Effect of Circular Economy Practices on Sustainable Performance of Plastic and Rubber Manufacturing Firms in Kenya

[1*] Catherine Gatari
Lecturer, College of Business, KCA University

*Corresponding Author's E-mail: njokicathygatari@gmail.com

[2*] Stephen Mutiso
Lecturer, College of Business, KCA University

*Corresponding Author's E-mail: stephen.mutiso89@gmail.com

Abstract

Purpose: The purpose of the study was to analyze the effect circular economy practices on sustainable performance of plastic and rubber manufacturing firms in Kenya.

Methodology: Descriptive research design was adopted in this study. The target population of this study included all 82 plastic and rubber manufacturing organizations in Kenya registered as members of KAM according to 2021 directory. The study used a census where all the 82 plastic and rubber manufacturing firms were surveyed. To identify the unit of observation, the head of production and the head of procurement function were selected purposively because they have similar skills, knowledge, experience and exposure in the area of research. This formed 164 respondents. The study used primary data as the main data which was collected using structured and semi structured questionnaires. The collected data was prepared and analyzed with the aid of the Statistical Package for Social Sciences (SPSS) Version 26. Descriptive statistics was used to summarize and organize characteristics of a data set collected which was presented in form of means, modes and standard deviations (Kothari, 2019). Then inferential statistics through a regression model was used to test the research hypotheses. Qualitative data was analyzed using content analysis. The analyzed data was presented in form of tables, graphs, histograms and pie charts. A multiple linear regression analysis was used to establish a mathematical model that explains the relationship between dependent and independent variable.

Results and conclusion: The response rate of the study was 63%. R square value of 0.647 means that 64.7% of the corresponding variation in plastic and rubber manufacturing firms in Kenya can be explained or predicted by (circular procurement, circular design, circular manufacturing, circular distribution) which indicated that the model fitted the study data. The results of regression analysis revealed that there was a significant positive relationship between dependent variable and independent variable at ($\beta = 0.647$), $p=0.000 <0.05$). The findings of the study concluded that circular procurement, circular design, circular manufacturing, circular distribution have a positive relationship with performance of plastic and rubber manufacturing firms in Kenya.

Policy recommendation: The study recommended that plastic and rubber firms should embrace Circular economy practices so as to improve sustainable performance and further researches should to be carried out in other firms to find out if the same results can be obtained.

Keywords: *Circular economy practices, circular procurement, circular design, circular manufacturing, circular distribution, sustainable performance*

1.1 Introduction

According to Camilleri, (2019) circular economy practices have recently received significant attention in academia and within industries to improve sustainable supply chain performance. The concept of a circular economy (CE) began in the 1990s, as the connection between environmental responsibility and organization's sustainable performance. However, only lately has the CE model increased adequate importance, as the manufacturing sector perceived the need to used renewable sources of energy, alternative sources of raw materials, waste reduction and minimizing negative impact to the environmental (Frishammar & Parida, 2019). The consciousness that industries are growing with the continuing and fast global industrialization indicates the need of implementing sustainable supply chain practices and a circular economy. Various organizations and industries across the world have started adopting sustainable supply chain practices and a circular economy in their business operations to alleviate negative environmental concerns, as sustainable supply chain practices and a circular economy result in waste reduction and responsible material usage (Guldmann & Huulgaard, 2020). Manufacturing sector, in spite of it contributing remarkably to world's economic growth and stability, does not bear a good image because of its role in the negative impact to the environment through pollution.

The circular economy is the idea of an industrial economy in which improved resource productivity is encouraged by implementing ways to continually re-use and re-cycle the disposed assets after the end the product life cycle (Rosa, Sassanelli & Terzi, 2019). There are two categories of value chains which one is a linear value chain and other is the closed loop value chain (Ünal & Shao, 2019). In a linear value chain, raw materials are procured then taken through the value addition in manufacturing where after processing is completed, production waste is generated. After production, products are ready for distribution to ultimate customers, which produce logistics waste (Wang, Kara & Hauschild, 2018). In the various distribution channels, packaging waste is produced. Consumption and usage wastes are produced once the product has been consumed. In the linear value chain situation, none of the waste produced in various supply chain stages are further re-used, recycled or re-manufactured (Whalen, 2019). The circular economy is a closed loop value chain where all wastes are collected through the use of proper waste collection channels and returned to the re-manufacturing stage to be recycled and reused (Govindan & Hasanagic, 2018). The circular economy practices ensure there is sustainable supply chain through ensuring considering practices such as eco-design, sustainable procurement, re-manufacturing, re-using, recycling and sustainable consumption. This results into waste reduction and prevention therefore improving environmental performance (Kipruto & Shale, 2018).

1.2 Statement of the Problem

Manufacturing is a significant pillar in supporting economic, environmental and social growth of a country (Ünal & Shao, 2019). According to Yang, Chen, Jia & Xu, (2019) most manufacturing organizations globally only focuses on linear value chain that has a philosophy of procuring raw materials, manufacturing, consumption then disposing off waste resulting to poor sustainable performance. Statistics from the Kenya National Bureau of Statistics- KNBS (2020), revealed that manufacturing posted a growth rate of 3.4 percent, agriculture 4.3 percent, energy 6.4 percent, transport 7.1 percent and building and construction at 9.1 percent. The poor performance can be attributed to increases cost of operations and wastes in the entire supply chain, which should to be addressed through implementation of circular economy practices (Camilleri, M.A., 2019). With the rising global awareness and growing consumer realization over the volumes of natural resources needed for production of goods, the reduction of natural resources by waste and its shortage, industries globally are being pushed to embrace circular economy practices and make their business processes more sustainable (Thorley, Garza-Reyes & Anosike, 2019).

According to Upadhyay *et al.,* (2019) Circular Economy Practices are attracting growing attention as a way to decrease the adverse negative environmental impacts of industries worldwide and to improve sustainable organizational performance. These practices can be used as a way of streamlining procurements, enhancing resource usage and extending products life cycle, reducing water and energy consumption, reducing carbon emissions, plastics and organic waste based on the principles of eco-design, reducing, re manufacturing, reuse and recycling (Mbovu & Mburu, 2018). Despite being confirmed to be economically, socially and environmentally helpful, popular examples of circular economy systems are few today. According to a study by Kipruto and Shale, (2019) their findings indicated that over 70% of manufacturing firms in Kenya are yet to integrate sustainable supply chain practices in their business operations thus affecting their sustainable performance.

