

ELECTRONIC WASTE MANAGEMENT PRACTICES AND PERFORMANCE OF INTERNET SERVICE PROVIDERS IN KENYA

¹ Onzere Martin Mugami, ² Dr. Thomas Mose, PhD

¹Msc. Student (Information Communication Technology), Jomo Kenyatta University of
Agriculture and Technology, Kenya

²Lecturer, Jomo Kenyatta University of Agriculture and Technology, Kenya

ABSTRACT

Internet Service Providers play a crucial role in enabling connectivity among individuals and businesses by utilizing a range of technologies such as landline telephony, mobile networks, and internet services. Telecommunication companies in Kenya face several challenges that hinder their sustainable performance, despite the rapid growth of the sector. The general objective of this study is to assess the influence of electronic waste management practices on environmental performance of Internet Service Providers in Kenya. Specifically, it sought to determine the influence of E-Refurbishment on environmental performance of Internet Service Providers in Kenya and to examine the influence of E-Safe Disposal on environmental performance of Internet Service Providers in Kenya. According to the communication authority report (2023), in Kenya there are Tier 1 (n=4), Tier 2 (n=35) and Tier 3 (n=113), N=152 ISP companies which are also categorized as network infrastructure service providers by CA market segmentation. The unit of analysis was 152 Internet Service Providers while the unit of observation was 304 respondents comprising of operations manager and the chief executive officers working with the Internet Service Providers. The study used Krejcie and Morgan (1970) formula to arrive at the sample size. The study used simple random sampling to select 173 respondents. This study also used questionnaire to collect data relevant to this study. Quantitative data collected was analyzed using descriptive statistical techniques which are frequencies, mean, standard deviation. Inferential statistics which include Pearson correlation and the Regression Analysis Model was used to test the relationship between study variables. The significance of the model was tested at 5% level of significance. Data was analysed using Statistical Package for Social Sciences (SPSS) software. The study results were presented through use of tables and figures. The study concludes that electronic waste refurbishment has a positive and significant effect on performance of Internet Service Providers in Kenya. The study also concludes that electronic waste safe disposal has a positive and significant effect on performance of Internet Service Providers in Kenya. Based on the finding, the study recommends that the management of internet service providers in Kenya should adopt a structured electronic waste refurbishment program to restore and reuse outdated but functional equipment. By refurbishing devices, ISPs can reduce capital expenditure on new equipment, expand service coverage in underserved areas cost-effectively, and support sustainability goals.

Key Words: Electronic Waste Management Practices, Environmental Performance, Internet Service Providers, E-Refurbishment, E-Safe Disposal

Background of the Study

The telecommunications industry is a vital driver of economic growth, social development, and national security in a country (Kabera, Nishimwe & Mukurarinda, 2023). It facilitates seamless communication, enabling businesses to operate efficiently and expand their markets through digital platforms. The industry enhances financial inclusion by supporting mobile banking and digital payments, fostering economic participation. In governance, telecommunications enable e-government services, improving transparency and public service delivery (Okoye & Odoh, 2023). Additionally, it plays a crucial role in education and healthcare by providing access to online learning and telemedicine. The sector also contributes to job creation, infrastructure development, and technological innovation, positioning the country for global competitiveness (Mor, *et al*, 2021).

Telecommunication companies significantly impact the economy. They provide essential infrastructure that supports a wide range of industries, from finance to healthcare. Businesses rely on robust telecommunication networks for daily operations, customer interactions, and data transmission. Moreover, the telecommunications sector itself contributes to job creation and economic growth, as it requires a skilled workforce for maintenance, development, and customer service (Rimantho & Nasution, 2020). By enabling efficient communication, telecommunication companies help drive productivity and innovation across various sectors. Telecommunication companies also play a crucial role in promoting digital inclusion and bridging the digital divide (Doan, *et al*, 2022). Access to reliable communication services is essential for education, healthcare, and economic opportunities. By expanding their networks into underserved and rural areas, these companies help ensure that more people can participate in the digital economy. This effort is particularly important in a world increasingly reliant on technology, as it allows individuals and communities to access information, online resources, and educational tools that can enhance their quality of life (Adon, Farid & Ayse, 2022).

E-waste management practices involve systematic approaches to handling discarded electronic devices to minimize their environmental impact and promote resource recovery. E-Refurbishment refers to the practice of repairing and upgrading used electronic devices to extend their lifespan and usability, thereby reducing the amount of waste generated (Adanu, Gbedemah & Attah, 2020). E-Safe Disposal encompasses the responsible disposal of e-waste that cannot be recycled or refurbished, ensuring that hazardous materials are treated properly and do not end up in landfills (Abenezer, 2022). This study sought to assess the influence of e-waste management practices and sustainable performance of telecommunication companies in Kenya.

Statement of the Problem

Telecommunication companies in Kenya face several challenges that hinder their sustainable performance, despite the rapid growth of the sector. One of the most significant issues is infrastructure development. Although Kenya has made strides in expanding its network coverage, particularly in rural areas, gaps remain (Gachuru, 2022). According to the Communications Authority of Kenya, as of 2022, mobile penetration stood at approximately 130% but still reflects disparities in access between urban and rural populations. In many rural regions, lack of reliable electricity and road infrastructure poses significant barriers to expanding telecommunications services, which can limit customer acquisition and service delivery. Another major challenge is regulatory compliance and the evolving policy environment (Simiyu, Wabwoba & Rono, 2023). The Kenyan government has implemented various regulations aimed at increasing competition and protecting consumer rights, such as the introduction of the Mobile Termination Rate (MTR). While these regulations aim to enhance service delivery, they can also impose additional costs on telecommunication companies (Anyango & Munyugi, 2022). For instance, the imposition of high taxes and levies, such as the 15% Value Added Tax on mobile data, has raised concerns among operators about

their profitability. According to the Kenya Private Sector Alliance (KEPSA), these regulatory pressures can stifle innovation and investment in new technologies, making it difficult for companies to maintain a sustainable competitive edge (Muhani, 2022).

