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Effect of green manufacturing practices on operational performance of large manufacturing firms in Nairobi County.

Odhiambo, Creff
Strathmore Business School
Strathmore University

EFFECT OF GREEN MANUFACTURING PRACTICES ON OPERATIONAL PERFORMANCE OF LARGE MANUFACTURING FIRMS IN NAIROBI COUNTY

CREFF ODHIAMBO

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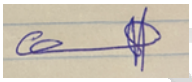
DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the project contains no material previously published or written by another except where due reference is made in the project itself.

Signature _____  _____ Date: __**10/19/24**___

CREFF ODHIAMBO

MCOM/148378

This thesis has been submitted for examination with my approval as the University supervisor.

Signature ____  ____ Date: ____10/19/2024_____

James Ndegwa

Lecturer, Strathmore University Business School

Signature _____ Date: _____

Executive Dean
Strathmore University Business School
Director Office of Graduate Studies

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DEDICATION

I dedicate this thesis to my parents, who assisted me tremendously while I pursued this thesis. Above all, I dedicate with thanksgiving this thesis to my God almighty, Ebenezer.

ABSTRACT

The increasing focus on environmental sustainability has led manufacturing companies to consider adopting green manufacturing practices. The empirical research in the area showed that there were mixed results on how green manufacturing related to operational performance. Some studies showed a positive relationship (Seth & Shrivastava, 2016; De Oliveira et al., 2019; and Musau, 2019) while others brought a negative (Hejazi et al., 2023; Adam et al., 2021) or insignificant (Ahmad et al., 2022; Otundo, 2019) relationship. The Kenyan studies brought out research gaps where the studies showed conceptual, methodological and/or contextual gaps. This research sought to fill the gaps through an examination on how green manufacturing practices affects operational performance of large manufacturing companies in Nairobi County, Kenya. Specifically, it looked into the effect of eco-friendly production methods, waste reduction and energy efficiency on operational performance. The study was carried out in the months of April and May 2024. The study used a multi-theory based on the resource-based view and triple bottom line theory. The study employed a positivist research philosophy and a descriptive cross-sectional research design targeting 115 large manufacturing firms in Nairobi County. A total of 89 manufacturing companies were sampled through simple random sampling. Data was gathered from 89 top managers in the operations department of large manufacturers in Nairobi using a structured questionnaire. Pilot study was done to establish the reliability and validity. Reliability was checked through internal consistency check using Cronbach alpha while validity was checked by having experts check on the research instrument. Descriptive statistics and simple linear regression analysis were adopted for analysis. The study found that eco-friendly production process, waste reduction and energy efficiency had a positive and significant regression coefficient on operational performance. This shows that green manufacturing practices positively affects operational performance of manufacturing companies. The study concluded that green manufacturing practices of eco-friendly production process, waste reduction and energy efficiency have a positive effect on operational performance of large manufacturing firms in Nairobi County. This study recommends that manufacturing companies in Nairobi County increase the adoption of eco-friendly production processes in order to improve their operational performance. They also need to gear up their waste reduction efforts and increase the adoption of energy efficiency in their operations for improved performance. The policy makers also need to come up with relevant policies that would support the implementation of green manufacturing among large manufacturers in Kenya. This would lead to improved performance among the manufacturing companies. There is need for further research based on other factors influencing operational performance of manufacturing companies; other measures of operational performance and green manufacturing practices; in a rural county like Kirinyaga County; and involving small manufacturing companies in Nairobi County. The study will be valuable to policy makers, management of large manufacturers, academicians and researchers as it creates an understanding on how green manufacturing practices affect operational performance.

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LIST OF ABBREVIATIONS AND ACRONYMS

GDP	Gross Domestic Product
GM	Green Manufacturing
GMP	Green Manufacturing Practice
GSCM	Green Supply Chain Management
KAM	Kenya Association of Manufacturers
KPI	Key Performance Indicator
PLS	Partial Least Squares
RBV	Resource-Based View
SEM	Structural Equation Modeling
SFA	Stochastic Frontier Analysis
SME	Small and Medium Enterprise
SPSS	Statistical Package for Social Sciences
TBL	Triple Bottom Line
VIF	Variance Inflation Factor
VRIN	Valuable, Rare, Inimitable, And Non-Substitutable

CHAPTER ONE: INTRODUCTION.

1.1 Background of the Study

In today's society, there is an increasing inclination towards adopting eco-friendly practices, evidenced by a growing number of businesses embracing sustainability. Recent years have seen companies invest significantly in the development of environmentally friendly products and more efficient production methods (Baumgartel, 2023). This reflects a heightened societal awareness of the detrimental impact of business activities on the environment, driving a collective effort towards implementing green initiatives (Scheurer et al., 2023). Green Manufacturing Practices (GMPs) have emerged as a viable solution for manufacturing firms to mitigate their environmental footprint and enhance operational performance (Albloushi et al., 2023). The manufacturing industry in Kenya plays a crucial role in the economic development of Kenya, contributing significantly to the region's construction and infrastructure sectors (Irandu & Owilla, 2020). However, its environmental impact has raised concerns globally, prompting a shift towards sustainable practices.

Empirical gaps exist in the area of operational performance and green manufacturing. Rehman, Seth and Shrivastava (2016) did a study on the impact of green manufacturing practices on organizational performance in Indian context. The research followed a survey method for data collection. A diagnostic research survey instrument was designed and used for data collection from the Indian manufacturing companies that had implemented/experienced green manufacturing. The study showed that green manufacturing practices had positive effect on operational performance. The study, however, was done in an Indian other than a Kenyan context bringing in contextual gaps. Further, six regression equation models were involved with the current adopting three simple regression models. This created methodological gaps.

Jabbour et al. (2016) looked into the barriers to the adoption of green operational practices at Brazilian companies with an investigation into the effects on green and operational performance. This research project aimed to confirm the extent to which adoption of green operational practices is impacted by internal and external barriers to environmental management, as well as if these barriers have an impact on the operational and green performance of the firms in a sample of Brazilian manufacturing companies. Partial Least Squares-Structural Equation Modeling (PLS-SEM) with WarpPLS 4.0 was utilized on 75

businesses. The primary findings demonstrate that when implementing GOPs, internal barriers were of greater significance than external barriers; and green operational practices had a direct relationship with the company's operational performance. The study looked at barriers of green manufacturing and how they affect operational performance. This created a conceptual gap. the study was done in Brazil which created a contextual gap. Further, PLS-SEM model other than simple regression was adopted bringing in methodological gaps.

De Oliveira et al. (2019) studied cleaner production practices, motivators and performance in the Brazilian industrial companies. The relationship between institutional pressures to embrace cleaner production techniques and the effects these practices have on the environment, the economy, and operational performance is developed in this research. The study used a survey with a sample of two hundred and eight (208) Brazilian industrial enterprises. The adoption of cleaner production techniques by enterprises was positively impacted by all institutional forces. Further, the adoption of cleaner production techniques positively impacted operational performance. The study involved Brazilian industrial companies other than Kenyan manufacturing companies creating a difference in context.

Ahmad et al. (2022) investigated how green supply chain management (GSCM) practices influence sustainable performance across the textile, automobile, and tobacco sectors in Pakistan. Data were obtained from 384 firms using a structured survey questionnaire, with analysis performed in SPSS and AMOS. The survey approach was employed to gather responses, allowing for an empirical examination of the link between GSCM practices and sustainable performance. Analytical techniques included descriptive statistics, confirmatory factor analysis (CFA), and structural equation modeling (SEM). Findings indicated that practices such as green manufacturing, green purchasing, eco-design, and green information systems had an insignificant but positive effect on the organizations' sustainable performance, extending beyond just operational outcomes. The study was undertaken in Pakistan indicating a contextual difference in that the present is a Kenyan study.

Hejazi, Al Batati and Bahurmuz (2023) aimed to assess the impact of these green practices on business sustainability performance in Saudi Arabia. Data from 250 completed questionnaires were analyzed using partial least squares (PLS) methodology. The results indicated that implementing green practices had a significant negative effect on corporate performance.

Adam et al. (2021) explored the moderating effect of IoT on the relationship between GSCM practices and operational performance in Nigeria's petroleum downstream sector. A quantitative approach was used, with data collected from 365 senior staff across seven companies using a stratified random sampling method. A validated questionnaire was employed, and the data were analyzed through Partial Least Square Structural Equation Modeling (PLS-SEM) using SmartPLS 3.

Musau (2019) delved into the effects of green manufacturing practices on operational performance, particularly within Mombasa County, Kenya, with a focus on cement manufacturing firms. Through a cross-sectional survey, data were gathered via questionnaires distributed among managers across various sectors. Results indicated a positive correlation between green practices such as streamlined processes and green supply chain management (GSCM) and improved operational performance. This depicts that firms that adopt effective green manufacturing practices displays high level of operational performance. The study was done on cement firms in Mombasa other than large manufacturers in Kenya indicating a contextual gap.

In contrast, Jason and Charles (2021) examined the broader spectrum of sustainable manufacturing practices and their influence on operational performance among cement manufacturing firms in Machakos county, Kenya. Utilizing descriptive and inferential statistical analyses on data collected from diverse firms, the study confirmed a significant positive impact of sustainable practices on operational performance.

The empirical studies have produced mixed results on how green manufacturing practices influence operational performance. Some studies have found that green manufacturing practices positively influence operational performance. These include Seth and Shrivastava (2016) in Indian context and De Oliveira et al. (2019) in Brazilian industrial companies. They found that green manufacturing practices led to improved operational performance. Musau (2019) who delved into the effects of green manufacturing practices on operational performance in Mombasa County, Kenya also found a positive correlation between green practices and operational performance.

Conversely, other studies indicated a significant negative relationship between GSCM practices and operational performance. The results were shown by Hejazi, Al Batati and

Bahurmuz (2023) in their assessment on the impact of green manufacturing practices on business performance in Saudi Arabia. They found that the costs in the implementation of green manufacturing led to reduced operational performance. In addition, Adam et al. (2021) in Nigeria's petroleum downstream sector found that green manufacturing practices negatively influenced operational performance.

Despite previous studies showing significant relationship between green manufacturing practices and operational performance, some studies have shown insignificant relationships adding to the empirical gaps. The outcomes differed with those studies that showed significant relationship between green manufacturing and performance. One such study is that of Ahmad et al. (2022) who investigated how green supply chain management (GSCM) practices influence sustainable performance across the textile, automobile, and tobacco sectors in Pakistan. Findings indicated that practices such as green manufacturing, green purchasing, eco-design, and green information systems had an insignificant but positive effect on the organizations' sustainable performance, extending beyond just operational outcomes. Another study that showed insignificant relationship was that of Otundo (2019) who studied the effects of green production practices on financial performance of manufacturing firms in Kenya. The study found that green production practices had insignificant effect on firm performance.

Among Kenyan studies, the results also differed. While Musau (2019); and Jason and Charles (2021) discovered positive correlations between green practices and performance, Ochieng (2019) suggested a specific practice (green purchasing) positively impacts performance while others were insignificant. This disparity might stem from the differing concepts examined: Rupario (2019); Jason and Charles (2021) investigated broad green practices, whereas Ochieng (2019) focused on a specific element within this broader framework. Moreover, the contextual differences, particularly the focus on the chemical industry in Ochieng (2019) study compared to the cement industry in the other two studies, could have influenced the outcomes.

In addition to the mixed results on green manufacturing practices and operational performance, the local studies have shown that empirical gaps existed in the area of research. Conceptual gaps came up where the studies adopted different concepts. For example, Jason and Charles (2021) examined the broader spectrum of sustainable manufacturing practices other than green manufacturing practices considered in the present research. On the other hand, Ochieng (2019),

narrowed the scope to green purchasing practices assuming other manufacturing practices adding to the gaps.

Several past studies have explored green manufacturing in varying contexts bringing in conceptual gaps. For example, Musau (2019) undertook the study on cement firms in Mombasa other than large manufacturers in Kenya indicating a contextual gap. Further, Jason and Charles (2021) involved cement manufacturing firms in Machakos county, Kenya adding to the contextual gaps. On the other hand, Ochieng (2019), narrowed the scope to green purchasing practices and their effects on the performance of large chemical manufacturing firms in Nairobi County. Kiptoo et al. (2020) focused on Nairobi, examining how environmental management practices affect Rhino Cement financial performance. Studies by Ongaro (2019); Kiptum (2021); Too (2019) lead to questions on how applicable studies on the impact of green manufacturing practices are to the operational performance of firms in Nairobi. The question is whether existing research focuses on only a few companies or specific industries, which might not represent the broader landscape of large manufacturing firms in the city accurately.

Despite their being studies being carried out on effect of green manufacturing practices, majority of the studies seemed to have focused on specific industries thus not making it possible to generalize the findings. The study aims to fill this research gap by analyzing the effect of green manufacturing practices on performance of large manufacturing firms in Nairobi County. By addressing this gap, the study aims to provide valuable insights and contribute to the knowledge base surrounding effect of green manufacturing practices on performance of all large manufacturing firms in Nairobi.

The studies also showed methodological gaps where different research methodologies were adopted. Ochieng (2019), employed a survey design involving supply chain managers other than a descriptive research design involving head of operations. This showed a methodological gap. In addition, Musau (2019) utilized a cross-sectional survey other than descriptive research design adding to the methodological gaps. Further, Jason and Charles (2021) adopted a multiple regression analysis model which differed with the simple regression model adopted in present study. The adoption of different research methodologies may lead to difference in the results on how green manufacturing practices influence operational performance.

The studies might overlook the diverse contexts and challenges faced by different firms in Nairobi. These findings may not apply to all manufacturing firms due to the narrow focus of the research as well as the adoption of different research methodologies. From the local studies, the studies have failed to focus specifically on large manufacturers in Kenya in their investigation on specific green manufacturing practices on operational performance. This shows than a knowledge gap exists as it is not known empirically on how green manufacturing practices influence operational performance of large manufacturers in Kenya. This creates the need for this study.

The research aimed to investigate how adopting environmentally friendly manufacturing practices affects the operational performance of major manufacturing companies in Nairobi County. This section presents background information and rationale for the study. It begins by examining the global adoption of green manufacturing practices, then focuses on regional perspectives, and ultimately zooms in on the specific challenges and opportunities related to green manufacturing in Nairobi County, Kenya. The chapter looked into a comprehensive discussion on operational performance, green manufacturing practices, and the characteristics of large manufacturing firms in Nairobi, identifying research gaps in each area. It outlined the context of the study, articulated the research problem, objectives, and questions, justified the significance of the study, and delineated its scope.

1.1.1 Green Manufacturing Practices

Green manufacturing (GM) is a method that combines product design with manufacturing processes, planning, and control to identify, measure, evaluate, and manage environmental waste flow (Karuppiah et al., 2022). Green manufacturing aims to transform inputs into outputs while reducing harmful substances, improving energy efficiency in lighting and heating, reducing waste, and actively designing and redesigning processes to be environmentally friendly (Hermundsdottir & Aspelund, 2021). On the other hand, green practices refer to optimizing resource use, minimizing waste, and using energy efficiently. This translates to long-term cost reductions, not just through lower energy bills and waste disposal fees, but also by streamlining operations and improving overall efficiency (Li et al., 2023; Srisathan et al., 2023).

