EFFECT OF CIRCULAR ECONOMY PRACTICES ONSUPPLY CHAIN PERFORMANCE OF CHEMICAL AND ALLIED SECTOR FIRMS IN KENYA

BY

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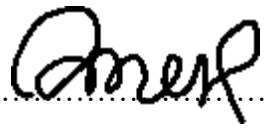
DECLARATION

This research projectis my original work and to the best of my knowledge has not been presented for the award of a degree in any other university.

Signature:  …….. Date:..08/12/2020……

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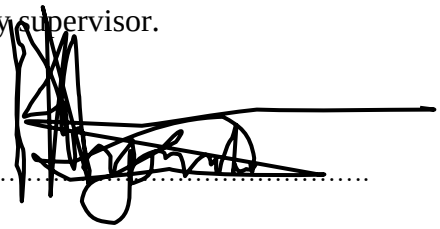
This research project has been presented for examination with my approval as the university supervisor.

Signed  …… Date ……8/12/2020…….

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DEDICATION

To my loving family, friends and classmates.

ACKNOWLEDGEMENTS

I thank God for giving me strength throughout this journey. I sincerely appreciate my supervisor Dr. Kingsford Rucha for his corrective guidelines when undertaking and writing this academic work. I wouldalso love to thank my beloved father and mother, Ali Omar Ali and Swaudah RashidSood, my dear wife Fatime SalehMtawa, my siblings Asha Ali, Mohammed Ali and Fatma Ali and my two aunts AswilaRashidSood and ShuwaliRashidSood and my beloved uncle, Sood Rashid Soodfor their moral support. Thank you all.

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ABSTRACT

The study sought to determine how circular economy practices affect supply chain performance of chemical and allied companies in Kenya. It equally conducted an assessment of the challenges in adopting circular economy practices.The population of the study was made up of all chemical and allied firms in Kenya (Appendix II). Primary data was used in the study and structured questionnaire was used during collection. To help generate inferential and descriptive statistics, statistical product for social scientists (SPSS) was used. The finding was that circular economy practices significantly affect supply chain performance of the chemical and allied manufacturing firms in Kenya (R^2 = 0.882). The F-statistics equally implied that circular supplies, product extension, resource recovery and product development reliably predict supply chain performance. Finally, the regression co-efficients established that resource recovery and product development significantly affect supply chain performance (β=.387, t=4.390, p<0.05; β=.219, t=2.729, p<0.05) respectively while circular supplies and product extension were insignificant on supply chain performance (β=.270, t=1.464, p>0.05; β=.041, t=.243, p>0.05). The study also found out that circular supplies, product extension, resource recovery and product development significantly and positively correlation with supply chain performance (.894; .875, .898, .834) respectively. Regarding the challenges faced by chemical and allied firms in adopting circular economy practices in Kenya, the study found out that 25.5% of the companies experienced the challenge of inadequate technology and cost implications in the short run while 12.8% of the companies faced challenges of lack of appropriate regulations and inadequate government policies. The study also found out that 10.6% of the companies faced the challenge of intense competition while the challenge that was faced by the lowest number of companies was low value of recovered material representing 4.3%.It was concluded that circular economy practices significantly affect supply chain performance of the chemical and allied manufacturing firms in Kenya. Specifically, circular supplies, product extension, resource recovery and product development reliably predict supply chain performance. It equally concluded that resource recovery and product development positively and significantly affect supply chain performance while circular supplies and product extension have positive but insignificant effect on supply chain performance. The researcher recommends that management of chemical and allied manufacturing firms should put in place mechanisms to facilitate improvement of circular economy practices with respect to being environmentally-friendly in terms of operations.

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ABBREVIATIONS AND ACRONYMS

CE	Circular Economy
EMF	Ellen McArthur Foundation
GSCC	Green-Oriented Supply Chain Cooperation
KAM	Kenya Association of Manufacturers
RBV	Resource Based View
RDT	Resource Dependency Theory
SDG	Sustainable Development Goals
VIF	Variance Inflation Factor

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Globally, there is resource scarcity, increased extraction of resources and changes in land cover leading to high level of deterioration of the environment making it fragile (Giljum, Dittrich, Lieber&Lutter, 2014). The implication is that there is need to ensure proper handling of resources by the primary industry. The implied resource consciousness ensures that their operations are environmentally friendly (Lieder & Rashid, 2015). The emphasis is tomaximize product reuse with minimum wastage of inputs (Murray, Skene& Haynes, 2015). This helps to deal with the case of volatile commodity and input prices and to ensure that production and operational activities are waste-free and environmental friendly.

This study was grounded onresource-based view, resource dependence theory and institutional theory.Resource-based view posit that companies need to build and complement effective resources to remain competitive (Lahti, Wincent&Parida, 2018). Resource dependency theory explains how firms rely on resources such as raw materials, goods; services, finance, and knowledge for facilitation of their survival (Ulrich & Barney, 1984). Institutional theory highlights effects of societal philosophy on environment, changes in technology and laws (Tate, Ellram&Kirchoff, 2010). The basis is that circular economy practices are considered within an institutional framework made up of regulations and provisions.

The 2030 Vision aims averagely for a growth rate of about 10% per year and is no exaggeration, the speed with which the Kenyan economy will grow in the future depends heavily on whether goods and services available. Circular economy addresses the causes and promises to speed up the execution of the Vision 2030 agenda. The emphasis is on

the need to ensure that activities of producing and consuming should be sustainable as per the requirement of sustainable development goals (SDG) 12.The focus is on critical issues such as safety of water, affordability and cleanliness of energy, decent work and growth in the economy as well as responsibility in consumptionand production by manufacturing companies (Schroeder, Anggraeni and Weber, 2018). Chemical and allied sector firms are large consumers of energy that accounts of up to 10% of total worldwide final energy demand with high greenhouse gas being emitted. The circular economy puts the chemical and allied industries at the forefront of solutions in creating a friendly and carbon-emission free environment.

1.1.1 Circular Economy Practices

Circular economy (CE) means a system that ensures regeneration and restoration of a production process and significant waste reduction (Lieder & Rashid, 2016). The aim is to create a framework and opportunities for economic growth that reduces negative effect on the environment by improving quality and value of materials, components and products or reusing them again and again (Bocken, Schuit&Kraaijenhagen, 2018).According to Botezat, Dodescu, Văduva and Fotea (2018) the central theme of circular economy is to maintain or increase economic performance with minimal usage of inputs in form of raw materials and reduced damage to the environment. The ultimate focus targets improved environmental safety by reusing and recycling products at every step in the supply chain (Murray, Skene&Haynes, 2015).

Circular economy strategies are developed on the premise that the exploitation of the planet's resources due to economic growth is on the higher side that it is time to find new ways to make use of resources. These include circular deliveries, the use of waste as inputs on a continuous basis, keeping products for use in a longer period and industrial

symbiosis (Kirchherr, Reike&Hekkert, 2017). Circular supplies emphasize on deliveries of fully recyclable and renewable materials. The focus is on companies no longer using limited resources by reducing waste and inefficiency (Accenture, 2014).Reclaiming resources focuses on recovering the value contained in goods through innovative technologies that ensure goods are recycled (Lacy &Rutqvist, 2015).

Product life extension aims to extend product life and assets and provide businesses with added value that may be lost through waste of materials. In this case, products will be reworked, repaired and updated. The sharing platforms, on the other hand, work in areas such as co-creating, creating, delivering, distributing, and consuming (Accenture 2014). When companies collaborate on innovations, they benefit from competition since the waste of one company becomes the inputs of another company. Finally, the use of a service model promotes the idea of letting the product to the customer. Companies that produce large volumes of products and have high operating costs can switch to leasing or pay-per-use and earn new profits (Bribián, Capilla&Usón, 2011).

1.1.2 Supply ChainPerformance

The emphasis is how to meet customer needs through the availability of products on a timely basis without compromise to quality and quantityThe emphasis is on the management of upward and downward collaborations involving those who supply and the end users (Neely, Gregory, &Platts, 2005). It is an indication of how end user of the products experience all round utility without compromise of efficient use of inputs. The emphasis is the assessment of how effective and efficient organizational structures, processes and resources are for the entire supply chain can be (Genovese, Acquaye, Figueroa &Koh, 2017).