Environmental sustainability poses a critical challenge for telecommunication companies in Kenya. The sector generates substantial electronic waste (e-waste), with an estimated 50,000 tons of e-waste produced annually, according to the National Environment Management Authority (NEMA). Many companies struggle to implement effective e-waste management practices, which can lead to environmental degradation and reputational risks (Wambui, 2021). As global awareness of sustainability grows, failing to address these environmental concerns could hinder the long-term viability of telecommunication operators in Kenya, as consumers increasingly demand environmentally responsible practices from the companies they support. The increasing prevalence of cyber threats and data privacy concerns presents a significant challenge. With a surge in digital services, telecommunication companies are responsible for protecting vast amounts of personal data (Gachuru, 2022). According to a 2021 report by Serianu, cybercrime cost the Kenyan economy about \$3 billion annually, highlighting the urgency for companies to invest in robust cybersecurity measures. Failure to safeguard customer data not only jeopardizes user trust but can also result in substantial financial penalties and operational disruptions, making sustainable performance even more challenging in an increasingly digital landscape (Simiyu, Wabwoba & Rono, 2023).

E-waste management practices significantly influence environmental performance by promoting resource conservation and economic efficiency. Effective management of electronic waste contributes to a circular economy, reducing the reliance on virgin materials and minimizing environmental degradation (Anyango & Munyugi, 2022). Various studies have been conducted in different parts of the world on e-waste management practices and sustainable performance. For instance, Gachuru (2022) assessed on e-waste management and its effect on employee performance. Simiyu, Wabwoba and Rono (2023) conducted a study on a critical evaluation of the environmental effects of the existing e-waste management practices and Wambui (2021) examined on e-waste management practices in government ministries. However, none of these studies focused on e-refurbishment and e-safe disposal on environmental performance of telecommunication companies in Kenya. To fill the highlighted gaps, the current study sought to determine the influence of e-waste management practices (e-refurbishment and e-safe disposal) on environmental performance of Internet Service Providers in Kenya.

Objectives of the Study

General Objective

The general objective of this study is to assess the influence of e-waste management practices on performance of Internet Service Providers in Kenya

Specific Objectives

- i. To determine the influence of electronic waste refurbishment on performance of Internet Service Providers in Kenya
- ii. To examine the influence of electronic waste safe disposal on performance of Internet Service Providers in Kenya

LITERATURE REVIEW

Theoretical Review

Innovation Diffusion Theory

Innovation Diffusion Theory (IDT) is a framework that seeks to explain how new ideas, practices, and technologies spread within and between social systems. Developed by Rogers

(1962), the theory emphasizes the process by which innovations are communicated over time among the members of a social group (Steuer, 2020). At its core, IDT identifies several key elements that influence the adoption of innovations, including the characteristics of the innovation itself, the communication channels used to disseminate information, the social system in which the innovation is introduced, and the individual adopter's characteristics (Ideho, 2021). One of the central components of IDT is the attributes of innovations, which are factors that determine how likely an innovation is to be adopted. Rogers identified five key attributes: relative advantage (the perceived benefits of the innovation compared to existing solutions), compatibility (how well the innovation aligns with existing values and practices), complexity (the perceived difficulty of using the innovation), trialability (the ease with which the innovation can be tested), and observability (the visibility of the innovation's results to others). These attributes play a critical role in shaping perceptions and, consequently, the rate of adoption among potential users (Ngethe, 2021).

Another significant aspect of IDT is the adoption process, which occurs in several stages: knowledge, persuasion, decision, implementation, and confirmation. During the knowledge stage, potential adopters become aware of the innovation. In the persuasion stage, they form opinions about the innovation, which can lead to a decision to adopt or reject it (Sugow, 2022). Implementation involves putting the innovation into practice, and confirmation is the stage where adopters seek reinforcement of their decision, either strengthening their commitment or leading to discontinuance if the innovation does not meet expectations. IDT also emphasizes the importance of social networks and communication channels in the diffusion process. Innovations are often spread through interpersonal communication among peers, opinion leaders, and early adopters who influence others within their social networks. This social aspect highlights that the diffusion of innovations is not merely a linear process but rather a complex interplay of individual choices and social dynamics (Yasir & Kulecho, 2021). This theory is relevant in determining the influence of E-Refurbishment on performance of Internet Service Providers in Kenya.

Unified Theory of Acceptance and Use of Technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology (UTAUT) was developed by Venkatesh, Morris, Davis, and Davis in 2003. This model was introduced as a comprehensive framework to consolidate and unify eight prominent theories of technology acceptance, including the Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), and Social Cognitive Theory, among others. The UTAUT model was formulated to better explain user intentions to use information systems and the subsequent usage behavior, particularly in organizational contexts. It identifies four core determinants of user acceptance: Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions.

According to UTAUT, these four constructs influence behavioral intention and actual use of technology, while gender, age, experience, and voluntariness of use act as moderating variables that affect the strength of these relationships. For example, younger users may be more influenced by effort expectancy (ease of use), while experienced users may be more concerned with facilitating conditions. The model offers a robust framework for predicting technology adoption and has been widely applied in fields such as mobile commerce, e-learning, healthcare IT, and enterprise systems. UTAUT has since been extended into UTAUT2 (2012), which adapts the model for consumer use by adding constructs such as hedonic motivation, price value, and habit, making it more applicable in commercial and everyday settings. This theory is relevant in examining the influence of E-Safe Disposal on performance of Internet Service Providers in Kenya.

