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A preliminary investigation of e-waste arising in Surabaya-East Java, Indonesia

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Abstract: The global market of electrical and electronic equipment (EEE) continues to grow exponentially over the last period. As a result, causing the life electrical and electronic equipment is becoming shorter. The main objective of this study is as a preliminary study that will provide information related to the quantity and types of electronic products in the people of Surabaya. This paper utilized a questionnaire adopted and modified from UNEP as a tool to collect data and information are distributed randomly in five residential regions in Surabaya, with 480 respondents interviewed. The results also showed that the total e-waste generation approximately 6209.218 kg/year, which everyone will generate e-waste around 3,234 kg/year. In addition, the estimated generation of e-waste in the city of Surabaya in 2025 is roughly 19,748,171.98 kg. Generally, the respondents do not dispose of used electronic equipment, however, given or sold to collectors of used goods. Thus, it is very difficult to find the e-waste at the end of the shelter. The amount of e-waste in Surabaya will increase due to the average life of products is one of the factors that influence the growth. In order to increase public awareness of electronic waste, need to enhance collaboration among stakeholders facilitated by the government.

Key words: *EEE, E-waste, Household, E-waste management, Surabaya*

INTRODUCTION

Surabaya is one of the busiest cities in eastern Indonesia, which is also the centre of East Java. There are approximately 3 million peoples living in Surabaya. Surabaya is supported by a wide range of infrastructure that makes this town as one of the entrances sectors of the economy. Surabaya has been organized to be an International Trading city. There are numerous development to support as an international trading city, such as build the buildings, manufacturing, airport and harbour. The city is a consumer electronic product the second largest in Indonesia after Jakarta. One of the main drivers of change in the economy in recent decades is industrial electronics products. This prompted a significant change to the digital revolution. The new electrical and electronic equipment has an influence on almost all aspects of everyday human life. Technologies such as a coin has two sides, where the technology has changed human life can be better. However, on the other hand, the technology may provide the problem for society and the environment. Growth in the use and discarding of electrical and electronic equipment is ready to increase and will significantly affect the increase in the quantity of waste electronics. Therefore, the practices being adopted electronic waste management become a necessity to learn.

The definition of electronic waste is an illustration of various categories electronics and electrical products, which have passed through its lifespan, such as computer, laptop, mobile phone, televisions and refrigerators [1]. In other words, that all types of waste containing electrically powered components is the term for electronic waste. Due to the content of valuable materials and hazardous substances in waste electronics led to recycling process specific methods required in the handling and management of waste electronics. For example: lead, mercury, arsenic, chromium, cadmium, and plastics capable of releasing, among other compounds, dioxins and furans [2] Furthermore, studies conducted by Leung et al., [3], found that persistent organic pollutants (POPs) and heavy metals may be easily found in electronics waste recycling centre.

There are three main factors that the reason for the cause of the high volume of e-waste, such as increased market infiltration, market substitution and a high level of obsolete. Furthermore, Arora [4] noted numerous other factors that also contribute to the increase of electronic waste such as affordability, the new discovery technology of electronics products and convenience in the purchase of the new electronic products compared to repair. Halluite et al., [5] highlighted the emergence of a global concern due to the

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problem of e-waste handling activities of the fastest growing in the world. Some sources indicated as a producer of electronic waste such as government offices, public and private sector, academia and research institutes. In addition, the contribution of households to increase the volume of electronic waste is also significant. Furthermore, the volume of electronic waste has also increased substantially even though the import of electronic waste is an illegal activity. The landfill is the location of the end of most consumer electronics devices. In addition, electronic waste disposed of to landfill, mostly without through proper recycling. However, in some developing countries do not dispose of electronic waste to The landfill due to waste electronics is considered still has value.

Recycling electronic waste is a profitable business if managed properly and professionally. There are some valuable materials in electronics waste content, for example metal, plastic and glass. Studies conducted by Windmer et al., [6] found that the electronic equipment may composed of approximately 60% metals, 15% plastic, PCB approximately 2%, approximately 2% cables, screens about 12%, and others around 6%. Furthermore, UNEP and UNU [7] reported that some metal materials used for the manufacture of electrical and electronic equipment, such as gold, silver, palladium, copper, tin, cobalt, selenium, antimony, and platinum. Established processes available for the processing of electronic waste in order to extract the precious metals with high yield has been applied in developed countries [8-9]. There are significant differences in the electronic waste recycling in developing countries and developed countries. Where, the recycling process is done automatically and using minimal labour. On the other hand, electronic waste recycling activities carried out in a way that is immature and still traditional in developing countries.