Individual measurementof how supply chains perform includequality, time, cost and flexibility. Circular economy achieves supply network performance based on adopting circular supply chains which is accrued on the principles of strategy and service outcome; closed, short and cascaded loops; biological and technical cycles flow; collaborative value capture; medium-low volume and regional and local scope. Generally circular supply chain emphasizes on extending products usage(EMF, 2013).

1.1.3Circular Economy Practices and Supply Chain Performance

Circular economy provides a basis of how organizations can reduce cases of depleted resources and waste to achieve a sustainable process by reversing existing practices (Linder &Williander, 2015). An essential principle involves the need to restoration and self-generation of the interconnected system that extends the use of products (Yuan &Moriguichi, 2006). This approach results in significant reduction in waste and increased business sustainability. A further emphasis is that adoption of circular economy practices requires collaboration between many players in the market including the government as the main regulator especially on issues of environmental consciousness.

The keeping of resources and products in long use through promotion of reuse ensures that waste is reduced and there is adequate planning throughout the supply chain. The overall effect is that consumption of materials is reduced as new inputs would not be needed for quite a long period in the supply network (Kok, Wurpel&Wolde, 2013). A further emphasis is that when there is reduced consumption of raw materials, emissions would also reduce and the end result is a pollution-free environment without compromise of quality, quantity and variety needed by the end users.

1.1.4 Chemical and Allied Sector Firms in Kenya

The chemical and allied sector makes up 9 percent of the total membership of the Kenya Association of Manufacturers. The sector is divided into three sub-sectors, namely industrial chemicals, which produce basic industrial chemicals such as fertilizers and pesticides; Cosmetics that make soaps and detergents, perfumes, cosmetics and other toilet products and then paints and resins that make paints, varnishes and varnishes (KAM, 2019). There are over 8,000 people who are in direct or otherwise involved in the firms that forms the sector in Kenya. Within this subsector, there are many categories of actors mostly composed of private firms without identified public organizations. The problem with Chemical and allied companies is that they depend a lot on importation of raw materials which in turn have high cost of transport and that directly affect the price of the end product (KAM, 2019). Circular economy practices would help improve operational efficiency to meet these challenges.

The concern of the circular economy is the high dependence on raw materials from other countries as imports. This implies that potential market participants in the sub-sector cannot ensure that the inputs are sufficiently available. The transportation cost and supply network rigidities alsodirectly affect the price of the final product (KAM, 2019). Adoption of circular economy practices would help execute the intended policy to adequately regulate the use of energy and chemicals of all forms for sustainability to be realized. The emphasis is also to ensure proper management of waste.

1.2 Research Problem

Circular economy means relocating to renewable energy and materials, promoting product life extension through maintenance and design, improving the efficient nature of products and elimination of wastages from supply networks, encouraging reuse of

inventory, delivering of goods and services virtually and application of new technologies such as 3D printing (Korhopnen, Honkasalo&Seppälä, 2018). The circular economy approach allows companies to transition from linear production to business models that allow goods to be designed and manufactured right from the start for extended use, disassembly, reuse and recycling (Aneja, Pal, Kupka&Militky, 2016).The companies can also produce items of economic importance with minimal wastage if any. The study by Botezat, Dodescu, Văduva and Fotea (2018) found that closed loop management practices significantly affect how firms perform economically and environmentally.

The chemical and allied industry is a perfect example of symbiotic production, since in an ideal chemical factory no waste but only products are allowed. Circular economy would mean innovation in recycling, which helps the chemical industry to develop a society with lower carbon emissions (Cucciniello&Cespi, 2018). The fact is that chemical companies and related companies are highly dependent on imported raw materials and provide costly transport and logistics services that directly affect the price of the end product (KAM, 2019). Circular economy practices would help improve operational efficiency to meet these challenges.

A number of local and global studies related to circular economy have been conducted. Botezat, Dodescu, Văduva and Fotea (2018) explored how the performance of Romanian firms depends on implementation of mechanisms to prolong the life of products and materials. The study found out that circular economy practices significantly influenced economic and ecologic performance of the firms. Masi, Day and Godsell (2017) reviewed literature onhow the supply network is configured in a circular economy. The literature review concluded that circular economy strategies adopted enhances supply

chain performance. In another study, Fernando and Tew (2016) established environment commitment and operational performanceare positively and significantly correlated with a mediating effect of reverse logistics. From a local perspective, Ochiri, Wario, Odhiambo and Arasa (2015) studied how strategies to reduce waste affect the achievement of publishing companies in Kenya. The study established that waste reduction measures improves firm performance.Malaba, Ogolla and Mburu (2014) studied howsugar manufacturing companies in Kenya rely environmental conscious supply procurement network. The findings also showed that the companies procure make better pricing decisions when they adopt green supply chain management. Lastly, David and Shalle(2014) assessed how reverse logistics assessment affect supply networks of companies involved in manufacturing in Kenya. The finding was that by adopting reverse logistics, manufacturing companies improve their performance significantly.

The studies mentioned above indicates existence of gaps that are addressed by the current study. The studies by Botezat, Dodescu, Văduva and Fotea (2018), Masi, Day and Godsell (2017) and Fernando and Tew (2016) were conducted in other countries. This creates a contextual gap in the operational climate of Kenya and the other countries have a significant difference. The studies by Ochiri, Wario, Odhiambo and Arasa (2015), Ogolla, Malaba and Mburu (2014) and David and Shalle (2014) were conducted in Kenya but presents a number of conceptual and contextual gaps due to differences in the sectors of focus. The current study focuses on the chemical and allied sector and therefore intends to answer the question, ‘How does circular economy practices affect supply chain performance of chemical and allied sector firms in Kenya?’

1.3 Research Objectives

To determine the effect of circular economy practices on supply chain performance of chemical and allied companies in Kenya. The specific objectives are:

i. To establish the relationship between circular economy practices and supply chain performance of chemical and allied companies in Kenya.
ii. To find out the challenges faced by chemical and allied firms in adopting circular economy practices in Kenya.

1.4 Value of the Study

It would help to guidethe chemical and allied firms in Kenya to help understand how circular economy influence operational performance. This would help to effectively implement circular economy practices in solving the challenges they face through reducing costs, improving quality, enhancing delivery speed thereby improving customer retention and loyalty, improving dependability through ensuring effective management of cylinder movement and enhancing flexibility through promotion of knowledge-sharing.

In the academic world, this research would be knowledgeablefor future generations by stimulating ideas for further research in different fields including circular supplies, product extension, resource recovery and product development, especially in determining the effect of circular economy on operational performance among different sectors. The circular economy practices highlighted in the study can serve as an inspiration to scholars interested in finding out the practices adopted by firms in other industries.

The research outcome would also help in the setting of policies that encourage adoption of circular economies not only among chemical and allied firms but also in other sectors.

The concept and practices of circular economy can be implemented in governmental institutions to ensure effective utilization of resources including taxpayers' funds. In addition, circular economy can be fully implemented in military operations to effectively dispose battle-damaged equipment, provide a cleaner environment through recycling and seek possible financial recovery of government-owned assets.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The section includes review oftheories and other research work related to the subject matter and a summary of knowledge gaps.

2.2 Theoretical Review

This involves synthesizing available theories and related concepts regarding the variables under study (Rocco &Plakhotnik, 2009). The review is inspired by the integration of literature from studies on circular economy activities and supply logistics performance. The theories are reviewed as follows:

2.2.1 Resource Based View

This view was advanced by Wernerfelt (1984) and Rumelt (1984). According to the theory, key capabilities that makes a company unique and strategically advantaged should not be outsourced by firms. The companies in this case have to make a comparison of their expertise and what exists in the market and then position themselves and their resources. The theory also posit that firms should use their strategies to position its resources in the market. Wernerfelt (1984) assert that the internal capability of a company depends on its resource base making it in a position to deal with its weaknesses. The internal capacity relies on the level of technology, strength of brand name, the nature and training levels of personnel, business agreements in force, nature of machines, efficiency of operations and financial capacity. Crook,Ketchen, Combs and Todd (2008) assert that companies have the ability to position themselves better in terms of competition by identifying and possessing key assets and possessions.

