

APPLICABILITY OF CIRCULAR ECONOMY FOR THE ELECTRONIC WASTE MINIMIZATION IN SRI LANKAN OFFICE BUILDINGS

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Abstract: Electronic equipment is one of the world's fastest-growing waste types. Office buildings can be identified as a major contributor to the electronic waste generation of any country, including Sri Lanka. Several electronic waste management strategies are utilised around the world, including landfilling and incineration, export, urban mining, 3R concept, extended producer responsibility, and circular economy. Among all, the circular economy is considered the best approach for minimising electronic waste in an office building. However, the circular economy concept is not widely used in Sri Lanka. Hence, this research aims to examine the applicability of the circular economy for electronic waste minimisation in Sri Lankan office buildings. To collect the required data, a comprehensive literature review was carried out initially, followed by a questionnaire survey and expert interviews. Manual content analysis was used to analyse the collected data. The findings revealed that the barriers to implementing the circular economy are high cost, lack of skilled labour, limited rules and regulation, limited rules and regulation on the circular economy, lack of continuous monitoring system when issuing the license, and lack of allocated resources for research on the circular economy. Further, conducting awareness-raising campaigns, using electronic equipment responsibly, and enacting electronic waste-related legislations were suggested for the better implementation of a circular economy in Sri Lankan office buildings.

Keywords: Circular Economy (CE), Electronic Waste (E-Waste), Office Building, Sri Lanka (SL), Waste Management.

1. Introduction

In the last two eras, production and consumption of electronic equipment have increased globally due to significant market penetration in developing countries and rises in the worldwide replacement market (Abalansa, Mahrada, & Icely, 2021). Electronic waste (E-waste) has increased over time as a result of urbanisation, due to the rapid growth of the economy and the lifestyle of people changing day to day (Abenezzer, 2015). Normally e-waste contains hazardous chemicals that negatively impact human health and the environment (Amer, Doan, & Lee, 2019). In addition, Tukhareli (2015) mentioned that these contain dangerous substances such as lead, cadmium, mercury, flame retardants, and others. Further, the environmental impact of e-waste is described as air pollution, water pollution, and soil pollution (Edirisinghe, Ranasinghe, & Sandeepani, 2015). Moreover, when e-waste gets accumulated fauna and flora will enter human bodies through foods and it will create various illnesses (Batuwitagwe, 2008). Accordingly, Sandhu and Dhillon (2017) highlighted that safely managing these wastes is a serious issue that many countries are facing nowadays.

There are various concepts are used globally for managing e-waste, for example, landfilling and incineration, export, urban mining, 3R concept, extended producer responsibility, CE, etc. (Lundgren, 2012). Among these, the CE concept has become highly applicable to managing e-waste globally in recent years (International Labour Organization (ILO), 2019; Moraga, Huysveld, Mathieux, & Blengini, 2019). Further, it helps to promote the transition from waste management to recycling and resource recovery (Hekkert, Kirchherr, & Reike, 2017). The CE is the business model which replaces the end-of-life concept with reducing, reusing, alternatively reusing, and recovering the material in the consumption process (Pauliuk, 2018). In the current setting of rising raw material consumption and accompanying environmental concerns, the CE is viewed as a viable answer to resource efficiency challenges (Parajuly, 2017). Further, the CE idea offers more instant solutions to ecological footprints and creates semi-skilled jobs in the market, by bringing innovative ideas to the office building (Xavier, Giese, & Duthie, 2021). finally, able to get economic benefits by saving net material, renewing, and increasing the productivity of land (Batuwitagwe, 2008).

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E-waste is currently a significant problem in Sri Lanka, both nationally produced and imported from other countries (Batuwitagwe, 2008). In addition, E-waste is one of the fastest-growing wastes in the world and this problem affects Sri Lanka as well. E-waste will become an emerging issue soon because the estimated e-waste generation in 2022 is 0.09 million tons in Sri Lanka (Panduawala & Samarakoon, 2020). However, the CE concept is not widely used in Sri Lanka for e-waste management, and a lack of studies has been carried out in Sri Lanka about the application of the CE concept for the minimization of E-waste (Bekchanov & Mirzabaev, 2018). Moreover, the office building has contributed more to E-waste generation when compared to other building types in Sri Lanka (Samarakoon, 2014). According to the author, the E-waste generation in Sri Lankan office buildings is 0.04 million tons by the end of 2021. Due to these reasons, this study is limited to office buildings.

