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Environmental and Information Safety of End-of-Life Electronics

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Abstract: With the introduction and expansion of ICT, there has been an increase in e-waste and the environmental safety on e-waste. An empirical study was conducted in Benin City using a well-designed questionnaire distributed among university college students in higher education, telecommunication providers, civil servants, computer dealers, computer technicians, and e-waste collectors in order to suggest a framework for e-waste management and the environmental safety of these e-waste on the health of the people living in such area where they are found. Averages of four hundred respondents have been surveyed. The data was analyzed using SPSS, and the findings show that the human eye is inadequate for e-waste management and environmental safety tools. The findings also revealed a well-known horrible way of thinking closer to the safety of statistics in damaged systems, owing primarily to a lack of information and the inconveniences associated with it. To address this, a framework and a functional online net web site have improved, which are based on reputation and sensitization of e-waste management and environmental safety of e-waste disposal. This tool has been suggested as a proper e-waste management and environmental safety tool.

Keywords: End-of-life electronics, Policy, Regulations, Environmental Safety, e-waste disposal

1. Introduction

In the digital age, it has become imperative for both individuals and companies to store data on electronic devices like computers, smartphones, and a variety of other gadgets while also wishing for this data to stay private [1]. Older electronic equipment will inevitably need to be disposed of when newer technologies advance since they are deemed obsolete and can sometimes be exported to be fixed, refurbished, or repurposed, which is mainly thought of as a sure way to extend their lifespan [2].

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Global reports on the rise in improper waste management have been made public by plastic pollution. With a growing global population and rising per capita consumption brought on by economic expansion, waste output is also rising. A total of 25 Mt worth of selected raw .materials were found in e-waste in 2019, with a value of $57 billion USD. Global e-waste may expand quickly during and after COVID-19, driven by demands for electronics owing to remote working and home schooling [3] in addition to previously expected increases in e-waste and notwithstanding the pandemic's economic impact. In order to prevent security breaches like identity theft, credit card fraud, and other computer crimes, the research suggested several suggestions to individuals and corporations on how to properly dispose of their computers [4].

This paper is organized as follows. Section 2 presents, the literature survey, Section 3 presents the proposed methodology, Section 4 represents the results analysis and lastly in Section 5 the conclusions and future recommendations are presented.

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2. Literature survey

The author Thomas [4] identified the absence of action plans in African nations, and the lack of infrastructure for proper and sustainable e-waste management as the major challenge facing proper e-waste management in Africa. They observed that the fastest growing and most valuable home waste stream in the world is e-waste. High levels of export from developed to developing countries are being driven by the growth in e-waste manufacturing. A large portion of the world's electronic garbage is amassing in open landfills in various African nations. Using the information at hand, we estimate that 5.8 to 3.4 metric tons of electronic garbage will be produced domestically and imported into Africa in 2019. They however predicted that in the next 30 years, the generation of e-waste is expected to increase by more than 100% globally. The use of EEE is still relatively low in Africa, but it is expanding at an astounding rate. For instance, e-waste in Senegal, Uganda, and South Africa is projected to rise by a factor of two to eight over the next ten years, and e-waste inflows into Ghana were predicted to double over the three-year period between 2017 and 2020, but there is currently no new data to confirm these projections. However, they did not identify the safety of the data that still remain in damaged system before disposing and the security of such information.

Also reverse logistics is the process of controlling the upstream flow of recovered goods from the customer to the supplier. Reverse logistics is a risky procedure that needs the assistance of the top management to run successfully because to the financial and operational constraints that may have an impact on a company's performance. There are several definitions of reverse logistics in the literature, all of which have different scopes and restrictions. Reverse logistics is described as "the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal" by the Council of Logistics Management.

Reverse logistics, according to [5] does not always begin at the point of consumption and need not be returned to the site of origin because products can move backwards inside the supply chain's intermediate stages. In a similar vein, [6] suggests that the reverse logistics process entails the methodical reception of shipped goods or parts from the place of consumption for remanufacturing, recycling, or disposal. Return management offers businesses the chance to acquire a competitive edge by reducing costs and increasing customer happiness, but it is frequently ignored [7]. Nevertheless, the security and safety of information in damaged system was not given addressed by these researchers which form the bases of this study [8-9].

3. Methodology

This study focused on discarded computers imported into Benin City which ends up mostly at electronic waste dumpsites in various places in Benin as shown in Fig. 1 and Fig. 2.

3.1 Design of study

The study adopted the cross-sectional research design which allows the research to be carried out in a natural setting without the control and manipulation of the variables. The design analyses data collected from a population or a representation subset at a specific point in time. The advantage with this design is that it allows statistical inferences to a broader population so that results can be extrapolated. Civil Servants, Students, Technicians, Waste Collectors and Others in Benin City form the population of the study. The total population of Benin City as of 2021 was 1,782,000.

3.2 Data collection and analysis

Data collection was done through the administration of a structured questionnaire to people of the selected sections. The questionnaires were screened for completeness by the researcher, for analysis. Descriptive statistics, simple percentages, mean and standard deviation were utilized to depict or evaluate the knowledge, attitude and practices of the respondents to e-waste data security.

Fig. 1: A section of e-waste dump site in Benin City.

Fig. 2: Recyclers at the Benin City e-waste dump site.

4. Analysis of Results

IBM SPSS software was used to analyze the results of the survey. Table. 1 below shows the data view of the results in SPSS, where the data was entered after coding and Table. 2 shows the variable view of the analysis in SPSS where the data are defined and edited.