Companies may utilize their resource capability by adopting circular economy strategies in order become more efficient. This will impact on operational performance through greater utilization of resources and waste minimization therefore reducing costs (Lahti, Wincent&VinitParida, 2018). What makes circular economy practices challenging to implement is that many firms do not have adequate knowledge on how to execute them. Companies need to practice circular economy before a competitors and improve operational performance through cost-savings made due to recycling, remanufacturing of materials and reuse.The chemical and allied companies being heavy consumers of raw materials would benefit largely through efficient resource use when they adopt circular economy practices (Antikainen&Valkokari, 2016)

2.2.1 Resource Dependency Theory

Pfeffer and Salancik (1978) posit that firms in any process of production or service provision should embrace collaboration and interdependence rather than gaining immediate advantage over others. The implication is that reliance on others through strategic alliances and other forms of collaboration is unavoidable (Heide, 1994; Ulrich & Barney, 1984). This would mean that firms are able to mutually relate with each other for the benefit of achieving sustainable mutual benefits.

Werner (2008) posit that companies depend on key resources for improving their operations leading to sustainable performance overtime. The argument is that all companies require reliable access to key resources to sustain operations. This can be achieved by introducing effective circular economy practices whereby companies that do not have the resources they need to achieve results collaborate with others strategically (Carter & Rogers, 2008).

2.2.3 Institutional Theory

It was advanced by Hirsch (1975). It explains how external pressure affects a business operations and apply pressure on key decisions made. The argument is that institutional frameworks and interconnections among organizations, policies and regulations cannot be ignored when making operational and strategic decisions (Iacobucci& Hopkins 1992). Companies must therefore identify and investigate how they can remain legitimate in business irrespective of the external environmental influence. Legitimacy is sought socially, culturally, compliance and economically(Brunton, Ahlstrom & Li, 2010; Scott, 2007).

Institutional theory explains the effect societal values, advance in technology, and policies affect decisions on sustainable action and environmental management (Tate, Ellram&Kirchoff, 2010). The theory presents an explanation of how a company deals with the circular economy practices caused by external pressure (Ball and Craig, 2010). Companies comply with administrative guidesthrough the introduction of environmentally friendly practices.Businesses are under pressure from various institutions to become conscious about the environment. Preston and Lehne (2017)argue that the growth of urban centres enforce appropriate rules and mandatory standards so as to regulate all circular activities.

2.3 Components of Circular Economy

The emphasis is on joint efforts across organizational boundaries, coordinating the upward partners to achieve environmental friendliness in terms of inputs, and the downward partners to enhance cooperation on the introduction of environmental management practices including returning, reusing and recycling (Masi, Day &Godsell, 2017).

2.3.1 Circular Supplies

This means that products can be returned to the supply chain for recycling or reuse (Nasir, Genovese, Acquaye, Koh&Yamoah, 2017). It means developing effective chain-sector cooperation to build a large-scale system. However, collaborations can be challenging, including the difficulty to co-ordinatecollaborations among companies (Franco, 2017). It is the analysis of how companies are close and the nature of knowledge that they can relevantly share for sustainability. The emphasis is that all forms of collaboration must focus on how the companies involved would benefit.

Supply chain circularity helps to sustain the creation of utility in goods and services for purposes of organizational achievement both economically and environmentally (Genovese, Acquaye, Figueroa &Koh, 2017). This is however achieved through good collaboration between suppliers and end users which ensures taylor-made products and services as well as ensuring quality supplies.

2.3.2 Product Extension

Van Nes and Cramer (2016) assert that product life begins and ends at the time of purchase if the product is either disposed of or replacement with other products. Afterwards, the product is either dumped or burned with the objective of not to produce waste or debris by allowing materials, components and products of the highest value (Stahel, Webster, Braungart, Hopkinson, Lovins, Birkeland, Goerner, Spicer, Tuppen, Voller, Mulhall&Sempels, 2014). Product life extension include repairing, reusing and reprocessing of products (Hopkinson & Spicer, 2013). It collects or procures waste and then transforming them into other products hence the extension of product life (Short, Bocken, Barlow &Chertow, 2014).

According to Vanegas, Peeters, Cattrysse, Tecchio, Ardente, Mathieux, Dewulf and Duflou (2018), it means a reduction in degradation time and associated costs, resulting in a longer product life and hence viability the circular economy in the industrial regions. Product extension can therefore be achieved through reuse involving repair or remanufacturing of products (Cooper &Gutowski, 2017).

2.3.3 Resource Recovery

This is practiced where one company productively use material stream that another company considers as waste. According to Chertow (2000), it is this part of industrial ecology that involves mutual collaboration between companies helping them to share resources and technology to reduce waste and competition (Lombardi &Laybourn 2012). One focus of resource recovery can be the sharing of resources leading to less consumption of inputs, reduced waste and emissions (Chertow&Ehrenfeld 2012).

When companies share resources and inputs, less pressure is imposed on the sources of raw materials and this helps to achieve environmental consciousness.Resource recovery encourages the principle of reuse, recycle and reprocess that improves the environment as a result of manufacturing operations (Velenturf& Jensen, 2016).

2.3.4 Product Development

Product development ensures customer value proposition and interface, as well as in the transfer and capture of value through the creation of new offerings (Urbinati, Chiaroni& Chiesa, 2017). This may allow for improved material selection, standardization of product design and modularization of components (Ellen MacArthur Foundation, 2012). Product design and development practices elevate the design and integrity of product and the entire production system (Bakker, Wang, Huisman& Den Hollander, 2014).

Product design gives an answer to the question of how a product can be designed to ease the process of recovering functionality from products (Bocken, Short, Rana&Evans, 2014)).The emphasis is that design strategies, guidelines and product features should enhance a product's potential to have multiple or/and long-life cycles are presented with a focus on the recovery operations to be performed on them and the expected quality output of each recovery strategy

2.4 Empirical Review

There are global and foreign studies with regard to circular economy practices. Botezat, Dodescu, Văduva and Fotea (2018) conducted an examination of how circular economy activities relate to performance of Romanian manufacturers. The study employed clustering approach. Thisstudy found out that clustering of the population have partial impact on circular economy activities and performance. Particularly, circular economy practices of Romanian producers significantly affect economic and environmental achievement of firms.

Yu, Tianshan and Din (2018) investigated how reverse logistics relate to environmental performance and competition ability of India-based pharmaceutical companies. The research used a simultaneous regression method. It was found out that business, environmental and financial benefits, with the exception of competitive advantages, have positive and significant correlation with reverse logistics operations.

Rahman, Ismail and Ariffin (2016) examined companies' management of waste and their influence on business development. Based on data from 119 manufacturers in Malaysia, correlations and a multiple regression analysis were used to test the allegations. The results reviled that there is a significant relationship between different components of

green and lean practices. The elements of environmental cooperation with customers and suppliers, investment recovery and waste management in environmentally friendly processes are comparable and, in the Lean philosophy, are essentially related to supplier relations, budget management and waste disposal. It was noted that both practices are also significantly related to business performance.

Banihashemi, Fei and Chen (2019) examined how reverse logistics relate to sustainability performance. The paper provided a comprehensive analysis that help in the assessment of how reverse logistics perform using the triple bottom line model. The research adopted content analysis in the collection and analysis of the gathered information. The study recommended on the need to focus on societal aspect of reverse logistics for purposes of maximizing people-benefits.

Locally, Ochiri, Wario, Odhiambo, and Arasa (2015) examined the impact of strategy in reducing wastes on corporate performance. The study employed description of data as the design. The study targeted 357 companies, sampling 189 of the companies using a stratified random sample. 138 replies were received from the respondents. Empirical findings confirmed that the revenues and wastes in the publishing industry were indeed high, and found that the introduction of waste reduction would actually improve the performance of publishing forms.