Empirical studies on circular economy practices have been carried out before internationally, the remarkable ones include; Gusmerotti et al., (2019), Schroeder, Anggraeni and Weber, (2019) and Lakatos et al., (2018) which found a positive relationship between circular economy practices and sustainable performance of an organization. Locally,

Studies have also been done mainly in the area of green supply chain practices and organizational performance by Ndua and Were, (2018), Njuguna, and Kagiri, (2017) and Samson, (2018) leaving an empirical gap. Therefore, the primary goal of this study was to fill an empirical gap and to assess whether circular economy practices affect the sustainable performance of plastic and rubber manufacturing firms in Kenya

1.3 Objectives of the study

- **i.** To establish the effect of circular procurement on sustainable performance of plastic and rubber manufacturing firms in Kenya
- **ii.** To analyze the effect circular design on sustainable performance of plastic and rubber manufacturing firms in Kenya
- **iii.** To assess the effect of circular manufacturing on sustainable performance of plastic and rubber manufacturing firms in Kenya
- **iv.** To determine the effect of circular distribution on sustainable performance of plastic and rubber manufacturing firms in Kenya

2.1 Literature Review

2.1.1 Triple Bottom Line Theory

Lakatos *et al.,* (2018) argued that Triple bottom line theory grows an organization accomplishment metrics to comprise the contributions to environmental well-being, social health, and a fair economy. This theory focuses on ensuring sustainable performance of an organization in relation to environmental considerations, social responsibility and economic growth (Moktadir *et al.,* 2018). Today, entities and businesses are aware of good achievements in not just focusing their profit and loss statements. Rather, to get a perfect, well-rounded viewpoint of their processes and connections with the environment, people wellbeing, and economy, businesses must fully account for all costs connected with doing business by going past compliance (Kipruto & Shale, 2019). This theory set up the key of long-term strategies for companies making the transition to sustainability, based on three important dimensions of sustainable development: environmental quality, social equity, and economic benefits.

Traditionally, profit has been the bottom line for organizations performance but there has an increased interest towards thinking as to what makes organizations successful and how to measure organization's success and performances (Ndua & Were, 2018). TBL distinguish that the accountant's profit bottom line of measuring an organization's performance has limitations. Therefore, concluding that other elements for determining an organization achievement and performance are required. Other measures needed include: customer satisfaction, growth and development, environmental compliance and social fairness. This requires organizations to appreciate the contributions of the TBL in measuring organizational performance to go beyond the profit bottom line (Lakatos *et al*., 2018). The theory state that, there is need to monitor activities that result to improvement of mutual knowledge and understanding of work requirement and outcomes, discuss performance feedback, pinpoint opportunities for learning and improvements, and assess performance outcomes (Osoro & Atambo, 2016). This way an organization will be able to improve and maintain a conducive workplace environment with continuous value addition, take advantage of changes in the environment, endeavors to achieve strategic objectives, encourages innovation, and supports training and professional development as ways of motivation employees towards improving organizational performance.

2.2 Circular Economy Practices and Sustainable Performance

2.2.1 Circular Procurement

According to Braun *et al.,* (2018) circular procurement is about ensuring that the products that are acquired for your organization are manufactured in agreement with the requirements of circular. The focus is to ensure that those products are designed for durability, reuse, repairability and recycling as well as ensuring an organization maximize the lifespan of the product. By understanding how products need to be disposed at the start of the product cycle, an organization can be better placed to develop the specification, by considering the products' total life cycle costing (Camacho-Otero, Boks, & Pettersen, 2018). Circular procurement seeks to reduce the waste of resources and reduce negative environmental effect within the setting of sustainability in procurement processes. It ensures that goods and services are procured sustainably, by reducing the consumption of resources (raw materials, water, and energy) and the production of waste, as well as improving the efficient use of resources (Moktadir *et al.,* 2018)

To support the circular economy, procuring entities ensure that they procure circular goods and services which are considered recycled or recyclable, eco innovative, eco-designed, bio based, re-usable, repairable, with accessible spare parts or with a warranty that is required to cover a longer period of time. Also, organizations are moving towards signing of circular contracts for using products and services for a specific period of time without taking ownership of them where suppliers are supporting this by ensuring buying back their products after use. Buying organizations are concerned more on paying for use or performance of the product acquired (Ngatara & Ayuma, 2016).

2.2.2 Circular Design

Circular design involved developing product or services designs with special consideration of the impact the product is likely to have in the environment throughout the whole life cycle. It is concerned on creating products where materials are in a closed-loop (Schroeder *et al.,* 2019). This ensures that products can be recycled or reused instead of extracting new materials. It focuses on developing products designs for reuse, design for refurbishment, design for adaptability, design for standardization, design for remanufacture, design for repair, and design for recyclability. The product development stage is a great opportunity consider the potential environmental impact of alternatives, therefore the need to design more environmentally friendly products (Thorley *et al.,* 2019). According to Wang *et al.,* (2018) a proactive circular-design strategy requires an early, high-level approximation of the environmental impacts, when developing product design. Designing products with functionality that supports responsible and healthy living helps an organization save on cost, time, energy, and resources. This again extends the customers' appreciation for organization's brand, and when they no longer need to use the product, they can sell it, refurbish it, or give it away, rather than just throw it out as waste.

2.2.3 Circular Manufacturing

Circular Manufacturing is a developing model in the setting of Circular Economy (CE) where production processes are designed to function as closed loops of materials stressing on produced products which are durable, easy to repair, reuse, remanufacture and recycle (Upadhyay *et al.,* 2019). Circular manufacturing involves production of products through the use of economically-sound processes that reduces negative environmental impacts while preserving energy and other natural resources. Currently most successful manufacturing firms understands that being concerned about the environmental is not only growing their business, but it is also becoming an important part of how their products are promoted, procured and operated. Henceforth, it is imperative to consider sustainability of produced products through various product lifecycle stages (Lakatos *et al.,* 2018). Circular manufacturing may be defined as a strategy that incorporates product and process design aspects with issues of production, planning and control to manage the environmental waste through re-manufacturing, use of alternative sources of raw materials, responsible packaging, refurbishing and maximizing resource efficiency so at the reduce negative impact to the environment (Braun *et al.,*2018).

2.3.4 Circular Distribution

According to Camilleri, (2019) Circular distribution focuses on ensuring that an organization is ken on eco-marketing, environment-friendly packaging, and environment-friendly transportation as ways of ensuring sustainable performance. Waste reduction in the distribution processes such as use of re-usable packaging can result into cost savings and improved competitiveness (Camacho-Otero *et al.,* 2018). As part of outbound logistics, circular distribution has a significant role to play in the connection between environmental innovation and competitiveness in the supply chain. The effect of circular distribution on customer satisfaction has been narrowly investigated (Gusmerotti et al., 2019). Inspiring vendors to use re-usable packages is a strategy of circular distribution initiative that can improve organizations sustainable performance. Lakatos *et al.,* (2018) study indicated that an improvement in customer satisfaction and loyalty in organizations that eco-labeled products. According Schroeder et al., (2019) organizations which packaged their products with re-usable packages in Thailand recorded an increased customer satisfaction in relation to brand loyalty and improved customer service.

2.3.4 Sustainable Performance

According to Camilleri, (2019) sustainable Performance involves integrating and achievement of environmentally and financially feasible practices such as re using, re-manufacturing, recycling, refurbishing and waste management into the comprehensive supply chain lifecycle, from product design and development, to acquiring of raw material, production, packaging, transportation, warehousing, distribution, consumption, return and disposal. All supply chains can be enhanced by means of sustainable practices. Sustainability in the supply chain summarizes a number

of different priorities: environmental responsibility, preservation of resources, waste reduction, cost savings and social responsibility (Sehnem *et al.*, 2019)

Sustainable supply chain performance incorporates social, environmental, and economic concerns when measuring the outcome of supply chain practices. Social aspects encompass use of open and transparent competitive procurement processes, involvement of relevant stakeholders in organizational processes, create rights and obligations, and ensuring decent remuneration and good working conditions, workers' rights to form and collectively bargain (Braun *et al.,* 2018). Environmental sustainability occurs when processes, and activities reduce negative environmental impact of organizations products and operations. Economic sustainability is used to analyze strategies used to enhance proper utilization of resources, adoption of advanced technologies in business operations and efficient allocation of available resources to improve organizational profitability (Lakatos *et al.,* 2018).