Generally, discarded electronic equipment is considered to have exceeded its lifespan. Studies conducted by Robinson [10], reported that there are approximately 20-25 million tons of electronic waste per year global production. The research also noted that some countries that are producers of electronic waste, among others, Europe, USA, Australia, and Eastern Europe. In addition, UNEP [11] also reported that it has been estimated that around 20-50 tons per year of waste produced electronics worldwide. Maculey et al., [12] states that people can have more than one electronic equipment of the same type as an increased ability to buy and the price is affordable. In developed countries, electronic waste is not a relatively new form of waste that has to be addressed when compared to household domestic waste. In contrast, for developing countries, electronic waste is important to consider because of the potential impacts that may arise. This study aims to investigate the prospective of waste electronic devices or products that may be targets for Waste Electronic and Electrical Equipment (WEEE) recycling and management in Surabaya. This paper is used for education, government and non government organizations in Surabaya City to measure inventory obsolete electronic devices. Global estimates indicate that WEEE is mainly composed of household electronic equipment such as televisions, personal computers (PCs), refrigerators, cell phone and dispensers [6,12-14]. The method of the United Nations Environment Programme (UNEP) is used to measure the generation of waste electrical and electronic equipment in the city of Surabaya.

1. Literature review

All devices that use electricity and has discarded because obsolete and no longer used can be defined as waste electrical and electronic equipment. E-waste is a generic term embracing various types of electronic equipment. Waste electrical and electronic equipment (WEEE) can be grouped into ten different categories based on the definition of the directive of the European Parliament and the Council on waste electrical and electronic equipment [15], following:

- Large household appliances (refrigerators/freezers, washing machines, dishwasher)
- Small household appliances (toaster, coffee makers, iron, hair dryers)
- Information technology and communication equipment (personal computers, telephones, mobile phones, laptop, scanners, photocopiers)
- Consumer equipment (televisions, stereo, electric toothbrushes, radio)
- Lighting equipment (fluorescent lamp)
- Electrical and electronic tools (handheld drills, saws, screw drivers)
- Toys (play station, game boy)
- Medical equipment system (with the exception of all implanted and infected products)
- Monitoring and control instruments)
- Automatic dispenser.

Electronic waste streams into one of the fastest growing waste caused by increased market penetration in developing countries substitute markets of developed countries [16-17]. For instance, UNEP [11], reported the shrinkage has occurred an average life span of a computer, whereby, in 1997 about six years to less than about two years in 2005. As a result, approximately 75% of the shipping trade of computers from developed countries to developing countries cannot be used. Moreover, LRD [18], noted an increase approximately 200 million users cellular phones in China from 1996 to 2002. The United Nation has estimated that every year the world produces electronic waste approximately 20-50 million tonnes collectively [19].

E-waste is different forms of household waste or industrial waste by a variety of chemicals and physical. E-waste contains various types of heavy metal components [20]. It contains valuable and hazardous

materials that require handling and recycling of specific methods. These parts are harmful to both human health and the environment [21]. There are several precious metals that can be recovered and reused through the recycling process. However, several factors are the reason not to recycle e-waste. For instance, the lack of facilities, high-wage labour, and environmental regulations are tough. Studies conducted by Cobbing [22] found that developed countries send electronic waste to poor countries, where the waste can be recycled in a very simple technique and less attention to the safety of workers and the environment. Thus, the community seemed oblivious has created its own toxic footprints [23-24].