Malaba, Ogolla and Mburu (2014) investigated how use of green practices in supply chain affect sourcing activities of sugar industry in Kenya. Based on an analysis of eleven sugar factories in Kenya, a sample of 132 respondents were examined. Descriptive and inferential statistics was used for the analysis. It was established that

application of green practices in procurement and producing of goods and services significantly affect purchasing activities.

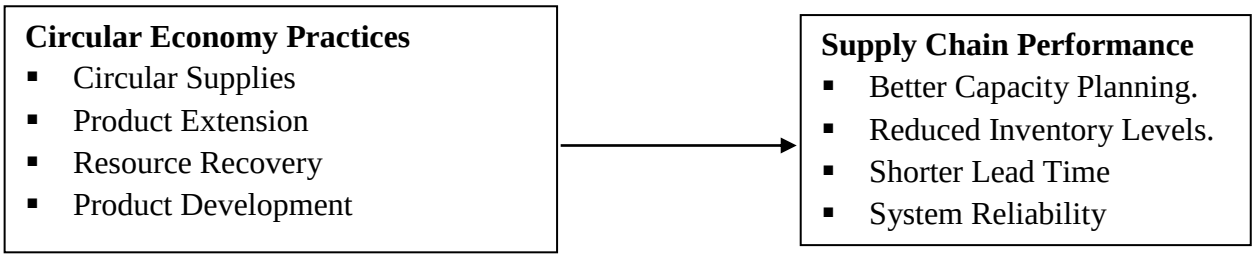
2.5 Summary of Literature Review

Collaboration among circular economy actors is an essential factor for reduction of waste by optimizing their use that subsequently improve supply chain performance. The literature reviewed provides insight on key circular economy aspects and the drivers for supply chain performance.The study byBotezat, Dodescu, Văduva and Fotea (2018) makes emphasis regarding significance of circular economy practices financially and environmentally. The focus is that producing companies need to realize the triple bottom-line effect on their operations. Yu, Tianshan and Din (2018) and Banihashemi, Fei and Chen (2019) focused on the role of revers logistics. The argument is that reverse logistics helps in transition to circular economy. Through adoption of reverse logistics, organizations improve through reuse, remanufacture, recycle and repair. Rahman, Ismail and Ariffin (2016) however focused on how companies can manage wastes that eventually reduce operational expenses. The local studies by Ochiri, Wario, Odhiambo and Arasa (2015); Malaba, Ogolla and Mburu (2014) and Kabergey and Richu (2015) makes emphasis on the roles of waste reduction, green technology and reverse logistics in circular economy and subsequently, their effect on organizational performance.

2.6 Conceptual Framework

The framework conceptualizes the relationship between circular economy practices and supply chain performance. Circular economy practices represent the independent variables while supply chain performance was the dependent variable. The framework is as given in the figure 2.1 as follows:

Figure 2.1: Conceptual Framework



Independent Variable Dependent Variable

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The section outlines the research approach, the population and how the data collection was done, how the study variables were operationalized and analyzed.

3.2 Research Design

This research employed a censusdesign. Kothari (2008) defines a census as the process of studying every unit in a population. It means that all items that forms the population forms a basis of study. The justification was that it suits a smaller population and is highly accurate. The design was considered appropriate because there are only fifty-eight (58) firms that forms the population of chemical and allied sector.

3.3 Population of the Study

The targeted population comprised of all chemical and allied firms in Kenya. The list of the firms from the directory of Kenya Association of Manufacturers (KAM, 2019)is presented as appendix II and it formed the unit of analysis. There are fifty-eight (58) firms in the chemical and allied sector manufacturing firms according to KAM directory (KAM, 2019).

3.4 Data Collection

The collection of primary data used of a questionnaire divided into sections, each section covering a particular concept. A questionnaire is a data collection tool that consists of a set of questions and other requests to collect information from respondents (Kothari, 2008). The justification for use was that questionnaires, when properly compiled and managed responsibly, become an important tool for making statements about particular groups, individuals or the entire population.

The questionnaire had four parts. Section A contains general information about the company; section B coverscircular economy practices; Section C has supply chain performance indicators while section D contains questions on challenges of adopting circular economy practices. The administration of the questionnaire wasdone by dropping and picking them later.

In data collection, one representative of the management team was targeted. The main correspondent in this study was the operations manager because they are deemed to be informed about application of circular economy practices as used by the companies. The implication is that; the number of respondents would befifty-eight (58).

3.5 Operationalization of Study Variables

The variables studiedincludedcircular economy practices that represent independent variable and supply chain performance representing the predictor variables. Operationalization was as indicated in Table 3.1

Table 3.1: Operationalization of Study Variables

Variable	Sub-Variable	Indicators	Source
Independent Variable Circular Economy Practices	Circular Supplies	▪ Cost Savings. ▪ Reduced Waste. ▪ Product Level Circularity.	Nasir, Genovese, Acquaye, Koh&Yamoah (2017).
	Product Extension	▪ Increased Resource Efficiency. ▪ Reduced Pollution. ▪ Reduced Waste.	Van Nes and Cramer (2016)
	Resource Recovery	▪ Reduced Consumption of Resources. ▪ Reduced Waste. ▪ Reduced missions.	Lombardi &Laybourn(2012).
	Product Development	▪ New Product Designs. ▪ High Product Integrity. ▪ Product Variety.	Urbinati, Chiaroni& Chiesa (2017).
Dependent Variable	Supply Chain Performance	▪ Better Capacity Planning. ▪ Reduced Inventory Levels. ▪ Shorter Lead Time. ▪ System Reliability.	Neely, Gregory, &Platts (2005).

Source: Research Data (2019)

3.6 Data Analysis

3.6.1 Reliability Test

The study used Cronbach's alpha coefficient in establishing whether the variables fall within the required range of between 0 and 1 (Mugenda&Mugenda, 2003). According to Nunnally (1978), values of not less than 0.7 is acceptable while Sekaran (2000) posit that values between 0.5 and 0.8 are appropriate as a measure of internal consistency. This study used values of 0.6 and above as a cut-off point for the items.

3.6.2 Diagnostic Test

To test normality, the researcher used Shapiro-wilk Test. In this test, values above 0.05 are within acceptable range.Assessment of multicollinearity was also done through the

use of VIF. The test recommends maximum values of 10. The testing of heteroscedasticity was done using the Koenker test with accepted value being above 0.05. Autocorrelation was then tested through the use of Durbin-Watson test.In this test, statistics of around two (2) is an indication of lack of serial correlation.

3.7 Data Analysis

Data collected was cleaned, edited and validated to confirmtheir accuracy, uniformity, consistency and completeness. To help generate inferential and descriptive statistics, statistical product for social scientists (SPSS) was used. A multiple linear regression was then used to establish the combined effect of the circular economy practices on supply chain performance as follows:

$$\mathbf{Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon}$$

Where:

Y = Supply Chain Performance (Dependent variable).

a = Constant

β_1, β_2 and β_3 = Coefficient of Independent variables

X_1= Circular Supplies

X_2= Product Extension

X_3 = Resource Recovery

X_4 = Product Development

ε = Error term.

3.7.1 Test Statistics

The determination of the significanceof each variable under study was achieved using the t-test and p-values. F-test and p-values helped in testinghow suitable the regression model is. Pearson correlation coefficient, R^2, beta coefficients, and p values was also done. Variance inflation factor (VIF) was then used to test multicollinearity. In this measure, when the VIF is below 10.0 for each variable, then there is no multi-

collinearity. Descriptive analysis was then conducted to assess the challenges that affect implementation of circular economy practices.

CHAPTER FOUR

DATA ANALYSIS, FINDINGS AND DISCUSSION

4.1 Introduction

This part is a presentation of the results and findings with respect to the research objective. This section consists of preliminary research findings describing the nature of study attributes by offering normality and reliability tests. It also includes a descriptive statistic of frequencies and percentages and correlation analyses of the study variables.