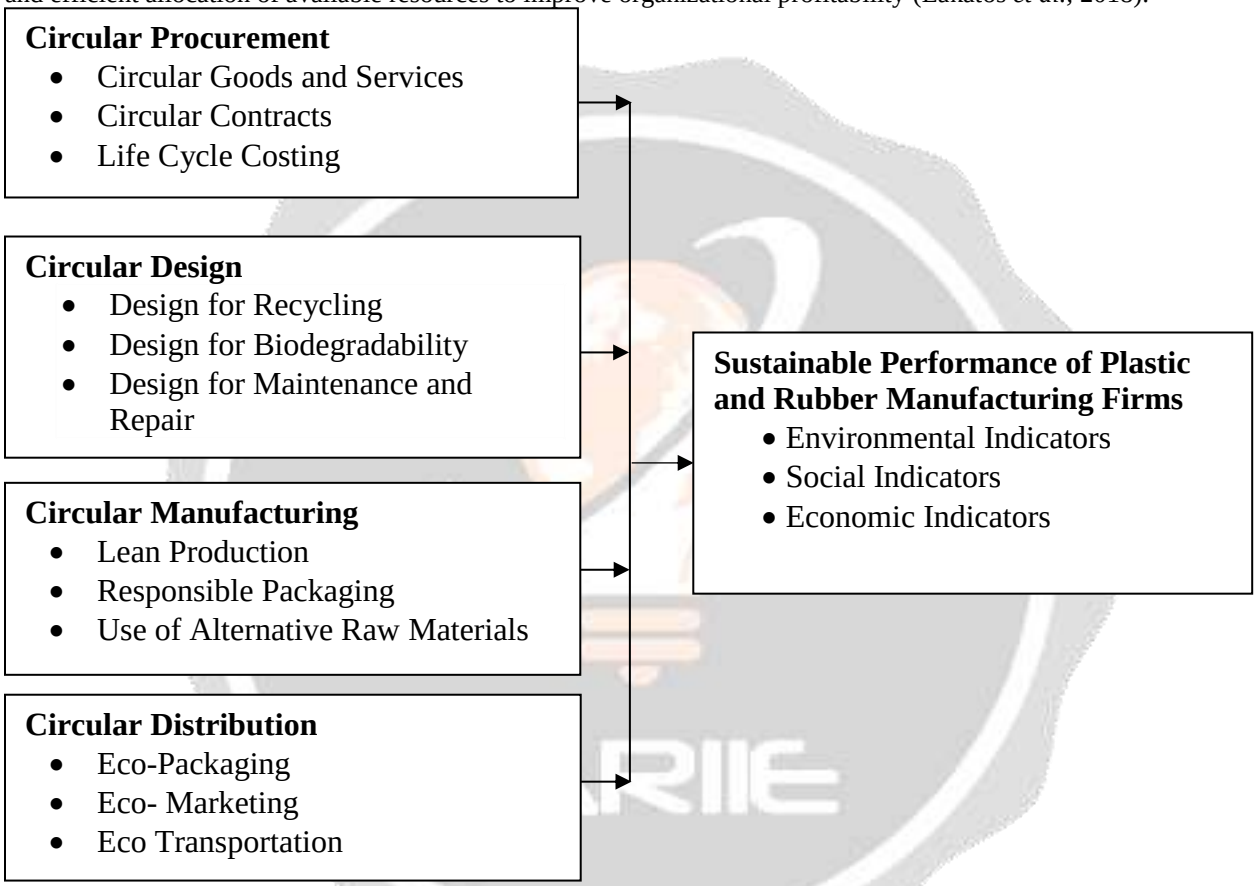

Figure 1: Conceptual Framework

3.1 Methodology

The study proposed the research methodology based on the reviewed theoretical and empirical literature to address the research gaps identified. Descriptive research design was adopted in this study. This design was ideal for this study since it defines data and characteristics about the population under study (Kinyua 2015). The target population of this study included all 82 plastic and rubber manufacturing organizations in Kenya registered as members of KAM according to 2021 directory. The study used a census where all the 82 plastic and rubber manufacturing firms were surveyed. To identify the unit of observation, the head of production and the head of procurement function were selected purposively because they have similar skills, knowledge, experience and exposure in the area of research. This formed 164 respondents. The study considered this approach because it allowed an in-depth study of the subject (Kombo & Tromp, 2016). The study used primary data as the main data which was collected using structured and semi structured questionnaires. The collected data was prepared and analyzed with the aid of the Statistical Package for Social Sciences (SPSS) Version 26. Descriptive statistics was used to summarize and

organize characteristics of a data set collected which was presented in form of means, modes and standard deviations (Kothari, 2019). Then inferential statistics through a regression model was used to test the research hypotheses. Qualitative data was analyzed using content analysis. The analyzed data was presented in form of tables, graphs, histograms and Pie charts. A multiple linear regression analysis was used to establish a mathematical model that explains the relationship between dependent and independent variable.

The following summary of a multiple linear regression model was used to model the data:

$$Y=\alpha+\beta 1X1+\beta 2X2+\beta 3X3+\beta 4X4+\varepsilon$$

Where:

Y= Sustainable Performance of Plastic and Rubber Manufacturing Firms
βo= Constant Coefficient
X1= Circular Procurement
X2= Circular Design
X3= Circular Manufacturing
X4= Circular Distribution
ε = Random Error Term

4.0 RESULTS FINDINGS

4.1 Response Rate

A sample of respondents were interviewed using questionnaires that allowed the researcher to drop the questionnaire to the respondents and then collect them at a later date when they had filled the questionnaires. A total of 164 questionnares were distributed to the heads of production and the heads of procurement function. Out of the population covered, 104 were responsive respresenting a response rate of 82%. This was above the 50% which is considered adequate in descriptive statistics according to (Kothari, 2018).

Table 1: Response Rate of Respondents

Response	Frequency	Percentage
Actual Response	104	63
Non-Response	60	37
Total	**164**	**100%**

4.2 Pilot Study

The cronbach's alpha was computed in terms of the average inter-correlations among the items measuring the concepts. The rule of thumb for cronbach's alpha is that the closer the alpha is to 1 the higher the reliability (Dunn, 2019). A value of at least 0.7 is recommended. Cronbach's alpha is the most commonly used coefficient of internal consistency and stability. Consistency indicated how well the items measuring the concepts hang together as a set. Cronbach's alpha was used to measure realibilty. This was done on the four objectives of the study. The higher the coefficient, the more reliable is the test.