Conceptual Framework

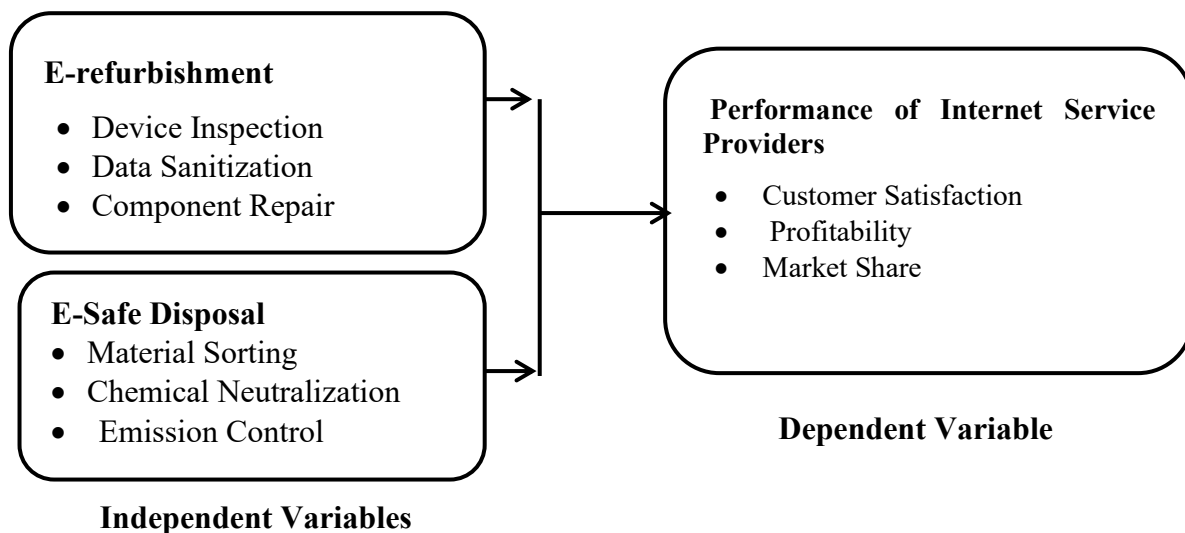


Figure 2. 1: Conceptual Framework

E-Refurbishment

E-Refurbishment involves the process of repairing, upgrading, and restoring used electronic devices to extend their lifespan and enhance their usability (Steuer, 2020). This practice typically includes inspecting and fixing faulty components, replacing outdated parts, and installing updated software to ensure the devices function properly. E-Refurbishment not only helps reduce electronic waste by keeping devices out of landfills but also provides affordable alternatives to new products for consumers (Ideho, 2021). Device inspection is a vital initial step in the e-refurbishment process, where used electronic devices are thoroughly assessed for functionality and condition. This stage involves checking for physical damages, operational issues, and the overall performance of the device (Ngethe, 2021). Trained technicians evaluate components such as screens, batteries, and internal hardware to determine whether they can be repaired or require replacement. The inspection process not only identifies issues that need addressing but also helps categorize devices based on their potential for refurbishment or recycling (Sugow, 2022). By ensuring that only quality devices are refurbished, this step enhances the reliability and performance of the final products, ultimately leading to greater customer satisfaction and reduced electronic waste.

Data sanitization is a crucial aspect of the refurbishment process, ensuring that all personal and sensitive information is securely removed from electronic devices before they are resold or recycled. This process involves the use of specialized software or physical destruction methods to wipe data from hard drives, solid-state drives, and other storage media. Proper data sanitization protects individuals' privacy and complies with data protection regulations, making it essential for businesses and consumers alike (Yasir & Kulecho, 2021). By implementing rigorous data sanitization procedures, refurbishers can mitigate the risk of data breaches and enhance consumer confidence in purchasing refurbished products. This practice not only safeguards sensitive information but also contributes to a responsible approach to electronic waste management.

Component repair focuses on restoring malfunctioning or damaged parts of electronic devices to extend their lifespan and improve functionality (Ideho, 2021). This process can involve replacing broken screens, repairing circuit boards, or rejuvenating batteries, among other tasks. Skilled technicians utilize various tools and techniques to fix these components, often enhancing performance and reliability (Yasir & Kulecho, 2021). By addressing specific issues

rather than discarding entire devices, component repair promotes sustainability and reduces electronic waste. Furthermore, repaired components can significantly lower the cost of refurbished products, making them more accessible to consumers. This practice not only aligns with environmental goals but also supports a circular economy by maximizing the use of existing resources and minimizing the need for new materials (Sugow, 2022).

E-Safe Disposal

E-Safe Disposal refers to the environmentally responsible method of discarding electronic waste (e-waste) to minimize harm to human health and the environment (Hideyuki *et al*, 2020). This process ensures that hazardous materials found in electronic devices, such as lead, mercury, and cadmium, are handled and disposed of properly. E-Safe Disposal involves utilizing certified e-waste recycling facilities that adhere to regulations and standards for safe handling, recycling, and disposal (Adane & Zelalem, 2022). Material sorting is a critical process in e-waste recycling that involves the separation of different materials obtained from dismantled electronic devices. This step is essential for maximizing resource recovery and ensuring that each material is processed using the appropriate methods. Common categories include metals, plastics, glass, and circuit boards, each requiring specific recycling techniques (Otieno & Omwenga, 2020). Effective sorting allows for higher recycling efficiency, as materials can be directed to specialized facilities that handle them best. Additionally, this process helps in identifying hazardous substances that need special care, thereby minimizing environmental risks. By promoting efficient material sorting, recycling facilities can significantly reduce the volume of e-waste sent to landfills and increase the availability of valuable recycled materials for new products (Cherutich, 2020).