Crude methods used for e-waste recycling include mechanical shredding of electronic equipment, open burning of plastics and insulation, and acid leaching of printed circuit boards. These have contributed to the release of hazardous chemicals, including polycyclic aromatic hydrocarbons (PAHs), polybrominateddiphenyls ethers (PBDEs), polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and heavy metals (e.g. Cr, Cd, Cu and Pb) [3]. Study in China by Deng et al., [25], reported that the current level of PAHs in the Guiyu air was higher than in Guangzhou, one of the most polluted cities in China. This possibly reflects the higher emission of PAHs from E-waste treatment, especially due to open burning of plastics and smelting. In addition, the recycling of e-waste forces of environmental degradation and human health in Guiyu [26]. Wong et al., [2] shows the persistent organic pollutant emissions from obsolete electrical equipment may affect the environment. Location of around the recycling activity and human health has a significant potential risk due to contamination of the emissions. Other studies have shown that E-waste recycling sites pose major threats to waterways such as contamination to nearby streams and rivers. Heavy metals and inorganic acids may leach into the waterways through wastewater or ambient air emissions and have the risk of contaminating natural resources such as soil, crops, drinking water, fish and livestock [27].

A study by Ma et al., [28], reported that 80% of children in Guiyu, China exposed to unsafe E-waste recycling practices suffer from respiratory diseases and are often overexposed to harmful heavy metals such as lead. In addition, Bi et al., [29], indicates the highest level of Polybrominated Diphenyl Ethers (PBDE) present in workers and the environment at an E-waste site in China. The authors also reported that PBDE is a chemical commonly found in electronic plastics as a flame retardant and is found in E-waste recycling sites in the form of dust. Only recently have studies produced causal evidence that there is a strong relationship between environmental pollution and e-waste [30]. Research on air pollution has shown that activities at e-waste sites, including dismantling and burning, produce hazardous emissions that may have damaging health effects [27]. Workers at these sites are also exposed to dust via inhalation, ingestion and dermal contact, which may contain harmful levels of heavy metals [31]. Moreover, Aliyu et al., [32], provides an overview of the known health effects of polychlorinated biphenyls (PCBs) in children residing near an E-waste facility and potential risk of postnatal exposure via breastfeeding.

2. Methodology

The survey was designed to obtain information about the generation of household e-waste. This investigation will be interviewed residents directly to achieve information about the purchase of electrical and electronic equipment and preferences disposal. The survey instrument was adopted from the United Nations Environment Programme E-waste assessment methodologies [33]. To investigate the behaviour of consumers, the survey questionnaire distributed to households to obtain information about the pattern of e-waste disposal them. The questions devised to know the following points: the type and number of electronic products, time to use and store electronic devices. The study was conducted in Surabaya, East Java. The household samples composed of high, middle, and lowincome groups. These groups were drawn from five regions of Surabaya that represent the northern, western, eastern, central, and southern localities. The study areas within these localities will be randomly selected. Sample size determination in health studies by WHO will be applied to determine the number of householders that will be recruited. Lwangga and Lemeshow [34], describe that to estimate a population proportion with specific absolute precision will require a confidence level of 95%, an anticipated population proportion of 50% and absolute precision of 10 percentage points. Based on this, the table of estimating a population proportion with specific absolute precision requires a sample size of 96 for each district. Thus, total number of subjects for this study is 480 households. Once knowing types of and quantity of electrical and electronic equipment owned by residents in Surabaya, then estimated the potential of electronic waste generated may be generated each type of items. The calculation electronic waste generation aims to determine the estimated potential rate of generation of e-waste in Surabaya. The type of equipment that is used as a study of any equipment owned by the residents. Then, calculated each the type based on the life span of the product. The data needed to calculate the rate of generation of e-waste such as quantity equipment, weight of the product, and the lifetime. The determination of the average the lifespan equipment used in an earlier study conducted by Oguchi et al. [35].

$$E = \frac{\left[\frac{W.N}{L}\right]}{\text{Number of respondent}}$$

Where:

E = Potential generation of e-waste (kg/year)
W = Average of weight of equipment (kg)
N = The number of unit equipment per type
L = Average of lifespan (year)

3. Result and Discussion

A study conducted in five regions in Surabaya to obtain information on potential waste generation from household electronics. From the survey results was obtained various types of electronic products such as refrigerators, washing machines, televisions, blenders, computer, mobile phone, radio, air conditioner, etc. The Ownership of the electronic equipment in accordance with the socioeconomic conditions of each household. According to the results of a survey conducted on 480 respondents was obtained a percentage of each type and amount of electrical and electronic equipment owned by the community. The ownership of electronic products is summarized in tables 1.