Table 2: Reliability Results

Variable	No. of Items	Respondents	α=Alpha	Comment
Circular Procurement	9	16	0.893	Reliable

Circular Design	9	16	0.987	Reliable
Circular Manufacturing	9	16	0.974	Reliable
Circular Distribution	9	16	0.976	Reliable

4.3 Descriptive Statistics

4.3.1 Circular Procurement

The first objective of the study was to assess the effect of circular procurement on sustainable performance of plastic and rubber manufacturing firms in Kenya. The respondents were asked to indicate to what extent circular procurement had an effect on sustainable performance of plastic and rubber manufacturing firms in Kenya. Results indicated that majority of the respondents 27% agreed that it was to a very effective, 25% said that it was effective, 29% said it was somehow effective, while ineffective was at 19%.

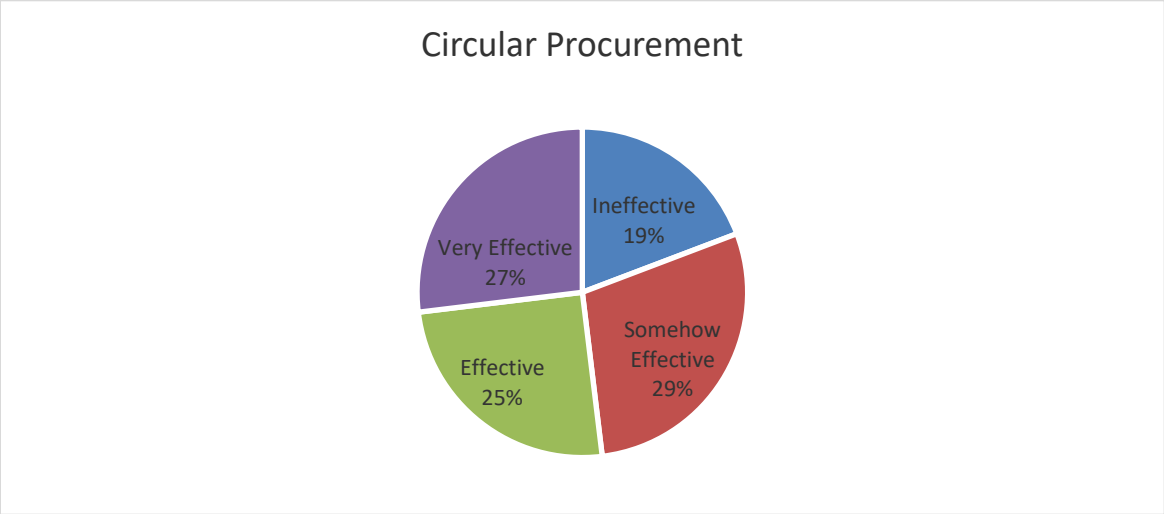

Figure 2: Circular Procurement

The respondents were also asked to comment on statements regarding circular procurement on in sustainable performance of plastic and rubber manufacturing firms in Kenya. The responses were rated on a likert scale and the results presented in Table 4.6 below. It was rated on a 5-point likert scale ranging from; 1 = strongly disagree to 5 = strongly agree. The scores of 'strongly disagree' and 'disagree' have been taken to represent a statement not agreed upon, equivalent to mean score of 0 to 2.5. The score of 'neutral' has been taken to represent a statement agreed upon, equivalent to a mean score of 2.6 to 3.4. The score of 'agree' and 'strongly agree' have been taken to represent a statement highly agreed upon equivalent to a mean score of 3.5 to 5.

The respondents were asked to indicate their responses on effect of circular procurement on sustainable performance of plastic and rubber manufacturing firms in Kenya. The results revealed that majority of the respondent with a mean of (4.13) agreed with the statement that Procuring eco- innovative products improves an organization economic and environmental performance. The measure of dispersion around the mean of the statements was 0.94 indicating the responses were varied. The result revealed that majority of the respondent as indicated by a mean of (4.27) agreed with the statement Acquiring recycled or recyclable products improves organization's sustainable performance. The standard deviation for was 0.968 showing a variation. The result revealed that majority of the respondent (4.55) agreed with the statement that Procuring eco- innovative products enhances sustainable performance of an organization. The results were varied as shown by a standard deviation of 0.5.

The average response for the statements on Signing of circular contracts for using products rather than owning them leads to cost reduction was (4.22). The results were varied as shown by a standard deviation of 0.955. The average response for the statements on Agreeing with suppliers to buy back their products at the end of their service life leads to improved sustainable performance was (4.4). The results were varied as shown by a standard deviation of 0.704. The result revealed that majority of the respondent with a mean of (4.46) agreed with the statement that

Paying for product use or performance improves resources optimization. The measure of dispersion around the mean of the statements was 0.787 indicating the responses were varied.

The result revealed that majority of the respondent as indicated by a mean of (4.44) agreed with the statement Life cycle costing helps an organization evaluate purchase options. The standard deviation for was 0.786 showing a variation. The result revealed that majority of the respondent (4.21) agreed with the statement that Life cycle costing provides better cost awareness. The results were varied as shown by a standard deviation of 0.942. The average response for the statements on Life cycle costing enable the company to procure the most profitable product was (4.01). The results were varied as shown by a standard deviation of 0.81.

The average mean of all the statements was 4.01 indicating that majority of the respondents agreed on circular procurement having an effect on sustainable performance of plastic and rubber manufacturing firms in Kenya. However, the variations in the responses were varied as shown by a standard deviation of 0.81. These findings imply that circular procurement is at the heart of the organizations. The findings agree with Kinyanjui (2017) that using circular procurement as a procurement best practice is a smart move and can reduce expenses significantly.

Table 3: Circular Procurement

Statements	Mean	Std. Deviation
Procuring eco- innovative products improves an organization economic and environmental performance	4.10	0.94
Acquiring recycled or recyclable products improves organization's sustainable performance	4.27	0.968
Procuring eco- innovative products enhances sustainable performance of an organization	4.55	0.5
Signing of circular contracts for using products rather than owning them leads to cost reduction	4.22	0.955
Agreeing with suppliers to buy back their products at the end of their service life leads to improved sustainable performance	4.41	0.704
Paying for product use or performance improves resources optimization	4.46	0.787
Life cycle costing helps an organization evaluate purchase options	4.44	0.786
Life cycle costing provides better cost awareness	4.21	0.942
Life cycle costing enable the company to procure the most profitable product	4.11	1.096
Average	**4.01**	**0.81**

4.3.2 Circular Design

The second objective of the study was to establish the effect of circular design on sustainable performance of plastic and rubber manufacturing firms in Kenya. The respondents were asked to indicate to what extent circular design affected sustainable performance of plastic and rubber manufacturing firms in Kenya. Results indicated that majority of the respondents 25% agreed that it was to a very great extent, 27% said that it was to a great extent, 35% said it was moderate, while little extent and not all were at 5 and 8% respectively.

