2025

Effect of sustainability practices on business performance of manufacturing firms in Nairobi, Kenya.

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EFFECT OF SUSTAINABILITY PRACTICES ON BUSINESS PERFORMANCE OF MANUFACTURING FIRMS IN NAIROBI, KENYA.

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ADMISSION NUMBER: 061123

A RESEARCH THESIS TO BE SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF COMMERCE OF STRATHMORE UNIVERSITY

JUNE, 2025

DECLARATION

I hereby declare that this research thesis has not been previously submitted for the award of a degree at this or any other university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person, except where proper citation is made within the dissertation itself.

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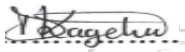
Signature:  Date:19th May 2025

ACKNOWLEDGEMENT

I would like to thank God Almighty for the knowledge, courage, providence and determination that saw me through the completion of this thesis. I would also want to thank my wife Purity and the entire Wanjohi family for their support and pushing me through to complete the program.

Finally, I would like to thank my supervisor, Dr. Diana Ominde for giving me immaculate guidance and wisdom to make this thesis a success.

ABSTRACT

Circular economy practices, which focus on reducing waste and enhancing resource efficiency. The shift from a traditional linear economy to a circular economy, where waste is minimized and materials are reused or recycled, has been recognized as essential for achieving sustainability goals. In Kenya, this transition is crucial, as industries can leverage circular practices to reduce energy consumption and mitigate environmental impacts. However, the adoption of these practices in the manufacturing sector remains limited. Therefore, the current study sought to determine the effect of sustainability practices on the business performance of manufacturing firms regulated by the Kenya Association of Manufacturers in Nairobi County, Kenya. The specific objectives that guided this study are to identify how Sustainable Material Sourcing, Waste Reduction, Energy Efficiency, and Lean Manufacturing currently implemented by manufacturing firms in Nairobi influence their business performance. This study explored the applicability of established theories like Institutional Theory and Resource-Based Theory to the field of sustainable manufacturing. This study adopted the positivist research philosophy and employed a descriptive research design. This research utilized primary data and secondary data. Data collection was undertaken in one month, starting from 20th January to 20th February. The study targets 439 manufacturing firms regulated by the Kenya Association of Manufacturers in Nairobi County, Kenya, which groups the firms into 12 productive sectors. A sample size of 136 manufacturing firms. The respondent of the study comprised one production manager from each manufacturing firm. This study employed a quantitative approach to analyze the collected data. Subsequently, collected data was analysed using statistical tools, which included software SPSS v27 software. Descriptive statistics, including Mean and standard deviations, were used in analyzing the data. Inferential statistics will also be conducted using binary logit linear regression analysis and correlation analysis. The correlation analysis suggests that each of the factors (Sustainable Material Sourcing, Waste Reduction, Energy Efficiency, and Lean Manufacturing) has a strong and statistically significant positive relationship with Business Performance. This implies that companies focusing on these factors are likely to see better business performance outcomes. The binary logit regression analysis confirmed that all independent variables (Sustainable Material Sourcing, Waste Reduction, Energy Efficiency, and Lean Manufacturing) were statistically significant predictors of business performance. The study concluded that sustainable material sourcing, waste reduction, energy efficiency, and lean manufacturing all contribute positively and significantly to the business performance of manufacturing firms in Nairobi. The study recommended that future studies investigate the long-term effects of sustainable manufacturing practices on business performance across different industries. This would provide a clearer picture of the sustained impact of sustainability over time. Additionally, further studies should explore the role of leadership in driving sustainability practices within family-owned or small-to-medium-sized enterprises (SMEs), especially in developing economies, where such firms are more prevalent. This research had potential benefits for several stakeholders, which include the academic fraternity, policymakers, and manufacturers in Kenya.

LIST OF ABBREVIATIONS

BMM: Best Manufacturing Practice

CE: Circular Economy

KAM: Kenya Association of Manufacturers

KEPSA: Kenya Private Sector Alliance

Kshs: Kenyan Shillings

MS Excel: Microsoft Excel

NRBV: Natural-Resource-Based View

ROI: Return on Investment

RBT: Resource-Based Theory

SIB-K: Sustainable Initiative Business Kenya

SMP: Sustainable Manufacturing Practices

SPSS: Statistical Package for the Social Sciences

UNIDO: United Nations Industrial Development Organization

DEFINITION OF TERMS

Sustainable Material Sourcing

The process of procuring raw materials in a manner that minimizes negative environmental impact by using recycled, renewable, or ethically produced resources (Mwangi, 2018).

Waste Reduction

Strategies and practices aimed at minimising the volume of waste generated during manufacturing processes, including reuse, recycling, and process optimisation (Kimeu, 2015).

Energy Efficiency

The practice of using less energy to perform the same task or produce the same outcome in manufacturing, often through the adoption of energy-saving technologies or practices (Nzau, 2023).

Lean Manufacturing

A systematic method for waste minimization within a manufacturing system without sacrificing productivity. It includes tools and techniques that improve efficiency, such as just-in-time production and continuous improvement (Khan et al.,2023).

Circular Economy

An economic model aimed at eliminating waste and the continual use of resources by reusing, repairing, refurbishing, and recycling existing materials and products (Koech et al., 2023).

Business Performance

A measure of how well a company achieves its business objectives. This study includes financial indicators such as cost savings, revenue growth, and return on investment (ROI) (Taouab & Issor, 2019).

Return on Investment (ROI)

A financial metric used to evaluate the profitability of an investment, calculated as the ratio of net profit to the initial cost of investment (Kakai & Ndeke, 2024).

Environmental, Social, and Governance (ESG)

A set of standards used to evaluate a firm's operations and future financial performance, based on its environmental stewardship, social responsibility, and governance structures (Li, 2019).

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VNVM SINT

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CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Manufacturing is widely recognized as a critical sector for economic growth across the world (UNIDO, 2020). Manufacturing has been generally acknowledged to be an important engine for economic development throughout the world, being the cornerstone of industrialization, employment, and technological innovation (UNIDO, 2020). The extensive implications of manufacturing extend beyond economic benefits to affect environmental and social elements on a massive scale (Amaral, et al., 2020).

But as the world economy keeps expanding and the need for manufacturing goods increases, the environmental and social issues associated with industrial production also increase (Turing, 2021). Consequently, manufacturers are under mounting pressure to implement sustainable practices that reduce environmental degradation and guarantee the long-term availability of resources (Yontar, 2023). As a result, manufacturing businesses are incorporating sustainability measures into their operations to achieve economic and environmental demands, hence ensuring success in the future. These measures do not only seek to sustain the level of production but also help positively in society and the environment (Squires, 2024).

United Nations is greatly favorable towards sustainable consumption and utilization of the earth's finite resources (Squires, 2024). These policies emphasize the need for the immediate transformation of industries' practices towards implementing steps that not only maximize productivity but also reduce the ecological footprint of production processes. Best Manufacturing Practice (BMM), 'green' manufacturing, and 'cleaner' manufacturing have been employed to raise awareness of the practices being implemented towards sustainable manufacturing (Galgani et al., 2021).

Best Manufacturing Practices have been applied in Germany and Japan, both of which have established industrial bases and environmental stewardship concerns. Among Japanese companies, there is a strong focus on leveraging the environmental benefits of their products and processes to strengthen their competitive market position. In the northern European countries, especially in Germany, sustainable manufacturing practices are applied alongside protectionist approach aimed at safeguarding the interests of EU countries, potentially creating barriers for external competitors (Gutowski et al., 2018).

In the United States, there is a significant level of awareness of sustainable manufacturing practices among large international companies, particularly in response to offshore practices. Green and cleaner production practices in Sweden have seen a high degree of environmental

concern in manufacturing (Brydges, 2021). Sustainable Manufacturing Practices (SMP) is a continuous improvement process where companies strive to include environmental, social, and economic issues in every step of manufacturing (Albloushi et al. 2023).

China, as the world's largest manufacturing hub, faces enormous challenges in managing its vast industrial base while addressing environmental concerns such as air and water pollution, resource scarcity, and waste management (Zhang et al. 2025). China has implemented stringent environmental regulations and incentivized green manufacturing technologies to promote a more sustainable industrial model (Zhang et al. 2025). Similarly, South Korea, known for its advanced manufacturing sector, has prioritized sustainability through policies encouraging resource efficiency and innovation in clean technologies (Chen et al. 2024).

Further, sustainable manufacturing practices have been observed in developing countries, specifically Brazil and India, where the rapid pace of industrialization has prompted the need to adopt sustainable manufacturing processes to curb the negative effects of quick growth (Markandya et al., 2021). In these two countries, the manufacturing sectors are expanding rapidly, but this comes with a significant environmental cost, including pollution and resource depletion. As a result, it has become crucial to implement practices that balance industrial development with environmental preservation. highlight the growing efforts in Brazil and India to integrate cleaner production technologies, reduce emissions, and minimize waste generation (Udeagha & Muchapondwa, 2023).

In South Africa, the adoption of cleaner technologies in the mining industry aligns with the country's goals of reducing its environmental impact while ensuring economic growth. South Africa has increasingly focused on the integration of cleaner, more sustainable technologies within the mining sector. These technologies are designed to enhance resource efficiency, minimize waste, and reduce harmful emissions, making a significant contribution to the country's sustainability objectives. The contribution of green manufacturing and sustainable practices towards reducing carbon emissions in South Africa's mining and mineral processing sectors has been immense (Maserumule et al.,2021).

Similarly, in Nigeria, the application of sustainable production approaches in the oil and gas industry has been essential in preventing pollution of the environment and long-term growth. Although the industry, as a significant economic driver, has contributed largely to environmental pollution, including gas flaring and oil spills, particularly in the Niger Delta region, measures are being taken to address these issues. Reducing gas flaring, improving control of pollution, and rehabilitating polluted ecosystems are taking priority. These eco-friendly practices are

necessary to counter environmental damage, the industry's future, and compliance with global sustainability policies (Nwobu et al., 2021).

Kenya has also begun to realize the importance of sustainable production and is actively employing green practices in several industries. Of particular note is the textile sector in Kenya, which has realized immense improvement in terms of energy efficiency and waste reduction due to the adoption of green production methods (Kimutai & Kimutai, 2023). These green practices not only assist in cutting down the emission of carbon but also improve the overall environmental performance of the sector, which incidentally is one of the country's primary economic drivers (Odero, 2023).

Moreover, Kenya's Vision 2030, a countrywide strategy to transform the nation into a middle-income economy, places a special focus on sustainable industrialization (Nzau, 2023). The strategy stresses green manufacturing's contribution to economic growth that is inclusive while ensuring the long-term sustainability of the country's resources. Vision 2030 aims to create an industrialized economy that fosters balanced growth and employment, particularly in the manufacturing sector, without compromising environmental integrity (Odero, 2023).

In Kenya, the requirement for manufacturing firms listed on the Nairobi Securities Exchange (NSE) to disclose their Environmental, Social, and Governance (ESG) performance directly supports the adoption of Sustainable Manufacturing Practices (SMP). The ESG Disclosures Guidance Manual encourages companies to integrate ESG considerations into their strategies and report on their environmental, social, and governance efforts (REUBEN, 2024). This aligns with SMP by pushing firms to document their sustainability practices, such as energy efficiency, waste reduction, and cleaner production technologies (Mumo, 2022).

1.1.1 Operational Sustainability Practices

Manufacturing for sustainable development is defined in this research more broadly as the general activities in enterprises for manufacturing concern and efficiency in resource utilization, cleaner production technology and sustainable social process in the manufacturing flow (Chen et al., 2024). Sustainable manufacturing is described as the effective and proper use of available resources in as a deal as possible manner or as a maximum degree as possible with less or without usage of resources. This often includes activities such as cuts on cost, minimizations in waste, and improvements on energy efficiency as well as in the development of more sustainable products and services (Shrivastava, 2018).

The integration of sustainable processes includes the reduction of pollutants, achieving a decrease in waste production, as well as the enhancement of productivity. They include in the use of renewable energy, recycling, and cutting down on waste and emissions during their

manufacturing processes (Ciliberto, et al., 2021). Sustainable packaging practices involve minimizing packaging materials and employing recyclable or returnable packaging options. Operational sustainability practices include pollution reduction, reuse and recycling, energy consumption, embodied carbon and water resource management (Montabon et al., 2018; Amaral et al., 2020).

The circular economy is one of the sustainable development strategies that proponents of sustainability are pushing for firms to embrace (Kanda & Aryee, 2024). According to Schroeder et al. (2019), the circular economy is defined through specific actions and practices such as reuse, eco-design, refurbishment, remanufacturing, product sharing, repair and industrial symbiosis. These practices are relevant elements for sustainable production and consumption.

Previous studies on circular economy provide several strategies and activities that are directed at improving operational sustainability. The strategies are: recycling (Klotz et al., 2024; Yontar, 2023) , reduction (Harala et al., 2023), reuse (Saleh and Ost, 2023; Yang et al., 2023), repackaging (Ahmad et al., 2023), refurbishing (Russell and Nasr, 2023), remanufacturing (Wrålsen and O'Born, 2023).

Recycling is a process of using waste disposal as a raw material to produce a new product (Yontar, 2023). Reduction targets the amount of waste produced at the production stage, as shown in the study conducted by Harala et al. (2023). The use of waste products for the same use by the next user or the immediate chain of users is known as reuse (Khan et al., 2023; Hadi et al., 2023). In a defined manner, repackaging involves using the product for some time, then reclaiming waste products and selling them to other markets, commonly known as secondary markets. whereas refurbishing means restoring used products for further use, while remanufacturing goes through more steps of processes to offer value to used goods.

Repair involves restoring serviceable but faulty products (Russell and Nasr, 2023). Redistribution entails restocking items that have been returned to the supply chain so that they may be used again. For instance, many beverage producers reclaim their bottles, crates pallets or totes within the chain of supply. Remanufacturing, or eco-design, is focused on developing environmentally sustainable organizational operations and product designs (Mesa and González-Quiroga, 2023). The last type is reselling, which involves the marketing of used or waste products in new markets: marketing such computer products as second-hand even after they have been refurbished (Russell and Nasr, 2023).

According to Mungai & Wagura (2023), cleaner production is a preventive, or pre-emptive strategy that seeks to reduce the generation of waste and emissions to attain maximum resource utilization during the production process. Cleaner production involves avoiding generating or

producing waste and pollutants in the first place, but it goes further to adopting sustainable waste management and treatment processes at every step through the production process. By enriching environmental performance, lessening costs of operations, and nurturing sustainability, this approach is both ecological and economic to manufacturing and industrial enterprises (Mungai & Wagura , 2023).

1.1.2 Business Performance

According to Baruah & Panda (2020), business performance is a multifaceted construct that encompasses how well a firm meets its strategic goals and objectives. It is a complex assessment, which goes beyond the confines of financial measures only (Taouab & Issor, 2019). Operationalizing sustainability can provide an avenue for cost reduction through better resource management as illustrated by Li et al. (2022). Whereas Chen et al. (2024) points out that strategic dimension of performance matter most when it comes to innovation and long-term value creation.

Skärin Rösiö and Andersen (2022) explore this potential connection, emphasizing that circularity practices, such as design for reuse and recycling, can generate both environmental benefits and financial success. Emphasizing that evaluating business performance requires considering both financial and environmental factors, indicating a synergy between profitability and sustainability. Additionally, Kithure (2022) highlights the importance of internalization-externalization collaboration, noting that such cooperation is essential for achieving optimal performance through sustainable practices. This research sets the foundation for understanding how businesses can integrate sustainable manufacturing practices into their strategies to enhance overall performance.

There are widely known benefits of sustainability on the environment and society at large, but it remains a mystery whether this has a direct impact on the business performance of corporations, especially in developing countries like Kenya (Kimutai & Kimutai, 2023). Consequently, sustainable practices do drive business performance; however, there are major obstacles to their efficient implementation (Koech et al., 2023). Therefore, the research problem revolves around identifying sustainable manufacturing practices to circumvent these barriers and how sustainability practices specifically affect manufacturing firms' business performance in Kenya. This study sought to address this research problem by examining the relationship between these practices and key performance indicators in Kenyan manufacturing sector with specific focus on start-up firms operating within Nairobi County.

1.1.3 Manufacturing Sector in Kenya

Kenya has 439 manufacturing firms regulated by the Kenya Association of Manufacturers (KAM). These firms were grouped into 12 productive sectors. These sectors included: Food & Beverages, Building, Construction & Mining, Energy, Electrical & Electronics, Metal & Allied, Paper & Board, Motor Vehicle & Accessories, Plastics & Rubber, Leather & Footwear, Chemical & Allied, Pharmaceuticals & Medical Equipment, Timber, Wood & Furniture, and Textile & Apparel (KAM, 2023).