The table 1 below describes the proportion of types of and number of electrical and electronic equipment belonging by households in Surabaya. Generally, the dominant electronic equipment includes television, refrigerator, iron, fan. It can be seen from the quantity of product that is greater than the number of respondents or in other words more than 50%. Thus, it is explained that the ownership of the equipment is required to support the daily activities of the respondent. For example, fan and mobile phones are the type most items owned by the respondent which is approximately 688 units and 791 units respectively. Furthermore, toasters and microwaves are rare products owned by a resident of roughly 133 units.

Table 1. The electrical and electronic equipment owned by the respondents

No.	Appliances	Regions of Surabaya					Total
		East	West	North	South	Centre	
1	Television	131	147	126	142	138	684
2	Fan	127	191	134	112	124	688
3	Iron	115	105	122	105	127	574
4	Refrigerator	81	95	98	79	96	449
5	DVD/VCD	76	85	101	106	98	466
6	Washing Machine	59	57	48	65	75	304
7	Laptop	110	89	101	115	121	536
8	Desktop computer	35	57	67	61	68	288
9	Air Conditioner	64	69	56	62	71	322
10	Mixer	37	31	52	56	61	237
11	Radio	31	35	41	39	39	185
12	Camera digital	20	17	37	42	51	167
13	Blender	76	92	102	80	112	462
14	Rice cooker	104	115	112	112	114	557
15	Toaster	22	15	22	36	38	133
16	Printer	39	52	72	56	59	278
17	Monitor	35	57	67	61	68	288
18	Portable game	21	21	41	43	51	177
19	Microwave	10	15	38	32	38	133
20	Hand phone	135	154	155	178	169	791

Table 2. The calculation of e-waste generated by type of electronic equipment

No.	Appliances	Type	Size	Weight (Kg) A	Amount B	Lifespan (Year) C	Total weight (AxB)	Potential generation of e-waste (AxB)/C
1.	Television	LCD	21”	5.1	112	22.5	571.2	25.387
			29”	8.5	87		739.5	32.867
			32”	10.5	49		514.5	22.867
			40”	18.67	33		316.98	14.088
		LED	32”	11	55		605	26.889
			40”	16.48	39		642.72	28.565
		CRT	14”	9.34	135		1,260.90	56.04
			21”	20.47	79		1,617.13	71.872
			29”	39.07	95		3,711.65	164.962
2.	Fan	Wall		4	68	8.3	272	32.771
		Desk		4.25	57		242.25	29.187
		Stand		9.6	366		3,513.60	423.325
		Box		0.6	118		70.8	8.53
		Celling		5	79		395	47.59
3.	Iron			0.5	574	10	287	28.7
4.	Refrigerator	1 door		31.82	314	11.8	9,991.48	846.735
		2 door’s		65.6	135		8,856	750.508
5.	DVD/VCD			1.8	466	7	838.8	119.828
6.	Washing Machine	Top door with 1 tube		27.25	137	10.1	3,733.25	369.628
		Top door with 2 tubes		41.5	101		4,191.50	415
		Side door with 1 tube		67.5	66		4,455	441.089
7.	Laptop		10”	1.38	225	7.4	310.5	41.96
			12”	1.9	212		402.8	54.432
			14”	2.5	99		247.5	33.446
8.	Desktop computer			4.2	288	6.6	1,209.60	183.272
9.	Air Conditioner		1 pk	31.16	95	12.7	2,960.20	233.086
			¾ pk	28.9	227		6,560.30	516.559
10.	Mixer			1.65	237	5	391.05	78.21
11.	Radio			4.5	185	9.5	832.5	87.631
12.	Camera digital			0.17	167	10	28.39	2.839
13.	Blender			2.57	462	5	1,187.34	237.468
14.	Rice cooker		1 L	2.8	145	8.3	406	48.915
			2 L	3.2	277		886.4	106.795
			2.5 L	4	135		540	65.06
15.	Toaster			3.54	133	5	470.82	94.164
16.	Printer			4.8	278	7.1	1,334.40	187.943
17.	Monitor	LCD	15”	4.4	101	14.6	444.4	30.438

		CRT	15”	7.9	187		1,477.30	101.184
18.	Portable game			0.3	177	10	53.1	5.31
19.	Microwave			12.2	133	13.2	1,622.60	122.924
20	Hand phone			0.115	791	4.3	90.965	21.154
Total								**6209.218**