4.2 Response Rate

In this study, fifty-eight (58)questionnaireswere distributed by the researcher and forty-seven responses were obtained accounting for 81% of the respondents. This is greater than the recommended 70% by Mugenda and Mugenda (2010). The response rate was therefore considered adequate.

4.3 General Information

This study used the number of years the respondents have served in the organization, positions held, number of employees, education levels and length of operation of the company to provide the general information. The analysis is as presented in the Table 4.1. Regarding length of continuous service with the firm, it was found that 46.8% of the respondents had served for between 10-15 years while 25.5% had served for over 15 years and 21.3% had served for between 5-10 years. The least representation included managers who had served the company for less than 5 years making up 6.4%. The implication was that a high percentage of the managers who responded worked in the firm for a reasonable number of years to enable them give valid and consistent response regarding the variables under study.

The study findings on position that the respondents held in their firms show that 48.9% were senior level managers, 38.3% being middle level managers and 12.8% represented supervisory level managers. The belief is that the managers have reliable information on how to adopt circular economy practices and a good representation of management levels meant a balanced and valid response relevant for the study. The results show that all management levels were represented hence it is possible to generalize the findings across all levels.

Table 4.1 also indicate the findings regarding firm size. In the findings, 57.4% of the firms had employees ranging between 501-1000 in number while 29.8% had employees of the range 101 – 500 and 10.6% had more than 1000 employees. The companies with less than 100 employees formed the smallest number representing 2.1%. The findings indicate that many respondents were from large-sized organizations. This implies that the collected data was appropriate and valid.

Table 4.1: Demographics

Length of Continuous Service with the Firm		Frequency	Percent	Valid Percent
Valid	Less than 5 years	3	6.4	6.4
	5-10 years	10	21.3	21.3
	10-15 years	22	46.8	46.8
	over 15 years	12	25.5	25.5
	Total	47	100.0	100.0
Position in the Firm				
Valid	Senior Level Management	23	48.9	48.9
	Middle Level Management	18	38.3	38.3
	Supervisory Level Management	6	12.8	12.8
	Total	47	100.0	100.0
Size of the Firm				
Valid	Less than 100 employees	1	2.1	2.1
	101-500 employees	14	29.8	29.8
	501-1000 employees	27	57.4	57.4
	More than 1000 employees	5	10.6	10.6
	Total	47	100.0	100.0
Level of Education				
Valid	Diploma Level	4	8.5	8.5
	Degree Level	23	48.9	48.9
	Post Graduate Level	20	42.6	42.6
	Total	47	100.0	100.0
Length of Operation of the Firm				
Valid	Less than 5 years	2	4.3	4.3
	From 5-10 years	3	6.4	6.4
	From 11-15 years	10	21.3	21.3
	From 16-20 years	15	31.9	31.9
	More than 20 years	17	36.2	36.2
	Total	47	100.0	100.0

Source: Research Data (2019)

Regarding education level of managers, 48.9% had acquired a degree level, followed by those with post-graduate qualification representing 42.6% while the least representation of 8.5% had diploma qualifications. Finally, the analysis was undertaken regarding length of operation of the firm. The finding also indicated that most firms representing 36.2% had operated for more than 20 years' while 31.9% for 16-20 years and 21.3% had operated for between 11-15 years. Few firms making up 4.3% had operated for less than five years. The findings imply that most of the firms had operated long enough to develop structural frameworks for adopting circular economy practices.

4.4Test Statistics

4.4.1 Reliability Test

This study used Cronbach's alpha coefficient values of 0.6 and above as a cut-off point for the items. This helped to establish whether the variables were ranging between 0 and 1 as a requirement (Mugenda&Mugenda, 2012). The reliability test is given in Table 4.2:

Table 4.2: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.467	.627	26

Source: Research Data (2019)

The alpha coefficient of all the variables are reliable since they are above the threshold of 0.6.

4.4.2 Validity Test

The study used Kaiser Meyer-Olkin (KMO) to measure how adequate the sample is and the p-values for Bartlett's Test of Sphericity were also evaluated.

Table 4.2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.851
Bartlett's Test of Sphericity	Approx. Chi-Square	313.294
	df	10
	Sig.	.000

Source: Research Data (2019)

Table 4.2 indicate that KMO values way high above the threshold of 0.65. The p-value in Bartlett's test of Sphericity was less than the significance level of 0.05. This means that the data was valid.

4.4.3 Normality Test

Table 4.3 show that the data indicated normaldistribution. This was indicated with Shapiro Wilk value greater than 0.05.

Table 4.3: Test of Normality for Study Variables

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Circular Economy Practices and Supply Chain Performance	.096	47	.200*	.960	47	.107

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Source: Research Data (2019)

4.4.4 Multicollinearity Test

Table 4.4 indicate that the VIF values for resource recovery and product development were less than 10 with the tolerance values above 0.20 indicatingthat the variables are not multicollinear. There was however multicollinearity with respect to circular supplies and product extension since the VIF values were more than 10 with tolerance values of below 0.2. The implication is that there was possible high correlation with respect to circular supplies and product extension.

Table 4.4: Multicollinearity Test

Variables	Tolerance	VIF
Circular Supplies	.060	16.610
Product Extension	.068	14.737
Resource Recovery	.270	3.704
Product Development	.343	2.917

Source: Research Data (2019)

4.4.5 Heteroscedasticity Test

Heteroscedasticity was evaluated using Koenker test. In this test,a p-Value >0.05 indicate that the data meets the requirement of homoscedasticity.To begin with, the macro syntax by Gwilym Pryce on Breusch-Pagan and Koenker was run in SPSS producingthe following output:

Run MATRIX procedure:

BP&K TESTS

==========

Regression SS15.2498

Residual SS98.1830

Total SS113.4328

R-squared.1344

Sample size (N) = 47

Number of predictors (P) = 4

Breusch-Pagan test for Heteroscedasticity (CHI-SQUARE df=P)7.625

Significance level of Chi-square df=P (H0: Homoscedasticity) .1063

Koenker test for Heteroscedasticity (CHI-SQUARE df=P)6.319

Significance level of Chi-square df=P (H0: Homoscedasticity).1766

------ END MATRIX -----

Since the p-value (0.1766) is greater than the level of significance (0.05), the implication is that the data was homoscedastic. This further implies thatthere is reliability in the model and it can predict the relationship between the variables. The conclusion is that circular economy practices significantly affect supply chain performance.

4.4.6 Autocorrelation Test

Autocorrelation was tested using Durbin Watson Test. This was done to check if the variables were auto correlated.

Table 4.5: Autocorrelation Test

Model	Durbin Watson Test
Circular Supplies, Product Extension, Resource Recovery, Product Development and Supply Chain Performance	1.610

Source: Research Data (2019)

Table 4.5 show that Durbin-Watson value was between the required values of $1.5 < d < 2.5$. Therefore, it was assumed that auto-correlation was absent in the data.

4.5Descriptive Analysisof the Study Variables

The analysis was based on response from the managers indicating how their companies have adopted circular economy practices using a rating scale where 5 = To a very large extent; 4 = Large extent; 3 = Moderate extent; 2 = Small extent and 1 = Very small extent.

4.5.1 Circular Supplies

Table 4.6 indicate that circular supplies were adopted by the company to a large extent with an overall mean of 4.54. The study found out that the highest adopted circular

supplies practice was the recycling of waste with a mean of 4.7 (SD = .548)followed by mechanisms to facilitate reuse, repair, redistribution, refurbishment and remanufacturing of products having a mean of 4.6 (SD = .614) and then the implementation of supply cost savings having a mean of 4.34 (SD = .635).