The Kenyan manufacturing sector faces a range of challenges that significantly impact its business performance, particularly in the context of sustainability practices (Kimutai & Kimutai, 2023). Among these challenges, high production costs stand out as a major concern, driven by factors such as limited energy supply and volatile fuel prices. While Kenya's contribution to global carbon emissions remains relatively small, its rapidly growing population and expanding economic activity pose the potential for a sharp increase in emissions in the future (Dalla Longa & van der Zwaan, 2017). From 2010 to 2019, Kenya witnessed a notable rise in energy consumption, with fuel consumption increasing by 40.43% and electricity consumption growing by 27.80% (Republic of Kenya, 2020).

The manufacturing sector in Kenya is one of the largest consumers of energy and plays a central role in the country's economic growth. Recognizing the importance of this sector, the Kenyan government in 2022 targeted increasing its contribution to GDP from 8.4% to 15%, which aims to accelerate job creation and reduce the trade deficit (Republic of Kenya, 2022). The sector is a leading consumer of electricity, accounting for 50.16% of total consumption in 2019, and is the second-largest consumer of fossil fuel after the transport sector (Republic of Kenya, 2023). Given its significance in both economic performance and energy consumption, the need for sustainable manufacturing practices in the sector has gained significant attention.

In response to these challenges, the Kenyan government introduced the Kenya National Energy Efficiency and Conservation Strategy (NEECS) in 2020, which aimed to improve energy efficiency across various sectors. The NEECS outlined ambitious targets for the manufacturing sector, including an increase in energy audits from 1800 to 4000 by 2025, and a goal of saving 100 MW of electricity, 250 million liters of heavy fuel oil, and 9 million liters of industrial diesel oil during the same period (Republic of Kenya, 2020).

Despite these efforts, energy consumption within the manufacturing sector continues to rise. Between 2020 and 2023, fuel consumption increased from 414.6 to 635.5 thousand tonnes, and electricity consumption grew from 3204.9 to 4441.0 GWh (Republic of Kenya, 2023). Yet, the performance of the sector has been suboptimal, with growth rates fluctuating and GDP

contribution decreasing from 10.7% to 7.5% during the same period (Republic of Kenya, 2023). This disparity between rising energy consumption and the lack of corresponding improvements in sector performance highlights the ongoing crisis in Kenya's manufacturing sector, underscoring the need for more effective and sustainable manufacturing practices (Macharia, Gathiaka, & Ngui , Energy Policy, 2022).

Another critical environmental problem faced by Kenya's manufacturing sector is plastic waste, which is particularly problematic within the context of the traditional linear model of the economy (Kimutai & Kimutai, 2023). Plastic waste, according to Otakwa et al. (2021), has turned into a huge concern as the linear economy fosters a "take-make-dispose" culture which allows high production and consumption but not an effective waste disposal strategy. KEPSA (2019) highlights that plastic waste is one of the largest problems with this model because it reveals that 79% of all plastic waste globally never makes it into recycling but instead goes into landfills or is strewn around the environment. Only 9% of recyclable plastic exists globally, and recycling in Kenya is worryingly low at 8%. This accumulation of plastic waste has very serious environmental effects, including water and land pollution, which affect public health as well as manufacturing processes.

To meet these challenges, in 2017, Kenya attempted to mitigate plastic pollution by prohibiting the use of plastic bags. However, apart from all these efforts, plastic waste management continues to be a great challenge in Kenya's manufacturing sector (Macharia et al., 2022). Plastic waste mostly just accumulates, in part due to insufficient recycling infrastructure and limited recycling capacity, which makes reusing products in manufacturing processes impossible (Famiyeh et al., 2018). In this sense, the plastic waste definition in the traditional linear economy is considered an undesirable burden of rejected items that are wastes polluting and degrading the environment (Yang et al., 2023). But in the circular economy model, waste is repurposed to refer to recovered material that will be reused, recycled, or refurbished into products for a higher degree of closed-loop sustainability (Ciliberto et al., 2021).

Circular economy practices, which focus on reducing waste and enhancing resource efficiency, are increasingly being promoted as solutions to these challenges. The shift from a traditional linear economy to a circular economy, where waste is minimized and materials are reused or recycled, has been recognized as essential for achieving sustainability goals (KEPSA, 2019). In Kenya, this transition is crucial, as industries can leverage circular practices to reduce energy consumption and mitigate environmental impacts. However, the adoption of these practices in the manufacturing sector remains limited, primarily due to financial constraints and regulatory challenges (Mungai & Wagura, 2023).

This study aimed to address these knowledge gaps by exploring the relationship between sustainability practices and business performance in Kenya's manufacturing sector. By assessing the impact of circular economy practices and energy efficiency measures, this research sought to provide valuable insights into how these practices can enhance both the environmental and economic performance of manufacturing firms in Kenya. The findings of this study contributed to the growing body of knowledge on sustainable business practices, offering practical recommendations for firms and policymakers aiming to foster a more sustainable manufacturing sector.

1.2 Problem Statement

Kenya's manufacturing sector is at a crossroads, grappling with significant challenges that threaten its long-term sustainability and overall business performance. A key issue is the rising energy consumption within the sector, which has escalated over recent years. From 2010 to 2019, fuel consumption increased by 40.43%, while electricity consumption rose by 27.80% (Republic of Kenya, 2020). Despite efforts to improve energy efficiency through policies like the Kenya National Energy Efficiency and Conservation Strategy (NEECS), which targets reducing energy consumption and increasing energy audits, the sector continues to face inefficiencies.

In addition to rising energy consumption, the sector's performance has been underwhelming, with growth rates fluctuating and GDP contribution dropping from 10.7% to 7.5% from 2020 to 2023 (Republic of Kenya, 2023). This disconnect between increasing energy use and below average sector performance highlights a crisis in Kenya's manufacturing sector, indicating that sustainability practices, particularly in energy efficiency, have yet to yield the expected improvements in business performance (Macharia, Gathiaka, & Ngui, 2022).

A further crisis within the sector is the problem of plastic waste, which is exacerbated by the traditional linear economy model of production and consumption. Kenya's plastic waste management system remains inefficient, despite efforts like the plastic bag ban in 2017. According to KEPSA (2019), the country's plastic recycling rate is alarmingly low, at just 8%, with the vast majority of plastic waste ending up in landfills or polluting the environment. The environmental and public health impacts of this waste are compounded by the lack of effective infrastructure for recycling and reusing materials.

According Otakwa et al. (2021), the linear economy approach in which waste is considered an undesirable byproduct contributes to the growing environmental crisis. In contrast, the circular economy model, which emphasizes recycling, reusing, and repurposing waste, offers a promising solution but is still underutilized in Kenya's manufacturing sector (Turing, 2021).

Despite existing research suggesting that sustainability practices can lead to better business performance (Lu, 2023; Shrivastava, 2018), challenges such as increased operational costs and regulatory constraints hinder the full adoption of these practices (Mungai & Wagura, 2023). This study aimed to address this gap by determining the effect of sustainability practices on the business performance within the Kenyan manufacturing sector, with a focus on manufacturing firms regulated by Kenya Association of Manufacturers (KAM) in Nairobi County. This research had potential benefits for several stakeholders which including the academic fraternity, policymakers, and manufacturers in Kenya.

1.3 Objectives of the Study

1.3.1 Broad Objective

The broad objective of this study was to determine the effect of sustainability practices on the business performance of manufacturing firms in Nairobi, Kenya. It is a case study of manufacturing firms regulated by the Kenya Association of Manufacturers (KAM) in Nairobi County.

1.3.2 Specific Objectives of the Study

The following specific objectives guided the study.

1. To identify how manufacturing firms in Nairobi currently implement sustainable material sourcing influences their business performance.
2. To determine how waste reduction currently implemented by manufacturing firms in Nairobi influences their business performance.
3. To examine how energy efficiency is currently implemented by manufacturing firms in Nairobi influences their business performance.
4. To determine how lean manufacturing is currently implemented by manufacturing firms in Nairobi influences their business performance.

1.4 Research Questions

The research questions that guided the study are:

1. How does sustainable material sourcing currently implemented by manufacturing firms in Nairobi influence their business performance?
2. How does waste reduction currently implemented by manufacturing firms in Nairobi influence their business performance?
3. How does energy efficiency currently implemented by manufacturing firms in Nairobi influence their business performance?

4. How does lean manufacturing currently implemented by manufacturing firms in Nairobi influence their business performance?

1.5 Scope of the Study

The study focused on manufacturing firms operating in Nairobi County, Kenya. This allowed for a geographically specific analysis within the Kenyan manufacturing sector. The study was limited to manufacturing firms, excluding other sectors like agriculture or service industries. The research specifically targeted firms regulated by the Kenya Association of Manufacturers (KAM). This ensured a sample group that adhered to certain industry standards and practices. This research utilized primary data and secondary data and was undertaken in one month starting from 20th January to 20th February 2025.

The study targeted 439 manufacturing firms regulated by the Kenya Association of Manufacturers in Nairobi County, Kenya, which grouped the firms into 12 productive sectors. The sample size of the study was 136 manufacturing firms. The respondents of the study comprised one production manager from each manufacturing firm, thus forming the unit of analysis.

1.6 Significance of the Study

This research was justified because it aimed to address a critical gap in our understanding of how sustainability practices specifically influence the business performance of manufacturing firms in Kenya. This study aimed to address this gap by investigating the relationship between these practices and key performance indicators within the Kenyan manufacturing sector, with a focus on manufacturing firms regulated by the Kenya Association of Manufacturers (KAM) in Nairobi County. This research had potential benefits to several stakeholders which include the academic fraternity, policymakers, and manufacturers in Kenya.

This research was valuable to academia because it not only advanced knowledge in the field but also provided a foundation on which other research can be built, examining long-term sustainability issues and opportunities in Kenyan manufacturing. In addition, provided by the research benchmarking can further improve knowledge sharing.

This study also added great value to the current literature and future studies by providing information to policymakers on encouraging favourable policies that fostered sustainable practices which in turn spurred a sustainable manufactures' network in Kenya for the benefit of the environment and the economy.

The findings on the association between sustainable enhancement of business performance such as lower cost and higher profit provide the research with leverage to persuade Kenyan manufacturers to adopt them. Further, the study establishes the various remarkable measures

that can be applied to distinct industry types and company sizes, so organizations can work on applicable solutions.

1.7 Chapter Summary

The introduction chapter introduced the study's intention, including its background, determinants of financial stability, statement of the problem, objectives, research questions, scope, and significance. The next chapter examined the literature available to support the study.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter contained the theoretical foundation, empirical literature review, summary of knowledge gaps, conceptual framework, operationalization of study variables and chapter summary.

2.2 Theoretical Framework

This study explored the applicability of established theories like Institutional Theory, and Resource-Based Theory to the field of sustainable manufacturing.

2.2.1 Institutional Theory

One theory of organizations which investigates how organizations respond to pressures in the external environment to gain legitimacy and synchronize with the prevailing norms and values is institutional theory put forward by Meyer & Rowan (1977) & further advanced by Scott (2008). It is an influential theoretical lens in the organizational research area that assumes that the workings of organizations are fundamentally shaped and driven by other organizations, as well as social, political, and cultural contexts. It suggests that organizations are affected by their external environment, which may include laws, regulations and norm espoused in the organization.

Many researchers have used the institutional theory and have studied on how organisations manage the regulatory and normative forces. There are quite a number of theories on why organizations adapt the same model over some period of time; DiMaggio and Powell (1998) established the institutional isomorphism which posit that organizational change is forced by coercion pressures, imitate and required by norms. In their work on both the public and private sectors they point out that firms adhere to the legal and professional requirements; this they do, by emulating successful competitors. Oliver (2006) developed this view further by examining how an organization could manage to strategically undermine the institutional pressures, an indication that compliance is not exactly uncontested or taken for granted. Her work also pointed out that organizations could engage in process of acceptance or non-acceptance and even rejection of norms based on the cost and benefits associated with such norms.

In the context of environment sustainability, Jennings and Zandbergen (2015) employed institutional lens to look at how organisational institutions assimilate other environmental principles including sustainable development. They contended that organizations imitate processes from other firms deemed environmentally sensitive to enhance legitimacy, given increasing social pressures toward sustainability. In recent past, Kwan and Ma (2006) have also

stressed on the imitation of peers while coming to the organizational behavior. They also looked at the manufacturing firms and noted that industries pursue sustainable activities wherever they find others doing so, thus establishing their integrity to the eyes of other industries and their clients.

Indeed, from the lens offered by institutional theory, organisations have been exposed to criticism further to the fact that they are depicted as being overly passive or captive to the institution. Greenwood et al., (2017) oppose this by pointing out that organizations have agency and that they can either resist or reframe institutional demands rather than merely copying them. They say that by emphasizing conformity it is possible to lose sight, how organizations come up with creativity in institutions.

As well, Carney et al. (2019) note that the same problem vitiate the use of applied institutional theory in viewing organisational actors as insufficiently self-motivated. They critic that while establishing a good theoretical framework in the way external pressure influence the organizational behaviour the theory is sometimes lacked in the way that internal leadership, cultural and strategic factors might act as moderator to the pressures. This oversight reduces the ability of the theory in explaining the operation of organizations in multiple and complex institutional contexts.

Therefore, this study also serves to advance knowledge in institutional theory by deploying it to Kenyan manufacturing firms and to identify how sustainable manufacturing practices currently implemented by manufacturing firms in Nairobi influence their business performance. However, Jennings and Zandbergen (2015) working on this subject have worked in the context of Western countries while this study aims at understanding the system of institutional pressures in developing economies. The environmental regulations in Kenya are tight and the concerns from the stakeholders on sustainability are increasing while firms should cope with these pressures in a context that is rather poor in resources.

In contrast to the previous research that primarily emphasise isomorphism and mimicry (Leary and Roberts, 2018), this work also includes resource dependencies into the list of factors that impact the organisation's reactions to the institutional pressures. This paper turning to resources dependency theory argue that in order to enhance sustainability, firms, particularly those of Nairobi County rely on resources from green investors and buyers. This perspective combines institutional and resource dependency theories to give more holistic view on how the firms operate in response to the external environments.

However, this research is a voice for losing the internal strategy of organizations within institutional theory. Using the understanding derived from Carney et al. (2019), it also analyses how leadership and company culture act as a moderator to internal institutional pressures on Kenyan manufacturing firms enhancing a balanced understanding of compliance and innovation.

In conclusion, this work extends the current uses of institutional theory by recognising its weakness in explaining the behaviour of organisational actors in the non- Western, and, more particularly, resource-scarce environment therefore applicable in identifying how sustainable manufacturing practices currently implemented by manufacturing firms in Nairobi influence their business performance.

2.2.2 Resource-Based Theory

The Resource-Based Theory (RBT), developed by Barney (1991) and Wernerfelt (1984) maintains that the source of competitive advantage lies in firm resources and capabilities that are valuable, rare, hard to imitate (VRIN), and describable by several perfect substitutes. Several authors have also written on the topic of RBT with emphasis on how various businesses deploy the firm-specific resources as a source of competitive advantage. For example, Barney (1991) looked at ways organizational culture, organizational knowledge and patents, trademarks and copyrights can be considered as strategic resources that are costly for rivals to imitate. His original papers stated that for the firms to sustain a competitive advantage in the competitive industry, firms require development and safeguarding of their VRIN resources. the

Within the sustainability framework, Hart (2005) presents the Natural-Resource-Based View (NRBV), a perspective that advances the RBT by the integration of environmental management as a source of competitive advantage. The above case analysis supports Hart's argument that the management of environmental issues like pollution control, product; stewardship, and sustainable development creates greater economic value in firms. His study focused on the role of natural resources as a critical asset in the firm, especially with growing concern on the environment in the world today. Lubis (2022) provided another important input to the construction of RBT by using it to explain firms' environmental performance/ profitability connection. They proved that the firms which use better environmental strategies tend to record improved operational performance, which argue the assertion that sustainability is a competitive tool in global markets.

Wicki and Hansen (2019) took it a notch higher by discussing the costs which are incurred while implementing sustainable strategies, especially by companies which are in the small category.

Some pointed out that although it may unlock many benefits in the long-run utilizing sustainability as a strategic management tool comes with very high initial costs in technology enhancement and process re-organization that small firms may not easily afford thus they cannot use sustainability as a competitive resource.