Chemical neutralization is a vital safety procedure in the management of hazardous materials found in electronic waste, such as batteries and circuit boards. This process involves treating harmful chemicals to render them non-toxic or less hazardous, thereby preventing environmental contamination (Anyango & Munyugi, 2020). For example, acidic or toxic substances can be neutralized through specific chemical reactions that stabilize them, making them safer for disposal or further processing. Chemical neutralization is essential not only for protecting environmental health but also for ensuring compliance with regulations regarding hazardous waste. By incorporating this process into e-waste management, facilities can mitigate risks associated with toxic materials and contribute to a safer and more sustainable recycling ecosystem (Adane & Zelalem, 2022).

Emission control refers to the measures taken to manage and reduce the release of pollutants into the atmosphere during the recycling and processing of electronic waste (Cherutich, 2020). This is particularly important due to the potential release of harmful substances, such as heavy metals and volatile organic compounds, during various stages of e-waste processing, including shredding and thermal treatment. Effective emission control strategies include the use of advanced filtration systems, scrubbers, and other technologies designed to capture and neutralize pollutants before they can escape into the environment (Anyango & Munyugi, 2020). By implementing robust emission control measures, recycling facilities can minimize their environmental footprint, protect public health, and adhere to regulatory standards. This commitment to responsible practices not only fosters a cleaner environment but also enhances the overall sustainability of the e-waste recycling industry (Otieno & Omwenga, 2020).

Empirical Review

E-Refurbishment and Performance

Steuer (2020) investigated on what institutional dynamics guide waste electrical and electronic equipment refurbishment and reuse in urban China? The study will used a different field of WEEE management, namely to refurbishment and reuse practices by formal and informal actors, focusing mainly on the investigation of the interaction between formal and informal

rules. The study found that the well-evolved informal institutional system is, however, not the only effective mechanism that refurbishes WEEE in China. As exemplified by the case of Taolü Huanbao, formal-private activities can also generate organizational and operational mechanisms that work well. In contrast to the informal systems, Taolü Huanbao emphasises transparency in its refurbishment and sale of obsolete devices. With regards to the future of WEEE refurbishment in China, the study concluded that any assessment has to take a number of elements into account. The first element concerns the future demand of secondhand devices in China. In contrast to the high demand for cheap, repaired electronics in the 1990s and 2000s, current urban consumer demand is increasingly focused on new products. However, there are at least three exceptions to this rule.

Ideho (2021) investigated on E-waste management by refurbishment: a case study of Lagos state, Nigeria. This research combines both quantitative and qualitative methods. Quantitative survey data enabled sample opinions from the target population. The use of key informant interviews was also utilized as a measure of reliability and validity of data. They were chosen according to their profession and activities in the electronic industry. Applying the quota sampling method helped to further specify the target group by dividing them into the stakeholder groups listed above. 100 participants were chosen from the four groups. The study found that although Nigeria has ratified the Basel Convention on Trans-boundary movement of hazardous waste and their disposal; it has not taken determined steps to address the growing need for a formal e-waste refurbishing plant as well as addressing the rising environmental pollution that is taking place as a result of improper disposal methods. The study concluded that In relation to electronic devices, the spike in growth and manufacture rate in this industry, defeats the ideology behind the Green Technology revolution. The electronic industry, though presumed to be embracing the Green IT initiative, churns out devices faster than they are consumed hence the need for refurbishment.

Ngethe (2021) investigated the influence of electronic waste refurbishment in Kenya. a critical literature review. The study adopted a desktop literature review method (desk study). This involved an in-depth review of studies related to influence of electronic waste management systems in Kenya. The search was done generally by searching the articles in the article title, abstract, keywords. Reduction of the literature to only fully accessible publications yielded specificity and allowed the researcher to focus on the articles that related to influence of electronic waste management systems in Kenya which was split into top key words. The study found that Most of the e-waste activities have not yet been regulated thus making it impossible to know the e-waste handlers and there level of awareness on the hazardous nature of e-waste. While conducting the interviews it was very clear that the waste handlers were not aware of the contents in the EEE that they were handling. The study concludes that the methods employed in e-waste management were still inadequate. Most importers disposed of the undistributed computers and mobile phone at a discounted price to retailers and consumers. Refurbishment was seen as one of the best way disposing electronic waste.

Sugow (2022) researched on the socio-economic impacts of refurbished computers on small and medium enterprises (SME) in Mombasa Kenya, and the role of the formal sector in promoting circular economy. This study investigates the potential impacts of refurbished computers on SMEs in the Mombasa region. a semi-structured interview was used as a guide to facilitate the interview process of this thesis. The SMEs and the CTG's representatives were the key participants in providing their experiences regarding the impact of refurbished computers on their businesses and social life. The results showed economic and social potentials in the effective management of electronic and related accessories in the study area. But the scope of this study is limited to refurbished computers imported by CTG and sold to SMEs as partners. Despite the challenges, such as lack of policies and guidelines on e-waste management, CTG follows international guidelines such as ISO standards to dispose of e-waste

responsibly. The study concluded that that effective e-waste management in the global south could have economic and social potentials for economic growth and societal wellbeing.

Yasir and Kulecho (2021) assessed the critical success factors for implementation of green IT in developing countries: The case of E-waste in Kenya. A questionnaire, interviews and reports were used to collect data. The semi-structured approach of the interviews employed allowed us to achieve an in-depth approach of collecting data. This in turn helped us collect many different views of the subject. The study found that the actors involved under users were many and most of them were professional consumers. These are the banks, telecommunication and education sectors who contributed the highest when it came to disposal of electronic waste. Individuals were also present in count but not as high as the professional consumers were. The study found it ironic that the country now ships out electronic waste that it cannot be able to break down, while on the other hand receiving a lot of e-waste in form of old and out dated computers and laptops. This shows that unless at one point the entry of e-waste is monitored then the refurbishers would be working effortlessly. In conclusion, we found factors that made it highly possible to carry out refurbishing in the country. Furthermore, the question of technology, economic value and the environment was challenged.