Table. 1: Data view of the SPSS analysis (Clean, unistall and software are "no" for all cases)

S/N	Gender	Device	Purchase	Service Center	Visited	Disposed	Format	Delete	Install	Restore	Consider	Family
1	male	no	no	no	no	yes	no	no	yes	yes	yes	no
2	male	no	no	no	no	yes	no	no	yes	yes	yes	no
3	male	yes	no	no	no	yes	no	no	yes	yes	yes	no
4	male	yes	no	no	no	yes	no	no	yes	yes	yes	no
5	female	yes	no	no	no	yes	no	yes	yes	yes	yes	no
6	female	yes	yes	no	no	yes	no	yes	yes	yes	yes	no
7	female	yes	yes	no	no	yes	no	yes	yes	yes	yes	no
8	female	yes	yes	no	no	yes	no	yes	yes	yes	yes	no
9	male	yes	yes	no	no	yes	no	yes	yes	yes	yes	no
10	male	yes	no	no	no	yes	no	yes	yes	no	yes	no
11	male	yes	no	no	no	yes	no	yes	yes	no	yes	no
12	male	yes	no	no	no	no	no	yes	yes	no	yes	no
13	male	yes	no	no	no	no	no	yes	yes	no	yes	no
14	male	yes	no	no	no	no	no	yes	no	no	yes	no
15	male	yes	no	no	no	no	no	yes	no	yes	yes	yes
16	male	no	no	no	no	no	no	yes	no	yes	yes	yes
17	male	no	no	no	no	no	no	yes	no	yes	yes	yes
18	male	no	no	no	no	no	no	yes	no	no	yes	yes
19	male	no	no	no	no	no	yes	yes	no	yes	yes	yes
20	male	no	no	no	no	no	yes	yes	no	no	yes	yes
21	male	yes	yes	no	no	no	yes	yes	no	no	yes	yes
22	male	yes	yes	no	no	no	yes	yes	no	yes	yes	yes
23	male	yes	yes	no	no	no	yes	yes	no	yes	yes	yes
24	male	no	yes	no	no	no	yes	yes	no	yes	yes	yes
25	male	yes	yes	yes	yes	no	yes	yes	no	yes	yes	no

Table. 2: Variable view of the SPSS analysis

S/N	Name	Type	Width	Decimals	Labels	Values	Missing	Column	Align	Mesure	Role
1	Interview ID	Numeric	0	0	Interview ID	1, Male	None	15	Right	Normal	Input
2	Gender	Numeric	0	0	Gender	1, Yes	None	0	Right	Normal	Input
3	Device	Numeric	0	0	Device	1, Yes	None	0	Right	Normal	Input
4	Purchase	Numeric	0	0	Purchase	1, Yes	None	0	Right	Normal	Input
5	Service Centre	Numeric	0	0	Service Centre	1, Yes	None	0	Right	Normal	Input
6	Visited	Numeric	0	0	Visited	1, Yes	None	0	Right	Normal	Input
7	Disposed	Numeric	0	0	Disposed	1, Yes	None	0	Right	Normal	Input
8	Format	Numeric	0	0	Format	1, Yes	None	0	Right	Normal	Input
9	Uninstall	Numeric	0	0	Uninstall	1, Yes	None	0	Right	Normal	Input
10	Delete	Numeric	0	0	Delete	1, Yes	None	0	Right	Normal	Input
11	Install	Numeric	0	0	Install	1, Yes	None	0	Right	Normal	Input
12	Restore	Numeric	0	0	Restore	1, Yes	None	0	Right	Normal	Input
13	Consider	Numeric	0	0	Consider	1, Yes	None	0	Right	Normal	Input
14	Clean	Numeric	0	0	Clean	1, Yes	None	0	Right	Normal	Input
15	Software	Numeric	0	0	Software	1, Yes	None	0	Right	Normal	Input
16	Family	Numeric	0	0	Family	1, Yes	None	0	Right	Normal	Input

Table. 3: Do you dispose of the remaining e-waste in your house

		Frequency	%	Valid Percent	Cumulative Percent
Valid	Yes	209	52	52.3	52.3
	No	191	47.5	47.8	100
	Total	400	99.5	100	NA
Missing	System	2	0.5	NA	NA
Total		402	100	NA	NA

Table. 4: Do you delete data from hard drives

		Frequency	%	Valid Percent	Cumulative Percent
Valid	Yes	176	43.8	44	44
	No	224	55.7	56	100
	Total	400	99.5	100	NA
Missing	System	2	0.5	NA	NA
Total		402	100	NA	NA

Results of some of the analysis that was carried out suing IBM SPSS, we could observe from Table. 3 above that 209 persons which represents 52.0% will disposed of the remaining of their e-waste in their house and 191 persons which also represents 47.5% do not disposed of the remaining of their e-waste in their house also in Table. 4, 176 persons who represent 43.8% of the total population under study will delete information from their hard drives before disposing them and 224 which represents 55.7% do not delete information from their hard drives before disposing them which will eventually expose the information on these devices to malicious people to commit crime against the owner and hazardous compound into the environment which will endanger the safety lives

5. Conclusion and Recommendations

Most people or establishment disposes off their computers when it has outlasted its usefulness. The task however is that, many of these computers would be discarded without considers the safety of the environment which in turn endangers the lives of its inhabitants. In this study it is however concluded that indeed e-waste is being disposed without due regard to the safety of the environment as the results revealed that about 65.2% of the survey conducted have never visited any e-waste service center. It is quite apparent that most users are unaware of the safety of the environment while disposing their e-waste. It is crucial to create some form of public awareness in both academia and public circles on the danger of not properly discarding our e-waste into the environment and to ensure the safety of lives when doing so. This study is among other several studies that will help in improving the safety of lives in the environment when disposing our e-waste. Future research is needed on intelligent recycling systems, intelligent sorting technology and improved e-waste logistics.

Conflict of Interest

The authors declared "No conflict of interest".

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