However, there are criticisms as to where and when RBT applies even though it applies in most cases. Based on the above analysis, Zahra (2021) questioned that is RBT tautological, that is, does RBT assume that valuable resources will result in superior performance, but provide little operational direction for identifying or creating these resources. Consequently, they posited that although the theory is good in providing a background on competitive advantage, it provides little guide for firms on how that they might undertake a strategic quest for VRIN resources.

Furthermore, Newbert (2007) pointed out that empirical review of RBT has been criticized with regards to not accurately measuring the effect of resources on the performance of the firm. In comparison with RBT, HRM pays particular attention to intangible assets such as knowledge or culture which are not easy to measure, thus, the relationships between resources and superiority often remain rather vague. This has consequently lead to the need for proper operationalization and theoretical testing of RBT in various settings.

In their study of the RBT framework, Wicki and Hansen (2019) noted that it does not easily lend itself to practicing sustainability at scale. They noted that although the big firms are always in a position to invest in sustainability and achieving the benefits, they found that the small firms have resource limitations which hinder them from fully leveraging sustainability as a strategic advantage. This critique therefore brings out the fact of a rather skewed field in terms of resources, something that RBT does not take into account.

In contrast to the prior research by Hart (2005) and Lubis (2022) that is based on the assumption that sustainability can become a source of competitive advantage, this research deploys a more granular view, analysing the influences of environmental factors and resource limitations in the context of a developing economy on sustainability implementation. Hence this focus on Nairobi manufacturing firms offers a complementary contribution by applying RBT in a relatively neglected geographical and economic setting.

This work contrasts Wicki and Hansen (2019) who forefront the high costs incurred in sustainability practices indicating that Kenyan firms can deploy the efficiency of resources like water and energy to generate cost-competitive advantages. This is especially important in developing contexts where firms may not be able to invest in newer technologies but could

upgrade their position in the value chain by lowering their operating expenses and meeting legal necessities.

Further, the present study contributes to this new perspective by incorporating sustainability practice as an element of resource-based theory. This study extends RBT by focusing on the how the sustainable manufacturing practices affect the business performance of manufacturing firms in Nairobi and establishing the relationship between the adoption of sustainable manufacturing practices and the business performance of manufacturing firms in Kenya.

Although previous research has not denied the possibility that sustainability might improve the firm performance, these works generally consider this factor as an external constraint. This study, however, directs a positive view toward sustainability by positing it as a source of competitive advantage and a value capable of being created, defended and leveraged by the firm. This extension of Barney's (1991) resource-based view of sustainability adds that, when properly deployed, sustainability can create a VRIN resource that perpetuates a company's competitive advantage.

In conclusion, this work provides a development of RBT and its use in sustainability and a developing, resource-scarce economy and so provides a different angle to the potential for firms to manage resources effectively for competitive advantage.

2.3 Empirical Review

2.3.1 Sustainable Material Sourcing

Sustainable material sourcing involves selecting raw materials that have minimal environmental impact. This includes using recycled, biodegradable, or renewable materials and substituting materials with high environmental footprints. Previous Research by Moshood, Nawanir, and Mahmud (2022) emphasized the importance of sustainable material sourcing in reducing the environmental footprint of manufacturing processes. Their study highlights that the choice of materials significantly influences a firm's overall sustainability.

Similarly, Russell and Millar (2018) expanded on this concept by defining manufacturing inputs as key factors in sustainable practices, stressing the need for careful material selection. In this research, sustainable material sourcing was evaluated based on the extent to which Kenyan manufacturing firms adopt recycled, biodegradable, or environmentally friendly materials. The rationale for including this initiative is its direct impact on reducing the environmental footprint of manufacturing processes, which is critical in aligning with global sustainability goals.

Additionally, understanding how firms select materials can provide insights into the broader operational and financial impacts of sustainable practices.

Conversely, Khan et al. (2023) empirically evaluated the impact of green capabilities on green purchasing practices to boost the triple-bottom-line performance of manufacturing organisations. The study analysed 386 manufacturing firms' responses using the covariance-based structural equation modelling approach. The results indicated a positive correlation between green capabilities and purchasing habits; however, green innovation capabilities did not establish a statistically meaningful correlation. Additionally, green buying strategies have significant favourable associations with the triple bottom line of performance. The results contributed to the advancement of the resource-based-view theory by empirically examining the impact of green capabilities and green purchasing practices in influencing the triple-bottom-line performance of manufacturing firms.

Wako & Lambaino (2024) established the influence of sustainable material sourcing on the performance of cement manufacturing firms in Kenya. This study was anchored by: Resource-Based View (RBV), Innovation Diffusion Theory, Systems Theory and Stakeholder Theory. A descriptive cross-sectional study design was used. The target population comprised 126 procurement and logistics officers working in seven cement manufacturing firms. The census method was used. The study used descriptive statistics in the form of measures of central tendencies (mean, standard deviation, and percentages) to describe the data. The study used inferential statistics (correlation and regression analysis) to test the relationship between the dependent and independent variables. The study findings show that sustainable material sourcing has a positive and significant effect on the performance of cement manufacturing firms in Kenya. In addition, the study established that green specification has a positive and significant effect on the performance of cement manufacturing firms in Kenya.

Thiga (2025) determined the relationship between green material sourcing and the performance of food and beverage manufacturing firms in Kenya. An explanatory research design was employed in the study. All 172 of Kenya's registered food and manufacturing businesses were considered using the census approach. Using questionnaires, primary data was gathered. This study employed 172 questionnaires. The primary data was analysed using descriptive and inferential statistical analysis techniques. The study found that there is a correlation of 0.701 between green material sourcing and the success of Kenyan food and beverage manufacturing companies. Green material sourcing accounted for 48.7% of the variation in the performance of food and beverage manufacturing firms in Kenya.

While the studies converge on the positive effects of sustainable material sourcing on environmental and business performance, they differ in their sector-specific findings and methodologies. Moshood et al. (2022) and Russell and Millar (2018) provide theoretical perspectives on sustainable material sourcing, while Khan et al. (2023) empirically examine the broader implications of green capabilities. Wako and Lambaino (2024) and Thiga (2025) provide industry-specific empirical insights, highlighting the positive influence of sustainable material sourcing in the cement and food and beverage manufacturing sectors, respectively. These studies collectively reinforce the importance of sustainable practices in improving both environmental sustainability and business performance, but they also highlight the need for tailored approaches depending on the industry and context

2.3.2 Energy Efficiency

Energy efficiency refers to optimizing energy consumption in manufacturing processes, while renewable energy use involves integrating renewable energy sources, such as solar, wind, or biomass, into production. Previous Research by Ciliberto et al. (2021) examined the role of energy efficiency and renewable energy in the European manufacturing sector, highlighting its importance in reducing carbon emissions and enhancing sustainability. Their findings suggest that adopting these practices leads to significant environmental benefits and cost savings, aligning with the circular economy model.

Li et al., (2021) investigated the mediating effect of green core competence on the relationship between low-carbon technological innovation and enterprise performance, and evaluated the moderating impact of firm size on this relationship in China In this study, 438 valid data points were empirically analysed, and the results indicate that low-carbon technological innovation significantly and positively affects the enterprise performance of manufacturing. Green core competence plays a mediating role in the positive effect of low-carbon technological innovation on enterprise performance. Firm size has a positive moderating effect on the relationship between low-carbon technological innovation and enterprise performance. Meanwhile, firm size also moderates the relationship between low-carbon technological innovation and green core competence. Namely, a larger firm size correlates with a more positive effect on the cultivation of green core capabilities from the low-carbon technological innovation of manufacturing companies and in stronger enterprise performance.

Macharia et al. (2022) study shows the results show significant potential to enhance electricity, fuel and total energy efficiency across all the sub-sectors. The findings further reveal that exporting status, research and development, top managers' experience and female ownership

enhance energy efficiency. The effect of these variables is, however, heterogeneous by sub-sector and energy form. Labour productivity negatively influences electricity, fuel and total energy efficiency, while the effect of firm age and size is ambiguous. Finally, the study provides policy implications for the design of policies to improve energy efficiency.

Kakai & Ndeke (2024) They aimed at examining stakeholders' perceptions on the influence of adopting energy efficiency practices on the economic performance of selected manufacturing SMEs in Nakuru County. The study was guided by the ecological modernisation theory (Win-Win principle). An explanatory sequential mixed-method research design was employed, targeting SME proprietors in the manufacturing sector with a sample size of 76 respondents. Descriptive and inferential statistics (linear regression) were used to analyze quantitative data, while content analysis was used to analyze qualitative data. The study found out that SMEs largely adopted the use of energy-efficient bulbs and turned off lights when not in use. However, they used solar lighting as an energy efficiency practice to a lesser extent because they consider this practice expensive. The study also found that stakeholders perceived that energy efficiency practices adopted had a significant influence on the economic performance of selected manufacturing SMEs.

The study on manufacturing energy efficiency and renewable energy offers different approaches between regions and firm sizes. Ciliberto et al. (2021) emphasize the benefits of renewable energy and energy efficiency in Europe based on environmental and cost advantages. Li et al. (2021) analyze the positive contribution of low-carbon technological innovation in China, where bigger firms benefit more from green innovations. Macharia et al. (2022) show that factors like exporting status and management experience enhance energy efficiency, though labor productivity can discourage it. Kakai & Ndeke (2024) prove that SMEs in Kenya apply basic energy-saving practices but are hindered by the affordability of solar energy, whose contribution to economic performance is recognized by stakeholders. Taken together, these studies suggest that energy efficiency practices are differentiated by technological sophistication, size of firm, and regional context, with both environmental and economic gains being primary drivers.

2.3.3 Waste Reduction

Waste reduction involves minimising waste generated during production, while recycling refers to the process of reusing materials that would otherwise be discarded. Previous Research by Famiyeh *et al.* (2018) investigated the effects of environmental management practices, including waste reduction and recycling, on the operational competitiveness of manufacturing firms in

developing nations. Their findings revealed that waste management practices are essential for improving operational efficiency and financial performance.

İncekara (2022) conducted a study that identified how process reengineering and waste management influence business performance in manufacturing SMES across Europe and the USA. The study utilized the secondary data gathered for the Flash Eurobarometer in September 2015 to 2055 manufacturing SMES across Europe and the USA. Employed binary logistic regression to classify the impact of several factors on reengineering and waste management practices. The results demonstrate that process reengineering and waste management influence business performance in manufacturing SMES across Europe and the USA. Moreover, customer demands and competition with rivals are two primary reasons for adopting waste management practices.

Ochiri et al. (2015) focused on the effect of adopting waste reduction strategy as a possible solution to the dwindling raw materials, increasing costs and high rate of returns. It used a descriptive research design. The study population consisted of 357 firms, from which a sample of 189 firms was taken using stratified random sampling, and 138 responses were obtained. Empirical findings confirmed that returns and wastes were high in the publishing industry in addition to establishing that indeed adopting waste reduction would enhance the performance of publishing forms. The study recommends that the firms view waste reduction as an investment with returns and not a cost.

Kimeu (2015) conducted a study on the existing waste management practices by hotels; how waste management practices affect hotel operational performance. The study employed a census survey research design. Data was then analysed by use of descriptive statistics and inferential statistics such as mean, standard deviation and frequency in the analysis. The study also noted that the model administered had a moderate explanatory power of the effect of waste management on hotel operational performance. Based on the findings of the study, the researcher recommended that hotels should adopt waste management practices that include waste reduction, reuse and recycling, waste collection and depositing, and waste composting to improve their operational performance. The researcher also recommended that hotels' top management and government agencies should formulate waste management policies and guiding principles.

The literature on waste reduction and recycling shows their impact on operational performance across various industries. Famiyeh et al. (2018) found that waste management strategies like reduction and recycling improve operational efficiency and financial performance in

manufacturing firms in developing nations. İncekara (2022) concentrated on the effects of process reengineering and waste management on the performance of manufacturing SMEs in Europe and the USA, where customer demand and competition were the reasons for their adoption. Ochiri et al. (2015) confirmed that waste reduction programs enhance performance in the publishing industry by preventing raw material shortages and high return rates, while Kimeu (2015) proposed waste management programs, including reduction and recycling, for improving hotel operational performance. Together, these works show that waste management is necessary to enhance performance, with industry-specific programs drawn in relation to the specific industry's problems.

2.3.4 Lean Manufacturing

Lean manufacturing involves streamlining production processes to eliminate waste and improve efficiency. Process optimisation focuses on refining manufacturing processes to achieve higher productivity with minimal resource input. Previous Research by Ciliberto et al. (2021) highlighted the significance of lean manufacturing in aligning with the circular economy model, emphasizing its role in minimizing resource use and maximizing efficiency. Their study found that lean practices not only improve sustainability but also enhance overall operational performance.

Mwangi & Kamau (2022) conducted a study on the status of lean manufacturing implementation in the Kenyan manufacturing sector. The study adopted a descriptive survey design. Stratified sampling was applied to the sampling frame to achieve equitable representation of respondents from different categories of the manufacturing companies. The results showed that a focus on customers is the main driving force that causes companies in the Kenyan manufacturing sector to implement lean manufacturing irrespective of their lean status. Increased flexibility and being part of the company's continuous improvement programs had the least influence on lean implementation. Lean barriers that had the greatest influence on hindering lean manufacturing implementation were a lack of understanding of Lean Manufacturing concepts followed closely by cost of implementation. It was concluded that a lot of education and training on lean manufacturing and implementation is required within the Kenyan manufacturing sector.

Osumo (2021) conducted a study to examine the extent of LMP application on LSMF in Nairobi, to ascertain its effect on LMP and operational performance of LSMF; to examine the shortcoming of implementation. The study adopted a descriptive research design and data collection was done using questionnaires from respondents which was adopted in the research methodology. The primary tool for collecting data was a questionnaire, which was administered

by the researchers dropped and picked the questionnaire later. Data analysis adopted method for the research were descriptive statistics, regression and correlation analysis. The study findings indicate that on a moderate extent, LMP have been implemented by LSMF's in Nairobi County. These findings show that a positive relationship exists between the LMP and operational performance.

Waigwa (2023), conducted a study to assess the environmental sustainability practices and their effects on performance in selected industrial enterprises in Nairobi and Eldoret. This study used a multi-case study approach to collect data from 27 select industrial enterprises in the study areas, which had adopted environmental sustainability practices. Primary data were collected using structured questionnaires, and the researcher also reviewed publicly available secondary data to inform the study objectives. The findings of the study indicate that the environmental sustainability practices mostly adopted by the enterprises are the use of renewable energy and the commitment to reducing greenhouse gas emissions. On the relationship between sustainability practices and performance, the study found that more than half of the respondents indicated they had recorded increased revenue had experienced a rise in employee satisfaction. The study concluded that green and ISO 14001 certifications, sustainable supply chain, policy and regulations are some of the key areas that need the most attention by both industries and governments.

Mwangi (2018) conducted a study to establish the relationship between sustainable manufacturing practices and operational performance of manufacturing firms in Nairobi, Kenya. Two theories anchored the study; institutional theory and the resource-based theory. A descriptive design of a cross-sectional type was used in the study. The target respondents were 59 respondents from manufacturing firms in Nairobi. Primary data was collected from the respondents using structured questionnaires through drop and pick method. The data collected was analysed using descriptive and inferential statistics such as means and standard deviation. The inferential statistics was undertaken. The study found that sustainable manufacturing practices have a significant impact on operational performance in manufacturing firms in Nairobi, Kenya. The study thus recommends that the manufacturing sectors to invest and enhance sustainable manufacturing practices within all the dimensions of their firms to improve operational performance.

The study of lean manufacturing and process improvement identifies their impact on performance in operations. Ciliberto et al. (2021) emphasize the impact of lean manufacturing on efficiency and sustainability, while Mwangi & Kamau (2022) refer to customer focus as a

primary driver in Kenya, though limitations such as cost and unawareness constrain implementation. Osumo (2021) confirms a positive correlation between lean practices and performance in Nairobi, though implementation is moderate. Waigwa (2023) focuses on the importance of environmental sustainability practices, pointing out their effect on revenue and employee satisfaction. Mwangi (2018) concludes that sustainable manufacturing has significantly improved operational performance. Lean practices are salient in all studies, but others focus on broader sustainability effects and implementation challenges.