E-Safe Disposal and Performance

Hideyuki *et al* (2020) assessed the use and disposal of large home electronic appliances in Vietnam. In order to estimate the amount of discarded appliances and the future trend for e-waste, the following steps were taken. The average lifespan of each appliance obtained from our survey and the electronics production data from the GSO were used to estimate the future trend for e-waste. The amount of discarded appliances was calculated using a population balance model described by Tasaki *et al*. The study found that technology saturation 365 may rapidly boost the electronics industry in Vietnam through foreign investment, making the home appliance demand rise faster than in Japan. On comparing the amount of e-waste estimated in this study with that from the GSO data of 2002 and 2004, our estimate is lower than the GSO figures. This is due to the difference in data sources. The latter is derived only from the GSO survey data in the two particular years, while the former takes into account the reuse and disposal ratios of the accumulated amount of e-waste over a 25-year period. The estimated amount of e-waste generated in Vietnam at present seems relatively small compared to that in Thailand or in the Philippines,⁵ and only a small part of the discarded appliances would directly become e-waste via the existing material recycling process. The rest will be reassembled or refurbished to extend the lifespan, and it seems that e-waste is well handled by the existing treatment system. However, since Vietnam has only outdated treatment systems in craft villages with low capacity and low efficiency, the rapid increase in e-waste will soon cause harmful effects on the environment and public health, as seen in India or China at the present time, unless a proper treatment system is introduced. The study concluded that from the standpoint of material recovery also, Vietnam, in the absence of a proper treatment system, will miss out on acquiring valuable resources of precious metals, which may flow to China, as is the case now.

Adane and Zelalem (2022) researched on E-waste awareness and management among people engaged in e-waste selling, collecting, dismantling, repairing, and storing activities in Addis Ababa, Ethiopia. A cross-sectional study was used to assess the awareness and management of 345 purposely selected e-waste workers including all those who are actively engaged in e-waste buying, selling, dismantling, storing, and transferring. A questionnaire was used to obtain the required information. The findings show that about 92% of the dismantlers, 70% of the sellers, and 55% of the repair and maintenance workers have poor awareness. Three hundred forty-five individuals were included in the survey. Of which, 82 were storekeepers working in health and educational institutions, 100 were repair and maintenance workers randomly selected from 316 registered repairers and maintenance shops, 60 were scavengers and traditional dismantlers

(Qorales), and 102 were old electronic and e-waste-sellers. The study found that Management of e-waste among the study groups is affected by several factors including job type, awareness level, educational status, gender, experience, absence of law enforcement, and presence of trash can. The study concluded that the wrong and inappropriate e-waste management among the study groups indicates that the solid waste management protocol of the city is not working at all. Moreover, the absence of proper e-waste management is an alarm to the existing environmental and human health risks.

Otieno and Omwenga (2020) investigated on E-Waste management in Kenya: challenges and opportunities. The researchers perform an exploratory study and analysis of the current e-waste management trends in the Kenyan landscape, identifies challenges and opportunities with the aim of contextualizing and making sound recommendations on how to address emerging issues in WEEE management. the study found that E-waste has the effect of polluting the environment when burnt or disposed without due diligence; discharging harmful heavy metals such as mercury and lead; depleting the ozone layer; blocking water drainage channels; and causing harmful effects including cancer to living organisms in an ecosystem. The study concluded that Despite the many challenges and harmful effects brought about as a result e-waste, there are many useful benefits including creating employment; generating revenue; and producing waste bi-products which can be used to feed other local industries.

Cherutich (2020) conducted a study on E-waste management in Kenya: a case study of mobile phone waste in Nairobi. This study employed a number of techniques and approaches which included field survey, case study and statistical analysis. The study targeted stakeholders in the mobile phone sector who included government agencies, mobile phone manufacturers, mobile phone network operators and repair shops. The study found that In 2006, NEMA developed the waste management regulation. The Environmental Management and Co-ordination (Waste Management) Regulations 2006 is described in Legal Notice No. 121 of the Kenya Gazette Supplement No. 69 of September 2006. It applies to all categories of waste as provided in the regulation. These include industrial wastes, hazardous and toxic wastes, pesticides, biomedical wastes, and radioactive substances. The regulation applies to E-waste by virtue of their composition, which includes several of the substances listed as hazardous waste. In terms of policy, it is clear that Kenya does not have a policy that deals with mobile phone E-waste. The status of E-waste policy that addresses mobile phone waste management in the country is inadequate. The lack of explicit and detailed mention on E-waste in most legislation has created loopholes in the regulation as the actors in the mobile phone E-waste and NEMA is trying to address this through incorporation of E-waste in the waste management regulations. Also the innovation in the mobile phone sector in most cases is changing must faster than the rate at which regulations are enacted.

Anyango and Munyugi (2020) assessed the E-Waste Management Practices: Policies Strategies and Regulations, In Selected National Institutions, Nairobi, Kenya. The study employed literature review; including institutional record. Key informants interviews and observations. The respondents were drawn from the major potential e-waste generators in the city including: computer and mobile phone importers and assemblers, end users: institutions, formal e-waste recyclers and key ICT and e-waste management institutions including cck and NEMA The study showed that end users are an important link in the production-consumption chain. End users have certain rights including the right to satisfaction of basic needs, right to safety, right to information, right to choose, right to be heard, right to redress, right to consumer education and right to a healthy environment. Unfortunately end users tend to be unaware of some of these rights, for example in Kenya we still have purchase receipts indicating that „goods once sold cannot be returned“ while in developed countries the statement changed to read „if you are not satisfied you get a refund“ The study concluded that The end users‘ reluctance to pay for recycling and disposal services reinforces the notion that nothing goes to waste and that garbage is money. The above perceptions make end users reluctant to freely participate in EoL

management of EEE that has not benefit to them. The study also concluded that there is need to develop a national e-waste disposal system, targeting the process of licensing of key actors and consumer awareness creation.