Hence, the purpose of this research is to gain a deeper understanding of the importance of a CE in the electronic industry showing the best practices for handling Information Technology (IT) and Telecommunication equipment waste in office buildings in Sri Lanka. Hence, this research aims to examine the applicability of the CE concept for E-waste minimisation in Sri Lankan office buildings. The remainder of the study is organised as follows. Section 2 described the literature synthesis and section 3 provides the methodology of the study. Further, section 4 presents the prime part, research findings, and discussion. Finally, section 5 presents the conclusions of this study.

2. Literature synthesis

Findings of the comprehensive literature review of the subject area are presented in this chapter. The literature review on types of e-waste in Sri Lankan office buildings, e-waste management strategies available in Sri Lankan office buildings, and circular economic concepts about e-waste management are discussed in this chapter.

2.1. E-WASTE

With rapid economic and technological development throughout the world, a lot of Electrical and Electronic Equipment (EEE) came into human use and markets. Most of these items soon become outdated with the advancements in technology. Thus, these items become waste requiring proper management to reduce their environmental and social impact. This waste, called “E-waste”, is becoming a major issue in both developed and developing countries. In the Sri Lankan context also, the accumulation of E-waste is creating a major issue in waste management.

“E-waste refers to obsolete, broken, or irreparable electronic devices. E-waste is any refuse created by discarded electronic devices and components as well as substances involved in their manufacture or use (Environmental Protection Agency (EPA), 2013). The life span of electronic goods is becoming shorter and the equipment we throw away as unwanted equipment is increasing in number (Abalansa, Mahrad, & Icely, 2021). Accordingly, several types of e-waste can be identified. Generally, e-waste comprises both white goods such as refrigerators, washing machines and microwaves, and brown goods which consist of televisions (TV), radios, and computers that have reached their ends for their current holder (Panduawala & Samarakoon, 2020).

2.2. TYPES OF E-WASTE IN SRI LANKAN OFFICE BUILDINGS

E-waste in Sri Lankan office buildings can be categorized into several types such as temperature exchange equipment, screens and monitors/ consumer equipment, lamps/ lighting equipment, large equipment, small equipment, small IT and telecommunication equipment, monitoring and control instruments, and automatic dispensers. Table 1 comprises the types of wastes identified through literature and examples for each identified waste type.

Table 1: Types of e-waste in Sri Lankan office buildings

Types	Example
Temperature exchange equipment	Refrigerators, Freezers, Air conditioners, Heat pumps
Screens and monitors/ Consumer Equipment	Televisions, Monitors, Laptops, Notebooks, and tablets
Lamps/ Lighting Equipment	Fluorescent lamps, High-intensity discharge lamps, LED lamps
Large equipment	Dishwashing machines, electric stoves, large printing, and copying equipment, photovoltaic panels
Small equipment	vacuum cleaners, Microwaves, electric kettles, electric shavers, radio sets, video cameras, small medical devices, small monitoring, and control instruments
Small IT and Telecommunication equipment	Mobile phones, Global Positioning, Personal computers, Routers, Printers, Telephones
Monitoring and Control Instruments	Smoke detectors; heating regulators; thermostats; measuring, weighing, or adjusting appliances for household or laboratory equipment
Automatic Dispensers	Automatic dispensers for hot drinks; automatic dispensers for hot or cold bottles or cans; automatic dispensers for solid products; automatic dispensers

Sources: (Lenz, Afoblikame, & Karcher, 2019), (Lenkiewicz, 2021), (Barapatre & Rastogi, 2021), (Ranasinghe & Athapattu, 2020) (Forti, Balde, & Garam, 2020)

2.3. E-WASTE MANAGEMENT STRATEGIES IN SRI LANKAN OFFICE BUILDINGS

Landfilling is the practice of dumping waste into the soil which is a widely practiced waste management strategy in Sri Lanka. For landfilling, proper procedures should be followed, such as lining the base with a protective layer, selecting a low groundwater level area, and so on. Further, the incineration process is practiced in Sri Lanka which is the process of burning waste at high temperatures. This procedure necessitates the use of skilled labor (Murugesan, 2020). Urban mining is a waste management strategy rarely practiced in Sri Lanka. This is used to recover valuable materials from e-waste. From an environmental and sustainability standpoint, urban mining of e-waste has the benefits of lowering global carbon footprints through reduced energy consumption as well as lowering natural resource extraction and waste generation (Slaveykova, Couture, & Duquesne, 2019). The 3R concept states that all stages of e-waste management, which emphasize the collection of waste, storage, transportation, recovery, recycling, and disposal, should be done in an environmentally sound manner, while considering working conditions, including the health and safety of those involved and it is used in Sri Lanka (Parajuly, 2017).