2.3.5 Business Performance

2.3.5.1 Cost Savings

Cost savings as a financial metric evaluates the reduction in expenses due to sustainable practices, such as reduced material and energy consumption, lower waste management costs, and optimized production processes (Galgani, et al 2021). Cost savings are a direct financial benefit of adopting sustainable practices. By reducing resource consumption and waste, companies can significantly lower their operating costs, impacts directly impacting their bottom line. This metric is crucial for demonstrating the economic viability of sustainability practices.

Chege and Wang (2020) found that technology innovation, often associated with sustainability, leads to substantial cost savings and improved financial performance. Their research supports the idea that sustainable practices can be financially beneficial, particularly through cost reduction. Ciliberto et al. (2021) support this perspective by demonstrating how lean manufacturing principles save on the cost of production, particularly in sustainable manufacturing contexts. Their research highlights that adopting lean strategies not only is cost-saving but also contributes to sustainability by minimizing resource consumption and waste.

2.3.5.2 Revenue Growth

Revenue growth measures the impact of sustainable practices on a company's ability to generate income, including market expansion opportunities due to a favourable brand image and increased customer demand for sustainable products (Shah, 2019). This metric has been chosen for this study because sustainability can be a significant driver of revenue growth by attracting environmentally conscious consumers and opening new market opportunities. Companies with strong sustainability credentials often enjoy a competitive advantage, leading to increased sales and market share (Schaltegger, 2018).

Famiyeh et al. (2018) suggest that firms with robust environmental management practices experience enhanced financial performance, including revenue growth. Their findings indicate

that sustainability can lead to greater customer loyalty and brand differentiation, driving revenue expansion.

2.3.5.3 Return on Investment (ROI)

ROI is a critical financial metric that measures the profitability of investments in sustainable practices. It indicates the financial return a company receives from its investments in sustainability practices, such as energy-efficient technologies, waste reduction programs, and green product development (Shrivastava, 2018). This metric has been chosen for this study because evaluating ROI is essential for understanding the long-term financial viability of sustainable practices. A positive ROI indicates that the investment in sustainability is paying off, not just in terms of environmental impact but also in financial returns (Baruah & Panda, 2020).

Li (2019) highlighted that companies with strong financial performance are better positioned to invest in and benefit from green innovation, demonstrating the importance of ROI in this context. Additionally, Skärin Rösiö and Andersen (2022) explored the relationship between circularity practices and financial performance, finding a positive correlation between sustainable investments and economic gains. Their research underscores the financial benefits of embracing sustainability, particularly in terms of ROI.

2.4 Literature Map

Table 2.1: Literature Map

Author(s)	Focus Area	Key Findings	Identified Knowledge Gap
Moshood, Nawanir, and Mahmud (2022)	Sustainable Material Sourcing	Emphasized the importance of sustainable material sourcing in reducing environmental footprint in manufacturing.	Limited industry-specific insights, especially in non-manufacturing sectors, and the need for more detailed operational and financial impact analysis of sustainable sourcing in various regions.
Russell and Millar (2018)	Sustainable Material Sourcing	Defined the role of manufacturing inputs in sustainability and stressed the need for careful material selection.	Lack of comprehensive data on the broader impacts of sustainable sourcing on firm performance and limited focus on sectors beyond manufacturing.
Khan et al. (2023)	Green Capabilities and Purchasing Practices	Found a positive correlation between green capabilities and purchasing practices, influencing triple-bottom-line performance.	Lack of clarity on how green innovation capabilities specifically impact long-term business outcomes across different regions and industries.
Wako & Lambaino (2024)	Sustainable Material Sourcing in Cement	Found that sustainable material sourcing positively affects performance in Kenyan cement firms.	Focused primarily on one industry (cement), leaving a gap in understanding how these practices apply in other industries and countries.
Thiga (2025)	Green Material Sourcing in Food & Beverage	Found a correlation between green material sourcing and the success of food and beverage manufacturing firms in Kenya.	Further research needed to explore the specific barriers to adoption and how different segments of the food and beverage sector implement green sourcing practices.
Ciliberto et al. (2021)	Energy Efficiency and Renewable Energy	Emphasized the importance of energy efficiency and renewable energy in reducing carbon emissions in Europe.	More empirical evidence needed to support regional variations and a deeper exploration of renewable energy integration challenges in non-European contexts.
Li et al. (2021)	Low-carbon Innovation and Enterprise Performance	Found that low-carbon technological innovation positively affects performance, with firm size as a moderating factor.	Greater focus needed on how small to medium enterprises (SMEs) can benefit from low-carbon innovation and the scalability of these innovations across industries.
Macharia et al. (2022)	Energy Efficiency in Manufacturing	Found that factors like exporting status, R&D, and management experience enhance energy efficiency.	Need for further research on how these factors impact smaller firms or firms in non-exporting sectors, as well as a deeper understanding of labor productivity's role in energy efficiency.
Kakai & Ndeke (2024)	Energy Efficiency in SMEs	Found that energy efficiency practices positively influence the economic performance of SMEs, but solar energy adoption is hindered by cost.	Research gap in understanding the barriers to renewable energy adoption in SMEs, especially regarding financing and technology access.

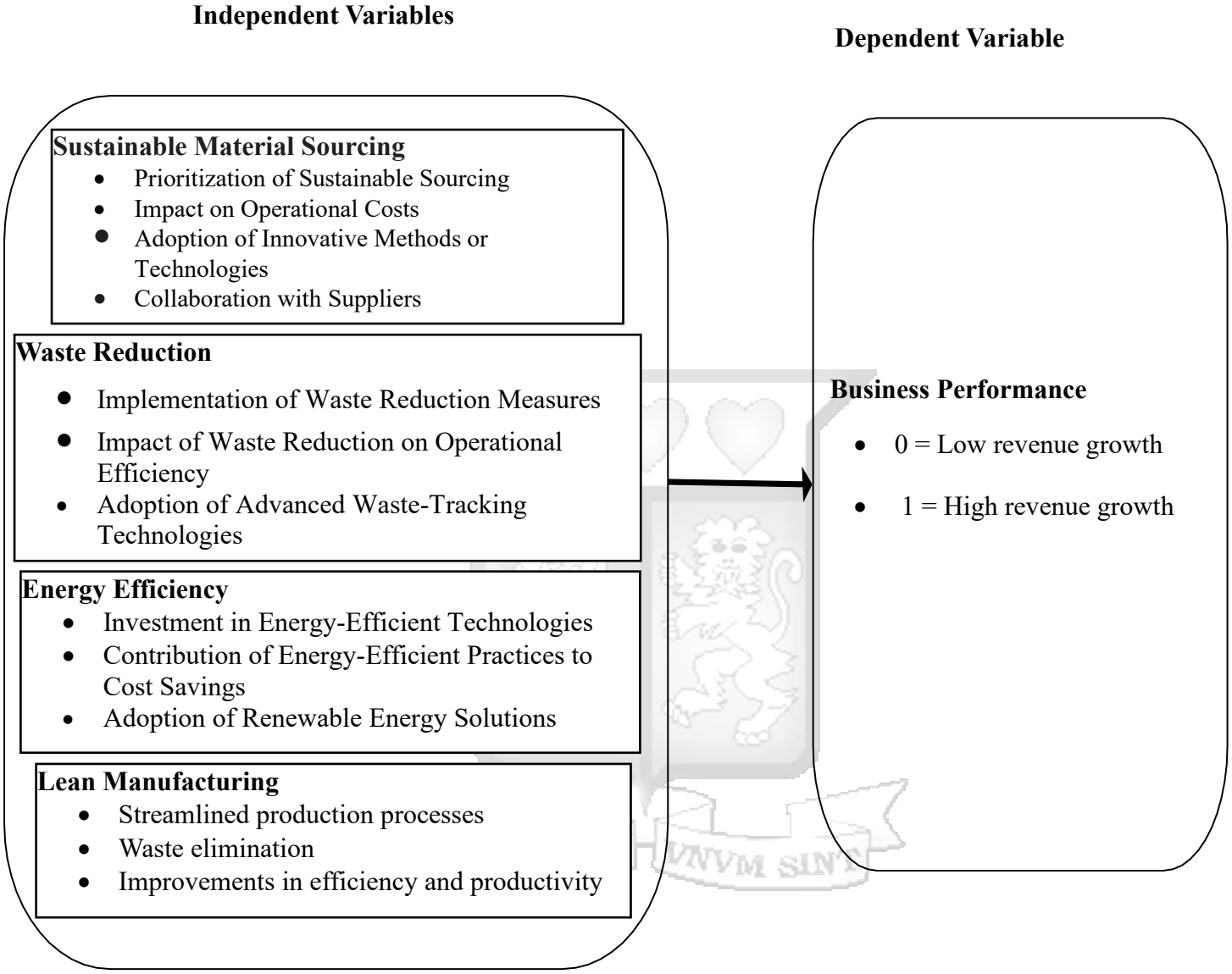
Famiyeh et al. (2018)	Waste Reduction and Recycling	Found that waste reduction and recycling improve operational efficiency and financial performance in manufacturing.	Lack of studies focusing on the long-term financial implications of waste reduction, especially in smaller firms or industries outside manufacturing.
İncekara (2022)	Waste Management in SMEs	Identified that process reengineering and waste management positively affect performance in SMEs across Europe and the USA.	Need for more detailed research into specific barriers to waste management adoption in SMEs and how cultural and economic factors influence their adoption.
Ochiri et al. (2015)	Waste Reduction in Publishing Industry	Found that waste reduction improves performance by addressing material shortages and returns in the publishing industry.	Limited focus on the impact of waste reduction in non-publishing industries and the financial metrics associated with waste reduction.
Kimeu (2015)	Waste Management in Hotels	Found that waste management practices, including reduction and recycling, improve operational performance in hotels.	Lack of detailed studies on how waste management affects financial performance in hospitality, especially concerning costs related to waste reduction technologies.
Mwangi & Kamau (2022)	Lean Manufacturing in Kenya	Found that customer focus is the main driver for implementing lean manufacturing, with barriers like cost and unawareness hindering adoption.	Need for further investigation into how lean manufacturing can be better implemented in small and medium-sized enterprises (SMEs) and how to overcome industry-specific barriers in Kenya.
Osumo (2021)	Lean Manufacturing in Nairobi	Found a positive relationship between lean manufacturing practices and operational performance in Nairobi.	Further studies on the challenges SMEs face in adopting lean manufacturing practices and how these practices can be scaled to larger firms.
Waigwa (2023)	Environmental Sustainability Practices	Found that renewable energy use and emission reduction practices improve revenue and employee satisfaction.	Lack of focus on industry-specific differences and the impact of these sustainability practices in regions outside Nairobi and Eldoret.
Mwangi (2018)	Sustainable Manufacturing Practices	Found that sustainable manufacturing practices significantly improve operational performance in Nairobi firms.	Need for more research on how sustainability practices can be integrated into large-scale manufacturing processes and how these practices affect competitiveness globally.

Source: Researcher (2025)

VT OMNES
VNVM SINT

2.5 Conceptual Framework

The conceptual framework explores the relationships between independent variables and dependent variables (Kothari, 2014).



Source: Researcher (2025)

Figure 2.1:Conceptual Framework

2.6 Operationalization of Study Variables

Table 2.2: Operationalization of Study Variables

Variable	Measurement	Measurement Scale	Source
Sustainable Material Sourcing	• Prioritization of Sustainable Sourcing • Impact on Operational Costs • Adoption of Innovative Methods or Technologies • Collaboration with Suppliers	Questionnaire Ordinal (Likert) scale	(Moshood et al., 2022; Russell & Millar, 2018).
Waste Reduction	• Implementation of Waste • Reduction Measures • Impact of Waste Reduction on Operational Efficiency • Adoption of Advanced • Waste-Tracking Technologies	Questionnaire Ordinal (Likert) scale	(Famiyeh et al., 2018; İncekara, 2022; Ochiri et al., 2015).
Energy Efficiency	• Investment in Energy-Efficient Technologies • Contribution of Energy-Efficient Practices to Cost Savings • Adoption of Renewable Energy Solutions	Questionnaire Ordinal (Likert) scale	(Ciliberto et al., 2021; Li et al., 2021; Kakai & Ndeke, 2024).
Lean Manufacturing	• Incorporation of Lean Manufacturing Techniques • Impact of Lean Manufacturing on Product and Service Quality • Adoption of Automation or Robotic Solutions	Questionnaire Ordinal (Likert) scale	(Ciliberto et al., 2021; Mwangi & Kamau, 2022; Osumo, 2021).
Business Performance	Revenue growth	Binary Scale • 0 = Low revenue growth • 1 = High revenue growth	(Chen et al. 2024), (Skärin et al. 2022)

Source: Researcher (2025)

2.7 Chapter Summary

This chapter delved into the theoretical foundations and empirical studies related to sustainable manufacturing and its impact on business performance. It explored key theories such as Institutional Theory, and Resource-Based Theory, Empirical evidence underscored the benefits of sustainable practices in enhancing business performance. The conceptual framework presented the relationship between variables and operationalizes them. The chapter concluded with a summary of these knowledge gaps, emphasizing the need for further research in diverse economic contexts.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter contained the research philosophy/paradigm, research design and methods, population and sampling, data collection method, data analysis, research quality, and ethical issues of research.

3.2 Research Philosophy/Paradigm

When selecting a research philosophy, four approaches are typically considered: pragmatism, interpretivism, post-positivism and positivism.

The paradigm of research used in this research was pragmatist philosophy. Creswell (2013) explains that pragmatic researchers are interested in both "what" and "how" to examine, guided by what they want to attain with their research. Pragmatism is not devoted to any single system of reality, and therefore, mixed-methods researchers are free to take on both quantitative and qualitative worldviews. Rather than assuming a monolithic strategy, pragmatists employ diverse data collection and analytical techniques, selecting the most suitable tools to answer their research questions in the most optimal manner (Christensen, 2022).

Interpretivism focuses on understanding the subjective reality, particularly in social environments. This approach emphasizes the importance of human perception and the meaning individuals attach to what they experience. Rather than seeking to uncover universal laws, interpretivism seeks to understand the complexity of social phenomena by revealing the diverse perspectives of those involved (Pervin & Mokhtar, 2022).

Post-positivism, however, is a philosophy that borrows elements from both positivism and interpretivism. Post-positivists still believe in the existence of an objective reality, but they accept that human knowledge is always fallible and limited. This approach is characterized by the position of critical realism, which maintains that even as we attempt to understand the world from the basis of quantifiable data, our findings are always subject to revision and improvement. Post-positivism calls for the adoption of both quantitative and qualitative approaches, with the understanding that diverse sources of information and methods can result in a more comprehensive explanation of a phenomenon.(Alharahsheh & Pius, 2020).

Positivism is grounded in the belief of an objective reality, often relying on numerical data. is based on the premise that reality is objective and can be observed and measured through empirical data. This approach emphasizes the use of quantitative methods, particularly numerical data, to identify patterns, test hypotheses, and establish generalizable findings.

The most suitable research philosophy for this study was the positivist research philosophy. The rationale is that the researcher used descriptive research as a methodology and is aligned with

positivism because this philosophy tends to work on secondary data to describe and explain phenomena that are observed. (Maksimovic & Evtimov, 2023). This study utilized secondary data which reflects a focus almost exclusively on objective data measurable by quantification; this corresponds well with positivist research.

This research used a quantitative data analysis approach to quantify the effect sustainable manufacturing practices have on business performance, which represents a typical positivist approach in that it aimed to draw relationships from data analysis. (Maksimovic & Evtimov, 2023). Therefore, the positivist research philosophy was adequate to support this research as it allows comparative objective analysis of data and testing for relationships or links between sustainable manufacturing practices with business performance.

3.3 Research Design and Methods

Different research designs can be used based on the study goals, including mixed research design, experimental, descriptive, and correlational studies.

Experimental design would typically be applied if the researcher's aim in the study is to establish causality, i.e., whether the researcher wishes to establish if changes in one variable (independent variable) will directly cause changes in another variable (dependent variable). Experimental design involves manipulating one or several independent variables and observing its effects on the dependent variable while other potential confounding variables are kept constant so that one can specify the specific cause-and-effect relationship (Huntington-Klein, 2021).

Correlational research design is used when the researcher wants to discover and measure the relationship between several or more variables but not manipulate them. Correlational research aims to determine whether and to what extent variables are related. Correlational research identifies only relationships between variables, unlike experimental research which attempts to discover causality (Huntington-Klein, 2021).