Table 4.6: Circular Supplies

Practices	N	Mean	Std. Deviation
My organization has put in place supplies cost savings mechanisms in the entire supply chain.	47	4.34	.635
There are measures in the organization for recycling waste.	47	4.70	.548
The organization has put in place mechanisms to ensure reuse, repair, redistribution, refurbishment and remanufacturing of products.	47	4.60	.614
Overall Mean Value		4.54	
Valid N (List wise)	**47**		

Source: Research Data (2019)

The highest mean for recycling of waste means that, it was the most adopted practice while the lowest mean of supply cost savings imply that it was the least adopted circular supplies activity. The standard deviations indicate the extent of variations in the response given on each practices as adopted. The lower standard deviations indicate that the respondents were having an almost similar view on the adoption of the activities while a higher standard deviation indicated that the respondents had significantly varied opinions regarding implementation of the activity.

4.5.2 Product Extension

Table 4.7 show that the companies adopt practices on product extension to a larger extent with an average mean value of 4.57. The mostly adopted practice was the use of waste reduction mechanisms throughout the supply chain with the highest mean of 4.68 (SD = .594) followed by implementation of systems to ensure efficiency in the production process with a mean of 4.64 (SD = .568) and lastly the practice of keeping the products in economic use to minimize extraction of new materials having a mean of 4.38 (SD = .677).

Table 4.7: Product Extension

Practices	N	Mean	Std. Deviation
My organization has implemented systems that ensure efficiency in the production process.	47	4.64	.568
The company adapts business models to keep products in economic use, minimizing extraction of new materials.	47	4.38	.677
The organization has implemented waste reduction mechanisms throughout the supply chain.	47	4.68	.594
Overall Mean Value		4.57	
Valid N (Listwise)	**47**		

Source: Research Data (2019)

The implementation of product extension practices had lower standard deviations indicating low variations in the views of the respondents across all the companies studied.

4.5.3 Resource Recovery

Table 4.8 indicate that the companies implemented resource recovery practices largely with a mean of 4.5. The highly practiced activities included the use of alternative fuels to

replace reliance on fossil fuels with a mean of 4.53 (SD = .584) followed by ensuring that emissions are reduced through the use of environmental friendly operations with a mean of 4.51 (SD = .621) and lastly the engagement in activities for recycling of waste to ensure reduced consumption of resources through the supply chain having a mean of 4.47 (SD = .718).

Table 4.8: Resource Recovery

Practices	N	Mean	Std. Deviation
The company engages in activities for recycling of waste to ensure reduced consumption of resources through the supply chain.	47	4.47	.718
My company is considering the use of alternative fuels to replace reliance on fossil fuels.	47	4.53	.584
The company ensures that emissions are reduced through the use of environmental friendly operations.	47	4.51	.621
Overall Mean Value		4.50	
Valid N (Listwise)	**47**		

Source: Research Data (2019)

The highest mean implies that the activity was implemented more than the activities with low mean values.

4.5.4 Product Development

Table 4.9 indicate that the companies implemented product development activities greatly having a mean of 4.19. Specifically, the companies ensured that products are of different varieties to fulfill diversity of end users and other supply chain players with a mean of 4.21(SD = .690) followed by implementation of mechanisms of ensuring integrity in the entire supply chain with a mean of 4.19 9 (SD = .798) and lastly the

development of mechanisms to ensure that different designs of products on a continuous basis that had a mean of 4.17(SD = .670).

Table 4.9: Product Development

Practices	N	Mean	Std. Deviation
The company develops mechanisms of ensuring different designs of products on a continuous basis.	47	4.17	.670
My organization ensures that there is integrity in the entire supply chain.	47	4.19	.798
The organization ensures that products are of different varieties to fulfill diversity in end users and other supply chain players.	47	4.21	.690
Overall Mean Value		4.19	
Valid N (Listwise)	**47**		

Source: Research Data (2019)

The activities with the highest mean meant that they were implemented to a greater level as compared to those with low mean values. The low standard deviations however indicated that the respondents had near similar opinions regarding the use of product development activities.

4.5.5 Supply Chain Performance

The findings were based on the extent to which the managers agreed that their companies had achieved the supply chain performance indicators by implementing the circular economy practices. The responses used the raring scale; 1 = Not at all; 2 = Small extent; 3 = Moderate extent; 4 = Great extent; 5 = Very great extent. The findings are as given in Table 5.0. There was achievement of reduced inventory levels and shorter lead time having a mean of 4.62. The companies also realized improved system reliability with a

mean of 4.60 (SD = .577). There was also the achievement of better capacity planning with a mean of 4.34. (SD = .635).

Table 5.0: Supply Chain Performance

Performance Indicator	N	Mean	Std. Deviation
Better Capacity Planning.	47	4.34	.635
Reduced Inventory Levels.	47	4.62	.534
Shorter Lead Time	47	4.62	.573
System Reliability	47	4.60	.577
Overall Mean Value		4.55	
Valid N (List wise)	**47**		

Source: Research Data (2019)

The general implication is that the companies experienced improved supply chain performance and that implementation of circular economy practices greatly affected supply chain performance having a mean of 4.55.

4.6 Challenges of Adopting Circular Economy Practices

Table 5.0 indicate that 25.5% of the firms experienced the challenge of the inadequate technology and cost implications in the short run while 12.8% of the companies faced the challenges of lack of appropriate regulations and inadequate government policies.

Table 5.0: Challenges Facing Adoption of Circular Economy Practices

Challenge	Frequency	Percent	Valid Percent
It is expensive	12	25.5	25.5
Lack of appropriate regulations	6	12.8	12.8
Intense competition	5	10.6	10.6
Inadequate technology by the firm	12	25.5	25.5
Government policies	6	12.8	12.8

Low value of recovered material	2	4.3	4.3
Resource inefficiency	4	8.5	8.5
Total	**47**	**100.0**	**100.0**

Source: Research Data (2019)

Table 5.0also indicate that 10.6% of the companies faced the challenge of intense competition while the challenge that was faced by the lowest number of companies was low value of recovered material representing 4.3%. The findings imply that the main challenges were inadequacy of technology and the high cost involved in implementing the circular economy infrastructure.

4.7 Effect of Circular Economy Practices on Supply Chain Performance

A multiple linear regression was used to determine the effect of the circular economy practices on supply chain performance.

4.7.1 Bivariate Correlation Analysis of the Study Variables

The findings in Table 5.1 indicate that there is a strong positive correlation between circular supplies, product extension, resource recovery, product development and supply chain performance (r = .894; r = .875, r = .898 and r = .834) respectively. The findings in Table 5.1 equally indicate the significance of the correlation using the alpha value of 0.05. The implication is that the correlation between circular supplies, product extension, resource recovery, product development and supply chain performance is significant since in each case, the alpha value is less than 0.05 as given in Table 5.1:

Table 5.1: Correlation Matrix

		Circular Supplies	Product Extension	Resource Recovery	Product Development	Supply Chain Performance
Circular Supplies	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	47				
Product Extension	Pearson Correlation	.964**	1			
	Sig. (2-tailed)	.000				
	N	47	47			
Resource Recovery	Pearson Correlation	.839**	.831**	1		
	Sig. (2-tailed)	.000	.000			
	N	47	47	47		
Product Development	Pearson Correlation	.795**	.765**	.751**	1	
	Sig. (2-tailed)	.000	.000	.000		
	N	47	47	47	47	
Supply Chain Performance	Pearson Correlation	.894**	.875**	.898**	.834**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	47	47	47	47	47

**. Correlation is significant at the 0.01 level (2-tailed).

4.7.2Regression Analysis

To assess the suitability of the model, a regression analysis was conducted. This also helped to predict causal relationship between circular supplies, product extension, resource recovery, product development and supply chain performance.The result indicated in Table 5.2 imply that 88.2% changes in supply chain performance is due to

changes in circular supplies, product extension, resource recovery and product development(R^2 = 0.892, adjusted R^2 = 0.882).

Table 5.2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.945[a]	.892	.882	.11035

a. Predictors: (Constant), PD, RR, PE, CS

Source: Research Data (2019)

The implication of findings in Table 5.2 indicate that supply chain performance of chemical and allied firms in Kenya is significantly affected by variations in circular economy practices studied in this research.