2.4. CE CONCEPT

CE with its 3R principles of reducing, reusing, and recycling material clearly illustrates the strong linkages between the environment and economics (Heshmati, 2017). CE models substitute the concept of end-of-life with minimization, alternatively reusing, recycling, reducing, and recovering, material or resources while reducing pollution. Closing the material loop means lowering the need for new raw materials, waste disposal, and energy while boosting economic development, creating new "green" employment, and expanding business opportunities (Hekkert, Kirchherr, & Reike, 2017). Further, Technologies of CE principles reduce leakages and environmental pollution, and lower input uses and costs in the production system by implementing Resource Recovery and Reuse (RRR) measures and recycling the waste. However, the CE concept is not widely practiced in Sri Lanka.

3. Research methodology

This research aims to examine the applicability of the CE for E-waste minimization in Sri Lankan office buildings. Initially, a literature review was conducted to gain in-depth knowledge of the research area. In addition, this study adopted a mixed method to gather primary, collecting both qualitative and quantitative data through semi-structured interviews and questionnaire surveys.

In the questionnaire survey, purposive random sampling was used to select respondents. It is evidenced by Trochim (2007) that, a researcher is bound to get information from a sample of the population that one thinks knows most about the subject matter. So, the questionnaire is adopted as one of the data collection methods to carry out this study. The purpose of the questionnaire survey is to learn about and assess the e-waste management practices used in Sri Lankan office buildings and to investigate the applicability of the CE concept for e-waste minimisation in Sri Lankan office buildings. Accordingly, the middle management level is selected for the data collection and, facility managers and maintenance managers were selected as they are considered the key personnel engaged in waste management in Sri Lanka. A total of forty (40) questionnaires were returned out of sixty (60) which were distributed, equivalent to 66.67% from the total number of respondents, 5% represented Hotels and 7.5% represented hospitals and 10% manufacturing organizations and 77.5% represented organizations of office. More than half of the respondents were from the office building. Further, 15% of respondents had been in the industry for 3 to 5 years, 25% had been in the industry for 5 to 8 years, and 60% had been in the industry for over 10 years. The questionnaire was developed with four sections. The first section is used to collect the respondents' general information. In section two respondents are requested to mention the types of electronic waste used in Sri Lankan office buildings and the waste management strategies used to manage this identified waste. In the third section, respondents are requested to describe waste management practices follow in their industries whereas the fourth section gathered information about the CE concept.

Following the questionnaire survey, expert interviews were conducted as a qualitative approach by industry professionals. The purpose of conducting an interview is to validate the data collected through a questionnaire survey such as the challenges or barriers related to E-waste management in Sri Lankan office buildings and the applicability of the CE concept for e-waste minimization in Sri Lankan office buildings. Employing the semi-structured interview method is preferred in the qualitative approach since the respondents have a structured flow to asking questions to interviewees. This expert interview guideline was also accompanied by open-ended questions in three sections to gather other opinions. Section one is structured to obtain the interviewee's background data. Section II was included to identify challenges or barriers related to E-waste management in Sri Lankan office buildings. Finally, section III is used to assess the CE concept and applicability of the CE concept for the e-waste minimisation in Sri Lankan office buildings. The number of experts was limited to 3 as there is a lack of experts, who are having experience both in e-waste management and CE due to time constraints. The interviewees included engineers and a facility manager with more than 10 years of industry experience in waste management. The profile of the experts who were interviewed for this study is presented in Table 2.

Table 2: The profile of the experts

	Interviewee A	Interviewee B	Interviewee C
Types of organisation	Office building	Office building	Office building
Experience	15	10	10
Current Designation	Facility Engineer	Facility Engineer	Facility Manager

Data analysis entails closely related operations, undertaken to summarise the collected data and organize them to address the research objective (Kothari, 2004). Data collected through questionnaires were analysed in frequency and percentage using Statistical Package for Social Sciences (SPSS), in which charts and tables were used to present the interpreted data. The manual content analysis method was used to analyse the qualitative data.

4. Research findings and discussion

The findings and analysis of the detailed questionnaire survey and expert interviews are presented in this section.

