Effect of Eco-design Practices on the Performance of Manufacturing Firms in Mombasa County, Kenya

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Abstract

Eco-design is a new approach to products design; it has emerged as a key approach for manufacturing firms seeking to become environmentally sustainable and globally competitive. The purpose of this study was to establish the effect of adoption of Eco-design practices on organizational performance of manufacturing firms in Mombasa County, Kenya. A cross sectional survey research design was adopted for this study. It targeted a population a population of manufacturing firms in Mombasa County listed by Kenya Association of Manufacturers (KAM, 2014). A sample of 65 firms was taken and data was collected using questionnaires. The results obtained indicated that Eco-design practices adoption was at the planning/ implementation stage as most of the manufacturing firms had considered adoption. The study also established that the major challenges of adopting Eco-design practices are Unsuccessful integration of Eco-design, Lack of knowhow in managing changes in design procedures, and Lack of technical knowledge about Eco-design. Lastly the findings show that Eco-design practices have positive influence on organization performance with greatest impact being on environmental impact reduction and financial performance. The study recommends that manufacturing firms should get enough training and empowerment on how to implement Eco-design practices so as to ensure success, reduce fear of failure and encourage environmental sustainability. They should also act fast and implement Eco-design practices since there are potential benefits after implementation such as improvement in environmental impact reduction and financial performance. Lastly the researcher recommends that since government rules and legislations and organization capabilities are the major drivers of adoption of Eco-design practices they should review their policies and allocate more resources to ensure effective adoption and implementation of Eco-design practices. This is because the bedrock of economic and social development in Kenya is the environment; hence environment sustainability should be given first priority.

Key words: Green supply chain management, Life Cycle Analysis, Design for Disassembly, Design for Environment, Design for Recycling

1. Introduction

Some of the challenges facing firms all over the world include global warming, declining natural resources, pollution control and a demand for goods which are environmentally friendly. They are forced to reduce their impact to the environment due to increasing awareness of environmental problems brought about by economic activities (Galdeano, Ce´spedes & Martı´nez, 2008). In order to satisfy these green demands, firms have to come up with innovative products and processes by implementing green technologies, eco-design, and international environmental management systems (Zhu, Sarkis & Lai, 2008; Hsu & Hu, 2011). The main aim of eco-design is the reduction of product environmental impact during a product's life cycle, which is composed of raw materials, production, distribution, use and final destination (Fiksel, 2006).

Although factories create wealth and jobs for urban residents and the country at large, some of them deal in substances that could be dangerous unless properly handled. Mombasa County is the centre of industrial activities in the entire coastal region. It accounts for 90% of the establishment and employment opportunities.

The ecosystem around the coastline receives large quantities of riverine and coastal watershed discharge which include industrial wastes that has impact on the water sediment quality, biodiversity, productivity and system functioning. Coastal and marine resources such as mangrove swamps and coral lagoons are under intense pressure from rapid population growth and industrial pollution from the coast (Mwaguni & Munga, 1997).

1.1 Eco-design

Eco-design is defined as a set of project practices whose aim is at the creation of eco-efficient products and processes; the concept was developed by the World Business Council for Sustainable Development (WBCSD) at the Rio, It is a proactive process which is very detailed and entailing. It influences all the stages of a life cycle of products including: raw material extraction, production, packaging, distribution, use, recovery, and recycling (Jeswiet & Hauschild, 2005). It is a new approach to products design and it involves identifying environmental aspects connected with the product and including them in the design process of product development (Nowosielski, Spilka & Kania, 2007). Karlsson and Luttropp (2006) defined it as a sustainable solutions of products and services changes that reduce negative sustainability and maximize positive sustainability and impacts economic, environmental, social and ethical throughout and beyond the life-cycle a products. Fiskel and Wapman (1994) defined Eco-design as a process which considers design performances with respect to environmental, health and safety over the product and process entire life cycle.

Eco-design is one of the practices of GSCM and is known by other names which includes; design for environment, green design, environmentally conscious design, life cycle design, clean design and sustainable design. It usually takes place early in the product's design so as to ensure that environmental consequences of the product's entire life cycle are well known before manufacturing decisions are made put into action (Gheorghe & Ishii, 2008).

1.2 Organizational Performance

Organizations have begun using new performance measures (non-financial measures) other than traditional financial measures. Antony and Bhattacharyya (2010) suggest that organizational performance needs to be measured along multiple levels: The organizational level, the key process level, and the work unit level, requiring complementary dimensions. This is in line with the findings of Tangen (2003), who indicate that in some instances different performance dimensions may have to be combined to get a balanced and complete view of the real situation. Intangible organizational elements like managerial capabilities, human capital, internal auditing, labor relations, organizational culture, and perceived organizational reputation each influenced organizational financial performance positively hence they also need to be considered (Carmeli & Tischler, 2004).

Environmental Performance can be divided into two, environmental impact reduction which includes and concentrates on reduction of air emission, reduction of waste water, reduction of solid wastes, in addition to decrease of consumption for hazardous/harmful/toxic materials, decrease of frequency for environmental accidents and improve an enterprise's environmental situation (Alvarez, 2001). Environmental cost saving includes and concentrates on positive economic performance, like decrease of cost for materials purchasing, decrease of cost for energy consumption, decrease of fee for waste treatment, decrease of fee for waste discharge, and at the same time trying to eliminate the negative economic performance, such as, increase of investment, increase of operational cost, increase of training cost, increase cost of purchasing environmentally friendly materials (Melnyk, 2002).

It has been argued that producing an environmentally friendly product may create a final product that is safer and less costly, and which has higher, more consistent quality and greater scrap value (Porter & van der Linde 1995; Sarkis, 2001). Operational performance is observed through the increase in amount of goods delivered on time, decreased inventory levels, decreased scrap rate, improved product quality, increased product line, and improved capacity utilization (Min & Gale, 1997). Financial performance is an objective measure of how well a firm can use its assets to generate revenues for itself. It measures financial health of a firm over a given period of time and can be used to compare similar firms (Ashok, 2009). There are different ways which can be used to measure financial performance as indicated by Needles (2011) including; return on investment (ROI), market share growth, sales Growth, return on sales (ROS), return on equity (ROE) and earnings before interest and tax (EBIT).

1.3 Eco-design and Organizational Performance

The systematic integration of environmental issues in the product design process often leads to a review of the current design activities and to subsequent improvements, hence benefiting the entire organization.

Eco-design is a solution which addresses the growing pressure caused by the increasing price of materials and energy, as well as growing legislative incentives and market demand. Hence, to ensure effective eco-design implementation organizational and strategic implications should well be considered. The modification of the design process should be planned and should incorporate the company's sustainability profile in to the bigger picture. Performance is a measure for assessing the degree of a corporation's objective attainment (Daft, 1995).

Eco-design can improve environmental performance by reducing waste and emissions as well as increasing environmental commitment. Hart and Ahuja (1996) demonstrate that the early moving firms may be opting for more advanced environmental strategies that are built on low emissions, but which also involve other sources of sustainable competitive advantage (Ghemawat, 1986). Firms with very low manufacturing emissions relative to competitors may be able to gain first-mover advantage in emerging green product markets (Russo & Fouts, 1997). Indeed, attempts to differentiate products as environmentally responsible while continuing to produce comparatively high levels of waste and emissions in production is risky, as outside observers can easily expose this and destroy the credibility and reputation of the firm (Hart & Ahuja, 1996). Wagner (2005) demonstrates that high levels of firm performance coincide with high levels of environmental performance only if the firm's environmental management technology has a pollution proactive orientation.

It can also improve operational performance by improving product quality, increasing efficiency, enhancing productivity, and cutting cost. Efficiency improvements brought about by integrating a proactive stance on pollution can encompass activities such as improvements in the firm's energy use, water use efficiency, and increased resource efficiency by reducing amounts of production input per unit of product output (Wagner, 2005). In their study, Klassen and Whybark (1999) indicate that pollution proactive technologies exert a positive influence on firm performance.