According to Boichuk and Kauf (2019), green manufacturing practices refer to specific, measurable, and environmentally sustainable actions and strategies employed by manufacturing firms to reduce their environmental impact and promote eco-friendly operations whose purpose is to meet or exceed customer demand. For this study, green manufacturing practices refer to the systematic approach of integrating environmentally sustainable methods into the design, production, and operational processes of manufacturing, with the goal of minimizing environmental waste, reducing harmful emissions, optimizing resource use, and improving energy efficiency, while simultaneously enhancing operational efficiency.

Islam, Perry and Gill (2021) in their study in apparel manufacturers in India, operationalized green manufacturing in terms of energy efficiency, water efficiency and material efficiency and emissions reduction in manufacturing. They also looked at eco-friendly production processes, energy saving, and waste reduction as the key green manufacturing practices. This study looked into eco-friendly production processes, production waste reduction and energy efficiency as the key green manufacturing practices. These were adopted as they were the key green manufacturing practices implemented in manufacturing companies with empirical studies confirming this.

Lee et al (2023) in the United States, the authors examined eco-friendly production processes as a green manufacturing practice within manufacturing firms. Similar to Lee and others, Reddy et al. (2023) looked at green manufacturing in terms of eco-friendly production processes that influence the operations of the manufacturers. Belhadi et al. (2020) in North African study found that eco-friendly production was a key green manufacturing practice adopted in companies. This was supported by Miranda et al. (2021) who adopted eco-friendly production processes as a key green manufacturing practice. On the other hand, Musau (2019) looked at green manufacturing in terms of green product design and development and efficient processes.

Urbański and Ul Haque (2020) looked at green manufacturing practices like waste management, emphasizing initiatives to minimize waste generation, implementing recycling and composting schemes, and adopt circular economy principles. Other studies by Abualfaraa et al. (2020); Walisundara, Thevanes, and Arulrajah (2022); and Al-Hakimi et al. (2022) adopted waste reduction as a key green manufacturing practice among manufacturers. Omar

(2023) in a study in Somalia found that waste reduction was practiced among the manufacturing SMEs within the country. This is supported by Otundo (2019) in their study on green practices of manufacturing firms in Kenya found that waste reduction was a key green manufacturing practice among the Kenyan companies. This displayed waste reduction as a major manufacturing practice.

Additionally, Karuppiah et al. (2020) they explored energy efficiency measures, including optimizing energy consumption in production processes, utilizing renewable energy sources, and upgrading equipment for increased efficiency. Further, Chen et al., (2021) and Khan et al. (2022) also adopted energy efficiency as a manufacturing practice. At the African arena, Afum et al. (2020) supported the studies by adopting efficient processes as green manufacturing practices. Further, Makanga and Kavindah (2020) in their Kenyan study measured green manufacturing in terms of green energy efficiency. This showed that energy efficiency was a critical green manufacturing practice in manufacturing companies.

1.1.2 Operational Performance

Operational performance refers to how well a company carries out its day-to-day activities to meet its objectives efficiently and effectively (Kaydos, 2020). Similarly, Cazuza de Sousa et al. (2023) define it as the assessment of how effectively and efficiently operational activities are conducted within an organization, focusing on core business functions. It involves identifying areas for cost reduction by improving processes, removing inefficiencies, and optimizing resource use. This entailed monitoring and enhancing key performance indicators (KPIs) like productivity, customer satisfaction, resource utilization, cost effectiveness and quality.

This study measured operational performance in terms of overall costs, product quality and organizational production resource efficiency and productivity. Measuring operational performance in terms of costs, quality, and resource efficiency and productivity provides a multifaceted view that helps organizations optimize their operations, enhance customer satisfaction, and achieve strategic goals sustainably. At the global arena, Sandaruwan et al. (2020) adopted costs as an indicator of operational performance. This was similar to a measure by Ngcobo et al (2022) who utilized data from South African firms and measured operational performance in terms of cost reduction. In a similar measure, El-Salamony et al. (2020) in

Egypt looked at operational performance in terms of cost savings. In the Kenyan space, Kim (2022); and Ongâ and Ndolo (2023) also adopted costs as measures of operational performance.

On the other hand, Walisundara, Thevanes, and Arulrajah (2022) adopted increased resource efficiency as a reflection of improved operational performance in a company. At the African scene, Ojo et al (2022) looked at operational performance in terms of increased efficiency. This was similar to the measures adopted by Musau (2019) who operationalized operational performance in terms of production cost among Kenyan manufacturing firms. Mwangi (2019) also measured operational performance in terms of operational efficiency in addition to cost savings.

In their research on small and medium-sized manufacturing enterprises (SMEs) in Saudi Arabia, Al-Hakimi et al. (2022) used product quality as a metric to evaluate operational performance. Similarly, Musau (2019) assessed operational performance by examining the enhanced quality of manufactured products. Ongâ and Ndolo (2023) focused on operational efficiency as a measure of operational performance among Kenyan manufacturers. Conversely, Ngui and Gathiaka (2022) evaluated operational performance based on productivity, a measure also adopted by Kasae (2014) to assess firm performance. Additionally, Otundo (2019) considered production as a metric for measuring performance.

Green manufacturing is becoming increasingly important for businesses aiming to align environmental concerns with financial prosperity (Sarfraz et al., 2023). Recent research has extensively examined the connection between adopting eco-friendly methods and a company's effectiveness in operations. A study by Shekarian et al (2022), investigates how actions such as designing sustainable products, using energy efficiently, and managing waste responsibly affect different aspects of operational performance like cutting costs, optimizing resource use, and improving production efficiency. Analyzing these findings provides valuable understanding of the advantages and challenges linked with embracing green manufacturing methods. This knowledge aids businesses in steering towards sustainable and prosperous operations.

Numerous studies have investigated the benefits of adopting eco-friendly manufacturing methods on how well businesses operate. For example, Susitha & Nanayakkara (2023)

examined manufacturing firms in Sri Lanka, using surveys to understand the impact of green practices. They discovered that strategies such as eco-friendly design, efficient processes, and sustainable supply chain management significantly enhanced operational performance by cutting costs, boosting flexibility, and improving production efficiency. Similarly, Marinelli & Janardhanan (2022) studied Indian cement companies and found that reducing waste and using energy more efficiently led to cost savings and better overall performance.

Nevertheless, some studies have faced criticism or shown different results. For instance, Schumacher (2020) looked into Japan cement manufacturers and found positive financial outcomes from green practices. However, critics argued that the study was narrow in scope and failed to consider long-term environmental effects. Furthermore, Dong & Ullah (2023) examined green manufacturing in China and found no significant link between eco-friendly practices and economic performance. This sparked debate, with some questioning the study's methods and applicability, while others suggested that China's unique manufacturing landscape, with government incentives and regulatory factors, might be influencing the results.

Ngcobo et al (2022) utilized data from South African firms. The study, employing a survey design, found positive correlations between green practices and performance, including cost reduction and increased efficiency. Similarly, El-Salamony et al (2020) analyzed cement companies in Egypt, revealing that waste reduction and energy-efficient processes contributed to cost savings and improved performance. Contrary to expectations, Ojo et al (2022) using regression analysis did not find a significant positive correlation between the adoption of green manufacturing practices and operational performance in the Nigerian automotive industry. This sparked debate, with some researchers questioning the study's methodology and suggesting further investigation into contextual factors influencing the outcomes.

In a study by Cheruiyot (2021) examined how adopting environmentally friendly practices, like reducing waste and using energy more efficiently, affected the performance of a cement manufacturing company in Kenya. By analyzing data from four years, they discovered a positive link. Introducing these practices resulted in lower production expenses, better product quality, and a stronger brand image.

Meanwhile, Ochoro (2021) looked into the effects of similar green practices on operational performance but in Kenyan textile and food processing businesses. Using a combination of

surveys and case studies, they found that while the food processing sector experienced positive outcomes, the textile industry saw limited benefits. This was attributed to the higher upfront costs of implementing green technologies in textiles, which might outweigh the eventual savings.

These differing results underscore how the impact of green practices on operational performance can vary based on specific factors. Industry type is crucial, as different sectors have distinct environmental impacts and may respond differently to eco-friendly initiatives. Additionally, the initial investment required and potential cost savings can greatly differ among industries (Matakanye et al., 2021)

Musau (2019) delved into the impact of green manufacturing practices on the operational efficiency of manufacturing firms in Mombasa County, Kenya. The objective was to understand how adopting environmentally friendly methods affects operations across various manufacturing sectors in the county. Through the utilization of surveys and regression analysis, data was collected from 61 companies. The findings revealed a positive correlation between green practices, such as eco-friendly product design and efficient processes, and the effectiveness of operations within these firms. Nshutiyayesu (2021) explored the influence of inventory management practices on the operational performance of Bamburi cement in Kenya. Through the analysis of historical data, the research aimed to discern the relationship between inventory management practices and company performance. Results highlighted the positive impact of inventory management on the performance of Bamburi cement and optimizing operational efficiency in this particular case.

While Musau (2019) mentions green practices, the study's specific focus may differ from the current study. The study also focuses on a location outside Nairobi County while the current study seeks to focus on Nairobi County. Nshutiyayesu (2021) investigated on inventory management practices focusing on a specific firm cement manufacturing firm while the current study seeks to investigate on green manufacturing practices on large all large manufacturing firms in Nairobi. This brought about conceptual, methodological and contextual gaps that the current study sought to fill.

1.1.3 Large Manufacturing Firms in Nairobi

According to World Bank (2020), manufacturing plays a significant role in Nairobi's economy, contributing approximately 15% to the city's gross domestic product (GDP). However, concerns regarding environmental impact have led to an increased focus on sustainable practices within the sector. The manufacturing sector in Kenya has been a key driver of economic growth, contributing significantly to job creation, foreign exchange earnings, and industrialization (Okumu, 2019). Nairobi, as the capital and largest city, plays a pivotal role in hosting diverse manufacturing industries, such as food processing, textiles, chemicals, and construction materials (KAM, 2021).

The Kenyan government has recognized the sector's importance and implemented policies to support its development, -including incentives, infrastructure development, and regulatory streamlining (Government of Kenya, 2023). The sector's contribution to GDP dwindled to around 10% by 2020, with job losses mounting. On the other hand, large manufacturing firms in Nairobi County have shown increased operational performance challenges in recent years. The manufacturers have experienced an increase in operational costs with increased complaints on poor product quality from these manufacturers. The manufacturers, according to KAM (2023), have also shown a reduction in their production with majority experiencing stock outs in recent years. Despite these challenges, Nairobi remains a key manufacturing hub in Kenya, boasting over 140 registered firms and holding immense potential for future growth (Kenya National Bureau of Statistics, 2019).

Although Nairobi possesses a multifaceted manufacturing sector, the uptake of environmentally friendly practices differs among different industries (Hagos et al., 2022). Research conducted by Musau (2020) and Ocholla (2021) underscore the slower adoption rates in the construction and chemical sectors. Despite Kenya's ambitious National Policy on Environment, obstacles such as restricted access to green technology, substantial initial investment requirements, and insufficient government incentives hinder the widespread adoption of such practices (Onyalo & Tembo, 2023).

1.2 Statement of the Problem

Green practices have become critical aspects in companies across the globe. Green manufacturing practices are critical in solving decreased operational performance in

companies through improved resource efficiency, reduced waste, and enhanced brand image (Bhattacharya et al., 2019). According to Olawumi et al (2023), green manufacturing practices contribute to increased productivity and reduction in operational costs within an organization. According to Ali et al (2021), Elshaer et al (2023), Rupa and Saif (2022), green manufacturing practices such as; waste management and recycling initiatives, energy efficiency measures as well as emissions reduction have a positive correlation with a company's operational performance. These authors contend that adoption of such practices can solve the issue of the decreasing operational performance in manufacturing firms in Kenya.

Large manufacturers in Nairobi County have been experiencing increased operational performance challenges in the recent years. For example, increased operational costs coupled with reduction in operational revenues led to Cadbury Kenya's factory closure and Eveready's decreased output. Further, EABL experienced an increase in costs in 2023 by 41 percent (EABL, 2023). According to KAM (2023), in 2023, the cost of manufactured food products such as bread, milk, cooking oil, maize flour and sugar went up by 5.69 percent, while the price of chemical products rose by 32.29 percent. The consumers have also complained of reduced product quality among manufacturers in the recent years. This has been shown by the perception that imported products are of better quality than what is locally produced. Generally, operational performance among large manufacturers in Nairobi has been deteriorating in the recent years (KAM, 2023).

Research findings on the impact of green manufacturing practices on operational performance have been varied. For instance, Sandaruwan (2020) in Sri Lanka and Dadhich, Purohit and Bhasker (2021) in India reported a positive correlation between green manufacturing and performance. Similar results were observed by Walisundara, Thevanes, and Arulrajah (2022) in Sri Lanka. Conversely, Hejazi et al. (2023) discovered a negative influence of green manufacturing practices on operational performance in a study conducted in Saudi Arabia. This aligns with the findings of Adam et al. (2021) in their research on large oil and gas companies in Nigeria. However, Ahmad et al. (2022) and Otundo (2019) did not find a significant positive impact on operational performance in manufacturers in Kenya. These conflicting results highlight the need for further investigation into the relationship between green manufacturing practices and operational performance.

Despite these studies being carried out on, various research gaps have come up in the study. Musau (2019), in their study on the effect of green manufacturing on operational performance of manufacturing firms in Mombasa County, adopted green design and development, efficient processes, GSCM and end-of-life management as independent variables which were different from the ones adopted in the current study. This brought a conceptual gap. In addition, Makanga and Kavindah (2020) looked at adoption of green energy and performance of Sugar Company. Contextual gaps also existed in the study. For example, Musau (2019) undertook their study on firms within Mombasa County bringing in a contextual gap. Further, Wanjiru and Karanja (2023) also showed a contextual gap by focusing on garment companies other than all manufacturing companies while Kim (2022) focused on textile sector other than large manufacturers within Nairobi. For Omar (2023), the focus was on manufacturing SMEs other than large manufacturing firms. However, Mutheke (2022)'s undertook a survey of the Kenyan food processing industry assuming other large manufacturing companies. The studies also showed methodological gaps. For example, Musau (2019) also adopted a cross-sectional survey design with the current adopting a descriptive cross-sectional design indicating a methodological gap. Adam et al. (2021), on the other hand, employed a mixed-methods approach other than a descriptive cross-sectional research design as for the current study. It is because of the evident presence of contextual, methodological and conceptual gaps that the present study sought to investigate how green manufacturing practices affected the operational performance of large manufacturing firms in Nairobi.

1.3 Research Objectives

1.3.1 General Objective

To determine the effect of green manufacturing practices on operational performance of large manufacturing firms in Nairobi County

1.3.2 Specific Objectives

The specific objectives were to establish the effect of:

i. eco-friendly production process on operational performance of large manufacturing firms in Nairobi.
ii. waste reduction on operational performance of large manufacturing firms in Nairobi.
iii. energy efficiency on operational performance of large manufacturing firms in Nairobi.