4.1. FINDINGS AND DISCUSSION OF QUESTIONNAIRE SURVEY

4.1.1 E-waste

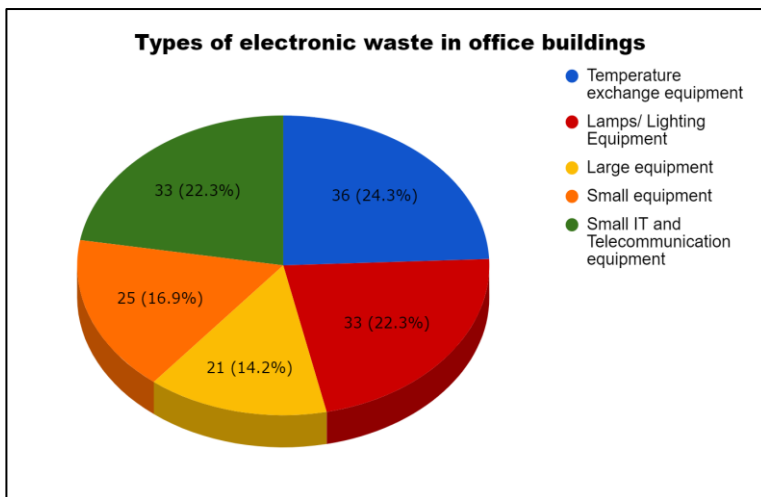


Figure 1: Types of electronic waste in Sri Lankan office buildings

Initially, the types of e-waste in Sri Lankan office buildings are identified using the questionnaire survey. The types of waste considered here are Temperature exchange equipment, Screens and monitors/Consumer Equipment, Lamps/ Lighting Equipment, Large equipment, Small equipment, and Small IT and Telecommunication equipment. As Figure 1 illustrated, 24.3% of respondents said, temperature and exchange equipment such as Refrigerators, Freezers, and Air conditioners are used in their office buildings. 22.3% of respondents said lamps/ lighting equipment and small IT and telecommunication equipment such as Fluorescent lamps, High-intensity discharge lamps, and LED are used in their office. 16.9%

amount of waste is small equipment such as vacuum cleaners, microwaves, electric kettles, and electric shavers. A very low amount of waste is generated by using large equipment such as Dish washing machines, electric stoves, and large printing.