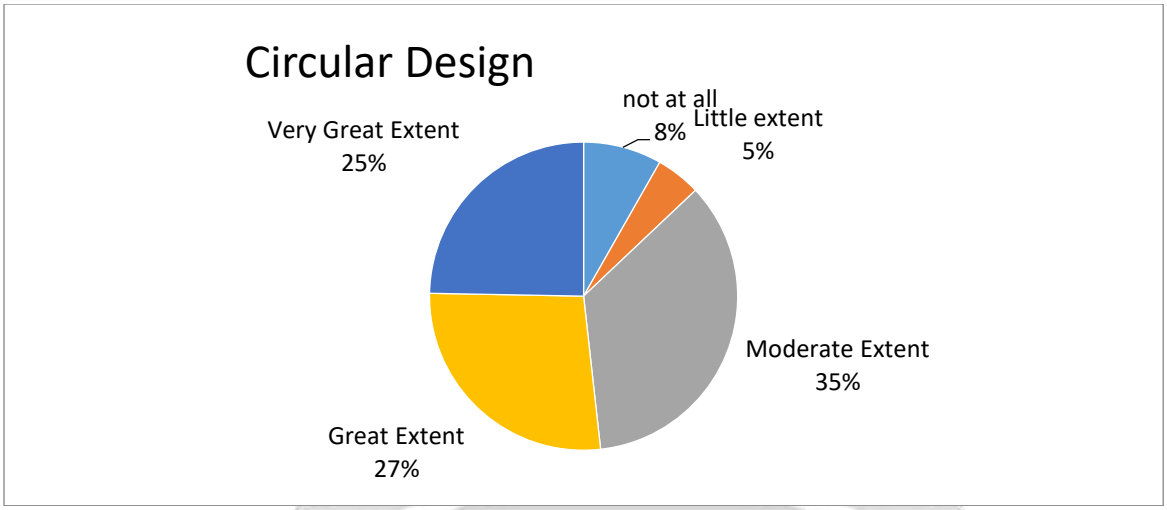

Figure 3: Circular Design

The respondents were also asked to comment on statements regarding circular design on sustainable performance of plastic and rubber manufacturing firms in Kenya. The results revealed that majority of the respondent with a mean of (3.58) agreed with the statement that Design for Recycling ensures proper utilization of resources. The measure of dispersion around the mean of the statements was 1.0 indicating the responses were varied. The result revealed that majority of the respondent as indicated by a mean of (3.63) agreed with the statement Design for recycling helps in Conserving natural resources. The standard deviation for was 0.9 showing a variation. The result revealed that majority of the respondent (3.6) agreed with the statement that Design for recycling reduces demand for new raw materials thus protecting the environment. The results were varied as shown by a standard deviation of 0.7.

The average response for the statements on Design for biodegradability make it easy to recycle products was (3.45). The results were varied as shown by a standard deviation of 1.2. The average responses for the statements on Biodegradable products consume less energy during their Manufacture was (3.5). The results were varied as shown by a standard deviation of 1.0. The results revealed that majority of the respondent with a mean of (3.61) agreed with the statement that Biodegradable products helps in reducing waste produced. The measure of dispersion around the mean of the statements was 0.6 indicating the responses were varied.

The result revealed that majority of the respondent as indicated by a mean of (4.17) agreed with the statement Maintaining products reduces the cost of replacements. The standard deviation for was 0.8 showing a variation.

The result revealed that majority of the respondent (3.63) agreed with the statement that Products maintenance reduces production downtime thus generating savings. The results were varied as shown by a standard deviation of 0.8. The average response for the statements on Product maintenance increases its life span was (3.66). The results were varied as shown by a standard deviation of 1.

The average mean of all the statements was 3.77 indicating that majority of the respondents agreed on circular design having an effect on sustainable performance of plastic and rubber manufacturing firms in Kenya. However, the variations in the responses were varied as shown by a standard deviation of 1.134. These findings agree with Kirungu (2018) that through circular design, companies can improve competitive positioning.

Table 4: Circular Design

Statements	Mean	Std. Deviation
Design for Recycling ensures proper utilization of resources	3.58	1.0
Design for recycling helps in Conserving natural resources	3.63	0.9
Design for recycling reduces demand for new raw materials thus protecting the environment	3.6	0.7
Design for biodegradability make it easy to recycle products	3.45	1.2
Biodegradable products consume less energy during their Manufacture	3.5	1.0
Biodegradable products help in reducing waste produced	3.61	0.6

Maintaining products reduces the cost of replacements	4.17	0.8
Products maintenance reduces production downtime thus generating savings	3.63	0.8
Product maintenance increases its life span	3.66	1.0
Average	**3.77**	**1.134**

4.3.3 Circular Manufacturing

There was also need to establish effect of circular manufacturing on sustainable performance of plastic and rubber manufacturing firms in Kenya as the third objective. Results indicated that majority of the respondents 47% agreed that it was to a very great extent, 45% said that it was to a great extent, 2% said it was moderate; little extent was 2% and not all at 4%.

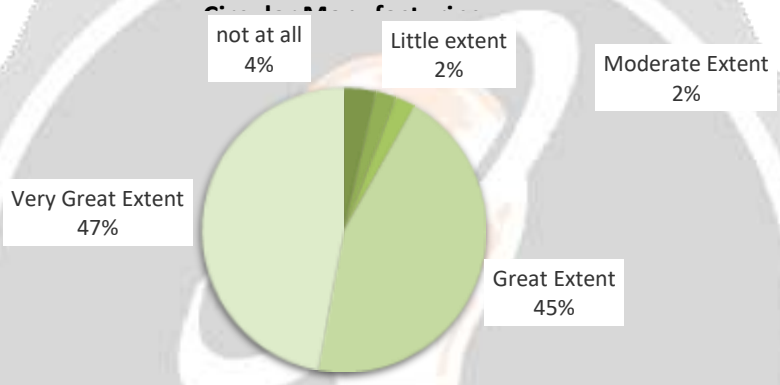

Figure 4: Circular Manufacturing

The respondents were asked to indicate their levels of agreement on statements regarding circular manufacturing. The results revealed that majority of the respondent with a mean of (3.8) agreed with the statement that Lean production leads to reduction of waste produced. The measure of dispersion around the mean of the statements was 0.9 indicating the responses were varied. The result revealed that majority of the respondent as indicated by a mean of (4.9) agreed with the statement Lean production ensures Increased product quality. The standard deviation for was 0.9 showing a variation. The result revealed that majority of the respondent (3.4) agreed with the statement that Lean production leads to Improved lead times. The results were varied as shown by a standard deviation of 1.3.

The average response for the statements on Product refurbishing reduces demand for new raw materials thus reducing cost was (3.6). The results were varied as shown by a standard deviation of 1.2. The average response for the statements on Product upgrading reduces cost of acquiring new products was (4.1). The results were varied as shown by a standard deviation 0.8. The results revealed that majority of the respondent with a mean of (4.1) agreed with Product reconditioning provides a product with a new look attracting new customers. The measure of dispersion around the mean of the statements was 0.9 indicating the responses were varied.

The result revealed that majority of the respondent as indicated by a mean of (4) agreed with the statement Remanufacturing helps in conservation of materials. The standard deviation for was 1 showing a variation. The result revealed that majority of the respondent (4.2) agreed with the statement that Remanufacturing helps in Reducing energy consumption during manufacturing. The results were varied as shown by a standard deviation of 0.8. The average response for the statements on Remanufacturing reduces product waste and disposal costs was (3.9). The results were varied as shown by a standard deviation of 0.9.