An increase in revenue can be brought about by a good environmental performance like better access to certain markets, differentiating products and offering pollution control technology. It can also lead to cost reductions for example risk management and relations with external stakeholders, cost of material, energy, and services and cost of capital (Ambec & Lanoie, 2008). The final consequence of any competitive advantage from a proactive environmental management is an improvement in financial performance (Gonzalez Benito & Gonzalez Benito, 2005). By improving their environmental performance, firms are able to increase their competitive edge by reducing costs, gaining a strong reputation among customers and increasing their competitiveness in international markets. Hence, these benefits impact positively on firm's overall financial performance (Lindell & Karagozoglu, 2001).

1.4 Research Problem

The primary focus of Eco-design is the reduction of environmental impact, other benefits include cost reduction, entrance into new markets and the launch of new products hence increase in competitiveness (Knight & Jenkins, 2008) which is expected to result in increased financial performance. The societal businesses responsibility has been a concern both of scholars and of practitioners for a long time (Salzmann, Ionescu-Somers & Steger, 2005). Increased concerns on the environment, the rising pressure from the public and regulatory requirements have forced a lot of organizations to increase their efforts in evaluation of environmental performance (Lundberg, Balfors & Folkeson, 2009).

From the earlier assessment of industrial pollution in Mombasa County manufacturing firms are found to be the major contributors (Mwaguni & Munga, 1997). These firms face different major challenges some of which include; sustainable consumption, management of solids and liquid wastes and compliance with strict environmental regulations. A big percentage of pollution effluent generated on Mombasa Island and it's environ mostly ends up in the estuarine creeks and rivers hence polluting them. Other industries release large quantities of liquid waste directly into the sea, causing a significant Biochemical Oxygen Demand (BOD) load (UNEP/AU/SIDA/Output 3.2 a, 2011). Eco-design adoption may lead to a great reduction of environmental footprint, reduction of wastes and re-use of materials, and also results in the use of scarce natural resources efficiently and effectively, while keeping the environment free from pressure (Dallas, 2008).

The examination of the possible direct link between environmental protection and organizational performance in the literature has produced mixed results. Despite the role played by green issues to green innovation and business success, the relationships among these aspects still remains controversial.

This is because, while some studies have found a positive relationship (Lopez Gamero, Molina Azorın & Claver-Cortes, 2009; Borchardt, Wendt, Pereira & Sellitto, 2011) others do not identify a positive link of environmental proactivity and organizational performance (Wagner, 2005; Watson, Klingenberg, Polito & Geurts, 2004). The lack of the consensus on these links causes a research gap in the literature. Therefore, this study aimed to examine if there is a relationship between Eco-design and firm organizational performance.

Most of the past studies in Kenya are on green supply chain management and green manufacturing. Momanyi (2013) did a study on the adoption of green manufacturing practices by food processing firms in Mombasa County. Mohammed (2012) did a study on green supply chain management and performance of manufacturing firms in Mombasa while Babu (2013) studied green supply chain practices and operational performance of personal care manufacturing firms in Nairobi. Although Eco-design is one of the facets of GSCM, most studies have not done it in details to include the whole product life cycle and also the research in this area is limited. Therefore, there is a need to conduct a study on Eco-design practices in manufacturing firms. From the discussions, the researcher is posing the following question; what is the effect of adoption of Eco-design practices on organizational performance of manufacturing firms in Mombasa County?

1.5 Research Objectives

The general objective is to establish the effect of adoption of Eco-design practices on organizational performance of manufacturing firms. The specific objectives are to:

i. Determine the extent to which Eco-design practices have been adopted by manufacturing firms in Mombasa County.
ii. Establish the challenges of adopting Eco-design practices by manufacturing firms in Mombasa County.
iii. Establish the relationship between adoption of Eco-design practices and organizational performance of manufacturing firms in Mombasa County.

2. Literature Review

2.1 Introduction

This chapter starts by looking at theories which support Eco-design, this is followed by a focuses on the literature already in existence, written by other scholars on the issue of Eco-design and organizational performance. The information is divided into both theoretical and empirical review of the literature.

2.2 Theoretical Foundation

The relationship between Eco-design and organizational performance is grounded on four major theories. These are resource dependence theory, resource based view, institutional theory and stakeholder theory.

2.2.1 Resource Dependence Theory

Resource dependence theory has been examined and greatly supported in studies of inter-organizational relationships (Oliver and Elsers 1998). The assumption of resource dependence theory is that the firm cannot be independent with regard to critical resources for its survivors. It depends on resources from outside parties to be competitive (Wathne & Heide, 2004) thereby develops a need to manage this dependence with other firms for sustainable development (Ulrich & Barney, 1984). Firms that lack the required resources to achieve its goals are left with no choice but to partner with others to acquire these resources. Where partnership and resource sharing are beneficial for environmental and productivity improvement this leads to diffusion of environmental practices between the partners (Sarkis, Gonzalez-Torre & Adenso-Diaz, 2010).

Eco-design practices require firms' partnerships to ensure performance benefits (Sarkis et al., 2010). Inter-organizational relationship is crucial for environmental management to gain performance outcomes, where partnership and resource sharing are important for environmental and productivity improvements (Zhu & Sarkis, 2004). Resource dependence argues for the diffusion of environmental practices among the partners involved. Lack of self-sufficiency creates dependence on suppliers by the customer organization. Thus, integration of supply chain management with quality management helps an organization establishing a competitive advantage.

2.2.2 Resource-Based View

Resource-Based View (RBV) provides a good theoretical foundation to discuss the contribution of resources and capabilities to firm's performance. The theory gives an insight on the relations among internal resources, capabilities, and performance.

The principal idea of the RBV is that for a firm to achieve competitive advantage then it all depends on its heterogeneous resources, which are inimitable, valuable and non- substitutable. It is perhaps one of the most influential frameworks in environmental management (Barney, 1991).

Environmental innovations may as well lead to complex, environmentally friendly technologies, products, and processes. These in turn lower overall company costs ensure long-term competitive advantage and finally boost financial performance (Christmann, 2000). Researchers should use resource-based view to investigate green issues (Dowell, Hart & Yeung, 2000; Hart, 1995). Proactive environmental strategies that go beyond regulatory compliance have a positive effect on firm performance when mediated by valuable firm capabilities (Galdeano-Go´mez et al., 2008; Russo & Fouts, 1997; Sharma & Vredenburg, 1998; Wagner, 2005).

2.2.3 Institutional Theory

Institutional theory has been applied ever since 1930 (Bansal & Clelland, 2004; Hoffman, 1999; Jennings & Zandbergen, 1995) in understanding response of the firm to increasing pressures for management of the environment. Due to increased public awareness of organizational failure and environmental demands, institutional theory recommend that companies can only gain legitimacy through reduction of their environmental impact and being socially responsible (Bansal, 2005; Bansal & Clelland, 2004).

Institutional pressure has led firms to adopt Eco-design practices. They can be; conformance to environmental strategies that complies with regulations and adopting industry standards, or reducing environmental impact of operations beyond regulatory requirements (Sharma, 2000). Firms can create good relationships with regulators by participating in government sponsored voluntary program which develops a voluntary agreement between government agencies and firms hence encourage technological innovation and reduction in pollution (Delmas & Toffel, 2008). Companies can also work with their customers as well as their suppliers to improve their environmental performance through exchange of ideas/information, suggestions and correction (Nelson & Winter, 2002).

2.2.4 Stakeholder Theory

Stakeholder theory starts with the assumption that values are necessarily and the main reason for doing business. It asks managers to be responsible and have a shared sense of value and have knowledge on what bring core stakeholders together. It also forces managers to be very clear about how they want to run the business, in particular what kinds of relationships they want and need to create and maintain with their stakeholders so as to deliver on their purpose and expectations. Firms should not narrowly focus their strategic management decisions on creating shareholder value only but rather broaden their objectives to include the expectations and interest of the wide group of stakeholders (D'Aunno, 2006).