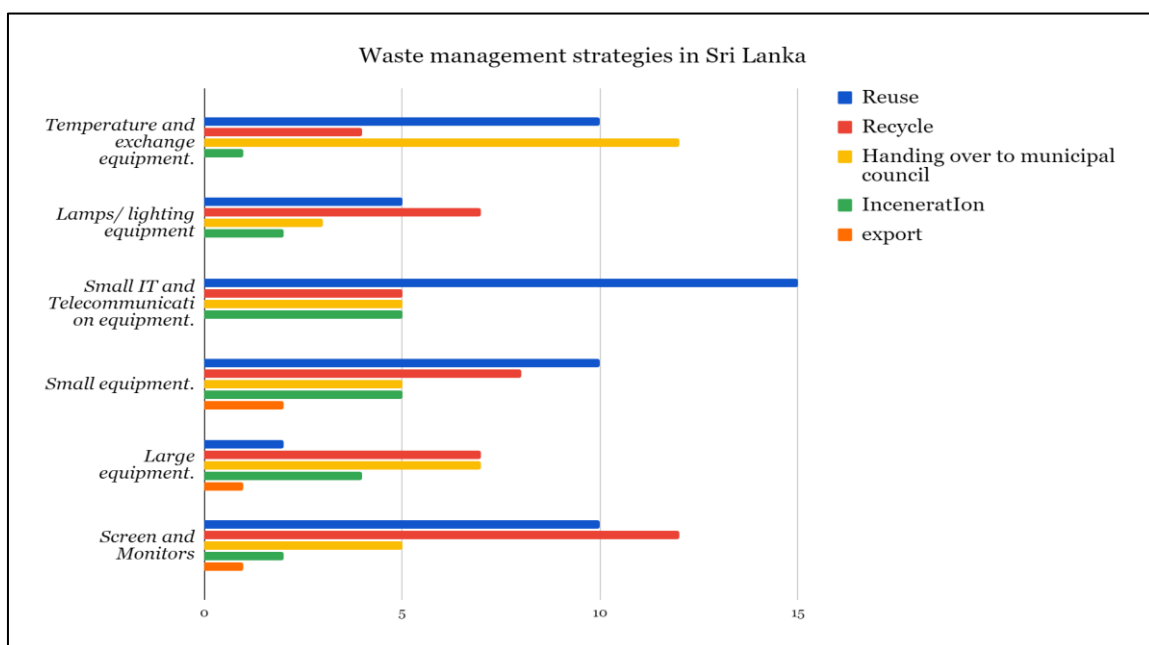


Figure 2: E Waste Management Strategies in Sri Lanka

The waste management strategies such as landfilling, export, recycling, reuse, incineration, and CE are identified in the literature. The applicability of those identified strategies is checked using the questionnaire survey. The results are briefly presented in Figure 2 which is given below. The findings of the literature review on E-waste management strategies such as reuse, recycling, handing over to the municipal council, incineration and export were generally agreed upon by all respondents. By questionnaire survey, it is evident that landfilling, export is a less used method. Moreover, recycling and reuse are identified as the most preferable e-waste management concept. All of the respondents agreed that the identified strategies were effective in the Sri Lankan context. And those strategies are simple to implement in an office building. Nowadays reduction, reuse, and recycling principles and handing over municipal council have been used in an office buildings. As well as, section 4 of the questionnaire identified CE also a trending technology in the present day.

4.1.2. CE concept

The CE concept is addressing the interconnection of economic functions. Thus, the material is reused, and waste minimization (Miao, 2018). The respondent's awareness level of the CE concept is illustrated in Figure 3. Accordingly, 30 respondents were known of the CE concept and 10 respondents were not aware of the CE concept. Hence, a lack of awareness about CE is a key barrier identified through the questionnaire. In addition, the lack of skilled people is one of the major problems for all the new e-waste management through a CE.

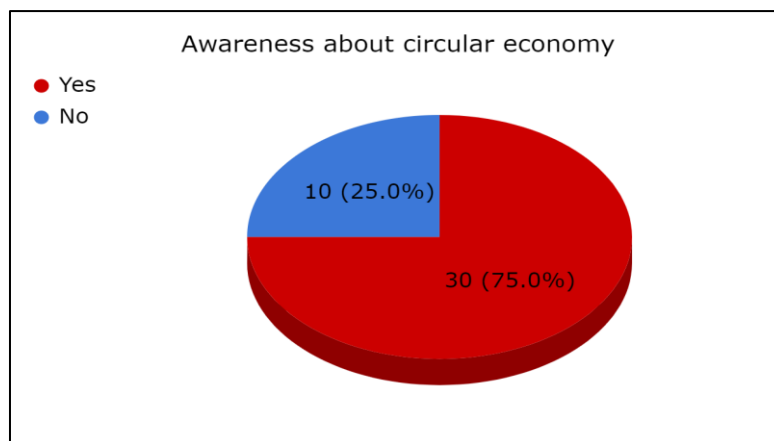


Figure 3: Awareness about circular economy

As illustrated in Figure 4, 30 out of 40 respondents mentioned CE principles. Among those 8 respondents mentioned refusing, 10 respondents mentioned rethink, 30 respondents mentioned about reuse, 8 respondents mentioned about reuse, 15 respondents mentioned repair, 5 respondents mentioned about re-manufacturer, 6 respondents mentioned repurposing, 25 respondents mentioned about recycle, 24 respondents mentioned about recover, 5 respondents mentioned about refurbish. However, reduce, recycle and recover methods most preferred methods among R0-R9 principles.

4.1.3. Current practices on CE in Sri Lankan office buildings

Considering solutions for waste management barriers implementing the CE concept is considered a large impact on the e-waste management process in Sri Lankan office buildings. Figure 5 illustrates that 75.9% of respondents mentioned as currently, they are not practicing the CE concept, and 24.1% of respondents mentioned as they are practicing the CE concept as a waste minimization strategy. Further, most of the respondents are using reduce and reuse principles in their facilities. However, they are not aware that those principles have come under CE principles. So, making awareness among the community is the best practice to increase awareness of this concept.