Average mean of all the statements was 3.8 indicating that majority of the respondents agreed on circular manufacturing having an effect on sustainable performance of plastic and rubber manufacturing firms in Kenya. However, the variations in the responses were varied as shown by a standard deviation of 0.9. The results are in tandem with Lin and Lee (2019) who opine that an organization benefits greatly when circular manufacturing is embraced in their circular economy.

Table 5: Circular Manufacturing

Statements	Mean	Std. Deviation
Lean production leads to reduction of waste produced	3.8	0.9
Lean production ensures Increased product quality	4.9	0.9
Lean production leads to Improved lead times	3.4	1.3
Product refurbishing reduces demand for new raw materials thus reducing cost	3.6	1.2
Product upgrading reduces cost of acquiring new products	4.1	0.8
Product reconditioning provides a product with a new look attracting new customers	4.1	0.9
Remanufacturing helps in conservation of materials	4.0	1.0
Remanufacturing helps in Reducing energy consumption during manufacturing	4.2	0.8
Remanufacturing reduces product waste and disposal costs	3.9	0.9
Average	**3.8**	**0.9**

4.3.4 Circular Distribution

There was also need to establish the effect of circular distribution on sustainable performance of plastic and rubber manufacturing firms in Kenya. Results also showed that 3% of respondents indicated to very great extent, great extent was at 12%, moderate extent was 37%, while little extent was at 27% and not at all was at 21%.

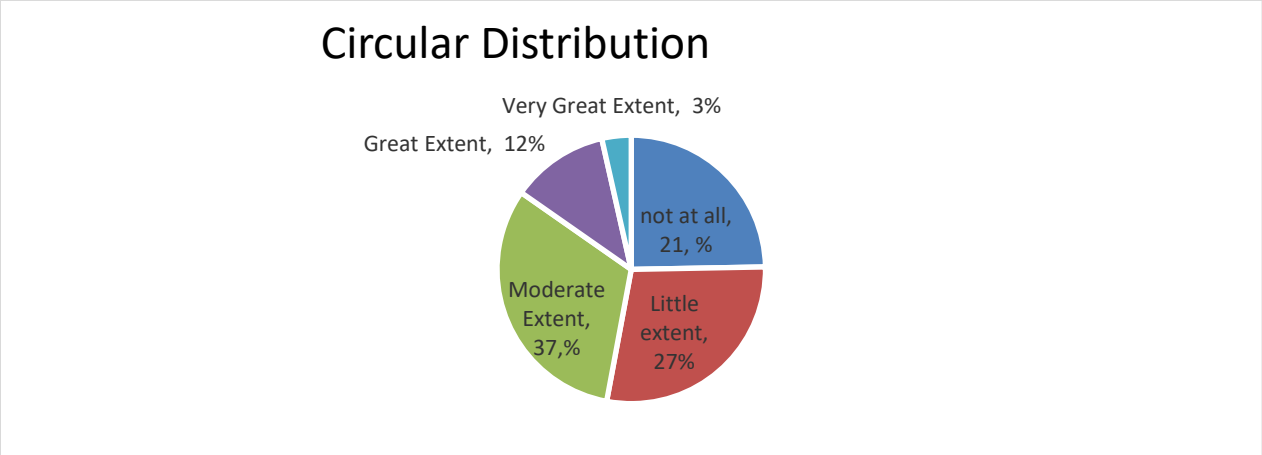

Figure 5: Circular Distribution

The respondents were asked to indicate their views on circular distribution. The results revealed that majority of the respondent with a mean of (4.5) agreed with the statement that Eco-Packaging Reduces use of natural resources. The measure of dispersion around the mean of the statements was 0.5. The result revealed that majority of the respondent as indicated by a mean of (3.9) agreed with the statement Eco-packaging ensures reduced carbon footprint to the environment the standard deviation for was 0.8 showing a variation. The result revealed that majority of the respondent (3.2) agreed with the statement that Eco-packaging can be reduced, reused and recycled sustainably. The results were varied as shown by a standard deviation of 1.4

The average response for the statements on Sharing information on environmentally sound product attributes to customers during marketing improves brand reputation was (4.5). The results were varied as shown by a standard deviation of 0.5. The average response for the statements on Eco-branding improves consumer brand loyalty was (4.4). The results were varied as shown by a standard deviation 0.6. The results revealed that majority of the

respondent with a mean of (4.4) agreed with the statement Eco-advertising leads increased customer base. The measure of dispersion around the mean of the statements was 0.9 indicating the responses were varied.

The result revealed that majority of the respondent as indicated by a mean of (4.3) agreed with the statement Combining smaller shipments into a single load reduces the number of trips thus reducing energy consumption and emissions. The standard deviation for was 0.7 showing a variation. The result revealed that majority of the respondent (4.5) agreed with the statement that Eco Transport helps in Combating climate change and reducing energy dependence. The results were varied as shown by a standard deviation of 1.0. The average response for the statements on Eco transportation Improves air quality and reduce noise was (4.1). The results were varied as shown by a standard deviation of 1.0.

Average mean of all the statements was 4.2 indicating that majority of the respondents agreed on circular distribution having an effect on sustainable performance of plastic and rubber manufacturing firms in Kenya. However, the variations in the responses were varied as shown by a standard deviation of 0.8. The results agree with Muge (2020) that an organization that embraces circular distribution benefits greatly in its operations.

Table 6: Circular Distribution

Statements	**Mean**	**Std. Deviation**
Eco-Packaging Reduces use of natural resources	4.5	0.5
Eco-packaging ensures reduced carbon footprint to the environment	3.9	0.8
Eco-packaging can be reduced, reused and recycled sustainably	3.2	1.4
Sharing information on environmentally sound product attributes to customers during marketing improves brand reputation	4.5	0.5
Eco-branding improves consumer brand loyalty	4.4	0.6
Eco-advertising leads increased customer base	4.4	0.9
Combining smaller shipments into a single load reduces the number of trips thus reducing energy consumption and emissions	4.3	0.7
Eco Transport helps in Combating climate change and reducing energy dependence	4.2	1.0
Eco transportation Improves air quality **and** reduce noise	4.1	1.0
Average	**4.2**	**0.8**

4.4 Correlation Analysis

Correlation analysis was used to determine both the significance and degree of association of the variables and also predict the level of variation in the dependent variable caused by the independent variables. The correlation summary shown in Table 7 indicates that the associations between each of the independent variables and the dependent variable were all significant at the 95% confidence level.