Poor environmental performance will definitely lead to poor company's relationship with its stakeholders. This will go ahead and affect the firm's reputation and shareholders will suffer financial losses if a firm's is found liable to environmental damages. Shareholders and financial institutions usually perceive companies with poor environmental reputation as riskier to invest in and therefore may demand a higher risk premium (Henriques & Sadorsky, 1999). Increased consumer awareness has led them to demand for industrial improvement on environmental management (Buysse & Verbeke, 2003). The threats posed by various stakeholders in response to the poor environmental management thus induce firms to comply and improve their corporate environmental practice.

2.3 Eco-design Practices

Eco-design is an approach that might help reducing the damages of the industrial activities. In Eco-design strategy wheel and product life cycle explanation Hemel and Brezet (1997), Hemel (1995), Singhal (2012) explain them as: design for use of raw materials, design for manufacture, design for distribution, design for product use and design for end of life

2.3.1 Design for use of Raw Materials

It involves selection of low-impact materials, materials which are non-hazardous, non-exhaustible materials, low energy content materials, recycled materials and recyclable materials. Also includes reduction of material, weight reduction and reduction in volume. Some materials and additives are better avoided because they are toxic or may cause toxic emissions during production, use or when dumped. Non-replenishable materials should be avoided since the source can become exhausted with time. (Hemel & Brezet, 1997)

Reduction of material used is one of the main issues addressed by Eco-design for the energy using products, and it is one of the priorities for products not using energy. Whether they are manufactured close to the customer or not, it does not make a difference in terms of quantity of material needed. The difference comes from the environmental burden created by the extraction of raw materials. Globalization may shift the raw material extraction to the manufacturing region. On the other hand, the life cycle perspective may include in the material selection analysis the location of the production site. (Hemel, 1995)

2.3.2 Design for Manufacture

It includes production techniques optimization, having alternative production techniques, low/clean energy use, fewer production processes, reduction in waste generation, few/clean production consumables. Good design should also have production phase in mind. Production techniques should have a low environmental impact:
They should also minimize the use of auxiliary materials and energy, should lead to limited losses of raw material and generate little waste as possible (Singhal, 2012).
Eco-design influences the efficiency of the manufacturing process as well. From the point of view of Eco-design, decisions on the choice of the manufacturing processes are trade-offs between economic and environmental criteria. Outsourcing allows less control over the manufacturing processes, and there may be a high discrepancy between the design intention (and thus the estimated environmental performance of the processes) and reality at the supplier (different manufacturing processes and waste management) (Hemel & Brezet, 1997; Hemel 1995).

2.3.3 Design for Distribution

This involves efficient distribution system, transport mode which is efficient, less/clean packaging, and efficient logistics. Environmentally efficient distribution is there to ensure that the product is transported efficiently from the factory doors to the retailer and finally to the user for consumption. It relates to the product, its packaging, its mode of transport, and the logistics involved. If a project involves analysis of packaging, then the packaging should be regarded as a product in itself, with its own life cycle. The main aim is to reduce transport by working with local suppliers to avoid long-distance transport. (Hemel & Brezet, 1997) Eco-design includes the avoidance of environmentally harmful forms of transport hence the choice of transport mode is important. The huge increase in the distance a product travels before reaching the customer, as opposed to locally produced goods, is probably the main negative effect on environment. Although these are the consequences of prevailing economic decisions, optimizing the weight and/or the volume of the product and its package plays an important role in reducing both environmental impact and cost due to transportation (Singhal, 2012).

2.3.4 Design for Product Use

It includes reduction of the environmental impact in the user stage; consumption of low energy, few/clean consumables needed during use, ensuring clean energy source and no energy/auxiliary material use. What is important during use are energy and waste. Products should be designed with use of the lowest energy consuming components. Clean energy sources greatly reduces the harmful emissions from the environment, especially energy-intensive products. Product should be designed so that it uses the least harmful source of energy as well as encourage the use of clean and renewable energy sources (Hemel, 1995).

From an environmental point of view the use phase contributes the most to the environmental impact for two broad categories: energy using products and products making use of consumable. Eco-design aims at reducing the energy and the quantity of consumables during the life time. There is a positive correlation between the energy consumption, cost of ownership and negative impact on environment. This state of the facts induced no incentive for producers to aim efforts towards this direction. The increased awareness of the consumers on the environmental issues has put pressure on companies to reduce energy consumption, combined with eco-labeling and smart marketing strategies (Singhal, 2012).

2.3.5 Design for End of Life

It involves optimization of end-of-life system, reuse of product, material recycling, and clean incineration. Product’s end-of-life system refers to what happens to the product after its initial lifetime. It aims at ensuring reuse of valuable product components and proper waste management. Reusing the product and its components or materials can reduce the environmental impact of a product by reinvesting the materials and energy involved in its manufacture while preventing hazardous emissions (Hemel & Brezet, 1997).

Eco-design encouraged optimizing products for disassembly, mainly due to the wide spread idea that disassembly plays an important role in the recycling strategy. It helps in designing products that are more robust with respect to the end of life treatment. In other words, regardless of the end of life treatments employed and geographical location, a high recyclability rate, economic efficiency and minimal impact on environment is the ultimate goal (Hemel, 1995).Advances in the development of separation and sorting technologies favor the “design for non disassembly” approach (Ram et al. 1998) combined with the design for easy removal of the hazardous parts and substances before mechanical treatments.

2.4 Empirical Review

An empirical study of Green Supply Chain and Eco-design in electronic industry by Singhal (2012) found out that Eco-design is positively related with organizational performance including competitive advantage, economic performance, and environmental performance. The result was evidenced also by the result that firms with large number of suppliers adopt Eco-design on a large scale than firms with lower number of suppliers. Large number of suppliers indicates that a firm is large is size. This result implies that large firms adopt more green initiatives than smaller firms do. Large firms generally had more resources and capabilities than smaller firms which enable them to attempt costly and/or risky environmental investments (Bowen, 2002). Lopez Gamero, Molina Azorın, and Claver Cortes (2009) did a study to establish the whole relationship between environmental variables and firm performance with competitive advantage and firm resources as mediating variables and found a positive relationship between the early investment in environmental issues and the adoption of a proactive environmental management. They also found out that this led to improvement of environmental performance and firm performance through reducing pollution, decreasing costs and improving credibility and reputation while also contribute to the development of valuable capabilities which increase the competitive advantage of the firm.

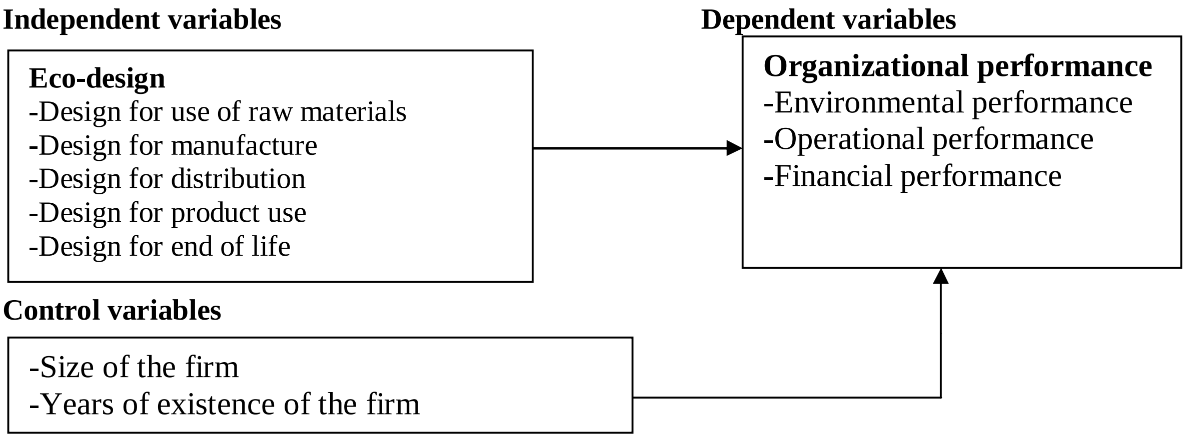
Borchardt, Wendt, Pereira, and Sellitto (2011) conducted a study on redesign of a component based on Eco-design practices: environmental impact and cost reduction achievements and the results strengthened the ideas presented in the theoretical framework that the introduction of new technologies based on Eco-design can help firm create competitive advantage, improve the company’s public image, and address legal requirements. The main contribution of the case has been the confirmation about Eco-design construct that could be further researched in the industry. Further analysis of technological ability and market potential to accept a redesigned product provide managerial support to the Eco-design team.