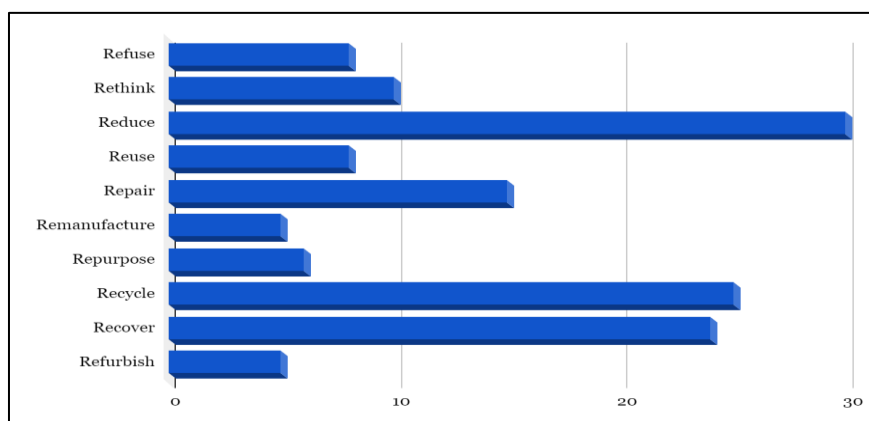


Figure 4: CE principles

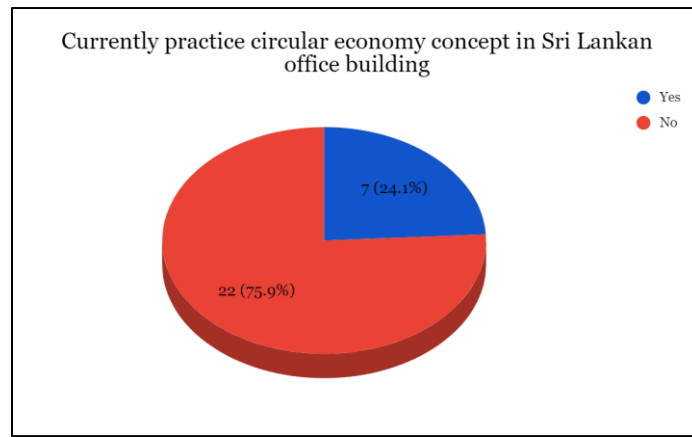


Figure 5: Current practices on CE in Sri Lankan office buildings

4.1.4. *Applicability of CE concept for the e-waste minimization in Sri Lankan office buildings*

The literature review consists of the findings of the CE to achieve the aim of the research. This section of the questionnaire is focused on finding the applicability of CE in Sri Lankan office buildings. Whether applying the CE concept is practically suitable or not. Further, to attain the aim, the respondents were required to rank as, agree, disagree, neutral, strongly agree, and strongly disagree. The findings of this section have been summarized in Figure 6. According to the questionnaire survey, 21 respondents strongly agree to, the CE concept applies to Sri Lankan office buildings. and 9 respondents agree that the CE concept does not apply to Sri Lankan office buildings. However, 9 respondents are neutral on their decision.

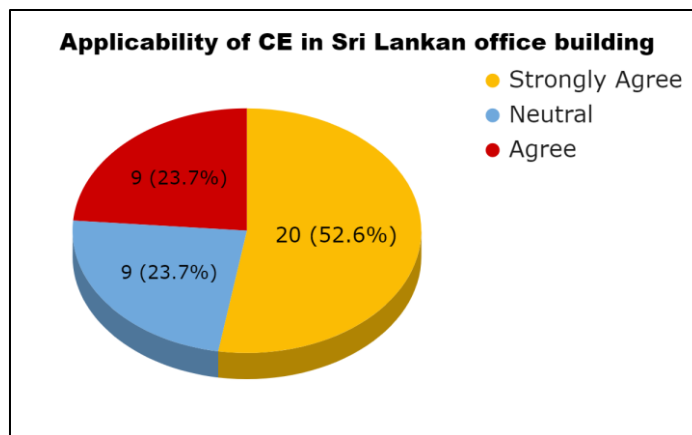


Figure 6: Applicability of CE concept in Sri Lankan office buildings

4.1.5. *Barriers to implementing CE in E-waste minimization in Sri Lankan office buildings*

Questionnaire data shown in Figure 7 showed facility executives and engineers' attitudes and low participation in CE e-waste management. However, it is also influenced by other factors. Most employees tend to adopt an easier approach. 48.3% of respondents strongly disagree that there is a no barriers to implementing a CE. However, 3.5 % of respondents agree that there is a barrier to implementing a CE. 13.8% of respondents are neutral on their decision.