Table 7: Summary of Pearson's Correlations

Correlations		Circular Procurement	Circular Design	Circular Manufacturing	Circular Distribution	Sustainable Performance of Plastic and Rubber Manufacturing Firms
Circular Procurement	Pearson Correlation	1				
	Sig. (2-Tailed)					
Circular Design	Pearson Correlation	.263**	1			
	Sig. (2-Tailed)	0.007				
Circular	Pearson	.350**	.346**	1		

Manufacturing	Correlation										
	Sig. (2-Tailed)		0		0						
Circular Distribution	Pearson Correlation	.363**		.516**		.543**			1		
	Sig. (2-Tailed)		0		0		0				
Sustainable Performance of Plastic and Rubber Manufacturing Firms	Pearson Correlation	.509**		.398**		.678**		.685**			1
	Sig. (2-Tailed)		0		0		0		0		

** Correlation is Significant at the 0.05 Level (2-Tailed).

The correlation analysis to determine the relationship between circular economy practices and sustainable performance of plastic and rubber manufacturing firms in Kenya, Pearson correlation coefficient computed and tested at 5% significance level.

The results indicate that there is a positive relationship (r=.509) between circular procurement and sustainable performance of plastic and rubber manufacturing firms in Kenya. In addition, the researcher found the relationship to be statistically significant at 5% level (p=0.000, <0.05). The results also indicate that there is a positive relationship (r=.398) between circular design and sustainable performance of plastic and rubber manufacturing firms in Kenya. In addition, the researcher found the relationship to be statistically significant at 5% level (p=0.000, <0.05).

The results indicate that there is a positive relationship (r=.678) between circular manufacturing and sustainable performance of plastic and rubber manufacturing firms in Kenya. In addition, the researcher found the relationship to be statistically significant at 5% level (p=0.000, <0.05). The results indicate that there is a positive relationship (r=.685) between circular distribution and sustainable performance of plastic and rubber manufacturing firms in Kenya. In addition, the researcher found the relationship to be statistically significant at 5% level (p=0.000, <0.05). Hence, it is evident that all the independent variables could explain the changes in implementation of sustainable performance of plastic and rubber manufacturing firms in Kenya, on the basis of the correlation analysis.

4.5 Regression Analysis

In this study multivariate regression analysis was used to determine the significance of the relationship between the dependent variable and all the independent variables pooled together. Regression analysis was conducted to find the proportion in the dependent variable (sustainable performance of plastic and rubber manufacturing firms in Kenya) which can be predicted from the independent variables (circular procurement, circular design, circular manufacturing, circular distribution).

Table 8 presents the regression coefficient of independent variables against dependent variable. The results of regression analysis revealed there is a significant positive relationship between dependent variable and the independent variable. The independent variables reported R value of .805a indicating that there is perfect relationship between dependent variable and independent variables. R square value of 0.647 means that 64.7% of the corresponding variation in sustainable performance of plastic and rubber manufacturing firms in Kenya can be explained or predicted by (circular procurement, circular design, circular manufacturing, circular distribution) which indicated that the model fitted the study data. The results of regression analysis revealed that there was a significant positive relationship between dependent variable and independent variable at ($\beta = 0.647$), p=0.000 <0.05).

Table 8: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate

1	.805[a]	.647	.633	.166295

a) Predictors: (Constant), Circular Procurement, Circular Design, Circular Manufacturing, Circular Distribution
b) Dependent Variable: Sustainable Procurement of Plastic and Rubber Manufacturing Firms

Table 9: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.027	4	1.257	45.449	.000[b]
	Residual	2.738	99	0.028		
	Total	7.765	103			

a) Predictors: (Constant), Circular Procurement, Circular Design, Circular Manufacturing, Circular Distribution
b) Dependent Variable: Sustainable Procurement of Plastic and Rubber Manufacturing Firms

The significance value is 0.000 which is less than 0.05 thus the model is statistically significance in predicting how circular procurement, circular design, circular manufacturing, circular distribution affects sustainable procurement of plastic and rubber manufacturing firms in Kenya. The F critical at 5% level of significance was 26.5. Since F calculated which can be noted from the ANOVA table above is 45.449 which is greater than the F critical (value= 26.5), this shows that the overall model was significant. The study therefore establishes that; circular procurement, circular design, circular manufacturing, circular distribution were all important circular economy practices affecting sustainable performance of plastic and rubber manufacturing firms. These results agree with Rotich (2019) results which indicated a positive and significant effect of circular economy practices on sustainable performance of plastic and rubber manufacturing firms.

Table 10: Coefficients of Determination

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.353	0.202		11.619	0.000
	Circular Distribution	0.183	0.037	0.392	4.948	0.000
	Circular Procurement	0.158	0.045	0.232	3.546	0.001
	Circular Manufacturing	0.121	0.023	0.383	5.272	0.000
	Circular Design	0.001	0.036	0.001	0.021	0.040

a) Predictors: (Constant), Circular Procurement, Circular Design, Circular Manufacturing, Circular Distribution
b) Dependent Variable: Sustainable Procurement of Plastic and Rubber Manufacturing Firms

The research used a multiple regression model

$$\mathbf{Y= \beta_0+ \beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+Ɛ}$$

The regression equation will be;

$$\mathbf{Y=2.353+ 0.183X_1 + 0.158X_2 + 0.121X_3 + 0.001X_4}$$

The regression equation above has established that taking all factors into account (circular procurement, circular design, circular manufacturing, and circular distribution) constant at zero, sustainable performance of plastic and rubber manufacturing firms in Kenya will be an index of 2.353

The findings presented also shows that taking all other independent variables at zero, a unit increase in circular procurement will lead to a 0.158 increase in sustainable performance of plastic and rubber manufacturing firms. The P-value was 0.001 which is less 0.05 and thus the relationship was significant.

The study also found that a unit increase in circular design will lead to a 0.001 increase in sustainable performance of plastic and rubber manufacturing firms. The P-value was 0.04 and thus the relationship was significant. In addition, the study found that a unit increase in circular manufacturing will lead to a 0.121 increase in sustainable performance of plastic and rubber manufacturing firms. The P-value was 0.000 and thus the relationship was significant.

Lastly, the study found that circular distribution will lead to a 0.183 increase in sustainable performance of plastic and rubber manufacturing firms. The P-value was 0.000 and hence the relationship was significant since the p-value was lower than 0.05. The findings of the study show that, circular distribution contributed most to sustainable performance of plastic and rubber manufacturing firms.

5. 0 Summary, Conclusion and Recommendations

5.1 Summary of Findings

The study sought to examine the effect of circular economy practices on sustainable performance of plastic and rubber manufacturing firms in Kenya. The study targeted 82 plastic and rubber manufacturing organizations in Kenya registered as members of KAM according to 2021 directory. The study used a census where all the 82 plastic and rubber manufacturing firms were surveyed. The head of production and the head of procurement function were selected This formed 164 respondents. The study endeared to determine effect of circular economy practices on sustainable performance of plastic and rubber manufacturing firms in Kenya. The regression results revealed that circular economy practices identified in the study, that is, circular procurement, circular design, circular manufacturing and circular distribution combined could explain approximately 64.7% of the variations in sustainable performance of plastic and rubber manufacturing firms. The other 35.3% may be attributed to other strategies not explained by the model or the variables. From inferential statistics, a positive correlation is seen between each predictor variable and sustainable performance of plastic and rubber manufacturing firms. The strongest correlation was established between circular distribution and sustainable performance of plastic and rubber manufacturing firms. All the independent variables were found to have a statistically significant association with the dependent variable at ninety five percent level of confidence.