Other studies do not identify a positive impact of environmental proactively on financial performance, Watson, Klingenberg, Polito and Geurts (2004) in a study on the impact of environmental management system implementation on organizational performance found that the data analyzed did not show any significant difference in organizational performance between environmental management adopters and non-environmental management adopters. Hence the argument that environmental management adopters experience significantly higher levels of profitability and market values compared to non-environmental management adopters could not be substantiated in the findings.

While the results from Wagner (2005) in a study on how to reconcile environmental and economic performance to improve corporate sustainability confirmed inversely U-shaped relationship between environmental management and economic performance in the fixed effects models. The positive part of the relationship was found to be relatively weak. For the input-oriented environmental performance index, no significant relationship could be detected.

2.5 Conceptual Framework

The framework looks at the relationship between Eco-design practices (Design for use of raw materials, design for manufacture, design for distribution, design for product use and design for end of life) and organizational performance (environmental performance, operational performance, financial performance) with control variables being size of the firm and years of existence of the firm.



Research Methodology

3.1 Introduction

This chapter outlines the methodology employed to study the adoption of Eco-design practices in manufacturing firms in Mombasa County. The chapter includes the following segments: research design, the population, sampling design, data collection, and data analysis.

3.2 Research Design

Cross sectional survey research design was used as it is appropriate where the overall aim is to establish whether significant associations among variables exist at some point in time. It aims at exploring and describing the issues in Eco-design to gain background information, clarify problems, and develop answers to questions. Cross sectional survey design was effectively used by Zutshi and Sohal (2004) in analyzing the relationship between environmental motivation and ISO 14001 certification and also Zhu and Sarkis (2004) used it in studying green supply chain management implications.

3.3 Population of the Study

Table 3.1: Sample of the Study

Sector	Sample
Pharmaceutical and Medical equipment	1
Metals and Allied	11
Textiles and Apparels	11
Energy, Electrical and Electronics	1
Paper and Board	4
Plastic and Rubber	8
Chemicals and Allied	3
Food and Beverages	19
Building, Mining and Construction	5
Motor vehicles and Accessories	2
Total	**65**

The study population consisted of all manufacturing firms in Mombasa County. According to the Kenya Bureau of Standards, there are firms 753 manufacturing firms in Mombasa County (KEBS, 2015).

3.4 Sample and Sampling Technique

The study employed purposive sampling technique by using a sample comprised of all 65 firms registered with the Kenya Association of Manufacturers (KAM, 2014). The primary reason why the sample was strictly limited to these firms is because they are perceived to be well organized and structured, and getting information from them will be easier.

3.5 Data Collection

Primary and secondary data were used for this study. Secondary data was obtained from published research. Primary data was collected using a semi-structured questionnaire that was administered using 'drop and pick later' method. The questionnaire allowed for a more flexible and comprehensive view in obtaining relevant information through structured questions. It was divided into four parts. The first part consisted of the company's basic information; the second section consisted of questions relating to Eco-design practices adoption, the third section established the relationship between adoption of Eco-design practices and organization performance of manufacturing firms in Mombasa County and the last section comprised of questions on the challenges of adopting Eco-design practices.

The questionnaires were dropped to each manufacturing firm to be filled by anybody in the organization who is responsible for environmental management activities for example Production managers, maintenance managers and quality assurance managers. Each manufacturing firm was to fill one questionnaire which would add up to sixty five questionnaires in total.

3.6 Data Analysis

The data was first checked for completeness, consistency, and accuracy, it was then coded. Some of the data collected was analyzed using descriptive statistic (percentages, frequency and mean scores). Percentages and frequency was used to examine the company's basic information. Mean scores was used to give extent to which Eco-design practices were adopted, The relationship between adoption of Eco-design practices and organizational performance of manufacturing firms in Mombasa County was analyzed using ordered probit regression to get the p-values and coefficients. While the challenges of adopting Eco-design practices were analyzed using descriptive statistics to get the mean scores then ranking followed.

Tables and other graphic presentations as appropriate were used to present the data collected for ease of understanding and analysis. The information generated was interpreted, explained, and discussed well. The data was summarized and interpreted with the aid of data analysis computer software's which are Microsoft excel, Stata and SPSS. Microsoft excel was used for data entry before importation to SPSS for analysis of descriptive data while Stata was used to do the ordered probit regression.

Ordered Probit Model

$$Y = \beta + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon_i,$$

Where:

Y = Organizational performance of manufacturing firms

X_1 = Design for use of raw materials

X_2 = Design for manufacture

X_3 = Design for distribution

X_4 = Design for product use

X_5 = Design for end of life

X_6, X_7 are control variables

X_6 = Size of the firm

X_7 = Years of existence of the firm

ε_i= random errors.

Chapter Four: Data Analysis, Findings and Discussion

4.1 Introduction

This chapter presents the findings of the study. It also gives the implication the findings on the basis of the objectives. The Information regard issues relating to Eco-design practices adoption, establishing the relationship between adoption of Eco-design practices and organizational performance of manufacturing firms in Mombasa County and lastly challenges of adopting Eco-design practices. Data collected was mainly ordinal in nature which captured the perception of the respondents in a 5- point Likert-type scale. Of the 65 targeted firms, 34 of them responded representing 52% response rate considered adequate to constitute a basis for valid conclusion.

4.2 Demographic Characteristics of Firms

This analyses the background information of the firms from the sector which they operate, years of operation, number of employees, and registration with environmental management body, environmental management department, and environmental management policy.

4.2.1 Manufacturing Sector of the Firm

Respondents were asked to indicate the sector in which they operate; the results are shown in the table below

Table 4.1: Manufacturing Sector of the Firm

Sector	Frequency	Percentage
Metals and allied	7	20.6
Textiles and Apparels	5	14.7
Plastic and rubber	5	14.7
Food and beverages	12	35.3
Building, Mining and Construction	1	2.9
Motor vehicles and Accessories	2	5.9
Other(s) please specify	2	5.9
Total	**34**	**100**

The findings in table 4.1 indicate that data was obtained from 8 sectors. Namely metals and allied textiles and apparel, plastic and rubber, food and beverages, building, mining and construction, motor vehicle and accessories, oil and soaps and lastly salt. Most of the data was obtained from food and beverages 35.3%, followed by metals and allied 20.6%, textile and apparels 14.7%, plastic and rubber 14.7%, motor vehicles and accessories 5.9%, the two additional firms had a percentage of 5.9 and lastly building, mining and construction with 2.9%. Data was not obtained from the following sectors pharmaceutical and medical equipment, energy, electrical and electronics, chemicals and allied and plus paper and board. This is because the manufacturing sector in Mombasa is mostly made up of food and beverage firms

4.2.2 Length of Operation

Here firms' were asked to indicate the number of years they have been in operation

Table 4.2: Length of Operation

	Frequency	Percentage
1-30	16	47.1
31-60	16	47.1
61-90	2	5.9
Total	**34**	**100**

The results from table 4.2 show that 47.1% of the firms surveyed had operated between 1and 30 years .47.1% had been in operation for between 31-60 years while the rest (5.9%) had been in operation for more than 60 years. This implies that most of the firms are still relatively new and therefore not expected to be more advanced in their implementation of Eco-design practices.