4.7.3 Analysis of Variance

Analysis of variance in Table 5.3is an indication that the model was significant ($p<0.05$). The implication is that circular supplies, product extension, resource recovery and product developmentreliably predict supply chain performance of the chemical and allied manufacturing firms in Kenya.

Table 5.3: Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.238	4	1.060	87.011	.000[b]
	Residual	.511	42	.012		
	Total	4.750	46			

a. Dependent Variable: SCP

b. Predictors: (Constant), PD, RR, PE, CS

Source: Research Data (2019)

4.7.4 Regression Co-efficients

Table 5.4 indicates that a unit improvement in circular supplies leads to .270 improvements in supply chain management while a unit improvement in product extension activities lead to .041 improvements in supply chain performance of the chemical and allied sector manufacturing firms in Kenya. It also indicates that a unit improvement in resource recovery leads to .387 improvements in supply chain performance and finally, a unit improvement in product development leads to a .219 improvement in supply chain performance of the firms under study.

Table 5.4: Regression Co-efficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.541	.227		2.389	.021
	Circular Supplies	.270	.185	.302	1.464	.151
	Product Extension	.041	.166	.047	.243	.809
	Resource Recovery	.387	.088	.428	4.390	.000
	Product Development	.219	.080	.236	2.729	.009

a. Dependent Variable: SCP

Source: Research Data (2019)

Further, the findings indicate that resource recovery and product development are significant (β=.387, t=4.390, $p<0.05$; β=.219, t=2.729, $p<0.05$) respectively. Circular supplies and product extension are however do not have a significant effect on supply chain performance as given by (β=.270, t=1.464, $p>0.05$;β=.041, t=.243, $p>0.05$). The analysis is as given in the Table 5.4:

Based on the findings, a multiple linear regression model can be established of the nature given as follows:

$$\mathbf{Y = .541 + .270X_1 + .041X_2 + .387X_3 + .219X_4 + \varepsilon}$$

Where:

Y = Supply Chain Performance (Dependent variable).

a = Constant

β_1, β_2 and β_3 = Coefficient of Independent variables

X_1= Circular Supplies

X_2= Product Extension

X_3 = Resource Recovery

X_4 = Product Development

ε = Error term.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This section is a presentation of the summary of research findings, conclusions and recommendations. It also gives analysis of the limitations experienced and the recommendations for future research.

5.2 Summary of Findings

The study found out that chemical and allied companies adopted circular supplies largely with an overall mean of 4.54. Circular supplies practices such as recycling of waste; reuse, repair, redistribution, refurbishment and remanufacturing of products and supply cost savings were implemented by the companies to a greater extent indicated by the means 4.7 (SD = .548); 4.6 (SD = .614) and 4.34 (SD = .635) respectively. The implication of the findings is that chemical and allied firms recycle their waste, encourage reuse, repair, redistribution, refurbishment and remanufacturing of products to extend the life cycle of the product. The companies also ensure supply cost savings. The study also established that circular supplies and supply chain performance are strongly and positively correlated (r = .894). The correlation was found to be significant implying that when circular supply activities are implemented to a greater extent, supply chain performance improves. The regression coefficient values showthat circular supplies have apositive relationship to supply chain performance. This implies that increased values of circular supplies would mean increased supply chain performance.

Regarding the practice of product extension, the findings indicate that the firms adopted them to a larger extent with an average mean value of 4.57. The meaning is that the firms

used waste reduction mechanisms throughout the supply chain, they implemented systems to ensure efficiency in the production process and they keep the products in economic use to minimize extraction of new materials to a greater extent with mean of 4.68, 4.64 and 4.38 respectively. On the basis of correlation between product extension and supply chain performance, the findings indicate that there is a strong positive correlation between product extension and supply chain performance. The correlation is significant implying that an improvement in product extension leads to a significant improvement in supply chain performance. The regression model indicate that product extension is positively related to supply chain performance as seen by their coefficientvalues. This shows that a rise in product extension would increase supply chain performance while a reduction in product extension would also reduce the level of supply chain performance.

The findings regarding resource recovery practices indicate that they were implemented by the firms to a greater extent with an average mean of 4.50. The firms used alternative fuels to replace reliance on fossil fuels, they ensured that emissions are reduced through the use of environmental friendly operations and engaged in activities for recycling of waste to ensure reduced consumption of resources through the supply chain with means of 4.53, 4.51 and 4.47 respectively. The correlation analysis indicates a strong positive correlation between resource recovery and supply chain performance. This means that when resource recovery activities are improved, supply chain performance improves as well. The regression coefficient values equally indicate that there is a positive relationship between resource recovery and supply chain performance.

On the basis of product development, the companies implemented product development activities to a greater extent having a mean of 4.19. The study found out that the

companies ensured that products were of different varieties to fulfill diversity of end users and other supply chain players, they implemented mechanisms of establishing appropriateness in the entire supply chain and they developed mechanisms to make sure that different designs of products on a continuous basis to a greater extent with means of 4.21, 4.19 9 and 4.17 respectively. The correlation between product development and supply chain performance was strong and positive. The regression coefficient values indicated that product development positively and significantly affect supply chain performance. This finding implied that improved product development activities would improve supply chain performance.

Regarding the challenges faced by chemical and allied firms in adopting circular economy practices in Kenya, the study found out that 25.5% of the companies experienced the challenge of the inadequate technology and cost implications in the short run while 12.8% of the companies faced the challenges of lack of appropriate regulations and inadequate government policies. The study also found out that 10.6% of the companies faced the challenge of intense competition while the challenge that was faced by the lowest number of companies was low value of recovered material representing 4.3%. The implication is that the companies majorly faced the challenge of lack of adequate technology and finances to support the implementation of the practices.

Finally, regarding the effect of circular economy practices on supply chain performance, the study found out that 88.2% variations in supply chain performance is explained by the changes in circular supplies, product extension, resource recovery and product development. The F-statistics equally impliedthat circular supplies, product extension, resource recovery and product development reliably predict supply chain performance of the chemical and allied manufacturing firms in Kenya. The p value (0.000) is less than

the level of significance (0.05) which implies thatthe overall model is significant. The regression co-efficients established that resource recovery and product development are significant as shown by their p-values of .000 and .009 which are all less than 0.05. The implication is that they can be justified to be included in the regression model.

5.3 Conclusion of the Study

The study concluded that, chemical and allied firms have used circular economy practices including circular supplies, product extension, resource recovery and product development to a greater extent. The companies implemented the activities of recycling of waste; reuse, repair, redistribution, refurbishment and remanufacturing of products and supply cost savings were implemented by the companies to a greater extent. The companies equally used waste reduction mechanisms throughout the supply chain, they implemented systems to ensure efficiency in the production process and they keep the products in economic use to minimize extraction of new materials to a greater extent while using alternative fuels to replace reliance on fossil fuels. They ensured that emissions are reduced through the use of environmental friendly operations and engaged in activities for recycling of waste. The study also concluded that the companies ensured that products were of different varieties whileimplementing mechanisms of ensuring integrity of the whole supply chain and they developed mechanisms to make sure that different designs of products on a continuous basis to a greater extent

The researcher also concluded that the companies majorly faced the challenge of lack of adequate technology and finances to support the implementation of the practices. The other challenges includedlack of appropriate regulations and inadequate government policies as well as intense competition and the issue of low value of recovered material.

Finally, the study concludes that adopting circular economy practices significantly improve supply chain performance of chemical and allied firms in Kenya. This is based on the observation that 88.2% variations in supply chain performance is explained by the changes in circular supplies, product extension, resource recovery and product development.

The findings of this study are the same as the findings by Botezat, Dodescu, Văduva and Fotea (2018) that circular economy practices of Romanian producers significantly affect economic and environmental achievement of firms as well as the study by Ochiri, Wario, Odhiambo, and Arasa (2015) who concluded that the introduction of waste reduction would actually improve the performance of publishing forms. The findings are as well in line with the study by Kabergey and Richu (2015) who found out that product recycling and reuse have a positive impact on how successful the companies were operationally.