5.2 Conclusions of the Findings of the Study

Based on the study findings, the study concludes that sustainable performance of plastic and rubber manufacturing firms can be improved by circular procurement, circular design, circular manufacturing and circular distribution. Drawing on this research, lack of circular procurement, circular design, circular manufacturing and circular distribution in plastic and rubber manufacturing firms is leading to poor sustainable performance. Though the plastic and rubber manufacturing firms are striving hard to improve their performance. It was articulated that the current phenomenon of poor sustainable performance in the manufacturing sector can be reversed if the government and other stakeholders ensure; circular procurement, circular design, circular manufacturing and circular distribution are embraced in the procurement function.

5.3 Recommendations and Further Research

Finally, the study recommended that plastic and rubber manufacturing firms should embrace circular economy practices so as to improve sustainable performance and further researches should to be carried out in other firms to find out if the same results can be obtained.

REFERENCES

Camacho-Otero, J., Boks, C., Pettersen, I., 2018. Consumption in the circular economy: a literature review. Sustainability 10 (8), 2758. https://doi.org/10.3390/ su10082758.

Camilleri, M.A., 2019. The circular economy's closed loop and product service systems for sustainable development: *a review and appraisal. Sustain*. Dev. 27 (3), 530e536. https://doi.org/10.1002/sd.1909.

Frishammar, J., Parida, V., 2019. Circular business model transformation: a roadmap for incumbent firms. Calif. Manag. Rev. 61 (2), 5e29. https://doi.org/10.1177/ 0008125618811926.

Govindan, K., Hasanagic, M., 2018. A systematic review on drivers, barriers, and practices towards circular economy: a supply chain perspective. Int. J. Prod. Res. 56 (1e2), 278e311. https://doi.org/10.1080/00207543.2017.1402141

Guldmann, E., Huulgaard, R.D., 2020. Barriers to circular business model innovation: a multiple-case study. J. Clean. Prod. 243, 118160 https://doi.org/10.1016/ j.jclepro.2019.118160.

Gusmerotti, N.M., Testa, F., Corsini, F., Pretner, G., Iraldo, F., 2019. Drivers and approaches to the circular economy in manufacturing firms. J. Clean. Prod. 230, 314e327. https://doi.org/10.1016/j.jclepro.2019.05.044

Kinyua (2015). *Research Methodology*. Methods and Techniques (Second Revised)

Kipruto, J., & Shale, N. I. (2019). Effect of green supply chain practices on performance of manufacturing firms in Kenya: A case of East Africa Portland Cement. International Journal of Social Sciences and Information Technology, 4(5), 414-424.

Kombo, D & Tromp, D, (2016): *Proposal and Thesis Writing* – An Introduction. Pauline's Publications Africa. Nairobi.

Kothari, C. R. (2019). *Research Methodology: Methods and Techniques* (4th ed.). Published by New Age International (P) Ltd., Publishers, New Delhi (2019)

Lakatos, E.S., Cioca, L.-I., Dan, V., Ciomos, A., Crisan, O., Barsan, G., 2018. Studies and investigation about the attitude towards sustainable production, consumption and waste generation in line with circular economy in Romania. *Sustainability* 10 (3), 865. https://doi.org/10.3390/su10030865

Mbovu, D. K., & Mburu, D. K. (2018). Effect of reverse logistics practices on enhancing competitiveness in manufacturing firms in Kenya: A case of East African Breweries Ltd. *International Journal of Supply Chain Management* 3(1), 1 – 16.

Moktadir, M.A., Rahman, T., Rahman, M.H., Ali, S.M., Paul, S.K., 2018. Drivers to sustainable manufacturing practices and circular economy: *a perspective of leather industries in Bangladesh. J. Clean. Prod.* 174, 1366e1380. https://doi.org/ 10.1016/j.jclepro.2017.11.063

Ndua, S. T., & Were, S (2018). Effect of green supply chain management practices on performance of Kenyan universities. A case of university of Nairobi. The Strategic *Journal of Business and Change Management*, 5(2), 553 – 574.

Ngatara, W. I., & Ayuma, C. (2016). Factors affecting the implementation of circular economy practices in Kenya: a survey of public secondary schools in Kilifi County. *The International Journal of Business and Management*, 4(4), 233-258.

Njuguna, E. K., & Kagiri, A. (2017). Effect of reverse logistics on operational performance of Bata Shoe Company. *International Journal of Social Science and Humanities Research*, 5(2), 564-578.

Osoro, M. P. & Atambo, W. (2016). Relationship between reverse logistics activities and performance of Kisii Bottlers Ltd. *Imperial Journal of Interdisciplinary Research*, 2(11), 1699-1710

Rosa, P., Sassanelli, C., Terzi, S., 2019. Towards circular business models: a systematic literature review on classification frameworks and archetypes. J. Clean. Prod. 236, 117696 https://doi.org/10.1016/j.jclepro.2019.117696.

Samson, D. K. (2018). Effects of reverse supply chain logistics on performance of imported furniture distributing firms in Nairobi County. Unpublished Masters Project, Jomo Kenyatta University of Agriculture and Technology.

Schroeder, P., Anggraeni, K., Weber, U., 2019. The relevance of circular economy practices to the Sustainable Development Goals. J. Ind. Ecol. 23 (1), 77e95. https://doi.org/10.1111/jiec.12732

Sehnem, S., Jabbour, C.J.C., Pereira, S.C.F., de Sousa Jabbour, A.B.L., 2019. Improving sustainable supply chains performance through operational excellence: circular economy approach. *Resour. Conserv. Recycl.* 149, 236e248. https://doi.org/ 10.1016/j.resconrec.2019.05.021

Thorley, J., Garza-Reyes, J.A., Anosike, A., 2019. The circular economy impact on small to medium enterprises. *WIT Trans. Ecol. Environ.* 231, 257e267. https:// doi.org/10.2495/WM180241.

Ünal, E., Shao, J., 2019. A taxonomy of circular economy implementation strategies for manufacturing firms: *analysis of 391 cradle-to-cradle products. J. Clean. Prod*. 212, 754e765. https://doi.org/10.1016/j.jclepro.2018.11.291.

Upadhyay, A., Akter, S., Adams, L., Kumar, V., Varma, N., 2019. Investigating "circular business models" in the manufacturing and service sectors. J. Manuf. Technol. Manag. 30 (3), 590e606. https://doi.org/10.1108/JMTM-02-2018-0063.

Wang, P., Kara, S., Hauschild, M.Z., 2018. Role of manufacturing towards achieving circular economy: *the steel case. CIRP Annals* 67 (1), 21e24. https://doi.org/ 10.1016/j.cirp.2018.04.049.

Whalen, K.A., 2019. Three circular business models that extend product value and their contribution to resource efficiency. J. Clean. Prod. 226, 1128e1137. https:// doi.org/10.1016/j.jclepro.2019.03.128.

Yang, Y., Chen, L., Jia, F., Xu, Z., 2019. Complementarity of circular economy practices: *an empirical analysis of Chinese manufacturers. Int. J. Prod. Res*. 1e16. https://doi.org/10.1080/00207543.2019.1566664