The table above shows the rate of generation of e-waste generated by people in Surabaya. There are several types of products are used as research, such as television, refrigerator, rice cooker, laptops, monitors and mobile phones. The survey shows that the refrigerator is a type of equipment that generates the greatest generation rate is around 1597.24 Kg.n/year. Furthermore, cellular phone is one type of electronic products most widely held by the respondent. However, the results indicate a mobile phone only contributes around 21.154 Kg.n/year on e-waste generation. In addition, the survey shows that the household has a television and a fan in a variety of types of. Both types of these products contribute around waste generation 443.57 Kg.n/year and 541 403 Kg.n/year respectively. A study performed by Peralta and Fontanos [36] concerning the estimated generation of electronic waste in the Philippines in 2010, explained that there are about 445.300 units of refrigerators, televisions around 943,000 and washer around 576.700 units are becoming obsolete. Furthermore, waste generation electronics, especially computers in the city of Gaborone, Botswana was also significant around 658 tons and is estimated to increase about 3.574 tons in 2015 [37].

In order to calculate the average potential generation of e-waste generated in the city of Surabaya, it is necessary to know the average of waste generated per person. For example, below is the calculation of the number of potential generation of e-waste generated by the community in the city of Surabaya.

- Statistical data Surabaya's population in 2012 is used to calculate projected future population. Geometric methods used to estimate the count [38]
- Total e-waste generation = 6209.218 kg/year
- The survey was conducted on 480 respondents with an average family of four people, so there are 1920 people who will be the basis for calculating projected waste generation.
- Thus, by using the formula:

$$E = \frac{\left[\frac{W.N}{L}\right]}{\text{Number of respondent}}$$

$$= \frac{6209.218 \text{ kg/year}}{1920}$$

$$= 3.234 \text{ kg/year}$$

Based on data from BPS Surabaya, reported that the population of the city of Surabaya in 2012 is approximately 3,125,576. Thus, the estimated rate of generation of e-waste can be seen in the table below.

Table 3. The estimation of e-waste generation in Surabaya

No.	Year	Population Projection	Average E-waste generation (Kg/Year)	Estimation of E-Waste Generation
1	2012	3,125,576	3.234	10,108,112.78
2	2013	3,278,729		10,603,409.59
3	2014	3,439,387		11,122,977.56
4	2015	3,607,917		11,668,003.58
5	2016	3,970,155		12,839,481.27
6	2017	4,164,692		13,468,613.93
7	2018	4,368,763		14,128,579.54
8	2019	4,582,832		14,820,878.69
9	2020	4,807,391		15,547,102.49
10	2021	5,042,953		16,308,910.00
11	2022	5,290,057		17,108,044.34
12	2023	5,549,271		17,946,341.9
13	2024	5,821,185		18,825,712.29
14	2025	6,106,423		19,748,171.98

Figure 1 below provides an illustration relating to the place when it was first purchased. Additionally, the graph illustrates that the majority of respondents, approximately 82% buy electrical and electronic products from the supermarket. In addition, households that obtain equipment from a friend about 5%. Interestingly, there are approximately 12% of respondents bought electrical and electronic tools from the second hand market. There are similarities to Malaysia in a way to obtain electrical and electronic equipment is currently owned. A study conducted by the Ministry of the Environment of Japan in collaboration

with the government of Malaysia reported that approximately 93% - 97.2% of people who buy electric and electronic products in stores or supermarkets [39]. Furthermore, there were no detailed statistical data about the source location of purchase electrical products and electronics in Vietnam [40].