5.4 Recommendations of the Study

Based on the conclusions, the researcher recommends that management of chemical and allied manufacturing firms should put in place mechanisms to improve the circular economy practices because they have a significant positive effect on their supply chain performance. The companies should put in place mechanisms to improve between circular supplies, product extension, resource recovery and product development practices.

The study also recommends that firms should increase investment in green technology that would help deal with the challenge of inadequate technology and undertake proper planning and execution of these activities to reduce the operational costs. Further

recommendation is that the Government should formulate adequate policies that would provide a good framework to make use of circular economy practices.

The management of the companies should also formalize adoption of circular economy practices through written down policies, guidelines and regulations provided by the industry regulators. So as to face the challenges, the recommendations are that companies should increase investments in the circular economy technology within the regulatory framework to reap more benefits.

5.5 Limitations of the Study

This researchhighlights the significance and primary challenges of adopting circular economy practices, but the findings are only valid within the narrowly defined scope of the context, which is chemical and allied firms in Kenya. Thus, the generalizability of the findings to other manufacturing companies is unknown. The study tried to cover up for this limitation by getting response from a larger percentage of the targeted population.

Another limitation of this study was that the researcher only received response fromone person per firm. The argument is that the perceptions and judgements of others are not included in the study and could have created a twist in the findings.

5.6 Suggestions for Further Research

More studies should be done on the key determinantsand drivers of circular economy practices. The present study also focused only on chemical and allied sector firms, a future study can be done to analyze CE practices among other sectors of the economy. Another research can also be made to assess quantitative aspect of performance such as changes in profits and many more.

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APPENDICES

APPENDIX I: QUESTIONNAIRE

SECTION B: CIRCULAR ECONOMY PRACTICES

Please indicate your level of agreement with the following statements as practiced in your organization. Please tick the appropriate box where:

5 = To a very large extent; 4 = Large extent; 3 = Moderate extent; 2 = Small extent and 1 = Very small extent.

	Statement	**1**	**2**	**3**	**4**	**5**
	Circular Supplies					
a	My organization has put in place supplies cost savings mechanisms in the entire supply chain.					
b	There are measures in the organization for recycling waste.					
c	The organization has put in place mechanisms to ensure reuse, repair, redistribution, refurbishment and remanufacturing of products.					
	Product Extension	**1**	**2**	**3**	**4**	**5**
a	My organization has implemented systems that ensure efficiency in the production process.					
b	The company adapts business models to keep products in economic use, minimizing extraction of new materials.					
c	The organization has implemented waste reduction mechanisms throughout the supply chain.					
	Resource Recovery	**1**	**2**	**3**	**4**	**5**
a	The company engages in activities for recycling of waste to ensure reduced consumption of resources through the supply chain.					
b	My company is considering the use of alternative fuels to replace reliance on fossil fuels.					
c	The company ensures that emissions are reduced through the use of environmental friendly operations.					
	Product Development	**1**	**2**	**3**	**4**	**5**
a	The company develops mechanisms of ensuring different designs of products on a continuous basis.					

b	My organization has put in place mechanisms to ensure that there is integrity in the entire supply chain.					
c	The organization ensures that products are of different varieties to fulfill diversity in end users and other supply chain players.					

SECTION C: SUPPLY CHAIN PERFORMANCE

Given below is a list of supply chain performance indices. Please indicate the extent to which they have been realized through implementation of the leagile manufacturing practices using the key:

1 = Not at all; 2 = Small extent; 3 = Moderate extent; 4 = Great extent; 5 = Very great extent

	Statement	**1**	**2**	**3**	**4**	**5**
1.	Better Capacity Planning.					
2.	Reduced Inventory Levels.					
3.	Shorter Lead Time					
4.	System Reliability					

SECTION D: CHALLENGES OF CIRCULAR ECONOMY PRACTICES ADOPTION

Given below are the challenges facing the implementation of circular economy practices, please tick a relevant one to your organization (TICK ONLY ONE):

	Challenges	**Tick**
1	It is expensive	
2	Lack of appropriate regulations	
3	Intense competition	
4	Inadequate technology by the firm	
5	Government policies	
6	Low value of recovered material	
7	Resource inefficiency	

APPENDIX II: RAW DATA

Respondents	Circular Supplies	Product Extension	Resource Recovery	Product Development	Supply Chain Performance
1	4	4	4	5	5
2	5	5	5	5	5
3	5	5	5	5	5
4	4	4	5	5	5
5	4	4	4	4	5
6	4	4	4	4	4
7	4	4	4	4	4
8	5	5	5	5	5
9	4	4	5	5	5
10	4	4	4	4	5
11	5	5	5	4	5
12	4	4	5	5	5
13	5	5	5	5	5
14	4	4	4	4	4
15	4	4	4	4	4
16	4	4	4	4	5
17	5	5	5	5	5
18	4	4	4	4	5
19	4	4	4	4	5
20	5	5	5	5	5
21	5	5	5	4	5
22	4	4	4	4	4
23	5	5	5	5	5
24	4	4	5	5	5
25	4	4	5	5	5
26	4	4	5	4	5
27	4	4	4	4	5
28	5	5	4	5	5
29	5	5	5	5	5
30	5	5	5	5	5
31	4	4	4	5	4
32	4	4	4	4	5
33	5	5	5	5	5
34	5	5	5	4	5
35	5	5	5	5	5
36	5	5	5	5	5
37	5	5	5	5	5
38	5	5	5	4	5
39	5	5	5	5	5

Respondents	Circular Supplies	Product Extension	Resource Recovery	Product Development	Supply Chain Performance
40	5	5	5	5	5
41	5	5	5	5	5
42	5	5	5	5	5
43	5	5	5	5	5
44	4	4	4	4	4
45	4	5	5	5	5
46	4	4	4	5	5
47	4	4	5	4	5

APPENDIX III: LIST OF CHEMICAL AND ALLIED FIRMS

	Chemical and Allied Sector		
	Company		**company**
1	Anffi Kenya Ltd	30	Pyrethrum Board of Kenya
2	Match Masters Ltd	31	Pan Africa Chemicals Ltd
3	Basco Products Ltd	32	Strategic Industries Ltd
4	Metoxide Africa	33	Desbro Kenya Ltd
5	Bayer East Africa Ltd	34	Soilexprosolve
6	Milly Glass Works Ltd	35	Eastern Chemicals Industries
7	Belersdorf East Africa Ltd	36	Supa Brite Ltd
8	Murphy Chemicals Ltd	37	Elex Products Ltd
9	Blue King Products Ltd	38	Superfoam Ltd
10	Odex Chemicals Ltd	39	Eveready Batteries East Africa Ltd
11	BOC Kenya Ltd	40	Syngenta E.A. Ltd
12	Orbit Chemicals Industries Ltd	41	Galaxy Paints and Coating Co.
13	Buyline Industries Ltd	42	Synresins Ltd
14	Osho Chemicals Industries Ltd	43	Grand Paints Ltd
15	Carbacid (CO2) Ltd	44	Tata Chemicals
16	Webuye Chemical and Solvents (E.A.) Ltd	45	Haco Tiger Brands (E.A.) Ltd
17	Polychem E.A.	46	Tri-Clover Industries (K) Ltd
18	Continental Products Ltd	47	Henkel Kenya Ltd
19	Procter & Gamble E. A. Ltd	48	Interconsumer Products Ltd
20	Cooper K-Brands Ltd	49	Twiga Chemical Industries
21	Nairobi Crown Gases Ltd	50	Johnson Diversey E.A. Ltd
22	PZ Cussons E.A. Ltd	51	Unilever E. and Southern Africa
23	Crown Paints (Kenya) Ltd	52	Kapi Ltd
24	Reckitt Benckiser (E.A.) Ltd	53	Vitafoam Products Ltd
25	Colgate palmolive	54	Kel Chemicals Ltd
26	Revolution Stores Ltd	55	Maroo Polymers Ltd
27	Magadi Soda	56	Ken Nat Ink & Chemicals
28	Rumoth Group of Co. Ltd	57	Sara Lee
29	Sadolin Paints (E.A.)	58	Tropikal Brand