1.4 Research Questions

i. How does eco-friendly production process affect operational performance of large manufacturing firms in Nairobi County?
ii. To what extent does waste reduction on operational performance of large manufacturing firms in Nairobi County?
iii. How does energy efficiency affect operational performance of large manufacturing firms in Nairobi County?

1.5 Scope of Study

The study was conducted in Nairobi County. The study focused on Large Manufacturing firms in Nairobi County as it is the leading financial hub not only in Kenya but East Africa. The study focused on 115 large manufacturing firms registered with Kenya Association of Manufacturers (KAM, 2023). The focus was on large firms because they are held more accountable for their green practices compared to the other firms due to their robust output to the environment.

The study looked at green manufacturing practices of eco-friendly production processes, waste reduction and energy efficiency. Operational performance was looked at in terms of productivity, quality, cost and resource efficiency. The study employed descriptive cross-sectional research design and target employees and management of large manufacturing firms in Nairobi County. Given the time constraints, the study was carried out in the months of April and May 2024. During this time data collection and analysis was done.

1.6 Significance of the Study

1.6.1 Management of Manufacturing Companies

The research explored how green manufacturing practices influence the operational performance of manufacturing companies. By comprehending this relationship, managers of manufacturing firms can gain valuable insights into leveraging green practices to enhance operational performance. The study's findings can offer management recommendations for improving operational performance, and strategies can be devised accordingly for optimal results.

1.6.2 Policy Makers

The study informs policymakers about the effect of green manufacturing practices on operational performance of manufacturers in Nairobi and Kenya as a whole. The understanding stemming from the research findings may aid in the formulation of policies that encourage green practices manufacturing within the country. The policies would be geared towards improved operational performance of manufacturing companies through green manufacturing within the sector.

1.6.3 Academicians and Researchers

This research addresses a gap in current literature by concentrating on the unique setting of Nairobi County and investigating how green manufacturing practices relate to operational performance in major manufacturing companies. Through offering real-world data from this specific context, scholars can enrich the overall understanding of green manufacturing and its effects on company performance, especially in developing nations.

1.7 Chapter Summary

The research investigated how green manufacturing practices affect the performance of major manufacturing companies in Nairobi County. While previous studies have been conducted, none specifically combined the objectives outlined in this chapter to assess their influence on the performance of large manufacturing firms in Nairobi County. The chapter outlined the research problem and defined the scope of the study, including the variables and duration. Additionally, it discussed the significance of the study.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter provided an extensive literature review encompassing prior research relevant to the study. Supported by resource-based view and triple bottom line theory, this chapter explored the effect of green manufacturing practices on operational performance. Within this section, the study examined the empirical studies of other researchers in alignment with the research objectives. Moreover, it also made summary research gaps alongside conceptual and operational framework.

2.2 Theoretical Foundation

This study required a multi-theory approach to fully explore the complex relationship between green manufacturing practices and a firm's operational performance. A single theory may not capture all the complexities of how green manufacturing affects large firms. By using multiple perspectives, researcher gain a richer understanding of the different mechanisms at play. This study drew upon two complementary theoretical perspectives - the Resource-Based View (RBV) and triple bottom line (TBL) Theory to comprehensively examine the proposed research objectives.

Resource Base view theory anchors eco-friendly production process and energy efficiency variables. Implementing eco-friendly production processes can be seen as developing valuable and unique resources. These processes can lead to cost savings, improved product quality and differentiation from competitors, contributing to sustainable competitive advantage. Energy-efficient practices can reduce operational costs and improve efficiency. These practices are valuable and can be a source of competitive advantage if they are unique to the firm and not easily imitated. On the other hand, triple bottom line theory anchors waste reduction and operational performance. Waste reduction aligns with the environmental aspect of TBL, aiming to minimize the ecological footprint of manufacturing processes. This practice contributes to environmental sustainability and can also improve operational efficiency by reducing waste disposal costs and resource consumption. Operational performance, under TBL, is measured not just by financial outcomes but also by environmental and social performance. In this context, the overall performance of the firm is influenced by how well it integrates eco-friendly production, waste reduction, and energy efficiency practices.

2.2.1 Resource Based View (RBV)

Wernerfelt (1984) introduced the Resource-Based View (RBV), which posits that the performance and competitive strategy of an organization are heavily influenced by its possession of valuable, rare, inimitable, and non-substitutable resources (VRIN). A rare resource is one that is not easily accessible to many competitors. The concept of value refers to the extent to which resources are aligned with the external environment to mitigate threats and capitalize on opportunities. Non-substitutability pertains to the degree to which competitors are unable to replicate similar resources (Chigara, 2021). Inimitability, as defined by Arbelo et al (2021), refers to the extent to which competitors cannot reproduce or obtain the resources, or can only do so at significant cost.

However, critics of the RBV raise concerns regarding its applicability and practicality. They argue that the VRIN criteria (valuable, rare, inimitable, and non-substitutable) are not always sufficient or necessary for ensuring a firm's sustained competitive advantage (Kosiol et al., 2023). Additionally, the definition of resource value is often subjective and challenging to quantify, leading to ambiguities in application. According to Gerhart & Feng (2021), critics also contend that the RBV's focus on resources may overlook the importance of other external factors and industry dynamics in shaping competitive outcomes. Therefore, while the Resource-Based view theory offers a valuable framework for understanding the relationship between green manufacturing resources and operational performance, further research is needed to validate its assumptions and address its limitations.

The Resource-Based View (RBV) supports your study by framing green manufacturing practices (eco-friendly production processes, waste reduction, and energy efficiency) as valuable internal resources that can significantly improve the operational performance of large manufacturing firms in Nairobi County. These practices are considered valuable because they reduce operational costs, improve efficiency, and enhance regulatory compliance. They are rare and difficult to imitate, especially when firms develop unique processes or technologies that optimize green manufacturing. Additionally, as environmental regulations increase and sustainability becomes critical, these practices are non-substitutable. By leveraging these VRIN resources, firms can achieve a sustainable competitive advantage, directly supporting the research questions on how green manufacturing affects operational performance. When

applied to the study of green manufacturing practices, RBV helps to pinpoint and assess the specific resources and abilities that lead to better operational performance while promoting environmental sustainability. For instance, firms investing in green manufacturing may develop unique capabilities in areas such as eco-friendly process, waste reduction, energy efficiency, or supply chain optimization. These capabilities can become valuable strategic assets that differentiate the firm from competitors and contribute to enhanced operational performance.

2.2.2 Triple Bottom Line Theory

The Triple Bottom Line (TBL) theory was developed by John Elkington in 1994. Elkington introduced the concept in his book "Cannibals with Forks: The Triple Bottom Line of 21st Century Business." The theory proposes that businesses should measure their performance and success not only based on financial profit (the "bottom line") but also on their impact on the environment and society. The TBL theory states that there are three primary dimensions of performance that businesses should consider: economic, environmental, and social (Ratna & Hasanah, 2019). The economic dimension focuses on traditional financial metrics such as profit, revenue, and shareholder value. The environmental dimension encompasses factors related to ecological sustainability, including resource use, pollution, and carbon emissions. The social dimension addresses the social impacts of business activities, such as employee well-being, community engagement, and human rights.

Critics of the TBL theory argue that its holistic approach, while well-intentioned, can be overly ambitious and challenging to implement in practice (Srivastava, Dixit & Srivastava, 2022). One common criticism is that the TBL theory lacks a standardized methodology for measuring and comparing social and environmental impacts alongside economic outcomes, leading to subjective interpretation and inconsistent reporting. Critics also contend that by attempting to balance three sometimes conflicting objectives of economic growth, environmental sustainability, and social equity can undermine the clarity of corporate goals (Żak, 2015). Moreover, skeptics question the feasibility of achieving meaningful trade-offs among the TBL dimensions, suggesting that in some cases, pursuing one aspect may come at the expense of others, rendering the pursuit of "triple" bottom-line outcomes elusive (Walker, Yu & Zhang, 2020). Additionally, critics argue that the TBL's emphasis on quantifiable metrics may

overlook qualitative aspects of sustainability, such as cultural preservation and human well-being, thereby limiting its applicability in diverse social contexts (Goh et al. 2020).

In this study, the TBL theory served as an indispensable guiding theory. By encompassing economic, environmental, and social dimensions, the TBL theory provided a holistic lens through which to evaluate the multifaceted impacts of green manufacturing practices adoption. Through meticulous analysis of productivity, quality, cost, and operational efficiency, researchers can discern how green manufacturing practices initiatives influence various facets of operational performance within each dimension of the TBL. Within the economic dimension, green manufacturing practices are scrutinized for their potential to enhance profitability through increased productivity and cost reduction. Simultaneously, environmental considerations probe the ecological benefits of green manufacturing practices, focusing on waste reduction, energy efficiency, and resource conservation. Social dimensions delve into the implications of green manufacturing practices on employee well-being, community engagement, and corporate reputation. By intertwining these dimensions, the study elucidates the interconnectedness between sustainable manufacturing practices and operational performance, providing invaluable insights for fostering resilience, innovation, and long-term value creation in large manufacturing firms.

2.3 Empirical Review

This part of the report summarized research from various levels (global, regional, and local) about how green manufacturing practices affected operational performance. It was organized by different study goals: assessing the impact of environmentally friendly production processes, waste reduction efforts, and energy efficiency measures on operational performance.

2.3.1 Eco-friendly production processes and operational performance

According to Reddy et al. (2023), eco-friendly production processes refer to methods of manufacturing goods or providing services that minimize their negative impact on the environment and promote sustainability. These processes typically involve reducing energy consumption, minimizing waste generation, conserving natural resources, and using renewable materials whenever possible. This approach often includes incorporating technologies and practices such as energy-efficient machinery, recycling and reusing materials, implementing pollution control measures, and adopting renewable energy sources like solar or wind power.

(Amaral et al., 2020). Panizzut et al., (2021) suggests that, by prioritizing environmental responsibility, eco-friendly production processes aim to mitigate pollution, decrease greenhouse gas emissions, preserve ecosystems, and promote long-term ecological balance while still meeting the demands of consumers and markets. Adopting eco-friendly processes can have several positive effects on a company's operational performance such as; cost savings, reduced risk, improved brand image, innovation and attracting talent (Lima et al., 2023).

Empirical studies reviewed have produced a positive effect of eco-friendly production on operational performance. In a study conducted by Lee et al (2023) in the United States, the authors examined the effect of implementing eco-friendly production processes on performance in manufacturing firms. Using a sample of companies across various industries, the researchers employed a quantitative methodology, analyzing performance metrics such as cost reduction, revenue growth, and profitability before and after the adoption of eco-friendly practices. The findings revealed a significant positive impact of eco-friendly production processes on operational performance, with companies reporting improved efficiency, reduced operational costs, and enhanced market competitiveness. The study adopted performance metrics such as cost reduction, revenue growth, and profitability which were different from the current ones. This created a contextual gap. Further, the study adopted a multiple regression model other than simple linear regression model which created a methodological gap.

Issau et al (2021) conducted research in Ghana focusing on small and medium-sized enterprises (SMEs) in the garment industry. They looked at how these businesses adopting environmentally friendly practices impacted operational aspects such as reducing costs, improving productivity, and maintaining product quality. Their findings showed a positive link between adopting eco-friendly practices and boosting operational performance. The study focused on small and medium-sized enterprises other than large manufacturers which created a contextual gap. This aligns with the results of Lee et al (2023), indicating that eco-friendly production improves operational performance by reducing costs and enhancing product quality.

Despite the positive effect, eco-friendly production has also shown negative influence on operational performance. Hejazi et al (2023) in Saudi Arabia explored similar themes and found that a negative effect existed between eco-friendly production and operational

performance. The outcomes may have differed with those of researchers who found a positive effect due to the difference in the contexts. The study adopted a qualitative approach and Partial least squares (PLS) analysis which may also have created a difference in the outcomes.

Results from a study by Adam et al. (2021) in large oil and gas companies in Nigeria showed that substantial initial investment costs led to a negative effect of eco-friendly production on operational performance. While acknowledging potential long-term advantages such as an improved brand image and diminished environmental footprint, they underscored the formidable obstacles and trade-offs faced by these sizable organizations during the transition which led to a negative overall impact. The adoption of large oil and gas companies creates a different context of manufacturing companies which may create a difference in outcomes. This contrasts with the studies on different contexts of SMEs (Issau et al., 2021; Wanjiru & Karanja, 2023) which suggest SMEs might be more adaptable and experience quicker cost savings. Issau et al (2021) examination of SMEs underscores the potential for swift adaptation and immediate cost-saving benefits, whereas Adam et al (2021) investigation of larger enterprises illuminates the intricacies and resource-intensive nature of effecting change within established systems.

Some studies have shown that ecofriendly production had no significant influence on operational performance. For example, Wanjiru and Karanja (2023) conducted a study on sustainable practices in garment manufacturing in Nairobi-based factories. This research, set in the local context of Nairobi, examined garment factories facing increasing sustainability demands from global brands. The authors utilized interviews with managers and analyzed operational data to investigate the implementation of sustainable practices. Their findings revealed notable cost savings achieved through waste reduction and energy conservation efforts. However, the study also highlighted challenges such as initial investment costs and the need for employee training. The researchers studied the sustainable practices assuming the aspect of operational performance creating a conceptual gap. The adoption of qualitative data other than quantitative data created a difference in the methodologies.

Mutheke (2022) carried out an investigation on green manufacturing and how it affects the performance of companies in the food processing industry in Kenya. This study looked at the entire food processing sector within Kenya. Using a comprehensive survey of companies and

statistical methods, the researchers examined how eco-friendly practices relate to company performance. They discovered a positive connection between implementing green manufacturing methods and profitability, although the effect was not significant. The study related the green manufacturing to general company performance other than operational performance. It also focused on food processing industry assuming other industries i the manufacturing sector creating a contextual gap.

2.3.2 Waste Reduction and Operational Performance

In today's age, with a strong focus on sustainability and environmental awareness, minimizing waste has become crucial in the manufacturing sector. Waste reduction involves any method that decreases waste by using fewer materials from the start (Abualfaraa et al., 2020). This can range from basic practices like opting for reusable ceramic mugs over disposable cups, utilizing both sides of paper to purchasing items in bulk rather than individually wrapped packaging. Waste reduction in the study is adopted as one of the green manufacturing practices. Green companies understand that minimizing waste not only benefits the environment but also enhances their bottom line by reducing costs and increasing operational efficiency (Munir, 2022). By analyzing each step of the production process and identifying non-value-added activities, manufacturers can streamline their operations and significantly reduce waste generation. This could involve optimizing material handling procedures, implementing just-in-time inventory management systems, or reorganizing production layouts for better flow (Amaral et al., 2020). Another important strategy for waste reduction lies in implementing closed-loop systems within the manufacturing process (Spišáková, Mésároš & Mandičák, 2021). These systems aim to create a circular economy in manufacturing by minimizing resource consumption and maximizing material reuse.