4.2.3 Number of Employees

The respondents were further required to indicate the number of employees who were working in their firms. The results are shown below in table 4.3

Table 4.3: Number of Employees

	Frequency	Percentage
1-400	29	82.9
401-800	3	11.6
801-1200	2	5.5
Total	**34**	**100**

Table 4.3 shows that 82.9% of the firms surveyed had between 1 and 400 employees. 11.6% had between 401-800 employees while the rest (5.5%) had more than 800 employees. Generally this implies that most of the respondents were small size organization hence do not have enough resources to implement Eco-design practices

4.2.4 Registration with Environmental Management Body

The respondents were also required to indicate if they are registered with any environmental management body. Table 4.4 shows the results

Table 4.4: Registration with Environmental Management Body

	Frequency	Percentage
No	3	8.8
Yes	31	91.2
Total	**34**	**100**

Most of the respondents (91.2%) indicated that their firms are registered with environmental management body while only 8.8% of them are not registered. This implies that external pressure such as government legislation and regulations, customers and investors are playing key role in forcing these firms to adopt Eco-design practices.

4.2.5 Whether Firm has an Environmental Management Department

In an attempt to establish how serious the firms were taking environmental management issues, the respondents were also asked whether their firms had an environmental management department. The results are presented in table 4.5

Table 4.5: Environmental Management Department

	Frequency	Percentage
No	2	5.9
Yes	32	94.1
Total	**34**	**100**

Table 4.5 shows that 94.1% of the respondents have an environmental management department whereas 5.9% do not have one. This implies that most manufacturing firms are either practicing or are considering practicing Eco-design practices.

4.2.6 Firm environmental Management Policy

The respondents were further asked to indicate if their firms had an environmental management policy. Table 4.6 shows the results

Table 4.6: Firm environmental Management Policy

	Frequency	Percentage
No	5	14.7
Yes	29	85.3
Total	**34**	**100**

Findings show that most of the firms (85.3%) had an environmental management policy. Only 14.7% of the firms indicated that they don't have one. Implying that most manufacturing firms are environmental conscious thus have started or intend to implement Eco-design practices.

4.3 Adoption of Eco-design Practices

The respondents were also required to indicate the extent to which their firms had implemented a list of Eco-design practices on a 5-point likert scale where 1 represented not being considered, 2-future considerations, 3-planning to implement, 4- currently implementing and 5-successfully implemented. The Eco-design practices included; design for use of raw materials, design for manufacture, design for distribution, design for product use, and design for end of life. The following subsection discuss the

4.3.1 Design for Use of Raw Materials

The respondents were required to indicate the extent to which they had implemented the various practices of design for raw material which includes; selection of low-impact materials, materials which are non-hazardous, non-exhaustible materials, low energy content materials, recycled materials, and recyclable materials

Table 4.7: Design for Use of Raw Materials

Practices	Mean	Rank
Non-hazardous materials	2.9706	1
Low energy content materials	2.9412	2
Non-exhaustible materials	2.9060	3
Recycled materials	2.7353	4
Recyclable materials	2.7353	5
Selection of low impact materials	2.5882	6

Table 4.7 indicate that the most adopted design for raw material practices is the use of non-hazardous materials with a mean score of 2.9706, this is followed by low energy content materials with a mean of 2.9412, non-exhaustible materials 2.9060, Recycled materials 2.7353 and Recyclable materials 2.7353. This confirms the earlier finding from section 4.2. That most manufacturing firms are conscious of the environment hence keen on the type of raw materials they use. They avoid hazardous materials and because they are still relatively new they are careful on cost, putting emphases on low energy and non exhaustible material. Also this implies manufacturing firms use a lot of packaging materials thus generating a great deal of waste and as a result have put measures to reduce these wastes by ensuring that the materials are recyclable and they use the recycled material.

The least adopted design for raw material practices is selection of low impact material with a mean score of 2.5882. This implies that manufacturing firms do not find it a priority, having considered other practices which deemed to be more necessary to them as mentioned above hence given them the first priority over the selection of low impact material

4.3.2 Design for Manufacture

The respondents were also required to indicate the extent to which they had implemented the various practices of design for manufacture which includes; production techniques optimization, having alternative production techniques, low/clean energy use, fewer production processes, reduction in waste generation, few/clean production consumables.

Table 4.8: Design for Manufacture

Practices	Mean	Rank
Alternative production techniques	3.2353	1
Low generation of waste	3.1176	2
Few/clean production consumables	3.0882	3
Low/clean energy consumption	3.0588	4
Fewer production processes	2.9118	5
Optimization of production techniques	2.5000	6

The finding in table 4.8 indicate that the most adopted design for manufacture practices is alternative production techniques with a mean score of 3.2353, followed by Low generation of waste 3.1176, few/clean production consumables 3.0882, low/clean energy consumption 3.0588 and fewer production processes with a mean of 2.9118. This implies that most manufacturing firms are conscious of the environment by having other production technique, taking care of the waste they produce, using few consumables among others. Low energy also demonstrates their keen on cost reduction. The least adopted design for manufacture practices is optimization of production techniques with a mean score of 2.5000. This implies that the manufacturing firms lack enough resources to implement the latest technology so as to optimize the old production technology for Eco-design practices this is because they are still relative new and are not yet very conversant with the whole Eco-design process.

4.3.3 Design for Distribution

Respondents were also asked to indicate the extent to which they had implemented the various practices of design for distribution which includes; efficient distribution system, transport mode which is efficient, less/clean packaging and efficient logistics.

Table 4.9: Design for Distribution

Practices	Mean	Rank
Efficient transport mode	3.0882	1
Less/clean packaging	3.0000	2
Efficient logistics	2.7941	3
Efficient distribution system	2.2647	4

Table 4.9 shows that efficient transport mode is one of the most adopted design for distribution practices with a mean score of 3.0882, next is less/clean packaging 3.0000 followed by efficient logistics having a mean of 2.7941 while the least adopted design for distribution practice being efficient distribution system as indicated in the table with a mean score of 2.2647.

This demonstrate that most manufacturing firms are putting enough effort to ensure proper distribution of their good like choosing efficient transport and logistics while reducing packaging to avoid pollution hence are conscious of the environment. It also implies that although the manufacturing firms are trying to ensure they have a proper distribution system they have not reached the very efficient level as shown by the mean of 2.2647.

4.3.4 Design for Product Use

Respondents were also asked to indicate the extent to which they had implemented the various practices of design for product use which include; reduction of the environmental impact in the user stage; consumption of low energy, few/clean consumables needed during use, ensuring clean energy source and no energy/auxiliary material use

Table 4.10: Design for Product Use

Practices	Mean	Rank
No energy/auxiliary materials use	3.3529	1
Clean energy source	3.2059	2
Low energy consumption	3.1176	3
Clean consumables during use	3.0588	4
Few consumables needed during use	2.9706	5
Reduction of the environmental impact in the user stage	2.7353	6

Table 4.10 indicate that the most adopted design for product use practices is no energy/auxiliary materials usewith a mean score of 3.3529, followed by clean energy source 3.2059, clean consumables during use 3.0588, few consumables needed during use with a mean of 2.9706. This implies that most manufacturing firms are conscious of the environment and their customers this is because they reduce and ensure clean consumables and energy used during product use.

Among the design for product use practices the least adopted one is reduction of the environmental impact in the user stage with a mean score of 2.7353. This implies that the manufacturing firms may be in the implementation process as they may be looking for more resources to implement it. As seen earlier most of the firms are still new and not that well established.