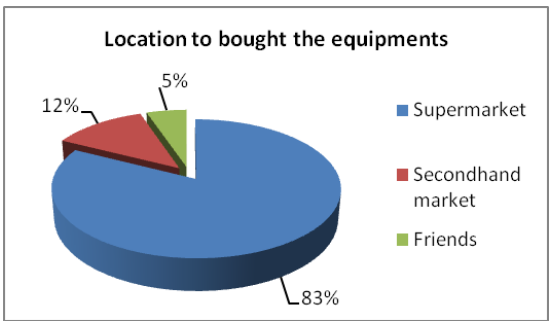

Figure 1. The location to purchased the equipments

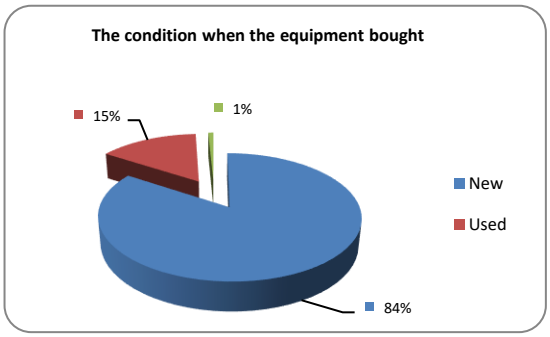

Figure 2: The condition when the equipments purchased

Figure 2 above provides information regarding the condition of electrical and electronic devices when purchased. The diagram testified that approximately 84% of the population obtain equipment that is new and has never been used before. In addition, roughly 15% of households bought the products in a condition that has been used. In addition, a small portion of respondents that purchased electrical and electronic tools in a damaged condition only around 1%. There is a detailed explanation of the reasons for purchase in the damaged condition. Generally, there is a similar condition to purchase electrical products and electronics in Malaysia and Cambodia [39,41].

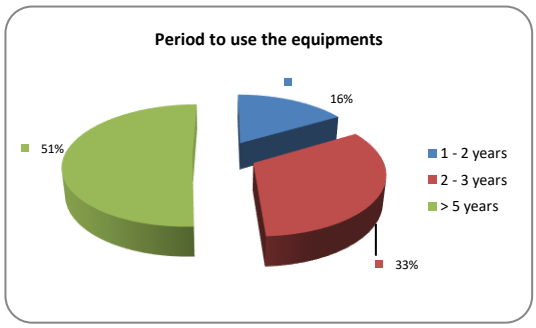

Figure 3: Period to use the equipments

The information about the lifespan of the electrical and electronic appliances based on figure 3 above can be explained as follows. There are approximately 51% of people in Surabaya that uses electrical and electronic equipment over five years. Furthermore, households that use the equipment for 2-3 years is around 33%. In addition, there are around 16% of respondents who utilize electrical appliances for 1-2 years. A study conducted by the Ministry of the Environment in collaboration with MONRE Vietnam and EX Corporation reported that the average lifespan of the use of electronic devices in Vietnam is around 5-10 years [40]. Moreover, Peralta and Fontanos [36] found that the lifetime of electronic equipments in the Philippines is around 8-10 years.

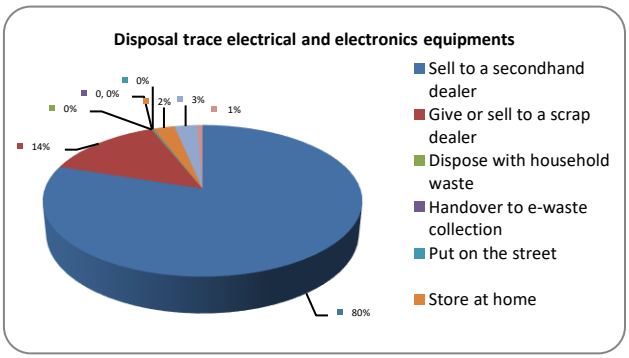

Figure 4. Disposal traces electrical and electronic equipments

There are various ways of respondents in terms of disposal of electrical and electronic products if it had not used any more, for example, is sold back to the second hand, donated, stored at home and sold to someone's. This study explores the trace information regarding the disposal of electrical and electronic equipment. As the results shown in Figure 4 above. According to the picture revealed that the majority of the respondent around 81% sells the electrical and

electronic devices that are not used anymore to a second hand dealer. Furthermore, the diagram also provides information that there are no electrical and electronic appliances damaged or used that disposed with domestic waste or dumped on the street. In addition, the household also keep at home or donate electrical and electronic equipment that are not used anymore about 2% and 1% respectively. In addition, a study on the issues of electronic waste in the Philippines also provides information that is similar to the condition in Surabaya, where only about 15% of obsolete electronic equipment brought into the landfill [36]. Further, Widyarsana [42] underlines that difficult to find the e-waste disposed to landfill in Indonesia. When the electrical and electronic equipment that is obsolete, these products in the E-waste collected by various collectors in Thailand [43].