RESEARCH METHODOLOGY

The study adopted a descriptive research design, which allowed systematic collection and analysis of data describing current conditions within Kenya's Internet Service Providers (ISPs). This design was suitable because it facilitated accurate profiling of operational realities in the sector and supported assessment of the relationship between the study variables, consistent with prior methodological guidance (Kothari, 2018; Kothari & Garg, 2019; Van Manen, 2020).

The target population consisted of 152 licensed Internet Service Providers in Kenya, categorized into Tier 1 (n=4), Tier 2 (n=35), and Tier 3 (n=113) according to the Communications Authority (2023). The unit of analysis was the ISP firm, while the unit of observation comprised 304 senior managers—operations managers and chief executive officers—from these ISPs.

The sample size was computed using the Krejcie & Morgan (1970) formula, yielding 173 respondents from the population of 304. The study applied stratified random sampling to ensure representation across ISP tiers, followed by simple random sampling within each stratum to give each respondent an equal selection probability (Geteria, 2019; Walpole & Myers, 2019).

Primary data were collected using structured questionnaires, selected for their standardization, efficiency, and suitability for management-level respondents (Patton et al., 2016). Prior to data collection, the researcher obtained the required approvals, including a NACOSTI research permit. The questionnaire underwent pilot testing with 17 respondents to assess validity and reliability, in line with Bashir (2018) and Glesne (2019). Data were collected using self-administered online questionnaires, a method chosen for its cost-effectiveness and ability to reach dispersed respondents (Cooper & Schindler, 2017). Introductory communication was issued to respondents, followed by scheduled appointments where the study's purpose and relevance were explained before questionnaire administration.

Quantitative data were coded and analyzed using SPSS version 28, which supports efficient handling of large datasets and clear graphical output. The study employed descriptive statistics (frequencies, percentages, measures of dispersion) and multiple regression analysis to test the relationship between the independent variables and the dependent variable, ISP performance (Y).

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

The researcher sampled 173 respondents who were each administered with the questionnaires. From the 173 questionnaires 153 were completely filled and returned hence a response rate of 88.4%. The response rate was considered as suitable for making inferences from the data collected. As indicated by Metsamuuronen (2017), a response rate that is above fifty percent is considered adequate for data analysis and reporting while a response rate that is above 70% is classified as excellent. Hence, the response rate of this study was within the acceptable limits for drawing conclusions and making recommendations.

Descriptive Statistics Analysis

Electronic Waste Refurbishment and Performance

The first specific objective of the study was to determine the influence of electronic waste refurbishment on performance of Internet Service Providers in Kenya. The respondents were requested to indicate their level of agreement on various statements relating to electronic waste refurbishment and performance of Internet Service Providers in Kenya. The results were as presented in Table 1.

From the results, the respondents agreed the organization regularly refurbishes old ICT equipment for continued use ($M=3.776$, $SD=0.868$). In addition, the respondents agreed that e-refurbishment is frequently used as a cost-saving measure in equipment management ($M=3.731$, $SD=0.564$). Further, the respondents agreed that the organization often restores outdated electronic devices for internal reuse ($M=3.724$, $SD=0.847$).

From the results, the respondents agreed that they use industry-standard methods for ensuring complete data removal ($M=3.711$, $SD=0.811$). In addition, the respondents agreed they prioritize using high-quality parts for component repairs to ensure durability ($M=3.667$, $SD=0.694$). Further, the respondents agreed that staffs receive training on advanced repair techniques for various device types ($M=3.608$, $SD=0.794$).

Table 1: Electronic Waste Refurbishment and Performance

	Mean	Std. Deviation
The organization regularly refurbishes old ICT equipment for continued use.	3.776	0.868
E-refurbishment is frequently used as a cost-saving measure in equipment management.	3.731	0.564
The organization often restores outdated electronic devices for internal reuse.	3.724	0.847
We use industry-standard methods for ensuring complete data removal.	3.711	0.811
We prioritize using high-quality parts for component repairs to ensure durability.	3.667	0.694
Staffs receive training on advanced repair techniques for various device types.	3.608	0.794
Aggregate	3.703	0.763

Electronic Waste Safe Disposal and Performance

The second specific objective of the study was to examine the influence of electronic waste safe disposal on performance of Internet Service Providers in Kenya. The respondents were requested to indicate their level of agreement on various statements relating to electronic waste safe disposal and performance of Internet Service Providers in Kenya. The results were as presented in Table 2.

From the results, the respondents agreed that the organization regularly follows approved procedures for safe disposal of electronic waste ($M=3.823$, $SD=0.816$). In addition, the respondents agreed that hazardous electronic components are consistently separated and disposed of in an environmentally safe manner ($M=3.809$, $SD=0.904$). Further, the respondents agreed that disposal of e-waste is frequently handled through certified environmental agencies ($M=3.787$, $SD=0.761$).

From the results, the respondents agreed that they ensure that all staff involved in chemical neutralization receive comprehensive training ($M=3.744$, $SD=0.869$). In addition, the respondents agreed that their organization actively monitors emissions during the disposal process ($M=3.721$, $SD=0.819$). Further, the respondents agreed that they implement technologies to minimize emissions associated with e-waste disposal ($M=3.700$, $SD=0.844$).