Several research studies have investigated waste reduction as a green manufacturing approach and its connection to operational and overall performance. Some of these studies have demonstrated that waste reduction contributes to enhanced operational performance. For instance, Walisundara, Thevanes, and Arulrajah (2022) conducted a study involving 70 manufacturing companies in the Kegalle District of Sri Lanka. They found that waste reduction significantly and positively influenced organizational performance by lowering costs and

improving operational efficiency. This study looked at organizational performance other than operational performance creating a conceptual gap.

Similarly, Omar (2023) supported these findings in their study involving 394 manufacturing SMEs, providing evidence for a positive link between waste reduction as a green manufacturing practice and corporate performance. This was based on an OLS model. The study involved manufacturing SMEs other than big manufacturers indicating a contextual gap. The study, on the other hand, adopted an OLS other than simple regression model showing a methodological gap.

Gull, Atif, Ahsan and Derouiche (2022) sought to answer the question on whether waste management affected firm performance based on international evidence. This study looks at waste management, a significant but little-studied component of businesses' sustainability efforts, and analyzes how it affects bottom line results. The research found that wastes had a detrimental effect on business performance. Thus, the study discovered a strongly positive association between waste creation (recycling) and financial performance utilizing the 2002–2019 data of listed corporations from 41 nations. The study focused on financial performance other than operational performance creating a conceptual gap. Further, the research was an literature review which showed methodological gaps.

Despite the generally positive association between waste reduction and operational performance, some studies have indicated a negative relationship between the two factors. For instance, Rehman, Seth, and Shrivastava (2016) conducted research in the Indian context and found that waste management practices, including waste reduction, had an adverse impact on organizational performance. This was attributed to increased expenses associated with waste management during the manufacturing process. The study looked at waste management practices other than green manufacturing which created a conceptual gap. Similarly, Al-Hakimi et al. (2022) conducted an empirical study on 328 Saudi manufacturing SMEs, analyzing the influence of green manufacturing practices on corporate sustainable performance using hierarchical regression analysis in SPSS. The results of their study confirmed a significant, but negative, effect of waste reduction on operational performance. The study involved manufacturing SMEs which creates a contextual gap as the current study involved large manufacturing companies.

On the flip side, some studies have revealed that there is no notable connection between waste reduction efforts and operational performance. For example, Sandaruwan et al. (2020) investigated the influence of green manufacturing practices on organizational performance in Anuradhapura District. They found that waste reduction did not have a significant impact on organizational performance, largely because the benefits were offset by the high costs associated with waste reduction efforts. The study looked at organizational other than operational performance creating a conceptual gap. The study also adopted SEM model other than simple linear regression one. This created a methodological gap. Afum (2020) supported these findings, noting that waste reduction had a positive but insignificant effect on operational performance. This highlights the understanding that while waste reduction often shows a significant impact on operational performance in many studies, it may have insignificant effects in other economic contexts.

2.3.3 Energy Efficiency and Operational Performance

Energy efficiency is gaining significance in manufacturing. As energy costs rise and environmental worries grow, manufacturers seek methods to lower energy use and enhance sustainability (Menghi et al., 2019). Energy efficiency entails using less energy to achieve the same outcome or task (Shove, 2018). Operations that prioritize energy efficiency utilize manufacturing facilities that consume less energy to produce goods. Energy efficiency not only aids in cutting energy expenses but also promotes a cleaner environment and fosters a more sustainable future. One of the primary benefits of energy efficiency in manufacturing is cost savings. Energy costs can account for a significant portion of a manufacturer's operating expenses (Chen et al., 2021). By improving energy efficiency, manufacturers can reduce energy consumption, lower energy costs, and improve their bottom line. Energy-efficient practices lead to reduced operational costs, giving manufacturers a competitive edge.

Research has investigated the relationship between energy efficiency and operational performance. Khan et al. (2022) examined the impact of green supply chain management practices on operational performance, including the mediation of technological innovation, in 223 manufacturing firms in Pakistan. Using partial least squares structural modeling (PLS-SEM), they found that energy efficiency had a significantly positive effect on operational performance. The study looked at green supply chain management other than manufacturing

practices which brought in a conceptual gap. Further, a PLS-SEM model was adopted other than simple linear regression model creating a methodological gap.

Additionally, Ongâ and Ndolo (2023) studied the influence of green manufacturing technologies on the performance of oil marketing companies in Kenya and discovered that energy efficiency plays a crucial role in operational performance. They observed that companies adopted machines that consumed less energy, water, and fuel, thereby increasing energy efficiency and subsequently improving operational efficiency and product quality while lowering operational costs. This study involved oil marketing companies other than manufacturing companies which created a contextual gap. The study also looked at performance other than operational performance which created a conceptual gap.

Makanga and Kavindah (2020) noted that companies significantly reduced emissions by adopting green energy, which led to increased use of renewable energy sources. This adoption of renewable energy was associated with reduced operational costs. These studies showed that an improved manufacturing through energy efficiency leads to improved organizational operational performance. Energy efficiency in manufacturing has been found to improve operational efficiency, reduce energy losses and minimize costs in energy.

Kim (2022) investigated the correlation between green manufacturing and performance within Nairobi's textile sector. The study revealed a favorable connection between adopting green practices like energy efficiency and operational performance. This was based on a PLS model. The study was based on textile sector assuming other manufacturing sectors. This created a contextual gap. Further, a PLS model was adopted creating a methodological gap since a simple linear regression model was adopted in the current study.

However, Kasae (2014) in a study on the relationship between energy efficiency and operational performance of manufacturing firms in Kenya established that a negative relationship existed between energy efficiency and operational performance. This was as a result of reduced productivity from reduced energy usage. Multiple regression model other than simple model was adopted which created a methodological gap.

Macharia, Ngui and Gathiaka (2022) on the effects of energy efficiency on firm productivity. This study employed SFA under a pooled model to analyze energy efficiency and productivity in Kenya's manufacturing sector. The results showed that productivity negatively related with

electricity, fuel and total energy efficiency. This depicts that despite the positive effects of energy efficiency on operational performance, some empirical studies have shown that energy efficiency influence operational performance in a negative way. The study adopted SFA under a pooled model other than simple regression model creating a methodological gap. The study compared energy efficiency to firm productivity other than operational performance in general. This showed a conceptual gap.

While most studies indicate a positive relationship between energy efficiency and operational performance, Musau (2019), in a study focusing on the impact of green manufacturing on operational performance of manufacturing firms in Mombasa County, found that energy efficiency had an insignificant correlation with operational performance. Similarly, Otundo (2019) investigated the effects of green production practices on the financial performance of manufacturing firms in Kenya and supported Musau's findings by demonstrating that energy efficiency did not significantly improve operational costs, quality, or efficiency. Consequently, there is an urgent need for further research to examine how energy efficiency, as a green manufacturing practice, influences the operational performance of manufacturing firms.

2.4 Summary of Research Gaps

From the reviewed studies, research gaps exist. Conceptual gaps have come up in the literature. For example, Musau (2019) looked at green design and development, efficient processes and end-of-life management as green manufacturing practices while this study looked at eco-friendly production process, waste reduction and energy efficiency. Further, Macharia, Ngui and Gathiaka (2022) adopted firm productivity as the dependent other than operational performance. On the other hand, contextual gaps came up strongly in the literature. For instance, Makanga and Kavindah (2020) involved sugar companies; Wanjiru and Karanja (2023) involved garment companies; Mutheke (2022) involved food processing firms; while Kim (2022) involved textile sector other than large manufacturers. In addition, Musau (2019) undertook the study in Mombasa County while Omar (2023) focused on manufacturing SMEs. The studies also showed methodological gaps. For example, Musau (2019) adopted a cross-sectional survey design other than a descriptive cross-sectional research design as for the current study. Macharia, Ngui and Gathiaka (2022) employed SFA under a pooled model other than a multiple regression model.

Table 2.1: Summary of Research gaps

Authors	Focus of Study	Findings	Research Gap	Focus of current study
Musau (2019)	The effect of green manufacturing on operational performance of manufacturing firms	Energy efficiency had no significant positive effect on operational costs, quality and efficiency	Done within Mombasa County Adopted cross-sectional survey design	Was done in Nairobi County Adopts descriptive cross-sectional survey design
Adam et al. (2021)	Green supply chain management and performance of listed oil and gas firms in Nigeria: A moderating role of internet of thing	Substantial initial investment costs led to a negative effect of eco-friendly production on operational performance	Was done in large oil and gas companies Adopted a mixed-methods approach Adopted PLS-SEM model	Was done in large manufacturing firms Adopts descriptive cross-sectional survey design Adopted multiple regression model
Hejazi, Al Batati & Bahurmuz (2023)	The influence of green supply chain management practices on corporate	A negative effect existed between eco-friendly production and operational performance.	Looked at corporate sustainability performance Adopted a partial least	Looked at operational performance Adopts a multiple

	sustainability performance		squares (PLS) model	regression model
Walisundara, Thevanes, and Arulrajah (2022)	Green manufacturing practices and performance of manufacturing companies	Waste reduction had a significant and positive impact on performance of organization through reduced costs and increased operational efficiency	Used convenience sampling Used simple regression analysis	Made use of simple random sampling Used multiple regression model
Khan et al. (2022)	Green supply chain management practices' impact on operational performance	energy efficiency had a significantly positive effect on operational performance	Looked at green supply chain management practices Used PLS-SEM as the model of analysis	Looked into green manufacturing practices Used multiple regression
Kasae (2014)	Relationship between energy efficiency and operational performance of manufacturing firms in Kenya	Negative relationship existed between energy efficiency and operational performance	Looked at energy efficiency and operational performance Involved manufacturing firms listed by Kenya	Looked at green manufacturing practices and operational performance Involved large manufacturing firms

			Association of Manufacturers	
Macharia, Ngui and Gathiaka (2022)	Effects of energy efficiency on firm productivity in Kenya's manufacturing sector	The results showed that productivity negatively related with electricity, fuel and total energy efficiency	Looked at firm productivity This study employed SFA under a pooled model	Looked into operational performance Adopted a multiple regression model

Source: Researcher (2024)

2.5 Conceptual Framework

A conceptual framework is a framework believed to be the most effective way to illustrate the natural development of the phenomenon being studied by the researcher. It links the overarching concept to the specific ideas, empirical research, and theories employed to describe the study (Adom et al., 2018). In this study, the independent variables were eco-friendly production processes, waste reduction and energy efficiency. The dependent variable was operational performance as measured by organizational productivity, product quality, overall costs and production resource efficiency. Higher productivity indicates that the organization can produce more output with the same or fewer inputs, demonstrating efficient use of resources. High-quality products or services lead to greater customer satisfaction, loyalty, and repeat business. Lower operational costs contribute directly to higher profitability and better financial health. Efficient use of resources reflects the organization's ability to optimize processes and systems, ensuring that resources are used in the most productive way possible.

Independent Variables Dependent Variable

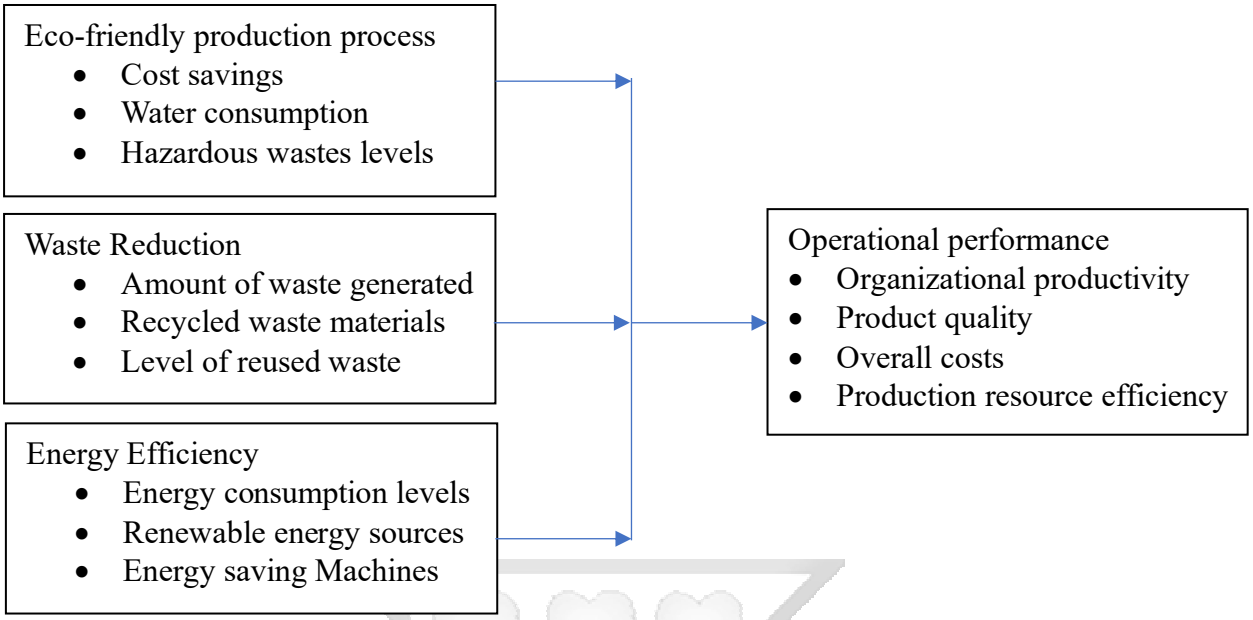

Figure 2.1: Conceptual Framework

Source: Researcher (2024)

2.6 Operationalization of Variables

Table 2.2: Operationalization of Variables

Variable	Types of Variables	Indicators	Scale	Supporting literature
Eco-friendly production processes	Independent	• Reduction in Energy consumption • Waste reduction • Cost savings	Ordinal 5-point Likert scale • Strongly disagree • Disagree • Neutral • Agree • Strongly agree	Wanjiru & Karanja (2023); Mutheke (2022); Adam et al (2021)

Waste reduction	Independent	• Amount of waste generated • Recycled waste materials • Level of reused waste	Ordinal 5-point likert scale •Strongly disagree •Disagree •Neutral •Agree •Strongly agree	Abualfaraa et al. (2020); Munir (2022)
Energy Efficiency	Independent	• Energy consumption levels • Renewable energy sources • Energy saving Machines	Ordinal 5-point likert scale •Strongly disagree •Disagree •Neutral •Agree •Strongly agree	Khan et al. (2022); Ongâ and Ndolo (2023); Makanga and Kavindah (2020)
Operational Performance	Dependent	• Organizational productivity • Product quality • Overall costs • Production resource efficiency	Ordinal 5-point likert scale •Strongly disagree •Disagree •Neutral •Agree •Strongly agree	Musau (2019); Mwangi (2019)

Source: Researcher (2024)

2.7 Chapter Summary

This chapter delved into the existing body of knowledge surrounding the research topic. It begins by reviewing key theories, providing a clear explanation of their relevance to the study's questions. The strengths, weaknesses, and any ongoing debates surrounding these theories are also explored. Next, the chapter examined past research in the field. This section summarized existing studies, highlighting any areas where further investigation was necessary. These included limitations identified in previous research, conflicting results found in different studies, or unexplored areas that warrant further exploration. Finally, the chapter presented the research framework. This framework, often presented visually, outlined the key concepts and their interrelationships that the study investigated. It demonstrated how the chosen theories and past research had informed the development of the research questions guiding the study.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

In this chapter, researcher described the specific methods researcher used to conduct our research and answer our research questions. Researcher discussed the overall approach researcher took (research philosophy), the type of study researcher conducted (research design), the group of people researcher studied (target population), how many people researcher included (sample size), how researcher selected participants (sampling technique), the ways researcher gathered information (data collection methods), the approach researcher used to analyze the information (datra analysis techniques), how researcher ensured the quality of our research, and the ethical considerations researcher addressed throughout the study.