4.3.5 Design for End of Life

The respondents were asked to indicate the extent to which they had implemented the various practices of design for end of life which includes; optimization of end-of-life system, reuse of product, material recycling, and clean incineration

Table 4.11: Design for End of Life

Practices	Mean	Rank
Reuse of product	3.1176	1
Recycling of material	2.7647	2
Clean waste treatment process	2.5294	3
Optimization of end-of-life system	1.7941	4

The findings form table 4.1l indicate that reuse of product is one of the practices of design for end of life which is the most adopted with a mean score of 3.1176, next is recycling of material 2.7647, followed by clean waste treatment process with a mean of 2.5294 while the least adopted is optimization of end-of-life system with a mean of 1.7941. This shows that most of the manufacturing firms are environmental conscious and keen on cost reduction by reusing of products and recycling materials as well as treating the waste they produce to avoid penalty. As seen before optimization of processes has been a challenge for the manufacturing firms and seen to be a trend which may be caused by the newness of the firms and the lack of capacity.

4.3.6 Eco-design practices

Lastly, the respondents were required to indicate the extent to which they had implemented the various Eco-design practices which include; design for use of raw materials, design for manufacture, design for distribution, design for product use and design for end of life. The results are shown in table 4.12 below

Table 4.12: Eco-design practices

Practices	Mean	Rank
Design for product use	2.9706	1
Design for manufacture	2.9412	2
Design for use of raw materials	2.7353	3
Design for distribution	2.6765	4
Design for end of life	2.5588	5

Table 4.12 indicate that most adopted Eco-design practice is design for product use with a mean score of 2.9706, followed by design for manufacture 2.9412, next is design for use of raw materials with a mean of 2.7353 and design for distribution 2.6765 while the least adopted Eco-design practice is design for end of life with a mean score of 2.5588. This implies that majority of the manufacturing firms have to some extent implemented Eco-design practices or are in the implementation stage. Hence generally firms in Mombasa have not fully implemented the Eco-design practices and this leads to the question why have they not implemented the practices in full hence justify the need to explore challenges of adopting Eco-design practices by manufacturing firms in Mombasa County i.e. the second objective of this study

4.4 Challenges of Adopting Eco-design Practices

To accomplish the second objective of this study, the respondents were requested to indicate the impact of different challenges of adopting Eco-design practices on a 5-point Likert scales where 1 represented no impact, 2-a little impact, 3-moderate impact, 4-strong impact and 5-very strong. Table 4.3 shows the results

Table 4.13 Challenges of Adopting Eco-design Practices by Manufacturing Firms in Mombasa County

Challenges	Means	Rank
Unsuccessful integration of Eco-design	**3.2941**	**1**
Lack of knowhow in managing changes in design procedures	**3.2059**	**2**
Lack of technical knowledge about Eco-design	**3.0588**	**3**
Tools are at hand but they are not used enough	**2.9412**	**4**
Many tools for Eco-design require experts	**2.9412**	**5**
Differences in perspective between proponents and executors	**2.8824**	**6**
Organizational complexities	**2.8824**	**7**
Lack of cooperation between Departments	**2.8824**	**8**
Lack of appropriate infrastructure	**2.7647**	**9**
Lack of Eco-design tools based on Technology	**2.7059**	**10**
Use Eco-design tools without transforming the company’s operations	**2.5882**	**11**

The findings in table 4.13 indicate that unsuccessful integration of Eco-design is one of the challenge with the greatest impact with a mean of 3.2941, followed by lack of knowhow in managing changes in design procedures 3.2059, lack of technical knowledge about Eco-design 3.0588, tools are at hand but they are not used enough 2.9412, many tools for Eco-design require experts 2.9412, differences in perspective between proponents and executors 2.8824, organizational complexities 2.8824, lack of cooperation between Departments, 2.8824, lack of appropriate infrastructure 2.7647, lack of Eco-design tools based on Technology 2.7059 while the one with the least impact is use Eco-design tools without transforming the company’s operations 2.5882

The above findings therefore indicate that unsuccessful integration of Eco-design is one of the leading challenges of implementing Eco-design practices hence this finding shows that although Mombasa firms may be having the urge to implement Eco-design what may be holding them back may be the fear of failure that's why most of them are stuck on the implementation phase. The other big challenge is lack of knowhow on issues related to Eco-design which may be the cause of unsuccessful integration. It also shows that manufacturing firms usually ensure that the Eco-design practices can well be integrated with other organization activities by transforming company operation to ensure compatibility.

4.5 Relationship between Eco-design Practices and Organization Performance

Ordered probit regression was used to help the researcher attain objective three which was to find out the relationship between the two variables with the dependent variable being organizational performance and independent variable being the Eco-design practices (design for use of raw materials, design for manufacture, design for distribution, design for product use and design for end of life). Two control variables were used which include; firm's length of operation and firm size.

4.5.1 Eco-design Practices and Environmental Impact Reduction

Oprobit Enviimpreduc Drawmat Desmaf Desdistr Desprouse Desendlife Lnyrsoper Lnstaffsize

Iteration 0: log likelihood = -35.29889
Iteration 1: log likelihood = -19.586294
Iteration 2: log likelihood = -17.913146
Iteration 3: log likelihood = -17.790219
Iteration 4: log likelihood = -17.789523
Iteration 5: log likelihood = -17.789523

Ordered probit regression Number of obs = 34
LR chi2(7) = 35.02
Prob > chi2 = 0.0000
Log likelihood = -17.789523 Pseudo R2 = 0.4960

Table 4.14: Eco-design Practices and Environmental Impact Reduction

enviimpreduc	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
drawmat	-.4094745	.4940521	-0.83	0.407	-1.377799	.5588497
desmaf	-1.088622	.762775	-1.43	0.154	-2.583633	.4063899
desdistr	.9555312	.5038155	1.90	0.058	-.0319291	1.942992
desprouse	1.524058	.7992251	1.91	0.057	-.0423949	3.09051
desendlife	1.22196	.5265022	2.32	0.020	.1900347	2.253885
lnyrsoper	1.483339	.618887	2.40	0.017	.2703423	2.696335
lnstaffsize	.4416411	.3234986	1.37	0.172	-.1924044	1.075687
/cut1	9.68405	3.0613			3.684013	15.68409
/cut2	11.51081	3.206046			5.227072	17.79454
/cut3	15.82113	4.145555			7.69599	23.94627

The final log likelihood was found to be -17.789523. Also all 34 observations in the data set were used in the analysis. The likelihood ratio chi-square of 35.02 with a p-value of 0.0000 indicates that the model as a whole is statistically significant and shows some association between the variables, as compared to the null model with no predictors. The pseudo-R-squared of 0.4960 is considered satisfactory. Design for end of life, design for product use and design for distribution are statistically significant with p-values of 0.020, 0.057 and 0.058 respectively hence have influence on environmental impact reduction. While design for manufacture and design for raw materials are not significant (0.154 $ 0.407) meaning that their influence on environmental impact reduction is not significant.

Table 4.14 established that taking all other independent variables at zero, a unit increase in design for raw material practice would lead to a 0.409 reduction in environmental impact reduction. A unit increase in design for manufacture would lead to a 1.089 decrease in environmental impact reduction.

A unit increase design for distribution would lead to a 0.956 increment in environmental impact reduction. A unit increase design for product use would lead to a 1.524 increment in environmental impact reduction. A unit increase design for end of life would lead to a 1.222 increment in environmental impact reduction. A unit increase years of operation would lead to a 1.483 increment in environmental impact reduction and a unit increase in staff size would lead to a 0.442 increase in environmental impact reduction.