Mixed research design integrates both quantitative and qualitative research designs to get a better description of a research problem. This design is particularly useful if the researcher wishes to create a detailed exploration of a phenomenon based on qualitative methods (e.g., case studies or interviews) and, simultaneously, measure relationships between variables through statistical analysis (Silver, 2016).

Cross-sectional study design is a single-instance study that provides a snapshot of a population or phenomenon at a particular point in time. It is particularly useful for analyzing the relationships between variables at a specific time without requiring the longitudinal tracking of subjects. Cross-sectional designs can determine correlations and patterns within a population

and not cause-and-effect relationships as they do not involve measuring change over a period of time. The design is widely used in surveys and observational studies (Sheehan, 2010).

Descriptive design is typically used when the aim is to describe the characteristics of a phenomenon or the current status of a situation without influencing or manipulating any variables. Descriptive research is most commonly conducted through surveys, observations, or case studies, where the researcher is going to gathers information from participants or settings without actively intervening (Creswell et al., 2018).

This study applied a descriptive research design, which is appropriate to the positivist philosophical approach. Descriptive research is conducted with the intent of documenting the population or phenomenon, the method entails the identification of aspects as they are without an explanation of why they occur. According to Creswell, Levitt, & Bamberg (2018), descriptive research designs are ideal for collecting, tabulating and analysing data in such a way that enables the identification of patterns and connections in line with the data type, which is quantitative in this case.

In this research, secondary data was collected to analyse the impact of sustainable manufacturing on business. The focus on quantitative criteria was also by both the descriptive design and the positivist epistemology. Because this design disregarded the extent to which two variables are associated with one another, it made it easier to gather vast amounts of data concerning how sustainable measures affect business performance, information that can be used to generalize to other populations.

Based on the research philosophy and the type of research question, descriptive research design best fitted this study. Positivism shares a good correlation with descriptive research mainly because the study involved the collection, analysis and presentation of secondary data that are quantifiable. This is in line with the positivist epistemology which aimed at utilizing empirical and measurable evidence to explain occurrences (Maksimovic & Evtimov, 2023). This approach was supported by a descriptive design that aims at compiling comprehensive data on certain occurrences since the design allows for the accumulation of number-oriented data capable of statistical analysis (Dubey & Kothari, 2022).

3.4 Population and Sampling

3.4.1 Target Population.

The study targeted 439 manufacturing firms regulated by the Kenya Association of Manufacturers in Nairobi County, Kenya, which grouped the firms into 12 productive sectors as illustrated in Table 3.3 below, forming the unit of observation for the study.

Table 3.3: Target Population

Manufacturing Sector	Sectoral population
1. Food & Beverages	**75**
2. Paper & board	**61**
3. Plastic & Rubber	**60**
4. Metal & Allied	**50**
5. Energy, Electrical & Electronics	**35**
6. Chemical & Allied	**33**
7. Motor Vehicle & accessories	**32**
8. Building, Construction & Mining	**30**
9. Textile & Apparel	**24**
10. Pharmaceuticals & Medical Equipment	**20**
11. Timber, Wood & Furniture	**15**
12. Leather & Footwear	**4**
Total	**439**

Source: KAM, (2023)

These sectors included: Food & Beverages, Building, Construction & mining, Energy, Electrical & Electronics, Metal & Allied, Paper & board, Motor Vehicle & accessories,Plastics & Rubber, Leather & Footwear, Chemical & Allied, Pharmaceuticals &Medical Equipment, Timber, Wood & Furniture and Textile & Apparel (KAM, 2023).

3.4.2 Sampling Techniques

Sampling techniques can be broadly categorized into two types: probability sampling and non-probability sampling. Probability sampling requires that all the members of the population have a chance of being selected and none of them is privileged (Creswell et al., 2018). On the other hand, there is a non-probability sampling: the methods are convenience or purposive sampling where specific populations are chosen (Martin, 2023).

The stratified random sampling method was more appropriate because the industrial grouping used by the representative industry association (KAM) can be considered to be homogenous. In this instance, the use of stratified sampling enhanced sample representation and lower the sampling error by reducing variability in the subgroups (Depoy & Gitlin, 2011). Further, the sector was stratified according to location (Nairobi) and firm size; roughlyone-third of the manufacturing firms in Kenya have 50 or more employees and approximately 60% of the firms have an annual turnover of Kshs.50 million and above(ADB, 2013).

3.4.3 Sample Size

The sample size was arrived at through the use of the published tables (Appendix III) which arrived at a sample size of 196 firms from a population estimate of 439 firms. The sample size

should possess a given combination of precision (0.05), confidence level (95%) and variability (sectors) (Barlett *et al.,* 2001) with other significant factors being the acceptable margin error, size of the population and the statistical analysis tools (Saunders *et al.,* 2009). In determining the sample size for a finite population, Berenson *et al.,* (2012) suggested that a finite correction factor be employed. This finite population correction factor was given by the equation below;

$$n = \frac{n_0 N}{n_0 + (N - 1)}$$

Where N is the population and n_0 is the sample size without considering the finite population correction factor.

The actual sample size n, $= \frac{196*439}{196+(439-1)} = \frac{86044}{634} = 136$

The sample size of the study was 136 manufacturing firms. The respondent of the study comprised one production manager from each manufacturing firm thus forming the unit of analysis.

Table 3.4: Sampling Frame

Manufacturing sector	Target population	Proportion	Sample size derivation	Sample size
1) Food & Beverages	**75**	0.252	0.252 *136	**34**
2) Plastic & Rubber	**60**	0.104	0.104 *136	**14**
3) Metal & Allied	**50**	0.112	0.112 *136	**15**
4) Chemical & Allied	**33**	0.075	0.075 *136	**10**
5) Building, construction & Mining	**30**	0.068	0.068 *136	**10**
6) Energy, Electrical & Electronics	**35**	0.061	0.061 *136	**8**
7) Motor Vehicle & accessories	**32**	0.069	0.069 *136	**9**
8) Pharmaceutical & Medical Equipment	**20**	0.032	0.032 *136	**4**
9) Paper & board	**61**	0.100	0.100 *136	**14**
10) Textile & Apparel	**24**	0.086	0.086 *136	**12**
11) Timber, Wood & Furniture	**15**	0.026	0.026 *136	**4**
12) Leather & Footwear	**4**	0.012	0.012 *136	**2**
Total	**439**	**1.000**		**136**

Source: Researcher (2024)

3.5 Instruments of Data Collection

In this study, primary and secondary data played a pivotal role. The study used questionnaires as an instrument of data collection for the independent variables (Dubey & Kothari, 2022). The use of questionnaires with many closed-ended questions enabled the collection of quantitative data, which is essential for identifying how Sustainable Material Sourcing, Waste Reduction, Energy Efficiency, and Lean Manufacturing are currently implemented by manufacturing firms in Nairobi influence their business performance.

The researcher also meticulously collected secondary data (Cumming & Leung, 2021). This data encompassed a comprehensive analysis of financial statements to determine the business performance of the manufacturing firms in Nairobi.

3.6 Data Collection Procedure

A letter of introduction from the university was presented, specifying the purpose and duration of the research. Questionnaires were distributed and collected using a drop-and-pick method to the 136 manufacturing firms in Nairobi (Akesson et al, 2020). The official financial statements were accessed from the Kenya Association of Manufacturers head offices in Nairobi.

3.7 Data Analysis

This study employed a quantitative approach to analysing the collected data, which ensured a comprehensive understanding of the variables under study. (Mulisa, 2022). The data underwent meticulous cleaning to facilitate comprehensive analysis and was organised within an MS Excel spreadsheet. Subsequently, Statistical Package for Social Science (SPSS) Version 27 was utilized for statistical analysis. Descriptive statistics, including the mean and median, were calculated to summarise the data (Silver, 2016).

Additionally, correlation coefficients and ANOVA (Analysis of Variance) were computed. Results were presented using tables and charts. This study adopted a binary logit regression model to convert the secondary data into categorical data that can be combined with ordinal data from the Likert scales (Bosibori, 2023). The model was as follows:

$$LN (P / 1 - P) = B0 + B1SMS + B2WR + B3EE + B4LN + e \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (i)$$

P = probability that a manufacturing firm had high revenue growth, and 1-P = probability that a manufacturing firm had low revenue growth.

B0= constant

B1,B2.B3, B4= Coefficient

SMS = Sustainable Material Sourcing

WR = Waste Reduction

EE = Energy Efficiency

LN = Lean Manufacturing

3.8 Research Quality

3.8.1 Reliability

Reliability refers to the consistency and stability of the data collection process and the accuracy of the results obtained (Bryman, 2016). To ensure reliability, the questionnaire underwent a pilot test with a small group of managers to ensure that the questions were clear and consistently understood. Any ambiguous questions were revised to improve clarity and reliability. One of the most widely used tests of reliability is the Cronbach Alpha Test. Cooper and Schindler (2010) suggest that a Cronbach Alpha coefficient that ranges from 0.70 to 0.90 should be considered reliable. This study therefore adopted the interpretation according to Cooper and Schindler (2010) that a coefficient of at least 0.70 was reliable. The Cronbach Alpha Test was calculated and analyzed using SPSS, and the results were that all the coefficients were reliable, as presented in Table 3.5. Therefore, no adjustments were made to the data collection tool.

Table 3.5: Reliability Results

Variable	**Cronbach's Alpha Coefficient**	**Interpretation for the study**
Sustainable Material Sourcing	0.872	Reliable
Waste Reduction	0.864	Reliable
Energy Efficiency	0.881	Reliable
Lean Manufacturing	0.850	Reliable

Source: Researcher (2025)

3.8.2 Validity

Internal validity is the confidence that we have of whether the results of the research study reflect the connection between variables (Mohajan, 2020). To ensure validity, the researcher made sure that all the research questions effectively covered what is intended in the study. The research supervisor went through the research questions to ascertain whether they adequately respond to the topic of study.

3.9 Diagnostic Tests

Diagnostic tests were applied to review the methods used to analyze data collected in the study. The heteroskedasticity test and multicollinearity test were used.

3.9.1 Heteroscedasticity Test

Heteroscedasticity occurs when the standard deviation is non-constant for different values of independent variables (Munir, 2023). This can occur in a conditional or non-conditional form. Conditional heteroscedasticity occurs when volatility is related to previous periods while unconditional heteroscedasticity occurs when volatility is related to structural changes not related to prior periods (Munir, 2023). To detect heteroscedasticity, this study used the Modified Wald test.

3.9.2 Multicollinearity Test

One more postulate of classical regression models is the nonexistence of multicollinearity. Multicollinearity is a sectional problem that arises whereby the independent variables are correlated (Lindner et al.,2022). A robust method for detecting multicollinearity is the Variance Inflation Factor (VIF), which measures how much the variance of a regression coefficient is increased due to collinearity between predictors (Pandey & Pandey, 2021). A VIF value exceeding 10 indicates serious multicollinearity, while values between 5 and 10 suggest moderate multicollinearity that might require further investigation. A VIF below 5 is typically considered acceptable (Pandey & Pandey, 2021). In this study, multicollinearity was assessed by calculating the VIF using SPSS V27 software.

3.10 Ethical Issues in Research

Before the commencement of data collection, the researcher filled out the ethical form to get clearance from the Strathmore University Ethics Committee. The researcher remained keen on ethical considerations such as confidentiality, anonymity, privacy, and informed consent in carrying out this study. Further, the conduct of the study was guided by Strathmore University's code of ethics. The researcher further applied for the National Commission for Science, Technology, and Innovation (NACOSTI) research permit. The researcher informed the Kenya Association of Manufacturers (KAM) of the intention of the research. The collected data was used for the research only.

CHAPTER FOUR: DATA ANALYSIS AND PRESENTATION

4.1 Introduction

This study sought to determine the effect of sustainability practices on the business performance of manufacturing firms in Nairobi, Kenya. It is a case study of manufacturing firms regulated by the Kenya Association of Manufacturers (KAM) in Nairobi County.

4.2 Response Rate

The study respondents returned 100 out of 136 distributed questionnaires, leading to a response rate of 73.53%. This excellent response rate agrees with Mugenda and Mugenda's (2003) prescription for a significant response rate for statistical analysis, which they established at a minimal value of 50%. This rate of response is normally acceptable for survey-based studies because it falls within the standard range for the response rates for comparable studies (Akesson et al., 2020). In comparison, the response rates for surveys on the manufacturing industry generally range from 50% to 80%, with the higher rates corresponding to more interested respondents or smaller, more accessible target populations (Edwards et al., 2017). This is related to similar surveys by Sheehan (2010) and Wu, Zhao, & Fils-Aime (2022).

4.3 Demographic Information

Demographic data indicated that the sample was heterogeneous in terms of representing different managerial levels, firm sizes, and years of operation (Mastella et al., 2021).

4.3.1 Position of the Respondent

The respondents consisted of managers, employees and supervisors as shown in Figure 4.2. The majority of the respondents, 40 were managers, 35 were supervisors, and 25 were employees. This distribution highlights the varying levels of managerial positions of the respondents, indicating a mix of both relatively highly experienced professionals. More specifically, the sample reflected different levels of managers (e.g., managers, employees and supervisors). Such diversity in experience may influence decision-making approaches and policy implementation in the manufacturing industry(Guillaume et al. 2017).

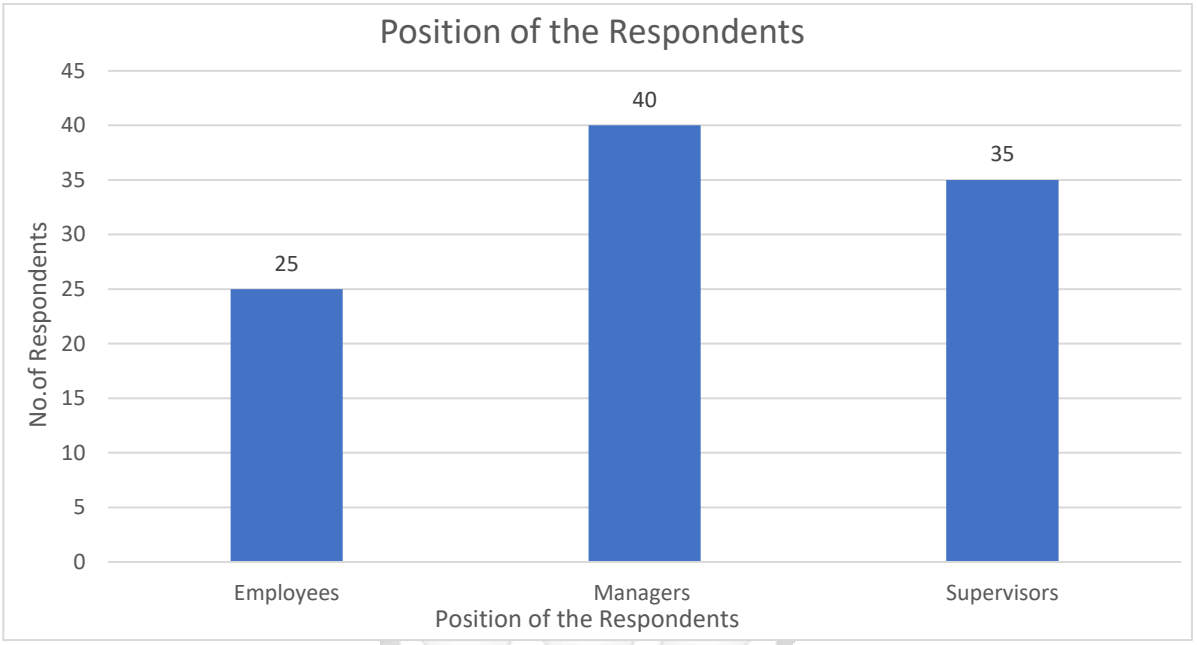


Figure 4.2: Position of the Respondent

4.3.2 Years of Operation

The findings in Figure 4.3 indicate that 30 manufacturing firms have between 5-10 years in operation, 28 manufacturing firms have between 11-15 years in operation, and 24 manufacturing firms have less than 5 years in operation (Arellano-Bover, 2024). The breadth allows for a comprehensive understanding of the implications of sustainable manufacturing practices on business performance across companies with different profiles (Cumming & Leung, 2021).