3.2 Research Philosophy

Research philosophy refers to the core beliefs and assumptions that steer your approach to a research study. It determines how one perceives knowledge, reality, and the dynamic between the researcher and the subject being studied. There are four types of research philosophies, namely, pragmatism, positivism, realism and interpretivism. Positivism assumes that there's an objective reality separate from the observer. Knowledge is acquired through observation and measurement, aiming to test and validate existing theories using quantitative data analysis techniques. Interpretivism highlights the subjective nature of reality, shaped by individual interpretations and experiences. Knowledge is obtained by grasping the meanings individuals attribute to their experiences. Pragmatism prioritizes the practical application of knowledge. It stresses the importance of selecting research methods best suited to address a specific issue. Finally, realism recognizes that reality exists independently of the human mind.

In order to investigate the relationships between various aspects of the phenomenon under study, a scientific approach aligned with a positivist research philosophy was chosen (Kothari & Garg, 2014). This philosophy allowed the adoption of quantitative data analysis techniques like descriptive statistics and inferential statistics like the ones adopted in this research. This made the philosophy a fit for this study.

3.3 Research Design

This part explained how the research was carried out, known as the research design. It's like a plan that shows how data was collected and research questions answered. Different types of research designs exist, including descriptive, correlational, causal, exploratory, and cross-sectional. This study used a descriptive research design, which allowed an in-depth investigation into the variables, their connections and their relationships. This design also allowed the researcher use statistics for analysis. So, it helped the researcher understand green manufacturing practices and operational performance among manufacturers in Nairobi County. Additionally, this design helped show how specific variables affect each other in the study. Therefore, it helped the researcher see how green manufacturing practices influence operational performance among manufacturers in Nairobi County.

3.4 Population of the Study

This part outlines the group of people or entities that the study intends to examine, according to Bryman (2016). For this research, the population was large manufacturing firms in Nairobi County. According to KAM (2023), there were 115 large manufacturing companies situated in Nairobi County as at the end of 2023. The large manufacturers were selected since they contributed to more than 70% of the revenues from the manufacturing sector. Further, the large manufacturers had been in the frontline in the adoption of green manufacturing in the sector with majority of them having adopted various green manufacturing practices. The researcher also concentrated on the large manufacturers as they had been showing deteriorating operational performance in the recent years in terms of reduced productivity, quality and resource efficiency coupled with increased operational costs.

3.5 Sampling and Sampling Techniques

A sampling frame, according to Cooper and Schindler (2014), is a complete list that includes everything in a certain population. Following the views of Schmidt and Cooper and Schindler (2014), sampling is about picking out a particular group of people who have the right information needed to solve a specific problem at a particular time. In this research study, the intention was to employ the complete population, encompassing all 115 large manufacturing firms in Nairobi County. The researchers focused on Nairobi County because a high percentage (over 80%) of manufacturing companies in the study area are located there (KAM, 2021).

Given that the population is greater than 100, there was need for the researcher to undertake sampling. The study used Yamane formula to determine the sample. This was because the population was less than 500 as recommended by Yamane (1967). The formula is n = N / (1+Ne2) where n=sample; N=population; e=error term (5%). Based on the formula, the calculation for required sample size was as follows: n = 115 / (1+115*0.05^2) =89 companies. The sample was adequate and sufficient as was greater than 10% of the population and had more than 30 units (companies) involved as recommended for quantitative research (Sukmawati, Salmia & Sudarmin, 2023).

The study used simple random sampling to select the 89 manufacturing firms within Nairobi County. This gave each and every manufacturing company an equal chance to be involved in the research. The design was preferred as the population is homogenous in terms of size and sector making it fit. While simple random sampling offers the advantage of equal representation and is suitable for a homogenous population, it also has inherent weaknesses, such as implementation complexity, potential under-coverage, and nonresponse bias. Addressing these weaknesses through careful planning such as ensuring accurate sampling frame can enhance the reliability and representativeness of the study's findings. The researcher used purposive sampling to select the head of operations in the 89 manufacturing companies selected. This sampling design allowed the researcher to pick the most fit person for the study.

3.6 Data Collection Methods

This research used a survey to collect data from manufacturers in Nairobi County. The head of operations served as the respondents for this study. The head of operations had the required information on green manufacturing and operational performance of the companies. The head of operations are involved in managing the operations as well as manufacturing processes within the companies. They were best placed to understand operational aspect of performance in their companies better than other employees.

The survey involved asking structured questions using a questionnaire, which gathered firsthand information. The questionnaire included closed-ended questions, meaning respondents choose from provided options. This helped guide respondents by connecting options to the study's variables and goals. The questionnaire was divided into three parts: section A on general information, section B on green manufacturing practices, and section C

on operational performance. Sections B and C used a 5-point Likert scale, where 1 meant strongly disagree and 5 meant strongly agree. This scale measured how much respondents agree with statements about green manufacturing practices and operational performance.

The questionnaire was self-administered where the respondents filled them in on their own. This was because the respondents were literate and so had an understanding on the questions in the questionnaire. The questionnaires were distributed electronically through Google Forms. However, the option to use paper questionnaires was also available. Electronic surveys were preferred due to their lower cost and the ease of reaching participants via email. This method also allowed respondents to complete the survey at their convenience, which likely increased their probability of participation.

For those who could not be reached online, printed questionnaires were delivered and responses collected in person. Potential participants were contacted by phone to introduce the researcher and the study. Those who agreed to participate were sent a link of the online survey through their official work email addresses. To ensure data quality, the survey link was only sent through respondents' official email address. A follow up with those who did not respond within a week was done, and they were offered the option of a paper questionnaire if they preferred.

3.7 Research Quality

3.7.1 Reliability

Reliability refers to how dependable research tools are in producing consistent results (Bryman & Bell, 2015). This study assessed internal reliability, which examines how consistent respondents' answers are (Bryman & Bell, 2015). Cronbach's Alpha was employed to evaluate internal consistency in the questionnaire. A pilot study involving nine (9) participants was conducted separately from the main research to test the reliability of the data collection instrument. The responses from the pilot study were analyzed using the Cronbach's Alpha tool in SPSS software. Afum et al. (2020) found a reliability index of 0.794 while Li, Lim and Wang (2020) found a Cronbach alpha of 0.821. The studies concluded that the research instruments were reliable. This shows that a threshold of 0.7 is considered acceptable for a reliability in the research instrument. A value less than 0.7 shows an unreliable research instrument. From

the data analysis, the variables showed Cronbach's Alpha values greater than 0.7. This shows that the questionnaire was reliable.

Table 3.1: Reliability Statistics

Variable	Cronbach's Alpha	N of Items	Conclusion
Eco-friendly	0.770	6	Reliable
Waste reduction	0.806	6	Reliable
Energy efficiency	0.739	6	Reliable
Operational performance	0.708	6	Reliable
Overall	**0.756**		**Reliable**

Source: Researcher (2024)

3.7.2 Validity

Validity is about how well a tool measures what it's supposed to measure. To make sure a tool is valid, it's important that the content it includes matches what the research needs. In this study, the content validity of the questionnaire was checked. This looked at how well the questionnaire covers all the constructs or variables in the study. To ensure this, the questionnaire was submitted to the lecturers among other experts to look into it. The supervisor and the experts give recommendations which when implemented by the researcher in the field before collecting data. Their helpful input guided any needed changes to make the tool better aligned with the research objectives. To ensure validity, the researcher made the corrections given on the questionnaire to align them to the variables and indicators. The researcher checked on the number of questions that were assumed valid by the expert (supervisor). This was compared to the total number of questions per variable to test the validity of the research instrument through Content Validity Index. Polit et al. (2007) suggested a critical CVR value equal to 0.78 for three or more panelists. From the analysis the findings showed that the variables showed a content validity index of above 0.75. From all the 36 questions in the questionnaire, 30 of them were indicated as valid giving an index of 0.833 (33/36) which is greater than 0.78. Therefore, the questionnaire met the requirement for a reliable research instrument.

3.8 Data Analysis

Data analysis means using statistical and logical methods to understand and evaluate data. In this study, researcher first ensured the data is complete and free from errors, then input it into the Statistical Package for Social Sciences (SPSS v.25.0). Next, the researcher analyzed the data using descriptive statistics such as mean, standard deviation, percentages, and frequencies, which summarized the data and were displayed in tables. Additionally, the researcher used inferential statistics to explore relationships between variables. This included employing simple linear regression analysis to illustrate how green manufacturing practices (eco-friendly production process, waste reduction and energy efficiency) influenced operational performance in manufacturing companies in Nairobi County. The study employed a simple regression analysis model:

$Y = \beta_0 + \beta X + \varepsilon$

Where;

Y = Operational performance of large manufacturing companies

X = Independent variable which was eco-friendly production process, waste reduction or energy efficiency with each variable regressed against operational performance independently

β_0 = Constant

β = Regression coefficient of variables

ε = Error term

3.8.1 Diagnostic Tests

The study tested for normality of residuals to ensure the model assumptions are met. Common tests that were considered include Shapiro-Wilk. If normality is violated, the study considered data transformations or robust regression techniques. The study also tested for the presence of heteroscedasticity (unequal variance of errors) using Breusch-Pagan test. If present, the study considered weighted least squares or robust regression. Further, the study checked for multicollinearity (high correlation between independent variables) using techniques like Variance Inflation Factor (VIF). If Multicollinearity existed, it might affect coefficient

estimates. The study considered model reformulation or variable reduction techniques to overcome the challenge of Multicollinearity.

3.9 Ethical Considerations

Ethics involves doing what is right and avoiding causing harm, as noted by Shamoo & Resnik (2015). By applying appropriate ethical principles, harm can be either prevented or minimized (Shamoo & Resnik, 2015). This study adhered to the principles outlined in the business research methods by Bryman & Bell (2015). It ensured full consent from participants before data collection, safeguard the privacy of research participants, maintain anonymity for individuals and organizations involved in the research, and ensured that participation in the study is voluntary.

3.10 Chapter Summary

This chapter has outlined the plan and methods for the study, which aims to investigate how green manufacturing practices effect large manufacturing companies in Nairobi County. The study focused on large manufacturing companies in Nairobi County, selecting a sample from the Kenya Association of Manufacturers. Data gathered was analyzed using SPSS software. Ethical guidelines were adhered to throughout the study. Data collection and analysis were scheduled for April and May 2024.

CHAPTER FOUR: PRESENTATION OF RESEARCH FINDINGS

4.1 Introduction

This chapter makes a presentation of findings based on descriptive and regression analysis. The discussions of the findings are also done in the chapter. This study sought to determine the effect of green manufacturing practices on operational performance of large manufacturing firms in Nairobi County. Specifically, it sought to establish the effect of eco-friendly production process on the operational performance of large manufacturing firms in Nairobi County; establish the effect of waste reduction on the operational performance of large manufacturing firms in Nairobi County; and establish the effect of energy efficiency on the operational performance of large manufacturing firms in Nairobi County.

4.2 Response Rate

This study sampled a total of 89 respondents who were issued with questionnaires. From the 89 questionnaires administered a total of 80 questionnaires were duly filled and returned. The number was also above 30 indicating that it was sufficient for analysis. The response rate was 89.9%. Mugenda and Mugenda (2012) recommended a response rate of more than 30% as sufficient. The response rate was above 30% indicating that the response rate was sufficient for analysis.

4.3 Descriptive Statistics

Descriptive stats were used to describe the data. This was done using percentages and frequencies. Further, mean and standard deviation were also used as descriptive stats in the research. The presentation was done based on demographic information as well as green manufacturing practices and operational performance.

4.3.1 Demographic Information

This study sought to establish the demographic information relating to the respondents and the organizations involved in the research. The information will relate to gender, age, years worked, highest level of education and job roles of the respondents. For the organizations, the information related to the sector of operation, number of employees, revenue turnover, registration with environmental management body as well as existence of environmental management department and policy.

Table 4.1: Gender of the Respondents

Gender	Frequency	Percent
Male	41	51.3
Female	27	33.8
Prefer not to say	12	15.0
Total	80	100.0

Source: Researcher (2024)

The findings on the gender of the respondents, as presented by Table 4.1, showed that majority of them were male (51.3%). However, 33.8% indicated female while 15% preferred not to say. This shows that majority of the manufacturing companies in Nairobi have majority of their managers in operations as male. There is an underrepresentation of women in the management due to traditional gender roles and risk aversion stereotypes. Male have an opportunity to get qualifications and experience to hold managerial positions compared to females who may be hindered by the gender roles like family in their career advancement. This may make the females few in the management positions. Further, manufacturing involves a lot of risks which females may avoid with the male being risk takes and thus thrive in the industry. There is need for women to come up with policies that would support women and enable them to take up management roles within the organizations.

Table 4.2: Age of the Respondents

Age	Frequency	Percent
Under 20 years	2	2.5
21-30 years	12	15.0
31-40 years	15	18.8
41-50 years	33	41.3
51 years and above	18	22.5
Total	80	100.0

Source: Researcher (2024)

From table 4.2 which presents the findings on the age of the respondents shows that majority of them (63.8%) were aged above 40 years. This is shown by 41.3% who were aged between 41 and 50 years plus 22.5% who indicated 51 years and above. However, 36.2% indicated that they were aged below 40 years. From the table, 2.5% indicated under 20 years, 15% 21-30 years, and 18.8% indicated 31-40 years. This shows that majority of the respondents were aged above 40 years with only a small number being under 40 years. For someone to take up a managerial role in an organization, he or she has to have the education and the experience required for the role. The young people lack the experience to take up management roles within manufacturing companies. Therefore, they may find themselves being over 40 years for them to hold the managerial roles. Under 40s may not have required experience with just a few being lucky to hold such positions in manufacturing companies. There is need for mentorship programs among manufacturers for the young professionals to enable them take up management roles. They also need to come up with a policy that drives training programs to provide the necessary skills for managerial roles among the manufacturers.