Table 2: Electronic Waste Safe Disposal and Performance

	Mean	Std. Deviation
The organization regularly follows approved procedures for safe disposal of electronic waste.	3.823	0.816
Hazardous electronic components are consistently separated and disposed of in an environmentally safe manner.	3.809	0.904
Disposal of e-waste is frequently handled through certified environmental agencies.	3.787	0.761
We ensure that all staff involved in chemical neutralization receive comprehensive training.	3.744	0.869
Our organization actively monitors emissions during the disposal process.	3.721	0.819
We implement technologies to minimize emissions associated with e-waste disposal.	3.700	0.844
Aggregate	3.764	0.836

Performance of Internet Service Providers

The respondents were requested to indicate their level of agreement on various statements relating to performance of Internet Service Providers in Kenya. The results were as presented in Table 3.

From the results, the respondents agreed that their organization sees a positive increase in market share over the past year ($M=3.874$, $SD=0.715$). In addition, the respondents agreed that sustainable practices contribute to enhancing their market presence ($M=3.851$, $SD=0.822$). Further, the respondents agreed that their customers are aware of their sustainability efforts and value them ($M=3.844$, $SD=0.615$).

From the results, the respondents agreed that they regularly gather feedback from customers regarding their sustainable practices ($M=3.814$, $SD=0.802$). In addition, the respondents agreed that their sustainability initiatives positively impact their overall profitability ($M=3.759$, $SD=0.718$). Further, the respondents agreed that they measure the financial returns of their sustainable practices regularly ($M=3.721$, $SD=0.644$).

Table 3: Performance of Internet Service Providers

	Mean	Std. Deviation
Our organization sees a positive increase in market share over the past year.	3.874	0.715
Sustainable practices contribute to enhancing our market presence.	3.851	0.822
Our customers are aware of our sustainability efforts and value them.	3.844	0.615
We regularly gather feedback from customers regarding our sustainable practices.	3.814	0.802
Our sustainability initiatives positively impact our overall profitability.	3.759	0.718
We measure the financial returns of our sustainable practices regularly.	3.721	0.644
Aggregate	3.811	0.719

Inferential Statistics

Inferential statistics in the current study focused on correlation and regression analysis. Correlation analysis was used to determine the strength of the relationship while regression analysis was used to determine the relationship between dependent variable (performance of Internet Service Providers in Kenya) and independent variables (electronic waste refurbishment and electronic waste safe disposal).

Correlation Analysis

The present study used Pearson correlation analysis to determine the strength of association between independent variables (electronic waste refurbishment and electronic waste safe disposal) and the dependent variable (performance of Internet Service Providers in Kenya) dependent variable. Pearson correlation coefficient range between zero and one, where by the strength of association increase with increase in the value of the correlation coefficients.

Table 4: Correlation Coefficients

		Performance of Internet Service Providers	Electronic Waste Refurbishment	Electronic Waste Safe Disposal
Performance of Internet Service Providers	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	153		
Electronic Waste Refurbishment	Pearson Correlation	.841**	1	
	Sig. (2-tailed)	.001		
	N	153	153	
Electronic Waste Safe Disposal	Pearson Correlation	.856**	.22	1
	Sig. (2-tailed)	.000	.086	
	N	153	153	153

The results revealed that there is a very strong relationship between electronic waste refurbishment and performance of Internet Service Providers in Kenya ($r = 0.841$, p value $=0.001$). The relationship was significant since the p value 0.001 was less than 0.05 (significant level). The findings are in line with the findings of Ideho (2021) that there is a very strong relationship between electronic waste refurbishment and performance

The results also revealed that there was a very strong relationship between electronic waste safe disposal and performance of Internet Service Providers in Kenya ($r = 0.856$, p value $=0.000$). The relationship was significant since the p value 0.000 was less than 0.05 (significant level). The findings are in line with the results of Hideyuki *et al* (2020) who revealed that there is a very strong relationship between electronic waste safe disposal and performance.

Regression Analysis

Multivariate regression analysis was used to assess the relationship between independent variables (electronic waste refurbishment and electronic waste safe disposal) and the dependent variable (performance of Internet Service Providers in Kenya)

Table 5: Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	0.244	0.065		3.754	0.000
electronic waste refurbishment	0.355	0.092	0.354	3.859	0.001
electronic waste safe disposal	0.367	0.095	0.368	3.863	0.000

a Dependent Variable: performance of Internet Service Providers in Kenya

The regression model was as follows:

$$Y = 0.244 + 0.355X_1 + 0.367X_2 + \varepsilon$$

The results revealed that electronic waste refurbishment has significant effect on performance of Internet Service Providers in Kenya ($\beta_1=0.355$, p value= 0.001). The relationship was considered significant since the p value 0.001 was less than the significant level of 0.05. The findings are in line with the findings of Ideho (2021) that there is a very strong relationship between electronic waste refurbishment and performance.

In addition, the results revealed that electronic waste safe disposal has significant effect on performance of Internet Service Providers in Kenya ($\beta_1=0.367$, p value= 0.000). The relationship was considered significant since the p value 0.000 was less than the significant level of 0.05. The findings are in line with the results of Hideyuki *et al* (2020) who revealed that there is a very strong relationship between electronic waste safe disposal and performance.

Conclusions

The study concludes that electronic waste refurbishment has a positive and significant effect on performance of Internet Service Providers in Kenya. Findings revealed that device inspection, data sanitization and component repair influence performance of Internet Service Providers in Kenya.

The study also concludes that electronic waste safe disposal has a positive and significant effect on performance of Internet Service Providers in Kenya. Findings revealed that material sorting, chemical neutralization and emission control influence performance of Internet Service Providers in Kenya.