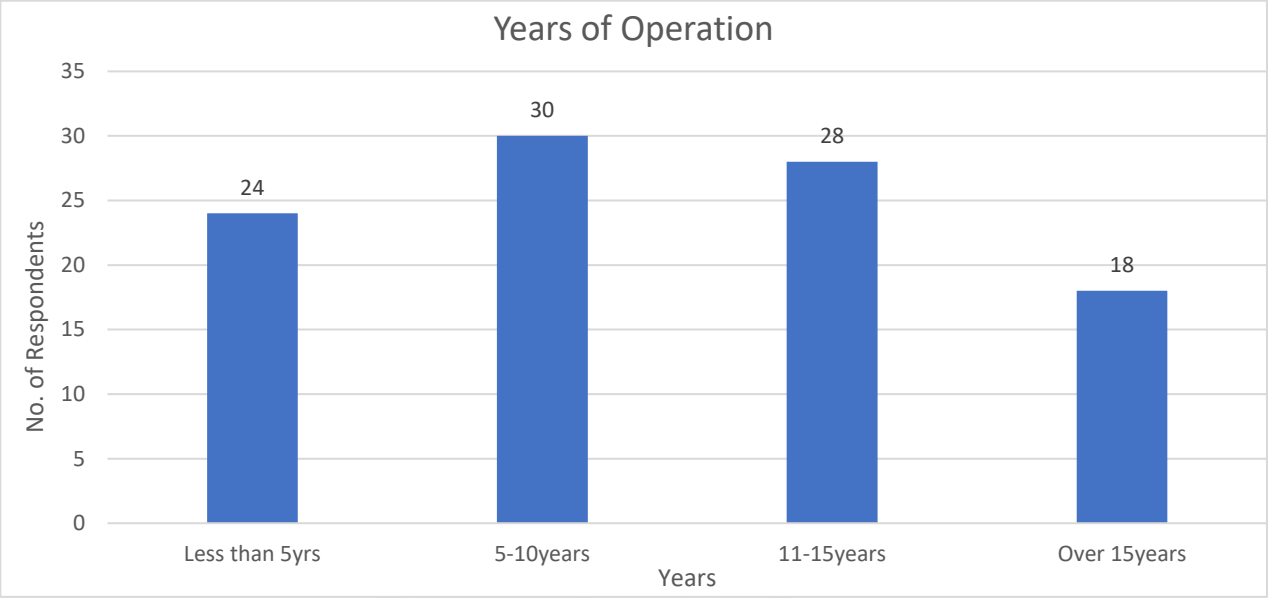


Figure 4.3: Years of Operation

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4.3.3 Size of your Company

The size of the manufacturing companies was categorized into three groups: small, medium, and large, as illustrated in Figure 4.4. Specifically, 43 of the manufacturing firms fell into the medium-sized category, employing between 50 and 249 individuals. A total of 35 firms were classified as small, each having fewer than 50 employees, while 22 companies were considered large, employing 250 or more individuals. This distribution underscores the diverse scale of manufacturing firms within the industry, demonstrating the presence of businesses of varying capacities and workforce sizes(Han & Tomaskovic-Devey, 2025). Such categorization provides valuable insight into the structure of the sector, reflecting the relative proportion of firms operating at different scales (Guillaume et al., 2017).

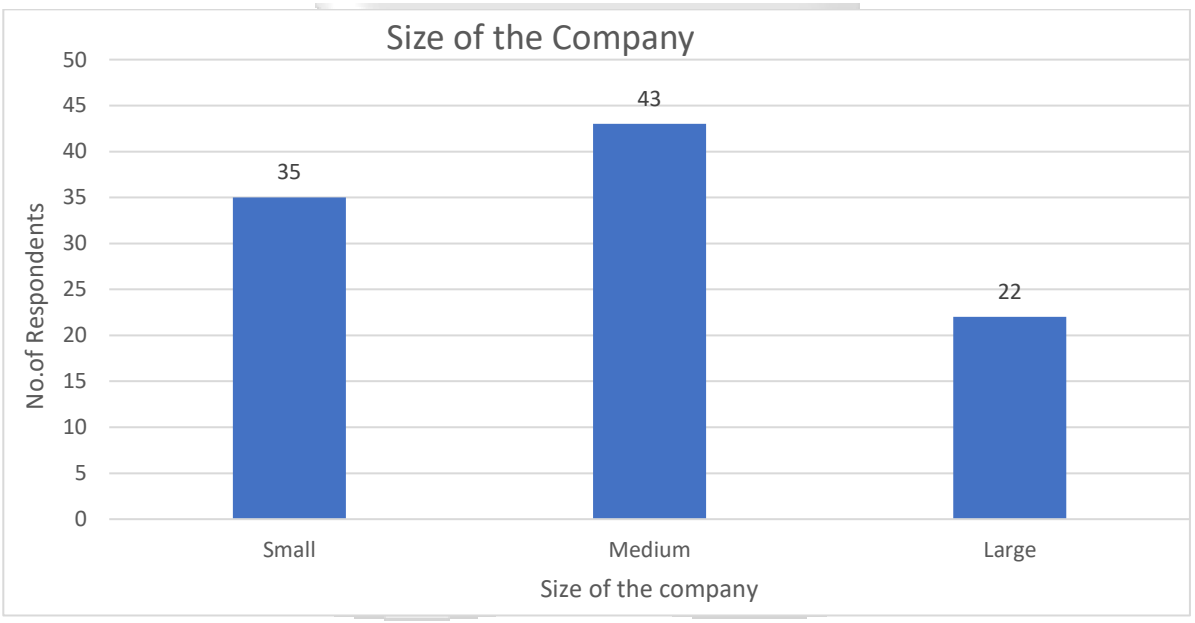

Figure 4.4: Size of the Company

4.4 Descriptive Statistics

4.4.1 Sustainable material sourcing and business performance.

Table 4.7 presents the findings on the sustainable material sourcing currently implemented by manufacturing firms in Nairobi that influences their business performance. Each statement was evaluated across a Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree with a mean Likert score indicating the distribution of responses for the statement.

Table 4.6 How sustainable material sourcing currently implemented by manufacturing firms in Nairobi, which influences their business performance

Statement	*Number of Respondents*	*Mean Likert Score*	*Standard Deviation*
Our company prioritizes sourcing materials from renewable or sustainable sources.	*100*	*1.97*	*0.31*
Sustainable material sourcing has positively impacted our operational costs.	*100*	*2.44*	*0.56*
We have adopted specific innovative methods or technologies to improve sustainable material sourcing (e.g., blockchain for supply chain transparency).	*100*	*3.81*	*0.29*
Our company collaborates with suppliers to enhance the sustainability of sourced materials.	*100*	*3.02*	*0.26*
Overall	*100*	*2.81*	*0.375*

Source: Researcher (2025)

The descriptive statistics for the influence of sustainable manufacturing practices on business performance, as outlined in Table 4.7, reveal a range of perceptions among respondents. Specifically, the statement "Our company prioritizes sourcing materials from renewable or sustainable sources" had a low mean score of 1.97 with a standard deviation of 0.31, indicating that the majority of respondents strongly disagreed with this claim, suggesting limited adoption of environmentally preferred sourcing practices.

Similarly, the statement "Sustainable material sourcing has positively impacted our operational costs" received a relatively low mean of 2.44 and a higher standard deviation of 0.56, which points to a general disagreement with greater variability in responses. This implies that while some firms may have observed cost benefits, many have yet to experience or recognize tangible financial advantages from these practices.

In contrast, the statement "We have adopted specific innovative methods or technologies to improve sustainable material sourcing (e.g., blockchain for supply chain transparency)" had a high mean score of 3.81 and a low standard deviation of 0.29, indicating that respondents

generally agreed with this statement and showed strong consensus on the adoption of such technologies. This suggests that despite lower emphasis on renewable sourcing or cost impact, there is a significant move toward incorporating innovative solutions for transparency and efficiency in material sourcing.

Lastly, the statement "Our company collaborates with suppliers to enhance the sustainability of sourced materials" achieved a mean of 3.02 and a standard deviation of 0.26, reflecting moderate agreement with low variability, pointing to consistent and modest levels of supplier collaboration across firms. Overall, these results highlight that while some elements of sustainable sourcing particularly innovation and collaboration are gaining traction, others, such as prioritizing renewable materials and realizing cost savings, are less commonly practiced or observed.

The overall mean score of 2.81 indicates that respondents were generally neutral to slightly agreeable regarding the implementation and impact of sustainable material sourcing on business performance. This suggests that while some practices are in place, widespread adoption remains moderate. The low pooled standard deviation of approximately 0.375 reflects minimal variation in responses, implying a consistent perception among manufacturing firms. Notably, while innovative sourcing technologies appear more widely adopted, practices like prioritising renewable materials and recognising cost benefits are less prominent, highlighting areas for improvement.

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4.4.2 Waste reduction and business performance.

Table 4.8 presents the findings of how waste reduction is currently implemented by manufacturing firms in Nairobi influences their business performance. Each statement was evaluated across a Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree, with a mean Likert score indicating the distribution of responses for the statement.

Table 4.7: How waste reduction is currently implemented by manufacturing firms in Nairobi influences their business performance.

Statement	***Number of Respondents***	***Mean Likert Score***	***Standard Deviation***
Our company has implemented measures to reduce waste during the manufacturing process.	*100*	*2.39*	*0.29*
Waste reduction practices have improved the overall efficiency of our operations.	*100*	*3.23*	*0.43*
We have adopted advanced technologies (e.g., IoT sensors or AI) to track and minimize waste.	*100*	*2.34*	*0.22*
Overall	*100*	*2.65*	*0.33*

Source: Researcher (2025)

The descriptive statistics in Table 4.8 highlight a range of perceptions regarding how waste reduction is implemented by manufacturing firms in Nairobi and its influence on business performance. The statement "Our company has implemented measures to reduce waste during the manufacturing process" recorded a mean score of 2.39 with a standard deviation of 0.29, suggesting that respondents generally disagreed or were neutral, indicating that many firms may not have fully embraced basic waste reduction measures. In contrast, the statement "Waste reduction practices have improved the overall efficiency of our operations" had a higher mean of 3.23 (SD = 0.43), pointing to a general agreement that waste reduction can contribute positively to operational efficiency, although responses showed moderate variability, reflecting differing experiences or levels of implementation across firms.

The statement "We have adopted advanced technologies (e.g., IoT sensors or AI) to track and minimize waste" had a lower mean of 2.34 with a standard deviation of 0.22, indicating that the use of technology-driven waste tracking solutions is limited among the surveyed firms, and responses were fairly consistent. These findings suggest that while some firms recognize the benefits of waste reduction, the adoption of both basic and advanced waste management practices remains limited. There appears to be an opportunity for broader implementation and investment in modern waste tracking technologies to enhance operational efficiency and sustainability performance.

The overall mean score of 2.65 indicates that, on average, respondents were neutral to slightly disagreeing about the implementation and impact of waste reduction practices within their firms. This suggests that while some waste reduction measures may be in place, their adoption or perceived effectiveness is moderate and not widespread across all firms. The pooled standard deviation of approximately 0.33 reflects low variability in responses, indicating a relatively consistent perception among respondents. Most firms appear to share similar views on the status of their waste reduction efforts.

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4.4.3 Energy efficiency and business performance.

Table 4.9 presents the findings on how energy efficiency is currently implemented by manufacturing firms in Nairobi influences their business performance. Each statement was evaluated across a Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree with a mean Likert score indicating the distribution of responses for the statement.

Table 4.8: How energy efficiency is currently implemented by manufacturing firms in Nairobi influences their business performance.

Statement	***Number of Respondents***	***Mean Likert Score***	***Standard Deviation***
We actively invest in energy-efficient technologies to optimize production processes.	*100*	*3.09*	*0.21*
Energy-efficient practices have contributed to cost savings and profitability.	*100*	*2.30*	*0.39*
Our company has adopted renewable energy solutions (e.g., solar panels, wind turbines) as part of its energy efficiency strategy.	*100*	*2.41*	*0.34*
Overall	*100*	*2.60*	*0.32*

Source: Researcher (2025)

The descriptive statistics for how energy efficiency is currently implemented by manufacturing firms in Nairobi and its influence on business performance, presented in Table 4.9, reveal a diverse range of responses, highlighting different perspectives and levels of adoption of energy-efficient practices among firms.

For the statement "We actively invest in energy-efficient technologies to optimize production processes," the mean score of 3.09 with a standard deviation of 0.21 suggests a moderate agreement with the idea that firms are making efforts to invest in energy-efficient technologies. The relatively low standard deviation indicates that there is minimal variability in responses, suggesting that most respondents acknowledge some degree of investment in energy-efficient technologies. However, while firms recognize the importance of such investments, the moderate mean score suggests that these efforts may not be widespread or deeply ingrained across all firms in the sector.

In contrast, the statement "Energy-efficient practices have contributed to cost savings and profitability" scored a mean of 2.30 with a standard deviation of 0.39, showing a general disagreement with the idea that energy-efficient practices have significantly contributed to cost savings and profitability. This score reflects a perception that, while energy-efficient practices may be implemented, they have not yet had a substantial financial impact. The higher standard deviation indicates some variability in the responses, suggesting that while most respondents disagree with the statement, a few may have seen benefits from these practices, although they appear to be in the minority.

For the statement "Our company has adopted renewable energy solutions (e.g., solar panels, wind turbines)," the mean score of 2.41 with a standard deviation of 0.34 indicates a mild disagreement with the adoption of renewable energy solutions. This suggests that, while some firms may be incorporating renewable energy sources into their operations, the adoption is not widespread. The relatively low mean score shows that renewable energy solutions are not yet a dominant part of the manufacturing sector in Nairobi, and the mild disagreement suggests that barriers or hesitations are preventing broader adoption. The standard deviation, though not very high, indicates some degree of variability in how firms perceive their renewable energy adoption.

The overall mean score of 2.60 indicates that respondents were generally neutral to slightly disagreeing about the implementation and impact of energy efficiency practices within their firms. This suggests that while some efforts may exist, energy efficiency is not yet a strong or widespread focus among most manufacturing firms in Nairobi. The pooled standard deviation of approximately 0.32 reflects low variability in responses, implying that firms have a fairly consistent perception regarding their energy efficiency practices.

4.4.4 Lean manufacturing and business performance.

Table 4.10 presents the findings on how lean manufacturing is currently implemented by manufacturing firms in Nairobi influences their business performance. Each statement was evaluated across a Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree with a mean Likert score indicating the distribution of responses for the statement.

Table 4.9: How lean manufacturing is currently implemented by manufacturing firms in Nairobi influences their business performance.

Statement	***Number of Respondents***	***Mean Likert Score***	***Standard Deviation***
Lean manufacturing techniques are a core part of our operations.	*100*	*2.31*	*0.23*
Lean manufacturing practices have enhanced the quality of our products and services.	*100*	*3.15*	*0.28*
We have adopted automation or robotic solutions to support lean manufacturing practices.	*100*	*3.04*	*0.39*
Overall	*100*	*2.83*	*0.48*

Source: Researcher (2025)

The descriptive statistics for the how lean manufacturing is currently implemented by manufacturing firms in Nairobi influences their business performance presented in Table 4.10, show varied responses. For the statement "Lean manufacturing techniques are a core part of our operations," the mean score of 2.31, with a standard deviation of 0.23, suggests a general disagreement with the idea that lean manufacturing techniques are fully integrated into the operations of the firms. This indicates that lean practices may not be deeply embedded in the day-to-day functioning of these companies, or that their implementation is still in the early stages or not prioritized. The low standard deviation indicates a relatively consistent view among respondents on this matter, with most agreeing that lean techniques are not a core part of their operations.

Regarding the statement "Lean manufacturing practices have enhanced the quality of our products and services," the mean score of 3.15, along with a standard deviation of 0.28, reveals moderate agreement that lean manufacturing practices have positively impacted the quality of products and services. Respondents generally acknowledge some improvements in quality due to the adoption of lean practices, although the level of impact varies across different firms. The relatively low standard deviation suggests that most respondents share a

similar view on this matter, though there is still some variability in the extent to which lean practices have enhanced quality.

On the statement "We have adopted automation or robotic solutions to support lean manufacturing," the mean score of 3.04, with a standard deviation of 0.39, indicates agreement with the idea that automation or robotic solutions are being adopted to support lean manufacturing. This suggests that while not all firms have fully implemented automation, many see it as a valuable tool for enhancing lean practices. The higher standard deviation reflects more varied opinions, implying that some firms have made greater strides in adopting automation, while others may still be in the early stages or have not adopted these technologies at all.

The overall mean of 2.83 suggests that, on average, respondents are between "Disagree" and "Neutral" on the statements regarding how lean manufacturing is implemented in their firms. The overall standard deviation of 0.48 indicates a moderate variation in the responses, showing some diversity in opinions on the extent to which lean manufacturing influences business performance in the firms surveyed.