Table 4.3: Years Worked Within The Companies

Years	Frequency	Percent
Less than 1 year	12	15.0
Between 1 and 3 years	20	25.0
Over 3 years	48	60.0
Total	80	100.0

Source: Researcher (2024)

Table 4.3 presents the results on the number of years worked by the respondents in their current companies. The results showed that majority of the respondents had worked for over 3 years (60%). This shows that majority of the respondents had worked for time sufficient for them to have understood the green manufacturing practices and how they had affected the operational performance of their companies. This also suggests a stable workforce that understands the company policies and experienced enough to deliver excellent performance. Only 40% had worked for less than 2 years. A 15% indicated less than a year while 25% indicated between 1 and 3 years. This calls for integration efforts for these employees to ensure that they have a clear and increased understanding on the green manufacturing practices and how it influences

organizational performance. There is a need for the long serving employees to support newer employees in driving performance through green manufacturing practices.

Table 4.4: Respondent's Level of Education

Level	Frequency	Percent
Certificate/Diploma	7	8.8
Degree	24	30.0
Masters	32	40.0
PhD	17	21.3
Total	80	100.0

Source: Researcher (2024)

The findings on level of education of the respondents is presented in Table 4.4. From the Table, majority of the respondents had a degree. This is shown by 30% who indicated degree as highest level of education, 40% who indicated Masters and 21.3% who indicated PhD. However, 8.8% indicated that they had a certificate and diploma as the highest education level. This depicts that a good number of the operations managers in manufacturing companies in Nairobi had a degree and so had the education to understand how green manufacturing affects operational performance. It also depicts that the employees holding the managerial positions in operations have the qualifications required for such positions. This education facilitates an informed decision on the green manufacturing practices to adopt among manufacturing companies which leads to improved operational performance.

Table 4.5: Sector of Operation

Sector	Frequency	Percent
Building, Mining and Construction	9	11.3
Chemical & Allied	5	6.3
Energy, Electricals & Electronics	3	3.8
Food & Beverage	11	13.8
Leather & Footwear	4	5.0
Metal & Allied	4	5.0
Automotive	3	3.8

Paper & Paperboard	4	5.0
Pharmaceutical & Medical Equipment	12	15.0
Plastics & Rubber	4	5.0
Service & Consultancy	5	6.3
Textile & Apparels	4	5.0
Timber, Wood & Furniture	9	11.3
Agriculture/Fresh Produce	3	3.8
Total	80	100.0

Source: Researcher (2024)

On the sectors of operations, the respondents indicated that their companies operated in different sectors with most (15%) operating in Pharmaceutical & Medical Equipment sector. This was followed closely by food and beverage (13.8%), Timber, Wood and Furniture (11.3%) as well as building, mining and construction (11.3%). Other sectors were represented by 6.3% each. They included chemical and allied as well as service and consultancy. At 5% sectors like Leather & Footwear, Metal & Allied, Paper & Paperboard and Textile & Apparels were represented. The sectors with the least representation among the companies included energy, electricals & electronics, automotive and agriculture/fresh produce all at 3.8%. This shows that manufacturing companies in Nairobi are in different sectors of the economy creating diversity in the population. Green manufacturing practices should be tailored to the various subsectors in manufacturing due to their unique nature of challenges. This calls for policy makers to consider the differences in the manufacturing sectors in the development of policies relating to manufacturing companies. Companies also need to focus on targeted resource allocation towards green manufacturing for improved operational performance.

Table 4.6: Number of Employees

Number	Frequency	Percent
100 or less	26	32.5
101 – 999	37	46.2
1000 and above	17	21.3
Total	80	100.0

Source: Researcher (2024)

On the number of employees, findings as presented in Table 4.6 showed that majority of the manufacturing firms had more than 100 employees. A total of 46.2% indicated that their companies had 101-999 employees with 21.3% indicating 100 employees and above. However, 32.5% indicated that their companies had 100 employees or less. This depicts that majority of the companies had more than 100 employees who would come in handy in the implementation of green manufacturing and enhancement of operational performance. Companies with many employees may have the capacity to invest in green manufacturing which would in turn lead to improvement in their operational performance. There is need for tailored practices in green manufacturing based on size (employees) of the companies.

Table 4.7: Approximate Annual Business Revenue Turnover in Kenya Shillings

Kenya Shillings	Frequency	Percent
Less than 1 billion	42	52.5
1 – 10 billion	20	25.0
11 – 20 billion	13	16.3
21 – 50 billion	4	5.0
Above 50 billion	1	1.3
Total	80	100.0

Source: Researcher (2024)

On the approximate annual business revenue turnover in manufacturing companies in Nairobi, 52.5% of the respondents indicated that their companies had less than a billion of annual business revenue turnover in Kenya shillings. This shows that manufacturing companies in Nairobi had experienced low levels of business revenues. However, 25% indicated 1-10 billion shillings, 16.3% indicated 11-20, 5% indicated 21-50 while 1.3% indicated above 50 billion shillings of revenue. These findings underscore the importance of considering the financial capacities of companies when implementing green manufacturing programs.

Table 4.8: Respondent's Job Role

Role	Frequency	Percent
Sustainability engineer	6	7.5
Production manager	23	28.7

Compliance officer	15	18.8
Environmental technician	15	18.8
Environmental management department employee	21	26.3
Total	80	100.0

Source: Researcher (2024)

The findings on the job roles among manufacturing companies in Nairobi, as shown by Table 4.8, showed that 7.5% of the respondents were sustainability engineers. On the other hand, 28.7% were production managers, 18.8% were compliance officers, 18.8% environmental technician and 26.3% were environmental management department employees. This shows that various experts in operations were involved which removed any bias among the respondents involved in the study. Such diverse expertise is essential for implementing effective green manufacturing practices and driving operational performance across the manufacturing sector in Nairobi.

Table 4.9: Whether Company Is Registered with Environmental Management Body

Opinion	Frequency	Percent
Yes	32	40.0
No	48	60.0
Total	80	100.0

Source: Researcher (2024)

The study sought to establish whether the companies were registered with any environmental management body. From the findings in Table 4.9, majority of the respondents indicated that their companies were not registered with environmental management body. However, a substantial number (40%) were registered with an environmental management body. This showed that majority of the manufacturers in Nairobi are not registered with environmental management bodies which may create a challenge in the push for green manufacturing. Companies not registered with environmental management bodies may face heightened regulatory risks, including fines, penalties, and legal consequences for non-compliance with environmental regulations. This could impact their operations, reputation, and overall business performance.

Table 4.10: Whether Firms Had Environmental Management Department

Opinion	Frequency	Percent
Yes	29	36.3
No	51	63.8
Total	80	98.8

Source: Researcher (2024)

On whether the companies had environmental management department, majority of them (63.8%) indicated that their companies did not have environmental management departments. However, 36.3% indicated that their companies had environmental management departments. This shows that majority of the manufacturing companies in Nairobi County do not have environmental management departments. This shows that they may experience challenges of coordination and implementation of green manufacturing practices which may affect their bearing on operational performance of the companies. This absence of formal environmental management structures can have significant implications for environmental sustainability and regulatory compliance within the manufacturing sector.

Table 4.11: Whether firms had environmental management policy

Opinion	Frequency	Percent
Yes	43	53.8
No	37	46.3
Total	80	100.0

Source: Researcher (2024)

The study sought to establish whether the companies had environmental management policy. From the findings, 53.8% of the respondents indicated that their companies had environmental management policies. However, 46.3% indicated that environmental management policies did not exist in their companies. This depicts that the companies had environmental management policies which guided their green manufacturing for improved operational performance. If companies do indeed have environmental management policies in place, it reflects a proactive approach to addressing environmental concerns and promoting sustainable practices. These policies likely play a crucial role in guiding green manufacturing initiatives aimed at improving operational performance, reducing environmental impacts, and ensuring regulatory compliance.

4.3.2 Eco-friendly production processes

The study sought to establish the status of eco-friendly production processes among manufacturing companies in Nairobi County. This was done by asking the respondents to indicate their level of agreement on statements relating to eco-friendly production processes within their companies. The results are presented in Table 4.12.

Table 4.12: Descriptive Statistics on Eco-friendly Production Processes

Statement	N	Mean	Std. Deviation
Our organization has adopted eco-friendly manufacturing processes	80	4.1500	1.31303
Our organization employs processes that use green energy	80	3.5443	.95806
Our organization minimizes waste generation throughout the production cycle	80	4.2625	.92427
Implementing green practices has resulted in cost savings for our organization (e.g., reduced energy bills, lower waste disposal fees).	80	4.3321	1.01811
Reduced energy consumption has led to lower operational costs in the organization's production processes	80	3.7750	.82638
Our organization adopts processes that reduce toxic and hazardous materials	80	3.7468	.83924
Overall		**3.9685**	**0.9798**

Source: Researcher (2024)

From Table 4.12, the respondents were neutral on the statements with a mean of 3.9685 supported by an overall standard deviation of 0.9798 which was below 2. This shows that large manufacturing companies in Nairobi County are moderately perceived to be adopting eco-friendly practices, but not to the extent that it would reflect a consensus. This moderate adoption could imply that while companies are taking steps toward eco-friendly practices, there is still room for improvement and not all companies are fully committed. Specifically, the respondents agreed that their organizations had adopted eco-friendly manufacturing processes (M=4.1500; Std. Dev.=1.31303), experienced cost savings from implementing green practices (M=4.3321 Std. Dev. =1.01811) and minimized waste generation throughout the production cycles (M=4.2625; Std. Dev.=0.92427). They, however, were neutral on the statement that their organizations employed processes that used green energy (M=3.5443; Std. Dev. =0.95806).

Further, the respondents were neutral on the statement that reduced energy consumption had led to lower operational costs in the organization's production processes (M=3.7750; Std. Dev. =0.82638) and that their organizations adopted processes that reduced toxic and hazardous materials (M= 3.7468; Std. Dev. =0.83924).

4.3.3 Waste Reduction

The researcher looked into the state of waste reduction as a green manufacturing practice among manufacturers in Nairobi County. The researcher did this by asking the respondents to state their level of agreement on various queries related to waste reduction within their companies. This was done using descriptive statistics like the mean and standard deviation. Results are shown by Table 4.13.

Table 4.13: Descriptive Statistics on Waste Reduction

Statement	N	Mean	Std. Deviation
My company categorizes waste before handing over	80	3.5937	1.02374
Our organization has experienced waste reduction in the recent years	80	3.6410	.95311
The organization explores ways to utilize waste materials in new products or processes	80	3.5500	1.08965
Our organization optimizes material usage in its production	80	3.6750	1.08820
My organization implements lean manufacturing practices for waste reduction	80	3.9359	1.10121
Our organization practices the concepts of reduce, reuse, and recycle in waste management	80	4.0291	1.07797
Overall		**3.7375**	**1.0556**

Source: Researcher (2024)

From results in Table 4.13, the respondents were neutral on the statements with an overall mean of 3.7375 and a standard deviation of 1.0556 which showed low variation in opinions. The respondents were neutral on the statement that the companies categorized wastes before handing over (M=3.5937; Std. Dev. =1.02374). The same was shown on statements that their organizations had experienced waste reduction in the recent years (M=3.6410; Std. Dev. =0.95311); explored ways to utilize waste materials in new products or processes (M=3.5500; Std. Dev. =1.08965); and optimized material usage in their production (M=3.6750; Std. Dev. =1.08820). The respondents were also neutral on the statements that their organizations implemented lean manufacturing practices for waste reduction (M=3.9359; Std. Dev.

=1.10121). The respondents agreed that the organization practiced the concepts of reduce, reuse, and recycle in waste management (M=4.0291; Std. Dev. =1.07797).

4.3.4 Energy Efficiency

On the status of energy efficiency, the researchers asked questions related to the level of agreement among respondents on energy efficiency within manufacturing companies in Nairobi. This was done via mean and standard deviation. The findings are shown by Table 4.14.

Table 4.14: Descriptive Statistics on Energy Efficiency

Statement	N	Mean	Std. Deviation
Our organization has experienced a reduction in energy consumption in recent years	80	4.0123	1.08140
Our organization practices automatic sleeping systems for equipment	80	3.5875	1.16591
Our organization invests in energy-efficient machinery and equipment whenever possible.	80	4.0595	1.06476
Our organization utilizes renewable energy sources (e.g., solar, wind) to supplement our energy needs	80	3.5584	.99331
Our organization shares and provides energy saving information to employees	80	3.5139	1.08349
Our organization has moved to cloud computing in order to save energy	80	3.8430	1.19558
Overall		**3.7624**	**1.0974**

Source: Researcher (2024)

The findings from Table 4.14 an overall mean of 3.7624 indicating that they were neutral on the statements with a standard deviation of 1.0974. The respondents were in agreement that their organizations had experienced a reduction in energy consumption in recent years (M=4.0123; Std. Dev.=1.08140); and that invested in energy-efficient machinery and equipment whenever possible (M=4.0595; Std. Dev.=1.06476). They, however, were neutral on the statements that and practiced automatic sleeping systems for equipment (M=3.5875; Std. Dev.= 1.16591); and utilized renewable energy sources (e.g., solar, wind) to supplement their energy needs (M=3.5584; Std. Dev.=0.99331). They were also neutral on the statement that the organization shared and provided energy saving information to employees (M=3.5139;

Std. Dev.= 1.08349); and moved to cloud computing in order to save energy (M=3.8430; Std. Dev.= 1.19558).

4.3.5 Operational Performance

The study looked into operational performance among manufacturing companies in Nairobi County. The level of agreement on statements related to operational performance among the companies. This was done through mean and standard deviation. The findings are shown by Table 4.15.

Table 4.15: Operational Performance

Statement	N	Mean	Std. Deviation
The organization has experienced an increase in production output since implementing green practices	80	3.7000	1.08383
There has been a reduction in production downtime due to environmental issues (e.g., equipment malfunctions, waste-related disruptions)	80	1.6361	.94459
My organization has experienced improvement in product quality (e.g., fewer defects, higher consistency).	80	3.7399	1.04025
The company has reduced overall production costs (e.g., lower energy bills)	80	1.6875	1.05054
There is a high initial investment costs associated with green practices	80	3.7250	1.03085
The organization is now operating in a more resource-efficient manner, reducing its environmental footprint.	80	1.6500	.98212
Overall		**2.6898**	**1.0220**

Source: Researcher (2024)

From Table 4.15, the respondents showed a disagreement on statements relating to performance based on the overall mean of 2.6898 and standard deviation of 1.0220, indicating poor operational performance among the companies. The respondents indicated a neutral opinion that their organizations had experienced an increase in production output since implementing green practices (M=3.7000; Std. Dev.=1.08383). They further indicated a neutral opinion that there was an improvement in product quality (e.g., fewer defects, higher consistency) (M=3.7399; Std. Dev.=1.04025); and high initial investment costs associated with green practices (M=3.7250; Std. Dev.=1.03085). However, the respondents indicated a disagreement that there had been a reduction in production downtime due to environmental

issues (e.g., equipment malfunctions, waste-related disruptions (M=1.6361; Std. Dev.=0.94459); their companies had reduced overall production costs (e.g., lower energy bills) (M=1.6875; Std. Dev.=1.05054); and were operating in a more resource-efficient manner, reducing their environmental footprint (M=1.6500; Std. Dev.=0.98212).

4.4 Regression Analysis Results

The study sought to determine the effect of green manufacturing practices on operational performance of large manufacturing firms in Nairobi County. Specifically, the study looked at the effect of eco-friendly production process, waste reduction and energy efficiency on operational performance of large manufacturing firms in Nairobi County. This was done through simple regression analysis whose findings are presented in this section.