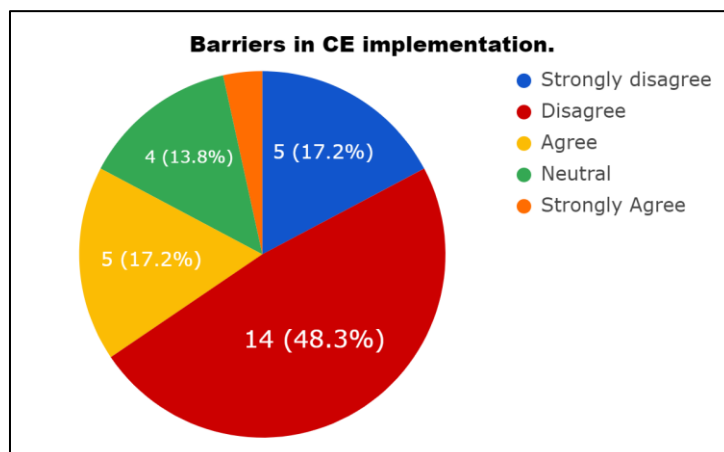


Figure 7: Barriers to implementing circular economy

4.2. FINDINGS AND ANALYSIS OF EXPERT INTERVIEWS

The interviews were conducted with three professionals who are currently working in the industry in Sri Lanka. For the expert interview data was collected through an interview guideline which consists of three sections.

4.2.1. Challenges or barriers related to E-waste management in Sri Lankan office building

Most of the studies indicate the increasing amount of e-waste increases challenges in now a day. There are several challenges in E-waste management. From the interview, there are several challenges identified and details were taken from the interview. Additionally, there are several factors were identified in the literature also regarding the challenges of e-waste. The expert survey assessed the validity of those challenges related to the Sri Lankan Context. Table 4-4 denotes the opinion of the respondents regarding the factors identified.

Interviewees described what were the barriers to e-waste management and they gave more details than the literature review. Interviewee A gave more details and explained how the overall cost is higher than using E-waste management methods. Furthermore, he stated that skilled people were required to conduct waste management procedures in Sri Lanka, which were not practical due to a lack of skilled employees. Interviewee C explained that the “applicability of Sri Lankan context was difficult”. Due to a lack, of knowledge. According to interviewees, the primary challenges to implementing e-waste management procedures in Sri Lankan office buildings were a lack of knowledge and a high cost. To implement new waste management strategies, there should be a skilled and proper waste management team. the proper planning process, there should be a proper management team.

4.2.2. Applicability of CE concept for the e-waste minimization in Sri Lankan office buildings

Expert interviews revealed that avoiding and reducing waste, reusing, and recycling waste are the four main waste minimization measures usually applied in office buildings. However, currently, the R0-R9 concept is not followed in an office building. But can implement through continuous training and awareness. It's not straight forward option. However, it can be implemented step by step.

Barriers to a CE in e-waste minimization were explained by the interviewees within expert interviews. So, this section mainly focuses on barriers to implementing a CE to achieve the aim of the research by analysing the applicability of a CE in Sri Lankan office buildings. Interviewees outlined the barriers to implementing the CE for e-waste disposal and provided further information. Interviewee A gave more details and explained how the cost was higher than using a CE. Moreover, he explained that skilled people were needed to implement a CE in the Sri Lankan context. it was not implemented yet due to a lack of knowledge of skilled employees. Interviewee C explained that lack of fund allocation in the office building for CE projects, and limited rules and regulations on the CE, are the berries to implementing CE. Further, interviewee B, explained limited rules and regulations on the CE, lack of continuous monitoring system when issuing the license and lack of allocated resources for research on the CE are the barriers in implement a CE.

The respondents recommend how to enhance the implementation of CE principles in office buildings in the future. All three respondents mentioned that awareness-raising campaigns should be extensively created and implemented. Furthermore, they have stated that appropriate electronic equipment usage should exist in office buildings to control the e-waste, and implementing e-waste-related laws and regulations or internal policies aligned with the CE concept in Sri Lanka will be a great advantage to improve CE implementation in Sri Lanka. Additionally, Interviewee B specifies that implementing Extended producer responsibility more cohesively will help to improve the implementation of CE principles and which is not available in Sri Lanka.