Environmental legislations

Generally, there are numerous legal framework and applied to the management of electronic waste [44]. For instance, one of the regulations governing e-waste is the Basel Convention. This Regulation supervises the trans-boundary movement of hazardous wastes and disposal of electronic waste. This guideline is one of the most inclusive environment agreements to hazardous waste in the globe. There are two main objectives to be achieved from the implementation of the Basel Convention, namely to protect human health and the environment from the adverse impact resulting from the generation, management, trans boundary movements and disposal of hazardous and toxic wastes. In 2009, the Basel Convention has conducted a number of workshops related to e-waste in the Asia Pacific region. In addition, two important initiatives have been developed to the Basel Convention in order to encourage private sector participation in the management of e-waste. Moreover, Japanese government to provide financial assistance to the secretariat of the Basel Convention to establish the Basel Convention Partnership on Environmentally Sound Management of e-waste in the Asia Pacific region in 2005. In 2003, Japan also proposes the development of the Asian Network for Prevention of Illegal Trans boundary Movement of Hazardous waste to provide solutions that trans boundary movements of e-waste.

The Indonesian government does not provide any specific regulations associated with the issues of electronic waste management. However, Indonesia has ratified the Basel Convention through Presidential Decree No. 61 Year 1993. Thus, to be able to regulate the management of e-waste is used hazardous waste regulations. The Law of the Republic of Indonesia Number 23 Year 1997 regarding Environmental Management stated that the management of hazardous waste generated from an activity is to become the responsibility of each stakeholder. Furthermore, in Article 7 of Government Regulation number 85 of 1999 governing the management of hazardous waste. This regulation provides a definition and classification of hazardous waste into three categories. For example, hazardous wastes from non-specific sources, specific sources and unused materials containing or contaminated with hazardous chemicals. Additionally, Agustina [45], noted that there are other legislations that govern the management of e-waste, such as, the Minister of Trade No. 63/M-DAG/PER/12/2009. The regulations governing the import of second-hand product reconditioning or reuse of used products. In addition, the Minister of Trade No. 39/M-DAG/PER/ 9/2009 managing the importation of Non Hazardous Wastes and Decree of the Minister of Industry and Trade No. 520/2003 concerning the prohibition of imports of hazardous waste.

Despite there are some rules that have been binding on all stakeholders related to the management of e-waste, there are loopholes that can be exploited by those who want to make a profit because the waste management is often governed by industrial consumers. This Law, however, does not state financial or legal penalty specified for meeting the requirements. Business segment which does not fulfil with compensation only has to withdraw or discontinue its product sales in the market. In addition, waste management in Indonesia was still having a problem because the policy at the national level and enforcement of environmental law was still low at the local level. For example, in 2005 the level of municipal waste management services around 41.3%. Consequently, in order to implement the Law of environmental protection laws and protect consumers, the Indonesian government established the Consumer Protection Agency which aims to protect consumers by conducting legal research and review, research on the quality of products, information dissemination and receipt of complaints about consumer protection and surveys on demand consumers.

4. Conclusion

The amount of e-waste will continue to increase in the estimates in the city of Surabaya. It is influenced by the average life of products is one indicator of consumer behaviour before recycling and final disposal. The majority of the population has electrical and electronic equipment that varies in accordance with their needs. Households prefer new equipment compared to buying a second hand product and use the product until it cannot be used anymore. The results showed that the estimated waste generated from electrical and electronic equipment will be greater in the future. Thus, it may affect the generation of e-waste and have a significant influence on the socioeconomic, environmental and human health. E-waste management in Surabaya is at an early stage, there is no doubt there

are several challenges in the management of e-waste in Surabaya. Reduction of the volume generated is one option that can be done in the management of e-waste. The technical standards and public-private partnerships and the government is absolutely necessary in order to handle hazardous materials contained in the e-waste stream. Reinforcement laws and regulatory sectors also strongly support the successful management of electronic waste. Public participation should be promoted within the framework of e-waste management related to the impact of e-waste on the environment and public health. In order to obtain a further situation regarding the management of electrical and electronic waste in Surabaya need to do further research on the entire scientific viewpoint. Thus, the management of e-waste could completely protect the environment and human health.

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