4.4.1 Diagnostic Tests

Diagnostic tests were done to check on the assumptions of regression modeling. This included normality, heteroscedasticity and Multicollinearity. Normality will be done using Shapiro Wilk statistics while heteroscedasticity was done using Breusch Pagan test. On the other hand, VIF was adopted in checking on Multicollinearity.

Table 4.16: Normality Test

Variable	Statistic	df	Sig.
Operational performance	.933	80	.097
Eco-friendly production process	.959	80	.132
Waste Reduction	.944	80	.101
Energy Efficiency	.974	80	.186

Source: Researcher (2024)

The Shapiro-Wilk test of Normality assumes that the data follows a normal distribution. The assumption is met where the statistics have P-values greater than 0.05. However, the assumption is not met when the statistics show p-values of less than 0.05 where the data is assumed not to follow a normal distribution. From the test results in Table 4.16, the variables showed statistics with significance above 0.05. This shows that the assumption of normality was met and so the variable data was normally distributed.

Table 4.17: Heteroscedasticity

Chi-Square	Df	Sig.
2.039	1	.153

Source: Researcher (2024)

For Breusch-Pagan test for heteroskedasticity, the null hypothesis that the variance of the errors does not depend on the values of the independent variables indicating a constant error term. Where the significance or P-value is greater than 0.05, the null hypothesis is not rejected showing homoscedasticity. However, when the P-value is less than 0.05, the null hypothesis is rejected indicating heteroskedasticity. Findings show that the P-value (0.153)>0.05 indicating that heteroskedasticity was not a problem in the variable data used in this study.

Table 4.18: Multicollinearity Test

Predictor	Tolerance	VIF
Eco-friendly production process	.577	1.733
Waste Reduction	.661	1.512
Energy Efficiency	.683	1.463
Overall		1.569

Source: Researcher (2024)

The study checked on multicollinearity using VIFs. The test assumes that there is no direct relationship among predictor variables (no multicollinearity). If the VIF is greater than 5, the test concludes that multicollinearity exists at unacceptable levels and so it's a problem in the data. Where the VIFs are between 2 and 5, multicollinearity exists but at acceptable levels. If the VIFs are below 2, then it's concluded that no linearity exists in the data and so multicollinearity does not exist. The outcomes showed that the VIF values were below 2 averaging at 1.569. This shows that multicollinearity is not a problem in the data.

4.4.2 Eco-Friendly Production Process

The study sought to establish how eco-friendly production process affects operational performance in large manufacturers. This was done through simple regression analysis. The findings are shown by table 4.19.

Table 4.19: Model Summary Eco-Friendly Production Process

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.463[a]	.214	.204	2.14868

a. Predictors: (Constant), Eco-friendly production process

Source: Researcher (2024)

From the model summary, eco-friendly production process and operational performance had a weak relationship. This was shown by an R value of 0.463 which was less than 0.5. Further, the model showed an r square value of 0.214. This shows that eco-friendly production process contributed 21.4% to the change in operational performance indicating that other factors contributed 78.6% of the operational performance of large manufacturers.

Table 4.20: Analysis of Variance for Eco-Friendly Production Process

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.502	1	5.502	10.834	.001[b]
	Residual	41.136	81	.508		
	Total	46.638	82			

a. Dependent Variable: Operational performance
b. Predictors: (Constant), Eco-friendly production process

Source: Researcher (2024)

From Table 4.20, the model had an F statistic (10.834) which was significant. This was displayed in the p-value which was less than 0.05. This shows that Eco-friendly production process had a significant effect on operational performance of large manufacturers.

Table 4.21: Regression Coefficients on Eco-Friendly Production Process

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	26.335	3.859		6.824	.000
	Eco-friendly production process	.477	.136	.463	3.498	.001

Source: Researcher (2024)

In the first objective the study sought to establish the effect of eco-friendly production process on the operational performance of large manufacturing firms in Nairobi County. From the Table of coefficients, eco-friendly production process showed a regression coefficient of 0.477 (p=0.001). This indicates that with a unit increment of eco-friendly production process, the operational performance would increase by 0.477. Hence, eco-friendly production process had a positive effect on operational performance of manufacturing companies.

4.4.3 Waste Reduction

The study sought to establish the effect of waste reduction on operational performance of large manufacturing companies in Nairobi. This was done through simple regression analysis with findings shown in this section.

Table 4.22: Model Summary on Waste Reduction

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.531[a]	.282	.274	4.12082

a. Predictors: (Constant), Waste reduction

Source: Researcher (2024)

From the findings, waste reduction showed an R (correlation) value of 0.531 indicating that there was a strong relationship with operational performance. Further, the R square was 0.282 showing that waste reduction contributed 28.2% to the change in operational performance

among large manufacturing companies. Hence, other factors contributed the remaining 71.8% of the change in operational performance.

Table 4.23: Analysis of Variance on Waste Reduction

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.166	1	4.166	5.771	.019[b]
	Residual	58.472	81	.722		
	Total	62.638	82			

a. Dependent Variable: Operational performance
b. Predictors: (Constant), Waste reduction

Source: Researcher (2024)

From the ANOVA table, the f statistics were 5.771 with a P-value of 0.019. This indicated that the statistics were significant as the p-value was below 0.05. Hence, waste reduction had a significant effect on operational performance of large manufacturers.

Table 4.24: Regression Coefficients on Waste Reduction

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	30.030	4.934		6.086	.000
	Waste reduction	.520	.217	.531	2.398	.019

Source: Researcher (2024)

In the second objective, the study sought to establish the effect of waste reduction on the operational performance of large manufacturing firms in Nairobi County. From the coefficient table, waste reduction had a regression coefficient of 0.520 (p=0.019). This indicates that a unit increase in waste reduction would increase operational performance by 0.520. Therefore, waste reduction displayed a positive effect on operational performance.

4.4.4 Energy Efficiency

The study sought to establish the effect of energy efficiency on operational performance of large manufacturing companies in Nairobi. This was done using simple regression analysis.

Table 4.25: Model Summary On Energy efficiency

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.440[a]	.194	.184	2.15283

a. Predictors: (Constant), Energy efficiency

Source: Researcher (2024)

The model summary shows that the model had an R of 0.440. This depicts that energy efficiency had a weak relationship with operational performance. The model also showed an R^2 of 0.194. This depicts that energy efficiency contributed 0.194 to operational performance. Hence, a proportion of 0.806 of operational performance was a contribution of other factors other than energy efficiency.

Table 4.26: Analysis of Variance on Energy Efficiency

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.713	1	2.713	10.022	.002[b]
	Residual	21.926	81	.271		
	Total	24.639	82			

a. Dependent Variable: Operational performance
b. Predictors: (Constant), Energy efficiency

Source: Researcher (2024)

The ANOVA table on energy efficiency showed that the model had an F value of 10.022 (p=0.002). The f value was significant indicating that the model was significant. Hence, energy efficiency had a significant effect on operational performance of large manufacturers.

Table 4.27: Regression Coefficients on Energy Efficiency

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	22.316	4.694		4.754	.000
	Energy efficiency	.571	.179	.440	3.190	.002

Source: Researcher (2024)

In the third objective, the researcher sought to establish the effect of energy efficiency on the operational performance of large manufacturing firms in Nairobi County. From the regression analysis, energy efficiency showed a positive and significant regression coefficient of 0.571 (p=0.002). Therefore, a unit increase in energy efficiency among manufacturers would increase operational performance of the companies by 0.571. Hence, energy efficiency possessed a positive effect on operational performance of manufacturing firms.

CHAPTER FIVE: SUMMARY OF DISCUSSIONS, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter is a summary of discussions of findings in addition to conclusions and recommendations. This chapter is based on the research findings from the objective where the researcher looked at the effect of green manufacturing practices on operational performance of large manufacturing firms in Nairobi County.

5.2 Discussion of Findings

This section makes a summary of discussions of findings based on the research objectives. The section will enable the reader to get a snapshot of the key findings from the data analysis. This section will be based on the effect of eco-friendly production processes, waste reduction and energy efficiency on operational performance.

5.2.1 Effect of Eco-friendly Production Processes on Operational Performance

The study sought to establish the effect of eco-friendly production process on the operational performance of large manufacturing firms in Nairobi County. In order to establish the effect, the researcher first looked at the state of eco-friendly production processes within the manufacturing companies. From the descriptive statistics, the study found that the companies were neutral about the adoption of eco-friendly production processes as a green manufacturing practice. This was concluded by looking into processes such as; green energy, reduced energy consumption and reduced toxic and hazardous materials. From regression analysis, eco-friendly production process had a positive and significant a regression coefficient. Therefore, eco-friendly production process positively affected operational performance of the selected manufacturing companies.

Lima et al. (2023) noted that adopting eco-friendly processes can have several positive effects on a company's operational performance such as cost savings. The findings are same as those of Lee et al (2023) who found a significant positive impact of eco-friendly production processes on operational performance through improved resource efficiency and reduced operational costs. Issau et al (2021) indicated that eco-friendly production improves operational performance by reducing costs and enhancing product quality. However, the

findings differed with those of Hejazi et al (2023) who found that a negative effect existed between eco-friendly production and operational performance. Adam et al. (2021) also found contradictory findings where initial investment costs led to a negative effect of eco-friendly production on operational performance.

In relation to RBV, the adoption of eco-friendly processes can be viewed as a strategic utilization of resources and capabilities to enhance operational performance. According to RBV, firms can achieve sustained competitive advantage by leveraging valuable, rare, and inimitable resources and capabilities. In this case, the adoption of eco-friendly processes can be considered a valuable resource that contributes to operational performance.

Eco-friendly processes not only contribute to economic performance but also address environmental concerns, aligning with the environmental aspect of the TBL Theory. By adopting eco-friendly practices, companies demonstrate their commitment to sustainability, which can enhance their reputation, attract environmentally conscious customers, and mitigate risks associated with environmental degradation. Additionally, eco-friendly processes may have social benefits by improving community health and quality of life.

5.2.2 Effect of Waste Reduction On Operational Performance

The study, in the second objective, sought to establish the effect of waste reduction on the operational performance of large manufacturing firms in Nairobi County. Based on the descriptive statistics, the finding from the statements was neutral on the adoption of waste reduction as a green manufacturing practice.

From the regression analysis results, waste reduction displayed a positive and significant regression coefficient indicating that operational performance improved with increased waste reduction. Therefore, waste reduction had a positive effect on operational performance. The findings are similar to those of Walisundara et al. (2022) who found that a positive link existed between waste reduction and operational performance. However, Al-Hakimi et al. (2022) found that a negative effect of waste reduction existed on operational performance. On the other hand, Sandaruwan et al. (2020) found that waste reduction did not have a significant impact on operational performance which differs with the current findings.

The findings are in support of the RBV theory. Waste reduction practices can be considered as valuable and potentially rare resources for large manufacturing companies. By adopting waste reduction practices, companies may develop capabilities that are difficult for competitors to replicate, contributing to their competitive advantage and improved performance. This aligns with the RBV's emphasis on leveraging firm-specific resources and capabilities to achieve sustainable operational performance.

The findings are aligned to the TBL theory. Waste reduction practices not only improve economic performance by reducing costs associated with waste disposal but also address environmental concerns, aligning with the environmental aspect of the TBL theory. Moreover, waste reduction practices can have social benefits by minimizing pollution and promoting environmental stewardship. Thus, the adoption of waste reduction practices reflects a consideration of environmental and social factors alongside economic ones, consistent with the TBL approach.

5.2.3 Effect Of Energy Efficiency On Operational Performance

The researcher also established the effect of energy efficiency on the operational performance of large manufacturing firms in Nairobi County. The findings were neutral on the organization’s adoption of energy efficiency in their operations. On the other hand, energy efficiency had a positive and significant regression coefficient in relation to operational performance. Therefore, operational performance increases with energy efficiency among manufacturers. Hence, energy efficiency had a positive effect on operational performance.

The findings are aligned to those of Khan et al. (2022) who found that energy efficiency had a significantly positive effect on operational performance. In addition, Ongâ and Ndolo (2023) found that energy efficiency plays a crucial role in operational performance while Makanga and Kavindah (2020) found that adoption of renewable energy was associated with reduced operational costs. However, some studies differed with the current findings where they found a negative or no effect of energy efficiency on operational performance. For example, Kasae (2014) established that a negative relationship existed between energy efficiency and operational performance due to reduced energy usage. On the other hand, Musau (2019) found that energy efficiency had an insignificant correlation with operational performance.

For RBV theory, the adoption of energy efficiency measures can be seen as a strategic utilization of resources and capabilities to enhance operational performance. According to RBV, firms can gain sustained competitive advantage by leveraging valuable, rare, and inimitable resources and capabilities. Energy efficiency measures can be considered valuable resources that contribute to operational performance by reducing costs and increasing resource efficiency.

In relation to theory, the findings are aligned to TBL theory. Energy efficiency practices not only contribute to economic performance by reducing energy costs but also address environmental concerns, aligning with the environmental aspect of the TBL theory. By adopting energy efficiency measures, companies demonstrate their commitment to sustainability, which can enhance their reputation, attract environmentally conscious customers, and mitigate risks associated with environmental degradation. Additionally, energy efficiency measures contribute to social sustainability by reducing carbon emissions and minimizing environmental impact on communities.

5.3 Conclusions

The study concludes that eco-friendly production process has a positive effect on operational performance of large manufacturing companies in Nairobi County. This is a sign that when the large manufacturing firms in Nairobi County improve their eco-friendly production process, they would experience an increase in operational performance in terms of reduced costs and increased productivity, quality, and resource efficiency. The study also concludes that waste reduction has a positive effect on operational performance of large manufacturing companies in Nairobi County. This is a reflection of an increased operational performance with waste reduction in large manufacturing companies in Nairobi County. The study, from the regression analysis results, further concludes that energy efficiency has a positive effect on operational performance of large manufacturing companies in Nairobi County. Hence, large manufacturing companies in Nairobi County experience improved performance from energy efficiency.

The study makes a contribution by addressing empirical gaps identified in prior research, which had not examined the effect of green manufacturing practices on operational performance in large manufacturing firms within Nairobi County. The studies also lack a specific outcome on how green manufacturing practices influence operational outcomes in the

context of large manufacturers. This leaves a gap in understanding the effects of green manufacturing practices on their effects on cost reduction, productivity, and resource efficiency as measures of operational performance in large manufacturers in Kenya. By empirically investigating these relationships, the study provides new insights into the local context, demonstrating that green manufacturing practices significantly improve operational performance in terms of reduced costs, increased productivity, and enhanced resource utilization. This contribution adds to the literature by offering evidence-based recommendations for firms in Nairobi County aiming to achieve operational benefits through sustainable practices.