4.5.2 Eco-design Practices and Environmental Cost Saving

Oprobit Envcostsav Drawmat Desmaf Desdistr Desprouse Desendlife Lnyrsoper Lnstaffsize

Iteration 0: log likelihood = -32.029892
Iteration 1: log likelihood = -17.565382
Iteration 2: log likelihood = -14.652035
Iteration 3: log likelihood = -14.251488
Iteration 4: log likelihood = -14.247183
Iteration 5: log likelihood = -14.247181
Iteration 6: log likelihood = -14.247181

Ordered probit regression Number of obs = 34
LR chi2(7) = 35.57
Prob > chi2 = 0.0000
Log likelihood = -14.247181 Pseudo R2 = 0.5552

Table 4.15 Eco-design Practices and Environmental Cost Saving

envcostsav	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
drawmat	.3284205	.708675	0.46	0.643	-1.060557	1.717398
desmaf	-.8451816	.7680645	-1.10	0.271	-2.35056	.6601972
desdistr	4.271052	1.474814	2.90	0.004	1.380471	7.161633
desprouse	-3.167989	1.36667	-2.32	0.020	-5.846612	-.4893657
desendlife	.9498102	.5447138	1.74	0.081	-.1178093	2.01743
lnyrsoper	-.0317835	.6809832	-0.05	0.963	-1.366486	1.302919
lnstaffsize	1.55367	.5557224	2.80	0.005	.4644741	2.642866
/cut1	11.59961	4.157449			3.451163	19.74806
/cut2	13.97277	4.491006			5.170562	22.77498

The final log likelihood was found to be -14.247181. All 34 observations in the data set were used in the analysis. . The likelihood ratio chi-square of 35.57 with a p-value of 0.0000 indicates that the model as a whole is statistically significant and shows some association between the variables, as compared to the null model with no predictors. The pseudo-R-squared of 0.5552 is considered satisfactory. Design for distribution and design for product use are statistically significant with p-values of 0.004 and 0.020 respectively. Hence influence environmental cost saving While design for manufacture, design for raw material and design for end of life are not significant (0.271, 0.643 $ 0.081) showing that their influence on environmental cost saving is not significant.

The findings from table 4.15 indicate that by taking all other independent variables at zero, a unit increase in design for raw material practice would lead to a 0.328 increment in environmental cost saving. A unit increase in design for manufacture would lead to a 0.845 decrease in environmental cost saving. A unit increase design for distribution would lead to a 4.271 increment in environmental cost saving. A unit increase design for product use would lead to a 3.168 decrease in environmental cost saving. A unit increase design for end of life would lead to a 0.950 increment in environmental cost saving. A unit increase years of operation would lead to a 0.032 decrease in environmental cost saving and a unit increase in staff size would lead to a 1.553 increase in environmental cost saving.

4.5.3 Eco-design Practices and Operation Performance

Oprobit Operper Drawmat Desmaf Desdistr Desprouse Desendlife Lnyrsoper Lnstaffsize

Iteration 0: log likelihood = -31.589359
Iteration 1: log likelihood = -15.099609
Iteration 2: log likelihood = -14.485308
Iteration 3: log likelihood = -14.480232
Iteration 4: log likelihood = -14.480232

Ordered probit regression Number of obs = 34
LR chi2(7) = 34.22
Prob > chi2 = 0.0000
Log likelihood = -14.480232 Pseudo R2 = 0.5416

Table 4.16: Eco-design Practices and Operation Performance

operper	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
drawmat	-.4509438	.5137905	-0.88	0.380	-1.457955	.5560671
desmaf	.3583814	.6522434	0.55	0.583	-.9199921	1.636755
desdistr	.3723911	.5015924	0.74	0.458	-.6107119	1.355494
desprouse	1.658115	.7376914	2.25	0.025	.2122662	3.103963
desendlife	.678272	.445582	1.52	0.128	-.1950526	1.551597
lnyrsoper	1.065064	.5405858	1.97	0.049	.0055355	2.124593
lnstaffsize	.2877543	.3217275	0.89	0.371	-.34282	.9183285
/cut1	11.04267	3.127232			4.91341	17.17194
/cut2	14.4901	3.601224			7.431827	21.54837

The final log likelihood was found to be -14.480232. All 34 observations in the data set were used in the analysis. . The likelihood ratio chi-square of 34.22 with a p-value of 0.0000 indicates that the model as a whole is statistically significant and shows some association between the variables, as compared to the null model with no predictors. The pseudo-R-squared of 0.5416 is considered satisfactory. Design for product use is statistically significant with a p-value of 0.025 hence influences operation performance. While design for end of life, design for raw material, design for distribution and design for manufacture are not significant (0.128, 0.380, 0.458, 0.583) meaning that their influence on operation performance is not significant.

Table 4.16 shows that by taking all other independent variables at zero, a unit increase in design for raw material practice would lead to a 0.451 decrease in operation performance. A unit increase in design for manufacture would lead to a 0.358 increment in operation performance. A unit increase design for distribution would lead to a 0.372 increment in operation performance. A unit increase design for product use would lead to a 1.658 increment in operation performance. A unit increase design for end of life would lead to a 0.678 increment in operation performance. A unit increase years of operation would lead to a 1.065 increment in operation performance and a unit increase in staff size would lead to a 0.288 increase in operation performance.

4.5.4 Eco-design Practices and Financial Performance

Oprobit Fincalperform Drawmat Desmaf Desdistr Desprouse Desendlife Lnyrsoper Lnstaffsize

Iteration 0: log likelihood = -32.505509
Iteration 1: log likelihood = -20.903688
Iteration 2: log likelihood = -20.376019
Iteration 3: log likelihood = -20.359249
Iteration 4: log likelihood = -20.35919
Iteration 5: log likelihood = -20.35919

Ordered probit regression Number of obs = 34
LR chi2(7) = 24.29
Prob > chi2 = 0.0010
Log likelihood = -20.35919 Pseudo R2 = 0.3737

Table 4.17: Eco-design Practices and Financial Performance

fincalperform	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
drawmat	-1.297558	.5305862	-2.45	0.014	-2.337488	-2576286
desmaf	.5849053	.5778984	1.01	0.311	-.5477548	1.717565
desdistr	1.256273	.4988897	2.52	0.012	.2784671	2.234079
desprouse	-.1848392	.6041788	-0.31	0.760	-1.369008	.9993295
desendlife	.7148729	.4035883	1.77	0.077	-.0761457	1.505891
lnyrsoper	.8259332	.5134549	1.61	0.108	-.18042	1.832286
lnstaffsize	.2324632	.2661018	0.87	0.382	-.2890868	.7540131
/cut1	6.045846	2.483272			1.178723	10.91297
/cut2	9.014524	2.959099			3.214797	14.81425

The final log likelihood was found to be -20.35919. Also all the 34 observations in the data set were used in the analysis. The likelihood ratio chi-square of 24.29 with a p-value of 0.0010 tells us that the model as a whole is statistically significant and shows some association between the variables, as compared to the null model with no predictors. The pseudo-R-squared of 0.3737 is considered satisfactory. Design for distribution, design for raw materials and design for end of life are statistically significant with p-values of 0.012, 0.014 and 0.077 respectively hence influence financial performance. While design for manufacture and design for product use are not significant (0.311 $ 0.760) meaning that their influence on financial performance is not significant.

The findings in table 4.17 shows that by taking all other independent variables at zero, a unit increase in design for raw material practice would lead to a 1.298 decrease in financial performance. A unit increase in design for manufacture would lead to a 0.585 increment in financial performance. A unit increase design for distribution would lead to a 1.256 increment in financial performance. A unit increase design for product use would lead to a 0.185 decrease in financial performance. A unit increase design for end of life would lead to a 0.715 increment in financial performance. A unit increase years of operation would lead to a 0.826 increment in financial performance and a unit increase in staff size would lead to a 0.232 increase in financial performance.

From the findings above it can be concluded that the responded perceived that there is a relationship between the dependent variable (organization performance) and the independent variables (Eco-design practices) this is according to the chi-Square values obtained. Hence support the argument that environmental proactiveness has a positive impact on organization performance.

Chapter Five: Summary, Conclusions and Recommendations

5.1 Introduction

In this chapter, the findings of this study are summarized alongside the conclusions. Next recommendations are given based on the findings and conclusion. This is followed by an explanation of the limitation of the study. Finally suggestions are made for future research. The aim of this study was to establish the relationship between adoption of Eco-design practices and organizational performance of manufacturing firms in Mombasa County. The survey also sought to determine the extent to which Eco-design practices have been adopted by manufacturing firms in Mombasa County and establish the challenges of adopting Eco-design practices by manufacturing firms in Mombasa County. This section draws conclusions from the research findings in this study.