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4.5 Diagnostic Tests

This section contains the results of the heteroskedasticity test and multicollinearity test.

4.5.1 Heteroscedasticity Test

The Modified Wald test produced a chi-square value of 9300.31 with a p-value of 0.629. The p-value of 0.629 is much greater than the 1% significance level (0.01). A p-value greater than the significance level indicates that there is no heteroscedasticity thus, there is no evidence of heteroscedasticity. This suggests that the variance of the errors is constant across observations. Thus, based on this explanation, there is no heteroscedasticity in the model.

4.5.2 Multicollinearity Test

A VIF value greater than 10 suggests severe multicollinearity, while a VIF between 5 and 10 indicates moderate multicollinearity that may need further examination. A VIF below 5 was generally considered acceptable. Table 4.11 shows the VIF results

Table 4.10: Variance Inflation Factor (VIF) Results

Predictor Variable	***VIF***	***Interpretation***
Sustainable Material Sourcing	*2.99*	*No Multicollinearity*
Waste Reduction	*2.12*	*No Multicollinearity*
Energy Efficiency	*2.58*	*No Multicollinearity*
Lean Manufacturing	*2.84*	*No Multicollinearity*

Source: Researcher (2025)

Since all VIF values are below 5, the results confirm that multicollinearity was not a concern in the dataset. Consequently, the assumption of non-multicollinearity in regression analysis was upheld, ensuring the reliability of coefficient estimates in the model.

4.6 Correlation Analysis

The correlation analysis was undertaken for the study to determine on whether the independent variables (Sustainable Material Sourcing, Waste Reduction, Energy Efficiency and Lean Manufacturing) had a correlation relationship with the business performance of manufacturing firms in Nairobi. The results are presented in Table 4.12 below.

Table 4.11: Correlation Analysis

		Sustainable Material Sourcing	**Waste Reduction**	**Energy Efficiency**	**Lean Manufacturing**
Business Performance	Pearson Correlation	.832**	.810**	.841**	.891**
	Sig.(2-tailed)	.000	.000	.000	.000
	N	100	100	100	100

($p < 0.001$)

The results in the table 4.12 indicate that all four factors (Sustainable Material Sourcing, Waste Reduction, Energy Efficiency, and Lean Manufacturing show a strong positive correlation with Business Performance.

Sustainable Material Sourcing and Business Performance (0.832): The Pearson correlation coefficient of 0.832 between Sustainable Material Sourcing and Business Performance suggests a strong positive relationship. This indicates that as companies increase their efforts in sourcing sustainable materials, their overall business performance improves.

Waste Reduction and Business Performance (0.810): A Pearson correlation coefficient of 0.810 between Waste Reduction and Business Performance also reflects a strong positive relationship. Companies that focus on reducing waste, such as through better resource management, waste recycling, or more efficient production processes, tend to see improvements in their business performance.

Energy Efficiency and Business Performance (0.841): The correlation of 0.841 between Energy Efficiency and Business Performance indicates a very strong positive relationship. Companies that prioritise energy-efficient practices, such as using less energy-intensive

machinery, optimizing production processes, or investing in renewable energy, are likely to experience better business performance.

Lean Manufacturing and Business Performance (0.891): The Pearson correlation of 0.891 between Lean Manufacturing and Business Performance represents the strongest positive correlation among the four factors. Lean manufacturing focuses on minimizing waste while maximizing efficiency, often through practices like process optimization, continuous improvement, and streamlining operations.

The correlation analysis suggests that each of the factors (Sustainable Material Sourcing, Waste Reduction, Energy Efficiency, and Lean Manufacturing) has a strong and statistically significant positive relationship with Business Performance. This implies that companies focusing on these factors are likely to see better business performance outcomes.

4.7 Binary Logit Regression Analysis

4.7.1 Model Fitness Test Findings

The R-squared findings, as per Table 4.13, indicated that the regression model's Nagelkerke R Square goodness test result of 69.7 %, which meant that the regression model was able to influence up to 69.7 % of the variance in in manufacturing firms' business performance in Nairobi (Hair et al., 2014).

Table 4.12: R Square Test

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
528.722a	0.198	0.697

The Hosmer and Lemeshow test were carried out as an additional test of model fitness, as presented in Table 4.14

Table 4.13: Hosmer & Lemeshow Test

Chi-square	Df	Sig.
10.139	4	.614

The null hypothesis for the Hosmer & Lemeshow Test was that the model's predictions fit perfectly with observed group memberships. Table 4.14 indicated that the p-value Hosmer &

Lemeshow test was 0.614 which was higher than the 0.05 level, and hence, the model fit was acceptable (Hair et al., 2014).

4.7.2 Regression

The goodness-of-fit tests were used to confirm the model's goodness of fit. The researcher applied the Pearson and Deviance Chi-square tests presented in Table 4.15.

Table 4.14: Pearson and Deviance Chi-square tests of Independence

Factor	Pearsons χ2 Value	Df	P Value
Sustainable Material Sourcing	212.117	4	0.006
Waste Reduction	114.531	3	0.004
Energy Efficiency	118.123	3	0.008
Lean Manufacturing	121.112	3	0.000

Source: Researcher (2024)

The findings show that financial sustainability was dependent on all four factors of sustainable material sourcing, waste reduction, energy efficiency and lean manufacturing at 5% significance levels. The proportionate odds assumptions made by the data were put to the test using the parallel lines test shown in Table 4.16. This was done to ensure that the model didn't go against the proportional odds assumption.

Table 4.15: Test of Paralleled lines

Factor	Model	-2 Log Likelihood	Chi-Square	df	sig
Sustainable Material Sourcing*Business Performance	Null Hypothesis	91.310			
	General	8.690	4.173	4	0.169
Waste Reduction*Business Performance	Null Hypothesis	53.416			
	General	46.584	3.510	3	0.236
Energy Efficiency*Business Performance	Null Hypothesis	64.164			
	General	35.836	2.881	3	0.184
Lean Manufacturing *Business Performance	Null Hypothesis	69.620			
	General	30.380	3.441	3	0.182

Link Function: Logit
Source: Researcher (2024)

The analysis in Table 4.16 shows that the variables did not go against the proportional odds assumption since they were not statistically significant (all were above 0.05), which allowed the interpretation of the parameter estimates. Further, the determination measures were established using the Nagelkerke Pseudo-R Square, presented in Table 4.17.

Table 4.16: Measures of Determination

Model	NagelKerke R^2	Cox and Snell R^2	McFadden R^2
Sustainable Material Sourcing*Business Performance	0.194	0.129	0.084
Waste Reduction*Business Performance	0.172	0.139	0.118
Energy Efficiency*Business Performance	0.184	0.093	0.049
Lean Manufacturing *Business Performance	0.147	0.053	0.026

Link Function: Logit
Source: Researcher (2024)

The pseudo-R square findings show that 19.4% of business performance was determined by sustainable material sourcing, 17.2% by waste reduction, 18.4% by energy efficiency, 14.7% b lean manufacturing. Table 4.18 shows the parameter estimates.

Table 4.17: Parameter Estimates

Step 1[a]	Estimate	Std. Error	Wald	df	Sig	95%CI Lower	Upper
Constant	0.261	0.061	37.110	1	0.590	0.314	0.904
Sustainable Material Sourcing	0.510	0.091	5.510	1	0.010	0.720	1.490
Waste Reduction	0.480	0.230	6.012	1	0.012	1.670	2.502
Energy Efficiency	0.440	0.126	4.590	1	0.006	0.402	1.204
Lean Manufacturing	0.520	0.103	3.910	1	0.013	0.321	1.122

Link Function: Logit
Source: Researcher (2024)

Substituted coefficient estimates in the equation:

$$LN (P / 1 - P) = 0.261 + 0.510SMS + 0.480WR + 0.440EE + 0.520LM + e \ldots\ldots\ldots\ldots\ldots\ldots (i)$$

The constant (intercept) in Table 4.18 has an estimate of 0.261, with a standard error of 0.061, and a Wald statistic of 37.110. The p-value of 0.590 indicates that the constant is not

statistically significant at the significance level $p > 0.05$. The 95% confidence interval for the constant is between 0.314 and 0.904. Since the p-value is above the threshold of 0.05, it does not have a meaningful effect on business performance in the model. The constant represents the log odds of business performance when all predictor variables (Sustainable Material Sourcing, Waste Reduction, Energy Efficiency, and Lean Manufacturing) are set to zero.As per Table 4.18, the sustainable material sourcing had a coefficient of 0.510 which lies within the lower bound 0.720 and upper bound of 1.490. This implied that sustainable material sourcing had a significant positive effect on the business performance of manufacturing firms in Nairobi (p-value = 0.010). Further, for every unit increase in sustainable material sourcing, there was a predicted increase of 0.620 in the log odds of business performance of manufacturing firms in Nairobi.

The coefficient for waste reduction was 0.480 which lies within the lower bound of 1.670 and upper bounds of 2.502, with a p-value = 0.012, indicating a significant positive impact on business performance. Suggesting that as waste reduction efforts increase, the log odds of business performance increase by 0.480 for each unit of increase in waste reduction.

The coefficient for energy efficiency was 0.440, which lies within the lower bound of 0.402 and upper bound of 1.204, with a p-value = 0.006, indicating a statistically significant positive effect on business performance. meaning that for each unit increase in energy efficiency, the business performance of manufacturing firms in Nairobi is expected to increase by 0.440 in log odds.

The coefficient for lean manufacturing was 0.520, which lies within the lower bound of 0.321 and upper bound of 1.122, with a p-value = 0.013, indicating that lean manufacturing practices significantly positively affect business performance. Suggesting that a unit increase in lean manufacturing results in an increase of 0.520 in the log odds of business performance.

Each of the independent variable (sustainable material sourcing, waste reduction, energy efficiency, and lean manufacturing) has a positive and statistically significant effect on the business performance of manufacturing firms in Nairobi. The coefficients show that for each unit increase in these practices, the business performance is expected to improve, with the log odds increasing by the respective coefficients.

CHAPTER FIVE: DISCUSSIONS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter contains the summary of findings, the study's discussion, conclusion, and recommendations, presented according to the study objectives.

5.2 Summary of Findings

The study aimed to investigate the impact of sustainable manufacturing practices on the business performance of manufacturing firms in Nairobi, Kenya, specifically focusing on firms regulated by the Kenya Association of Manufacturers (KAM). The questionnaires were responded to by 100 respondents, representing a 73.53% response rate. This rate of response is normally acceptable for survey-based studies because it falls within the standard range for the response rates for comparable studies (Akesson et al., 2020). In comparison, the response rates for surveys on the manufacturing industry generally range from 50% to 80%, with the higher rates corresponding to more interested respondents or smaller, more accessible target populations (Edwards et al., 2017). Relative to similar surveys by Sheehan (2010) and Wu, Zhao, & Fils-Aime (2022).

Demographic data indicated that the sample was heterogeneous in terms of representing different managerial levels, firm sizes, and years of operation (Mastella et al., 2021). More specifically, the sample reflected different levels of managers (e.g., managers, employees and supervisors) from different-sized firms, 43 of the manufacturing firms were with 50-249 employees, 35 were small with less than 50 employees and 22 were large with 250+ employees (Han & Tomaskovic-Devey, 2025). Also, firms covered under the study had been operating for varying lengths of time, stretching from 30 manufacturing firms between 5-10years in operation, 28 manufacturing firms have between 11-15years in operation, 24 manufacturing firms have less than 5 years in operation (Arellano-Bover, 2024). The breadth allows for a comprehensive understanding of the implications of sustainable manufacturing practices on business performance across companies with different profiles (Cumming & Leung, 2021).

The correlation analysis suggests that each of the factors (Sustainable Material Sourcing, Waste Reduction, Energy Efficiency, and Lean Manufacturing) has a strong and statistically

significant positive relationship with Business Performance. This implies that companies focusing on these factors are likely to see better business performance outcomes.

The binary logit regression analysis confirmed that all independent variables (Sustainable Material Sourcing, Waste Reduction, Energy Efficiency, and Lean Manufacturing) were statistically significant predictors of business performance. The R-squared findings indicated that the regression model's Nagelkerke R Square goodness test result of 69.7 %, which meant that the regression model was able to influence up to 69.7 % of the variance in the manufacturing firms business performance. The pseudo-R-squared findings show that 19.4% of business performance was determined by sustainable material sourcing, 17.2% by waste reduction, 18.4% by energy efficiency, and 14.7% by lean manufacturing. These results are similar to the findings of Pramana & Murdyani (2023) and Rahayu et al., (2025).

5.3 Discussions

5.3.1 Sustainable material sourcing and business performance.

Sustainable material sourcing has a significant and positive influence on the business performance of manufacturing firms in Nairobi. As firms increase their efforts in sourcing sustainable materials, their business performance improves. This improvement is likely attributed to reduced environmental impact, better resource management, and an enhanced brand reputation.

This finding aligns with the empirical findings of Khan et al. (2023) the results indicated a positive correlation between green capabilities and purchasing habits; however, green innovation capabilities did not establish a statistically meaningful correlation. Additionally, green buying strategies have significant favorable associations with the triple bottom line of performance. The results contributed to the advancement of the resource-based-view theory by empirically examining the impact of green capabilities and green purchasing practices in influencing the triple-bottom-line performance of manufacturing firms.

Further, the findings of the study align with the findings of Wako & Lambaino (2024). The study findings show that sustainable material sourcing has a positive and significant effect on the performance of cement manufacturing firms in Kenya. In addition, the study established that green specification has a positive and significant effect on the performance of cement manufacturing firms in Kenya.

Further, the findings of the study align with the findings of Thiga (2025) the study found that there is a correlation of 0.701 between green material sourcing and the success of Kenyan food and beverage manufacturing companies. Green material sourcing accounted for 48.7% of the variation in the performance of food and beverage manufacturing firms in Kenya.

Additionally, the findings of this study also support the Resource-Based Theory (RBT) that firms gain competitive advantage by strategically deploying and acquiring valuable, rare, inimitable, and non-substitutable resources. In this instance, sustainable manufacturing competencies such as incorporating clean technologies, employee expertise on sustainable operation, and efficient use of resources can be considered strategic resources that yield long-run performance enhancements. Companies that optimize these resources more effectively are best placed to innovate, respond to changes in markets, and maintain competitive edges over time (Turing, 2021).

5.3.2 Waste reduction and business performance.

Waste reduction has a significant and positive influence on the business performance of manufacturing firms in Nairobi. Companies that implement effective waste reduction practices, such as efficient resource management, recycling, and streamlined production processes, experience improved business outcomes. Waste reduction not only leads to cost savings but also enhances operational efficiency and supports sustainability goals.

This finding aligns with the empirical findings of Famiyeh *et al.* (2018) findings revealed that waste management practices are essential for improving operational efficiency and financial performance.

Additionally, the findings of the study align with the findings of İncekara (2022) results demonstrate that process reengineering and waste management influence business performance in manufacturing SMES across Europe and the USA. Moreover, customer demands and competition with rivals are two primary reasons for adopting waste management practices.

Further, the findings of the study align with the findings of Ochiri et al. (2015), findings confirmed that returns and wastes were high in the publishing industry, in addition to establishing that indeed adopting waste reduction would enhance the performance of publishing forms.

Lastly, the findings of the support the findings on waste reduction align with Institutional Theory and Resource-Based Theory (RBT) in the context of sustainable manufacturing.

Waste reduction practices, such as efficient resource management and recycling, reflect the firm's response to external pressures like industry norms and societal expectations. By adopting these practices, manufacturing firms gain legitimacy and improve business performance, supporting the idea that organizations conform to institutional pressures to achieve sustainability goals. From an RBT perspective, waste reduction enhances a firm's operational efficiency and cost savings, which are valuable resources that contribute to a sustainable competitive advantage. By optimizing resources, firms gain an edge over competitors, improving their overall performance.

5.3.3 Energy efficiency and business performance.

Energy efficiency has a significant and positive influence on the business performance of manufacturing firms in Nairobi. Manufacturing firms that prioritize energy-efficient practices, such as using less energy-intensive equipment and optimizing production processes, significantly improves business performance. These companies enjoy reduced operational costs, improved financial performance, and enhanced brand image.

This finding aligns with the findings of Li et al., (2021) results indicate that low-carbon technological innovation significantly and positively affects the enterprise performance of manufacturing. Green core competence plays a mediating role in the positive effect of low-carbon technological innovation on enterprise performance.