4.3. DISCUSSION OF FINDINGS

All these identified wastes are available in office buildings. food waste and e-waste are high when compare to other types of waste. initially, the types of e-waste in Sri Lankan office buildings are identified. According to that, the literature reviews classified e-waste into six major types. Such as Temperature exchange equipment, Screens and monitors/ Consumer Equipment, Lamps/ Lighting Equipment, Large equipment, Small equipment, and Small IT and Telecommunication equipment. This was validated through the findings from the expert survey and questionnaire survey. So, it is clear that e-waste can be classified into six categories and all these types are used in office buildings. According to the literature findings, whole over the world, the generation of e-waste rapidly increasing in both developed and developing countries in that Sri Lanka has implemented “E-Waste Management Project in many ways. Further, literature review findings identified Landfilling and Incineration, Export, Urban Mining, CE, 4R concept, and Extended producer responsibility (EPR) are waste management strategies. However, the expert survey identifies the 4R concept (Reduce, Reuse, Recycle, and Recovery), handing over to the municipal council, auction /resell, and Replacing are the identified waste management strategies. However, the questionnaire survey identified, that reuse, recycling, and handing over municipal council are the high-use waste management strategies used in Sri Lankan office buildings. Further, according to studies, electronic equipment selling shops or donating organizations play an important role in e-waste management by producing and marketing original and environmentally friendly electronic appliances. After analysis of the questionnaire survey and expert survey, it is clear that Sri Lankan office buildings are not collecting main equipment from the second-hand market or donating organisations.

Further, the study reveals that even though, there is several e-waste management practices exist in Sri Lanka, there are key barriers that exist in e-waste management. All these factors were validated through expert interviews. Such as the Absence of e-waste regulation in Sri Lanka, the lack of research related to e-waste management, the need huge cost to manage e-waste in Sri Lanka, the low involvement of private sectors, and the shortage of skilled manpower. All these factors were identified in the literature review and validated through expert interviews.

Further, discussed CE practices and their applicability and importance are identified in the literature survey. According to the literature survey, the CE concept is addressing the interconnection of economic functions. Thus, the material is reused, and waste minimization (Miao, 2018). From that expert survey and questionnaire survey respondents identified, that they are well aware of the CE concept and they are not currently implementing this concept in an office building and it mentioned it should be implemented step by step. Further, the literature survey identified, nine CE principles (R0-R9). Expert interviews revealed that preventing and reducing waste, as well as reusing and recycling waste, are the four main waste minimization measures used nowadays in office buildings.

Further, the study reveals that the CE concept is fitting for a developing country like Sri Lanka additionally, the CE could be used to improve economic development since it could fulfil certain needs within the local economy. The key barriers which were identified in the survey when implementing a CE are lack of fund allocation, limited rules, and regulations, lack of continuous monitoring system, lack of allocated resources for research, lack of knowledge of skilled employees, and costs may high compare to buying new equipment. The application of CE in Sri Lankan office buildings is concluded as can implement through continuous training and awareness. It's not straight forward option. However, it can be implemented step by step.

5. Conclusion

Electronic equipment is one of the fastest growing waste types in the current world, which is difficult to manage and costly to handle sustainably. Sri Lanka is now struggling with a large e-waste problem, both domestically produced and imported from other nations. Further, the general public is not much aware of the impact of e-waste. After the COVID-19 pandemic usage of electronic equipment is high in office buildings. So, it should be managed properly. There are several strategies implemented worldwide to manage e-waste and the CE concept plays a vital role. However, the CE concept is not widely used in Sri Lanka for e-waste management. Through this study, it is evident that by implementing the CE concept E-waste consumption will be minimized consequently while recycling wastes across the system. The study reveals that the CE concept is fitting for a developing country like Sri Lanka and, the CE could be used to minimise the accumulation of E-waste in Sri Lankan office buildings. However, lack of fund allocation, limited rules, and regulations, lack of continuous monitoring system, lack of allocated resources for research, lack of knowledge of skilled employees, and costs may high compare to buying new equipment are identified as the key barriers to the implementing a CE concept in Sri Lankan office buildings. Finally, it is proved that the CE concept can be implemented in Sri Lankan office buildings through continuous training and awareness.

The findings of this study will help office building professionals in the industry to implement the CE concept in Sri Lanka to minimise E-waste generation. Therefore, making aware of the CE concept that can be used to minimise E-waste allows better implementation of the CE concept within office buildings. In addition, the research findings can be used as study material when leading awareness programs on the CE concept. Moreover, the findings of this study can help industry practitioners to have a better understanding and more clarity of the importance of CE, the CE implementation, and the possible CE principles for E-waste minimisation that can be beneficial to industry practitioners in their endeavour to implement the CE in their facilities.

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