Recommendations

The study recommends that the management of internet service providers in Kenya should adopt a structured electronic waste refurbishment program to restore and reuse outdated but functional equipment. By refurbishing devices, ISPs can reduce capital expenditure on new equipment, expand service coverage in underserved areas cost-effectively, and support sustainability goals

The study also recommends that the management of internet service providers in Kenya should implement and enforce safe electronic waste disposal policies in compliance with national and international environmental regulations. Proper disposal of hazardous components, minimizes health and environmental risks, protects company staff and communities, and prevents costly legal penalties.

Suggestions for Further Studies

This study was limited to the influence of e-waste management practices on performance of Internet Service Providers in Kenya hence the study findings cannot be generalized to organization performance in other organizations in Kenya. The study therefore suggests further studies on the influence of e-waste management practices on organization performance in other organizations in Kenya.

REFERENCES

- Abenezer, W. (2022). Electronic waste management and disposal methods in Addis Ababa University: Challenges and prospects. *International Journal of Science and Research*, 3(11), 1164–1168.
- Adane, S. A., & Zelalem, K. A. (2022). E-waste awareness and management among people engaged in e-waste selling, collecting, dismantling, repairing, and storing activities in Addis Ababa, Ethiopia. *Environmental Health Insights*, 16(10), 1–8.
- Adanu, S. K., Gbedemah, S. F., & Attah, M. K. (2020). Challenges of adopting sustainable technologies in e-waste management at Agbogbloshie, Ghana. *Hellyon*, 6(1), 1–7.
- Adon, K. I., Farid, S., & Ayse, B. (2022). A critical interrogation of e-waste management in Canada: Evaluating performance of environmental management systems. Retrieved from <https://articlearchives.co/index.php/JLAE/article/view/>

- Anyango, S. O., & Munyugi, L. K. (2022). E-waste management practices: Policies strategies and regulations in selected national institutions, Nairobi, Kenya. *Journal of Environmental Science, Toxicology and Food Technology*, 12(3), 81–92.
- Cherutich, E. J. (2020). E-waste management in Kenya: A case study of mobile phone waste in Nairobi. Retrieved from <http://erepository.uonbi.ac.ke/bitstream/handle/>
- Cooper, D. R., & Schindler, P. S. (2019). *Business research methods* (12th ed.). Boston, MA: Irwin McGraw-Hill.
- Doan, L. T. T., Amer, Y., Lee, S., & Phuc, P. N. K. (2022). Strategies for e-waste management: A literature review. *International Journal of Energy and Environmental Engineering*, 13(3), 157–162.
- Gachuru, G. G. (2022). E-waste management and its effect on employee performance in Nakuru Water and Sanitation Company (NAWASCO), Kenya. *African Multidisciplinary Journal of Research*, 1(2), 378–390.
- Hideyuki, O., Duc-Quang, N., Eiji, Y., & Keiichi, N. I. (2020). Use and disposal of large home electronic appliances in Vietnam. *J Mater Cycles Waste Manag*, 11(1), 358–366.
- Ideho, B. A. (2021). E-waste management by refurbishment: A case study of Lagos State, Nigeria. Retrieved from <https://jyx.jyu.fi/bitstream/handle/>
- Kabera, T., Nishimwe, H., & Mukurarinda, J. (2023). E-waste management in Rwanda: A situational and capacity need assessment. Retrieved from file:///C:/Users/user/Downloads/
- Kothari, C. R. (2019). *Research methodology: Methods and techniques*. New Delhi, India: New Age International.
- Mor, R. S., Sangwan, K. S., Singh, S., Singh, A., & Kharub, M. (2021). E-waste management for environmental sustainability: An exploratory study. Retrieved from <https://pdf.sciencedirectassets.com/>
- Muhani, D. A. (2022). Sustainable e-waste management in manufacturing and processing industries, Industrial Area Nairobi County. Retrieved from <https://dlwqtxts1xzle7.cloudfront.net/>
- Ngethe, D. (2021). Influence of electronic waste refurbishment in Kenya: A critical literature review. *Journal of Environment*, 1(1), 45–60.
- Okoye, A., & Okoye, C. (2023). Assessment of the level of awareness of e-waste management and concern for the environment amongst the populace in Onitsha, Southeastern Nigeria. *Journal of Environmental Protection*, 5(1), 120–134.
- Otieno, I., & Omwenga, E. (2020). E-waste management in Kenya: Challenges and opportunities. *Journal of Emerging Trends in Computing and Information Sciences*, 6(12), 621–665.
- Rimantho, D., & Nasution, S. R. (2020). The current status of e-waste management practices in DKI Jakarta. *International Journal of Applied Environmental Sciences*, 6(1), 1451–1468.
- Simiyu, P. W., Wabwoba, F., & Rono, R. (2023). A critical evaluation of the environmental effects of the existing e-waste management practices in Kenya. *International Journal of Multidisciplinary Research and Publications*, 1(1), 1–4.
- Steuer, B. (2020). What institutional dynamics guide waste electrical and electronic equipment refurbishment and reuse in urban China? *Recycling*, 1(10), 286–310.
- Sugow, Y. (2022). Socio-economic impacts of refurbished computers on small and medium enterprises (SME) in Mombasa Kenya, and the role of the formal sector in promoting circular economy. Retrieved from <https://jyx.jyu.fi/bitstream/handle/>
- Wambui, M. S. (2021). E-waste management practices in government ministries in Kenya. Retrieved from <https://repository.kcau.ac.ke/bitstream/handle/>
- Yasir, & Kulecho. (2021). Critical success factors for implementation of green IT in developing countries: The case of e-waste in Kenya. Retrieved from <https://www.diva-portal.org/>