This finding aligns with the findings of Macharia et al. (2022) findings further reveal that exporting status, research and development, top managers' experience and female ownership enhance energy efficiency. The effect of these variables is, however, heterogeneous by sub-sector and energy form. Labour productivity negatively influences electricity, fuel and total energy efficiency, while the effect of firm age and size is ambiguous.

This finding aligns with the findings of Kakai & Ndeke (2024) found out that SMEs largely adopted the use of energy-efficient bulbs and turned off lights when not in use. However, they used solar lighting as an energy efficiency practice to a lesser extent because they consider this practice expensive. The study also found that stakeholders perceived that energy efficiency practices adopted had a significant influence on the economic performance of selected manufacturing SMEs.

The findings on energy efficiency support Institutional Theory and Resource-Based Theory (RBT). Energy-efficient practices, such as using less energy-intensive equipment, align firms

with external pressures like environmental regulations and societal expectations. This alignment enhances brand image and helps firms gain legitimacy, improving business performance. Energy efficiency reduces operational costs and enhances financial performance, serving as a valuable internal resource that contributes to a competitive advantage, supporting long-term business success. Energy efficiency improves business performance by meeting external pressures and optimizing internal resources, aligning with both Institutional Theory and RBT.

5.3.4 Lean manufacturing and business performance.

The study concluded that lean manufacturing has a significant and positive influence on the business performance of manufacturing firms in Nairobi. Lean manufacturing focuses on minimizing waste while maximising efficiency through techniques like process optimization and continuous improvement. Firms that implement lean principles are likely to experience substantial cost savings, improved productivity, and the ability to quickly adapt to market demands. This, in turn, leads to enhanced output, reduced costs, and greater customer satisfaction.

This finding aligns with the findings of Li et al., (2021) indicate that low-carbon technological innovation significantly and positively affects the enterprise performance of manufacturing. Green core competence plays a mediating role in the positive effect of low-carbon technological innovation on enterprise performance.

This finding aligns with the findings of Macharia et al. (2022) reveal that exporting status, research and development, top managers' experience and female ownership enhance energy efficiency. The effect of these variables is, however, heterogeneous by sub-sector and energy form. Labour productivity negatively influences electricity, fuel and total energy efficiency, while the effect of firm age and size is ambiguous.

Further, this finding aligns with the empirical findings of Kakai & Ndeke (2024) found out that SMEs largely adopted the use of energy-efficient bulbs and turned off lights when not in use. However, they used solar lighting as an energy efficiency practice to a lesser extent because they consider this practice expensive. The study also found that stakeholders perceived that energy efficiency practices adopted had a significant influence on the economic performance of selected manufacturing SMEs.

The findings on lean manufacturing support Institutional Theory and Resource-Based Theory (RBT). Lean manufacturing helps firms align with external pressures for efficiency and

sustainability, enhancing reputation and legitimacy, which improves business performance. Lean principles create valuable internal resources, such as process optimisation and continuous improvement, that lead to cost savings, improved productivity, and a competitive advantage, driving superior performance. Lean manufacturing enhances business performance by meeting external pressures and leveraging internal resources, supporting both Institutional Theory and RBT.

5.4 Conclusion

The conclusions of the study were made in line with the study objectives:

The study concluded that sustainable material sourcing has a significant and positive influence on the business performance of manufacturing firms in Nairobi. As firms increase their efforts in sourcing sustainable materials, their business performance improves. This improvement is likely attributed to reduced environmental impact, better resource management, and an enhanced brand reputation.

The study concluded that waste reduction has a significant and positive influence on the business performance of manufacturing firms in Nairobi. Companies that implement effective waste reduction practices, such as efficient resource management, recycling, and streamlined production processes, experience improved business outcomes. Waste reduction not only leads to cost savings but also enhances operational efficiency and supports sustainability goals.

The study concluded that energy efficiency has a significant and positive influence on the business performance of manufacturing firms in Nairobi. Manufacturing firms that prioritize energy-efficient practices, such as using less energy-intensive equipment and optimizing production processes, see significant improvements in business performance. These companies enjoy reduced operational costs, improved financial performance, and enhanced brand image.

The study concluded that lean manufacturing has a significant and positive influence on the business performance of manufacturing firms in Nairobi. Lean manufacturing focuses on minimizing waste while maximising efficiency through techniques like process optimization and continuous improvement. Firms that implement lean principles are likely to experience substantial cost savings, improved productivity, and the ability to quickly adapt to market demands. This, in turn, leads to enhanced output, reduced costs, and greater customer satisfaction.

The results from this analysis indicate that sustainable material sourcing, waste reduction, energy efficiency, and lean manufacturing all contribute positively and significantly to the business performance of manufacturing firms in Nairobi. Firms that focus on these areas are likely to see improvements in efficiency, profitability, and sustainability. Moreover, these factors not only help enhance operational performance but also position companies to better meet market demands, improve customer loyalty, and strengthen their competitive advantage, ensuring long-term success in the industry.

5.5 Limitations of the Study

However, the study is not without limitations. This study was limited to manufacturing firms in Nairobi County in Kenya, and this may restrict the generalizability of the findings. Firms in other regions may have contrasting environmental, infrastructural, and regulatory concerns impacting both sustainability practices and firm performance differently. Additionally, the research targeted firms regulated by the Kenya Association of Manufacturers (KAM), hence excluding informal or unregistered manufacturers and potentially missing out on the dynamics of those SMEs that operate outside formal regulatory frameworks. This targeting may lower the generalizability of the results to the broader manufacturing sector in Kenya.

Further, the study employed a descriptive study design, collecting data for only one month. This does not allow for observing changes over time or long-term impacts of sustainable strategies on performance, which limits the potential for making causal inferences. Additionally, the study was solely quantitative in approach, which, while helpful in revealing trends and statistical relationships, might have missed more in-depth contextual data. Adding qualitative data (focus groups or interviews) would have provided deeper insight into firm-level motivations, internal barriers, and strategic decision-making.

Lastly, though the study draws on Institutional Theory and Resource-Based Theory (RBT) to guide its investigation, it applies the theories largely in a descriptive manner without critically evaluating their full applicability to the Kenyan manufacturing industry. Institutional Theory, by emphasising the role of exogenous norms and regulations, may not be fully sufficient in explaining internal strategic decisions or informal pressures influencing sustainability adoption in resource-poor settings.

Resource-Based Theory (RBT) assumes that firms have the potential to develop and leverage distinctive and inimitable resources, but most Kenyan manufacturing firms especially small ones may not have access to such strategic resources, and thus the theory may have low

explanatory power in this context. This study does not mention potential interactions between the two theories or consider other relevant theories, such as stakeholder theory or dynamic capabilities theory, that can offer alternative insights into the sustainability performance link.

5.6 Recommendation

5.6.1 Policy Recommendations

This study recommends that the Kenya Association of Manufacturers (KAM) and the Government of Kenya should enhance incentives for sustainable manufacturing through improved targeted incentives and more effective incentives. These include tax rebates, grants, and technical support programs, which are significant in reversing the high initial cost of implementing sustainable manufacturing practices. In the case of Kenya, the majority of manufacturing companies are small and medium enterprises that are struggling financially and cannot afford to raise the capital needed to invest in clean energy technologies, waste management equipment, and other green technologies. Tax credits and grants can reduce the threshold costs, making it economically feasible for firms to adopt green solutions that would otherwise be financially prohibitive. Apart from financial incentives, technical support programs may also provide businesses with important tips on how to transition to sustainable manufacturing practices.

Additionally, this study recommends strengthening regulatory systems to create a predictable and stable policy environment. Transparent, enforceable, and transparent sustainable regulations will reduce uncertainty among producers, foster long-term investment and planning for sustainable activities, and minimize degradation of the environment. Harmonization of the rules with local and global sustainability plans, such as Kenya's Vision 2030 and the UN Sustainable Development Goals, will enhance compliance and enable businesses to operate sustainably and remain competitive.

Finally, this study recommends better cooperation between the public and private sectors is crucial. Shared platforms with the government, KAM, sectoral bodies, and manufacturers can facilitate the sharing of best practices, resources, and innovations and accelerate the adoption of green approaches in sectors. Synergized programs can better provide access to green funds, develop industry-specific sustainability standards, and transform innovation centers to develop localized solutions that fit the Kenyan industrial context.

5.6.2 Recommendation for Theory

This study recommended more research on Institutional Theory and sustainable manufacturing practices from the perspective of developing economies like Kenya using Longitudinal data from secondary sources. In doing so, scholars can understand and know how external pressure, i.e., government policy and international environmental norms, influences organizational response in the manufacturing industry over a long period of time.

In addition, this study recommended that the use of Resource-Based Theory (RBT) should be extended to study how firms can leverage internal resources such as technological innovation and organizational capabilities to achieve a competitive advantage through sustainability practices. Finally, the study suggests the integration of both Institutional Theory and Resource-Based Theory to analyze the combined influence of external institutional pressure and internal resources management on sustainable practice implementation and company performance.

Integrating Institutional Theory and Resource-Based Theory (RBT) offers a unified view of the way external pressures and internal resources interact to spur sustainable manufacturing practice. Institutional Theory explains how government policies and worldwide norms influence organizational behavior from outside, while RBT focuses on how internal assets like technology and capabilities enable firms to achieve competitive advantage through sustainability. By integrating these views, researchers can gain a more complete picture of both the why (external drivers) and the how (internal capacity) of sustainable practice uptake.

This integration is especially valuable in emerging economies, where outside pressures and resource limitations may differ from those in developed economies. It gives more information about how firms in these contexts, such as firms in Kenya, respond to sustainability pressures with few resources. The integrated theories provide a richer, context-specific understanding of sustainable practices, with enhanced predictive capability and offering clearer insight into what perpetuates sustainability in manufacturing.

5.6.3 Recommendation for Practice

This study recommends that manufacturing firms in Nairobi invest in state-of-the-art technologies to raise their sustainability levels. Some of them are renewable energy technologies, waste reduction technologies, and automation, which have been found to

enhance operating effectiveness and bottom-line performance. Firms should also make sustainable operations part of their core activities, with a focus on waste minimization, energy conservation, and sustainable procurement of materials. Such an integration not only helps firms meet regulatory and consumer needs but also their ultimate sustainability.

This study recommends a phased adoption of sustainable manufacturing practices, most crucial to companies with limited resources. They can begin by adopting low-cost energy-saving strategies, such as upgrading lighting to LED. Equipment re-optimisation to maximize energy use, before investing in extensive renewable technology or automation. Taking advantage of government incentives or accessing financing packages for green technology might also reduce up-front costs. Moreover, capacity-building is essential since organizational culture with a focus on sustainability is vital to the long-term sustainability of any sustainability program. Through insourcing workers of all levels, corporations can carry out these practices efficiently without committing much upfront capital, but can accomplish it less painfully and sustainably in the long run.

Moreover, the study underscores the necessity for capacity-building exercises and training in sustainability for workers at all levels to enable the successful adoption and implementation of sustainable practices. This would help create a culture of sustainability within the processes cost-effective, but they also comply with regulations and customers' requirements for sustainability.

5.6.4 Recommendations for Further Research

This study recommends that future research should focus on specific aspects when conducting comparative studies, particularly between manufacturing firms that have adopted sustainability practices and those that have not. Key areas for comparison should include financial performance (e.g., profitability, cost savings, return on investment), regulatory compliance (e.g., adherence to environmental regulations, certifications), and customer perception (e.g., brand image, customer loyalty, market share). These factors are critical in evaluating the tangible and intangible benefits of sustainability practices, providing a comprehensive view of their impact.

Further , this study recommends that future research should use longitudinal data (e.g., 5, 8, or 10 years) to assess the sustained effects of sustainability practices on business

performance. Indicators such as reductions in energy costs, waste management efficiency, improvements in product quality, or market positioning can be used to measure sustainability's effectiveness over time. Establishing clear timelines and measurable outcomes will help in understanding the enduring value of sustainable practices and provide actionable insights for firms considering long-term investments in sustainability.

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APPENDICES

APPENDIX I: QUESTIONNAIRE

This questionnaire has been designed to collect information on the effect of sustainability practices on the business performance of manufacturing firms in Nairobi, Kenya. It is a case study of manufacturing firms regulated by the Kenya Association of Manufacturers (KAM) in Nairobi County. Please complete each section as instructed. Do not write your name or any other form of identification on the questionnaire. All the information in this questionnaire was treated in confidence**.** Please tick (√) where applicable

SECTION A: DEMOGRAPHIC INFORMATION

1. What is your position in the company?

- [ ] Manager
- [ ] Supervisor
- [ ] Employee
- [ ] Other (please specify)

2. How many years has your firm been operational?

- [ ] Less than 5 years
- [ ] 5-10 years
- [ ] 11-15 years
- [ ] Over 15 years

3. What is the size of your company?

- [ ] Small (<50 employees)
- [ ] Medium (50-249 employees)
- [ ] Large (250+ employees)

SECTION B: SUSTAINABLE MATERIAL SOURCING

1. Our company prioritizes sourcing materials from renewable or sustainable sources.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

2. Sustainable material sourcing has positively impacted our operational costs.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

3. We have adopted specific innovative methods or technologies to improve sustainable material sourcing (e.g., blockchain for supply chain transparency).

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

4. Our company collaborates with suppliers to enhance the sustainability of sourced materials.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

SECTION C: WASTE REDUCTION

5. Our company has implemented measures to reduce waste during the manufacturing process.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

6. Waste reduction practices have improved the overall efficiency of our operations.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

7. We have adopted advanced technologies (e.g., IoT sensors or AI) to track and minimize waste.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

SECTION C: ENERGY EFFICIENCY

8. We actively invest in energy-efficient technologies to optimize production processes.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

9. Energy-efficient practices have contributed to cost savings and profitability.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

10. Our company has adopted renewable energy solutions (e.g., solar panels, wind turbines) as part of its energy efficiency strategy.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

SECTION D: LEAN MANUFACTURING

11. Lean manufacturing techniques are a core part of our operations.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

12. Lean manufacturing practices have enhanced the quality of our products and services.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

13. We have adopted automation or robotic solutions to support lean manufacturing practices.

[ ] Strongly Disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly Agree

APPENDIX II: SAMPLE SIZE DETERMINATION

Table for Determining Minimum Returned Sample Size for a Given Population Size for Continuous and Categorical Data

Sample size						
Size of Population	**Continuous data (margin of error=.03)**			**Categorical data (margin of error=.05**		
	alpha=0.10 t=1.65	**alpha=0.05 t=1.96**	**alpha=0.01 t=2.58**	**p=0.50 t=1.65**	**p=0.50 t=1.96**	**p=0.50 t=2.58**
100	46	55	68	74	80	87
200	59	75	102	116	132	154
300	65	85	123	143	169	207
400	**69**	**92**	**137**	**162**	**196**	**250**
500	72	96	147	176	218	286
600	73	100	155	187	235	316
700	75	102	161	196	249	341
800	76	104	166	203	260	363
900	76	105	170	209	270	382
1,000	77	106	173	213	278	399
1,500	79	110	183	230	306	461
2,000	83	112	189	239	323	499
4,000	83	119	198	254	351	570
6,000	83	119	209	259	362	598
8,000	83	119	209	262	367	613
10,000	83	119	209	264	370	623

Adapted from *Organizational Research: Determining Appropriate Sample Size in Survey Research* by Barlett, Kotrlik, and Higgins (2001).

APPENDIX III: NACOSTI RESEARCH PERMIT

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **349968**

Date of Issue: **25/February/2025**

RESEARCH LICENSE

This is to Certify that Mr.. Robert Wanyiri Wanjohi 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 Sustainability Initiatives on Business Performance of Manufacturing Firms in Nairobi, Kenya for the period ending : 25/February/2026.

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See overleaf for conditions

APPENDIX IV: SU-ISERC ETHICAL APPROVAL

Strathmore UNIVERSITY

17th February 2025

Mr Wanjohi Robert,
robert.wanyiri@strathmore.edu

Dear Mr Wanjohi,

RE: Effect of Sustainability Initiatives on Business Performance of Manufacturing Firms in Nairobi, Kenya

This is to inform you that SU-ISERC has reviewed and **approved** your above **SU-masters** proposal. Your application reference number is **SU-ISERC2610/25.** The approval period is from **17th February 2025 to 16th February 2026.**

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

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APPENDIX V: DATA COLLECTION SHEET

Manufacturing company name	2020	2021	2022	2023	Growth Rate (%)	Revenue Growth (High or Low)	Comments