Green manufacturing practices are consistent with the RBV, which emphasizes the strategic utilization of firm-specific resources and capabilities for improved performance by gaining competitive advantage. The findings suggest that by improving their eco-friendly production processes, waste reduction practices, and energy efficiency, large manufacturing companies in Nairobi experience increased operational performance, including reduced costs and increased productivity, quality, and resource efficiency. This aligns with the RBV's proposition that firms can achieve sustained performance by leveraging valuable, rare, and inimitable resources and capabilities.

These green manufacturing practices reflect the companies' consideration of environmental and social factors alongside economic performance, as advocated by the TBL Theory. The positive effects of these green manufacturing practices on operational performance, as evidenced by reduced costs and increased productivity and resource efficiency, support the TBL's premise that businesses can create value not only financially but also socially and environmentally.

5.4 Recommendations

5.4.1 Recommendations For Policy Makers

The study found that green manufacturing practices enhanced operational performance among large manufacturing companies. The policy makers should create a favourable policy framework that would support green manufacturing among large manufacturers. This could be related to policies on waste management, energy and eco-friendly environment for manufacturers to operate optimally. The policies would enable the manufacturers to go green

in an effort to enhance their operational performance, The policies would enable them to cut on costs and enhance resource efficiency, product quality and firm productivity. The favourable policies should be adopted through sectoral organizations like the Kenya Association of Manufacturers which should ensure uniformity of the policies across the industry.

To enhance the adoption of eco-friendly production processes in manufacturing, stricter enforcement of NEMA regulations is essential. By ensuring that companies comply with environmental guidelines, such as those governing energy efficiency, waste reduction, and green energy use, the government can promote sustainable practices while also driving better operational performance. The findings highlight that these practices lead to improved efficiency and profitability, making the case for NEMA to play a more active role in ensuring compliance across the manufacturing sector.

Given the positive relationship between waste reduction and operational performance observed in the study, introducing financial incentives for companies that implement waste reduction strategies could drive more widespread adoption. Policies such as tax breaks, grants, or subsidies can motivate manufacturers to invest in sustainable waste management technologies and practices. This approach would support the goals of the Sustainable Waste Management Act while improving operational outcomes for businesses.

Energy efficiency emerged as a significant driver of improved operational performance in your study, highlighting the need for targeted government programs to promote energy-saving practices. Policies that provide access to affordable green technologies, energy audits, and advisory services can help manufacturing firms reduce energy consumption. These programs should be aligned with national energy policies and climate goals to ensure that both the environment and businesses benefit from energy efficiency improvements.

Policies that encourage manufacturers to adopt international environmental standards, such as ISO 14001 for environmental management, can enhance both operational performance and sustainability. The study found that eco-friendly practices positively influence performance, and aligning with global standards will enable Kenyan manufacturers to compete more effectively on the international stage. Certification programs can also help firms demonstrate their commitment to sustainability, further improving their market position and operational efficiency.

Incorporating eco-friendly production processes as key performance indicators in Kenya's national industrial policy can provide the framework needed for sustained improvement in operational performance. The study underscores the positive impact of these practices, and by embedding them into national policy, the government can ensure that they become a priority for the manufacturing sector. This alignment between industrial and environmental policy will not only benefit businesses but also contribute to the country's broader sustainability goals.

5.4.2 Recommendations for Practice

The study found that eco-friendly production process has a positive effect on operational performance of large manufacturing companies in Nairobi County. This means that if the manufacturing firms improve their eco-friendly production process, the operational performance would improve. Manufacturing companies in Nairobi County should actively integrate more eco-friendly production processes into their operations. This can be achieved by investing in renewable energy sources, adopting cleaner technologies, and reducing the use of hazardous materials. Companies can start by conducting environmental audits to identify areas for improvement and by partnering with organizations that offer green technology solutions. By taking these steps, firms can enhance product quality, increase resource efficiency, and reduce operational costs, ultimately leading to better overall operational performance.

The study also found that waste reduction has a positive effect on operational performance of large manufacturing companies in Nairobi County. Therefore, manufacturing firms with a high level of waste reduction in their operations display a high level of operational performance. There is need for the manufacturing firms in Nairobi County to increase their efforts towards waste reduction in order to reduce operational costs and increase productivity, product/service quality and resource efficiency. These measures include implementing more efficient recycling programs, reducing material wastage during production, and reusing by-products where possible. Companies can also work with waste management professionals to optimize waste disposal processes. These efforts will not only minimize costs associated with waste management but also increase productivity and enhance resource utilization.

The study further found that energy efficiency has a positive effect on operational performance of large manufacturing companies in Nairobi county. Hence, large manufacturing companies

in Nairobi County that have implemented energy efficiency in their operations have a high level of operational performance. Therefore, manufacturing companies in Nairobi should focus on boosting energy efficiency by adopting energy-saving equipment, using energy-efficient lighting, and optimizing production processes to reduce energy consumption. Companies can conduct regular energy audits to identify areas of energy wastage and implement corrective measures. Additionally, leveraging government incentives for energy efficiency, such as tax rebates or grants, can help offset the costs of upgrading to energy-efficient systems. Improved energy efficiency will lead to lower operational costs, higher productivity, and better resource management.

5.4.3 Recommendations for Theory

The study indicates that eco-friendly practices, waste reduction and energy efficiency positively affect operational performance. The study's findings regarding the positive impacts of eco-friendly production processes, waste reduction, and energy efficiency on operational performance in large manufacturing firms in Nairobi County offer significant theoretical implications. These conclusions provide a foundation for enriching existing theories such as the Resource-Based View (RBV) and Triple Bottom Line (TBL) Theory. Specifically, scholars can extend the RBV by integrating eco-friendly practices as strategic resources, emphasizing their role in enhancing firms' competitive advantage and operational efficiency. Moreover, the study supports the refinement of TBL metrics to include operational performance alongside economic, environmental, and social dimensions, thereby offering a more comprehensive understanding of organizational sustainability.

The study recommends that large manufacturing companies apply contingency theory to understand under what conditions green manufacturing practices are most beneficial for operational performance. This theory posits that the effectiveness of a management practice depends on the context in which it is applied. Identifying key contingencies (such as industry type, market conditions, and organizational structure) can provide a nuanced understanding of when and how sustainable practices improve operational performance. The companies also need to use institutional theory to explore how environmental regulations and societal expectations drive large manufacturing companies to adopt eco-friendly production processes.

This perspective can help theorize the role of external pressures in shaping internal operational strategies and performance outcomes.

The study also recommends the need to expand the RBV to explicitly categorize eco-friendly production processes, waste reduction initiatives, and energy efficiency measures as strategic resources. The study's findings suggest these practices lead to improved operational performance, indicating their potential to provide a competitive advantage. The study also recommends a development of a sub-theory within RBV that focuses on sustainable resources, identifying characteristics that make these resources valuable, rare, inimitable, and non-substitutable (VRIN). This can include specific examples from the study, such as energy-efficient technologies and waste management systems.

Encourage further empirical studies to validate and refine the proposed theories. Longitudinal studies and cross-industry comparisons can provide robust evidence on the relationship between eco-friendly production and operational performance, contributing to the generalizability and applicability of the theoretical models. By integrating these theoretical recommendations, future research can deepen the understanding of the mechanisms through which eco-friendly production practices enhance operational performance and provide actionable insights for large manufacturing companies in Nairobi County and beyond.

5.5 Study Limitations and Areas for Further Research

The study was limited to green manufacturing practices on operational performance. This study recommends various areas where further research can be done. Other factors contributed 54.4% operational performance. This study recommends future studies to focus on other factors influencing operational performance of manufacturing firms. In addition, future studies should focus on other measures of operational performance and green manufacturing practices for comparison of results. Further, the inclusion of control variables in future studies on the effect of green manufacturing practices on operational performance. This would enable the readers to understand other ley influencers of operational performance.

Another limitation was that it only looked at large manufacturing firms in Nairobi County. More detailed research could be done on the whole manufacturing sector across Kenya. Further, the studies can undertake similar research based in a rural county like Kirinyaga

County. The involvement of small manufacturing companies in Nairobi County is recommended in future studies.

In another limitation, the study adopted quantitative kind of data and simple regression analysis model. There is need for a similar study based on a mix of qualitative and quantitative data. The adoption of multiple regression analysis is recommended in future studies to allow for the inclusion of control variables in the modelling.

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APPENDICES

Appendix I: Letter of Introduction

Dear Respondent,

REF: REQUEST FOR DATA

I am a student at Strathmore University studying for a Master of Commerce degree. Currently, I'm researching the **Effect of green manufacturing practices on the operational performance of large manufacturing firms in Nairobi County**. I would appreciate your cooperation in answering some questions related to this topic. Please be assured that any information you provide will be kept completely anonymous and confidential, and will only be used for this academic study.

Your cooperation will be highly appreciated.

Yours faithfully,

Creff Odhiambo

MCOM/148378

Masters Student,

Strathmore University

Appendix II: Research Questionnaire

This questionnaire aimed to collect information regarding the effect of green manufacturing practices on the operational performance in large manufacturing companies within Nairobi County.

Confidentiality clause

The responses you provide in this questionnaire will be used in strict confidence and solely for academic purposes advanced by this research.

SECTION A: GENERAL INFORMATION

1. State your Gender

Male [ ]

Female [ ]

2. What is your age?

Under 20 years [ ]

21-30 years [ ]

31-40 years [ ]

41-50 years [ ]

51 years and above [ ]

3. For how long have you been with the company?

Less than 1 year [ ]

Between 1 and 3 years [ ]

Over 3 years [ ]

4. Level of education

Certificate/Diploma [ ]

Degree [ ]

Masters [ ]

PhD [ ]

5. Indicate the sector of your organization?

1. ☐ Building, Mining and Construction
2. ☐ Chemical & Allied
3. ☐ Energy, Electricals & Electronics
4. ☐ Food & Beverage
5. ☐ Leather & Footwear
6. ☐ Metal & Allied
7. ☐ Automotive
8. ☐ Paper & Paperboard
9. ☐ Pharmaceutical & Medical Equipment
10. ☐ Plastics & Rubber
11. ☐ Service & Consultancy
12. ☐ Textile & Apparels
13. ☐ Timber, Wood & Furniture
14. ☐ Agriculture/Fresh Produce

6. How many employees does your organization have?

☐ 100 –or less

☐ 101 – 999

☐ 1000 and above

7. What is the approximate annual business revenue turnover in Kenya Shillings?

☐ Less than 1 billion

☐ 1 – 10 billion

☐ 11 – 20 billion

☐ 21 – 50 billion

☐ Above 50 billion

8. What is your job role at the institution?

☐ Sustainability engineer

☐ Production Manager

☐ Compliance officer

☐ Environmental technician

☐ Environmental management department employee

9. Is your company registered with any environmental management body?

a) Yes
b) No

10. Does your firm have environmental management department?

a) Yes
b) No

11. Does your firm have an environmental management policy?

a) Yes
b) No

12. Please tick the sector in which your firm belongs and the type of products you manufacture

	Manufacturing Sector	Tick	Type of product

1	Building, Mining and Construction		
2	Chemical & Allied		
3	Energy, Electricals & Electronics		
4	Food & Beverage		
5	Leather & Footwear		
6	Metal & Allied		
7	Automotive		
8	Paper & Paperboard		
9	Pharmaceutical & Medical Equipment		
10	Plastics & Rubber		
11	Textile & Apparels		
12	Timber, Wood & Furniture		
13	Agriculture/Fresh Produce		

SECTION B: Green Manufacturing Practices

Please indicate in the table with a tick (√) your level of agreement based on the below scale:

1= Strongly Disagree 2= Disagree 3= Neither Agree nor Disagree 4= Agree

5= Strongly Agree

Eco-friendly production processes		1	2	3	4	5
1	Our organization has adopted eco-friendly manufacturing processes					
2	Our organization employs processes that use green energy					
3	Our organization minimizes waste generation throughout the production cycle					

4	Implementing green practices has resulted in cost savings for our organization (e.g., reduced energy bills, lower waste disposal fees).					
5	Reduced energy consumption has led to lower operational costs in the organization's production processes					
6	Our organization adopts processes that reduce toxic and hazardous materials					
Waste Management						
1	My company categorizes waste before handing over					
2	Our organization has experienced waste reduction in the recent years					
3	The organization explores ways to utilize waste materials in new products or processes					
4	Our organization optimizes material usage in its production					
5	My organization implements lean manufacturing practices for waste reduction					
6	Our organization practices the concepts of reduce, reuse, and recycle in waste management					
Energy Efficiency						
1	Our organization has experienced a reduction in energy consumption in recent years					
2	Our organization practices automatic sleeping systems for equipment					
3	Our organization invests in energy-efficient machinery and equipment whenever possible.					

4	Our organization utilizes renewable energy sources (e.g., solar, wind) to supplement our energy needs					
5	Our organization shares and provides energy saving information to employees					
6	Our organization has moved to cloud computing in order to save energy					

SECTION C: OPERATIONAL PERFORMANCE

Please rate the performance of your company in the following areas on a scale of 1 (Strongly Disagree) to 5 (Strongly Agree).

No	Operational performance	1	2	3	4	5
1	The organization has experienced an increase in production output since implementing green practices.					
2	There has been a reduction in production downtime due to environmental issues (e.g., equipment malfunctions, waste-related disruptions).					
3	My organization has experienced improvement in product quality (e.g., fewer defects, higher consistency)					
4	The company has reduced overall production costs (e.g., lower energy bills)					
5	There is a high initial investment costs associated with green practices					
6	The organization is now operating in a more resource-efficient manner, reducing its environmental footprint.					

Thank you for your time and cooperation

Appendix III: Authorization Letter

Strathmore UNIVERSITY

24th May 2024

Mr Odhiambo Creff,
creff.odhiambo@strathmore.edu

Dear Mr Odhiambo,

RE: Effect of Green Manufacturing Practices on Operational Performance of Large Manufacturing Firms in Nairobi County

This is to inform you that SU-ISERC has reviewed and **approved** your above **SU-masters** proposal. Your application reference number is **SU-ISERC2261/24.** The approval period is from **24th May 2024 to 23rd May 2025.**
This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by SU-ISERC.
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to SU-ISERC within 72 hours of notification.
iv. Any changes anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to SU-ISERC within 72 hours.
v. Clearance for the export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to the expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days of completion of the study to SU-ISERC.

Before commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology, and Innovation (NACOSTI) https://research-portal.nacosti.go.ke/ and obtain other clearances needed.

Yours sincerely,

Mr Ambrose Rachier,
Chairperson; SU-ISERC

Ole Sangale Rd, Madaraka Estate. PO Box 59857-00200, Nairobi, Kenya. Tel +254 (0)703 034000
Email admissions@strathmore.edu www.strathmore.edu

Appendix IV: NACOSTI License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **750052**

Date of Issue: **23/May/2024**

RESEARCH LICENSE

This is to Certify that Mr.. Creff Ogwada Odhiambo of Strathmore University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: EFFECT OF GREEN MANUFACTURING PRACTICES ON OPERATIONAL PERFORMANCE OF LARGE MANUFACTURING FIRMS IN NAIROBI COUNTY. for the period ending : 23/May/2025.

License No: **NACOSTI/P/24/35601**

750052

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

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See overleaf for conditions