Research findings show that data was obtained from 8 sectors namely metals and allied, textiles and apparel, plastic and rubber, food and beverages, building, mining and construction, motor vehicle and accessories, oil and soaps and lastly salt with most of it having been obtained from food and beverages giving a percentage of 35.3 and least from Building, Mining and Construction with a percentage of 2.9%. Majority of the firms have been in operation between 1-30 years and 31-60(47.1%) and have between 1-400 employees (82.9%), further 91.2% of the firms were registered with an environmental management body, 94.1% had environmental department and 85.3% of the firms had established an environmental policy. These results show that the firms surveyed were taking environmental management seriously

With regard to Extent to which Eco-design practices have been adopted by manufacturing firms in Mombasa, the findings shows that the most favored Eco-design practice is design for product use (no energy/auxiliary material use, clean energy source, low energy consumption, clean consumables during use, few consumables needed during use and reduction of the environmental impact in the user stage) with a mean of 2.9706.

Followed closely by design for manufacture(alternative production techniques, low generation of waste, few/clean production consumables, low/clean energy consumption, fewer production processes and optimization of production techniques) mean of 2.9412, then design for use of raw materials (non-hazardous materials, low energy content materials, non-exhaustible materials, recycled materials, Recyclable materials and selection of low-impact materials) with a mean of 2.7353 and lastly design for distribution (efficient transport mode, less/clean packaging, efficient logistics and efficient distribution system) while the least is design for end-of-life (reuse of product, recycling of materials, clean waste treatment process and optimization of end-of-life system).

In overall the study found the adoption of green manufacturing practices is in the planning/implementation phase. With regards to challenges of adopting Eco-design practices by manufacturing firms in Mombasa County, Unsuccessful integration of Eco-design, Lack of knowhow in managing changes in design procedures and Lack of technical knowledge about Eco-design with means of 3.2941, 3.2059 and 3.0588 were the major challenges of adopting Eco-design practices with the least challenge being use Eco-design tools without transforming the company's operations having a mean of 2.5882. The overall indication is that this challenges poses as hindrances in the adoption of Eco-design practices. Ultimately, data was collected and analyzed on the relationship between Eco-design practices and organizational performance and it was found out that design for end of life, design for product use and design for distribution influence environmental impact reduction with p-values of 0.020, 0.057 and 0.058 respectively. Whereas the influence of design for manufacture and design for raw materials (0.154 & 0.407) on environmental impact reduction is not significant. Design for distribution and design for product use influence environmental cost saving with p-values of 0.004 and 0.020 respectively.

While the influence of design for manufacture, design for raw material and design for end of life 0.271, 0.643 & 0.081) are not significant on environmental cost saving. Design for product use influence operation performance with a p-value of 0.025. Whereas the influence of design for end of life, design for raw material, design for distribution and design for manufacture (0.128, 0.380, 0.458 & 0.583) on operation performance is not significant. Design for distribution, design for raw materials and design for end of life influence financial performance with p-values of 0.012, 0.014 and 0.077 respectively. While the influence of design for manufacture and design for product use (0.311 & 0.760) on financial performance is not significant.

5.2 Conclusions

From the study's findings, it can be concluded that, most manufacturing firms in Mombasa County, are at the planning phase of adopting Eco-design practices. Hence generally firms in Mombasa have not implemented Eco-design, this confirm the findings by Mwaguni and Munga (1997) that Manufacturing firms in Mombasa County have been connected to negative environmental impacts and these firms face different challenges of sustainable energy consumption, management of solid and liquid wastes, and compliance with environmental regulations. The major Eco-design practices established were, design for product use (no energy/auxiliary material use, clean energy source, low energy consumption, clean consumables during use, few consumables needed during use and reduction of the environmental impact in the user stage) followed closely by design for manufacture(alternative production techniques, low generation of waste, few/clean production consumables, low/clean energy consumption, fewer production processes and optimization of production techniques). The use of Eco-design tools without transforming the company's operations, lack of Eco-design tools based on technology and lack of appropriate infrastructure were considered as the least challenging factor for implementation of Eco-design practices. These practices require long-term investment and commitment by the firm thus most firms don't take them in early (Hart, 1995). The major challenges to adopting Eco-design practices include; unsuccessful integration of Eco-design, lack of knowhow in managing changes in design procedures and lack of technical knowledge about Eco-design hence this finding shows that although Mombasa firms may be having the urge to implement Eco-design what may be holding them back may be the fear of failure and lack of knowledge that's why most of them are stuck on the planning phase, these findings are in line with the outcome of Jonbrink and Melin (2008) and Theyel (2000) which identify unsuccessful integration of Eco-design in the product development process, Lack of knowhow in managing changes in design procedures and Lack of technical knowledge about Eco-design as some of the challenge of adopting Eco-design.

Lastly, from the findings it can be generally concluded that Eco-design practices has positive influence on organization performance with greatest impact being on environmental impact reduction and financial performance and less on operational performance. Hence supporting the finding by Singhal (2012) who found out that Eco-design is positively related with organizational performance including competitive advantage, economic performance, and environmental performance and also by Lopez-Gamero, Molina-Azorın and Claver-Cortes (2009) who did a study on the relationship between environmental variables and firm performance. And established that this leads to improvement of environmental performance and firm performance through reducing pollution, decreasing costs and improving credibility and reputation while also contributing to the development of valuable capabilities which increase the competitive advantage of the firm. Hence support the argument that environmental proactiveness has a positive impact on organization performance.

5.3 Recommendations

Based on the conclusion drawn in section 5.3, the researcher makes the following recommendations; First manufacturing firms should have measures in place to take care of the environment when the product is at the end of life phase because it is the least practiced and they should also embrace design for use of raw material as this is the source of every problem and prevention is better than quire. They should also get enough training and empowerment on how to implement Eco-design practices so as to ensure success, reduce fear of failure and encourage environmental sustainability. They should strive to achieve Eco-design practices as this will lead to efficiency and synergy in the society, environmental performance and reduce waste. Allocation of resources towards Eco-design practices is the most convenient way to ensure success. To make such investment, firms must develop strategic organizational resources to enable the recognition and deployment of pollution prevention Eco-design practices.

Secondly, manufacturing firms should act fast and implement Eco-design practices since there are potential benefits after implementation such as improvement in environmental impact reduction and financial performance. This benefits leads to good customer services, environmentally friendly goods, increased sales among others hence improves firm's competitive advantage. Lastly the researcher recommends that since government rules and legislations and organization capabilities are the major drivers of adoption of Eco-design practices they should review their policies and allocate more resources to ensure effective adoption and implementation of Eco-design practices. This is because the bedrock of economic and social development in Kenya is the environment; hence environment sustainability should be given first priority.

5.4 Limitations of the Study

This study was limited by the fact that some respondents deemed the information required as confidential hence some questionnaires were left unanswered.
Lastly only a section of manufacturing firms were considered, that is those registered by the Kenya Association of Manufacturers, but to enable generalization, all manufacturing firms in Mombasa county should be analyzed.

Some of the information collected from the primary source was perceived information hence faced high chances of biasness because it was subjective in nature, based on people's opinion on how they perceived a given situation or how they think about a given issue hence made it a hard for the researcher to make a general conclusion because different individuals have different opinion on the same issue or situation.

5.5 Suggestions for Further Research

The researcher recommends that future research should be undertaken in adoption of Eco-design practices by other economic sectors such as mining industry and service, since they contribute much to the growth of the economic system. What leads to adoption of Eco-design practices should also be examined. To achieve a more concrete conclusion on Eco-design practices, the research recommends a study on relationships between Eco-design practices and organization performance based on objective empirical data rather than opinions and perceptions that were used in the field.

A research on the relationship between adoption of Eco-design practices and firm's Financial performance should be conducted as it will be free from biasness and will be more objective hence make a generalize conclusion unlike perceived information where it becomes hard to make a more general conclusion as it is based on different opinions from the respondents.

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