrive disposal capability ascertain.

- Step-1: Identification and Gathering details of Expired gadgets - Every electronic gadgets, has limited life time as per the OEM (Original Equipment Manufacturers). There are challenges in arriving the expiry period of gadgets. However, there could be a reasonably identifiable single component which may make the gadget to be non-functional earliest, thereby by landing the expiry. "The industries that generate e-waste (i.e. industrial e-waste) employ an online portal known as the electronic scheduled waste information system (eSWIS) to record the generation, collection, storage, disposal and recovery of scheduled e-waste, before being transported to recovery facilities"[5].

- Step-II: Such expire-able gadgets are categorized based on the field of it use for the selected period of expiration.

- Step-III: Hazard impact chart is prepared from the existing laboratorial records, for each type of the hazardous item and impact level. It maps to gadget on one side and all toxic components and its level on the other side.

- Step-IV: Grouping of the gadgets categorized under the step-II is done based on the hazardous items it emits. This grouping is very challenging as very less gadgets will come under single or couple of hazardous items. However, this give a reasonable metric for the environmental impact.

- Step-V: By combining the Step III and Step IV, the volume of hazard of each time could be reasonable reached. This will help to design the planning for the e-Waste disposal it terms of disposal methodologies availability, capacities of disposal, no of units, resources & safeguards needed. This planning is extend with time bucket for efficient handling.

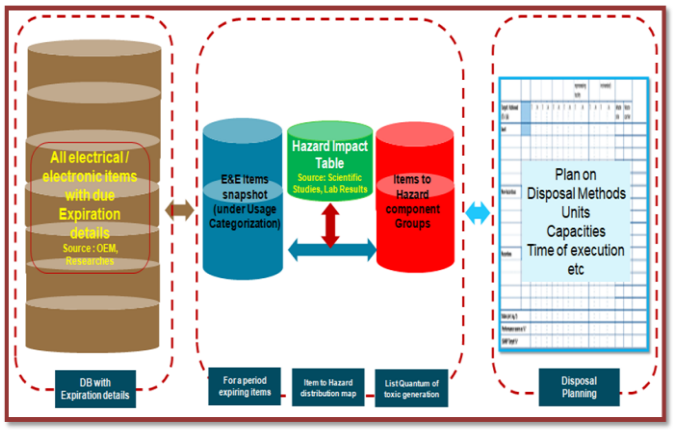

Fig.1 .Analytical Model

3. RESULTS AND DISCUSSION

Gathering volume of history data on e-Waste and Continuous study & analyze the scope of e-wastes and the methodologies for disposal, includes qualification, quantification, characterization, disposal practices, environmental impacts, methodology for disposal to be carried out utilizing suitable data analytics with the help of emerging technology like Big Data and Data Science. "The current developments concerning industrial internet of things (IIoT) technologies, machine learning algorithms and big-data availability provide

platforms for the realization of sophisticated process data analytics"[8]. All parts of e-Waste management to be relooked / revisited often ie in short span of time intervals, to handle effectively and efficiently. The use of data analytics will improvise on

- Policy and Legistration should be clearly amended, for the changing technological developments

- Strict implementation of e-waste disposal laws & the punitive actions for the non-compliances.

- Time to time changes in level of Enforcement to Corporate to include e-waste disposal as one of their social responsibility.

- Levels of extended producer responsibility on the post consumer stage of the product's life cycle.

- Popularizing and Educating e-Waste implications on environments.

- Information to be circulated / popularized to public on hazardous components and impact on any innovation on technological gadgets, while licensing to the company. "EPR, one of the more widely used approaches for regulating e-waste globally, places the responsibility of the end-of-life management of products on the manufacturers or the producers. Conceptually, EPR is designed to make the manufacturers internalize the external costs associated with the end-of-life disposal of their products"[3].

- Changes in monitoring disposal methods in inspecting / verifying / auditing authorities of disposal of e-waste which should be approved / accepted / certified method for e-wastes in the industry.

4. CONCLUSIONS

It is the known fact that industries much depend on technology for their business as well as internal purposes. Hence equivalent importance should be provided to e-waste for right disposal, on par with the procurement in order to have healthy environment. Re-look on the strategy on e-waste accumulation and their disposal should be treated at Corporate level and suitable policy should be derived by every corporate. It may be included in all related policies existing in the corporate (ex. IT Policy). The principle of "Reduce, Reuse and Recycle" may be followed meticulously by all concerned. Reduce significances on how to reduce the generation of e-waste. This can be achieved by smart procurements ie. scalable technology that should survive reasonably long time with industry standards and good maintenance support. Reuse focuses on the possibility of reusing the items. This includes using the items for different way related to its functional capacity or donating or selling them to someone who can still use them. Recycle can be taken up on those components that cannot be repaired. For a right business we need right technology and the right disposal of tech-waste, provides a right environment. Considering the growth, e-Waste Management is slowing migrating to everybody's responsibility More researching on effective e-Waste management time to time is the best solution considering fast changing technological scenarios.

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