A SURVEY OF ENVIRONMENTAL MANAGEMENT AND ITS IMPLICATIONS ON MANUFACTURING STRATEGY FOR MANUFACTURING FIRMS IN KENYA

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DECLARATION

This research project is my original work and has not been submitted for a degree in any other university.

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This project has been submitted for examination with my approval as university supervisor.

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DEDICATION

To the Lord God Almighty who provided me with all the resources that I needed during my time of study. ''Apart from Him we can do nothing'', John 15: 5

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I give thanks to the almighty god for making the whole program a success.

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ABSTRACT

Environmental management concerns are becoming more and more prominent in business due to the continued increase in environmental awareness. Environmental management affects both structural and infrastructural components of operations as it involves choices of product and process technology and underlying management systems. Product technology includes use of recycled raw materials or post-consumer recycling. Process technology involves more efficient production systems. Environmental management therefore is a significant part of manufacturing strategies.

The aim of the study was to document environment management practises among manufacturing firms in Kenya and to determine the relationship between environmental management and manufacturing strategy in Kenyan firms.

Our findings indicate that the manufacturing strategy's competitive priorities of a firm play a role in determining the level of environmental management proactiveness in Kenyan firms. Our evidence from the Kenyan manufacturing firms indicate that a host of others factors influence the adoption of environmentally conscious manufacturing strategies. It is however clear that Kenyan manufacturing firms are moving towards greater environmental awareness and responsibility.

The empirical findings of the study are consistent with empirical studies by (Noble, 1995; Ferdows and De Meyer,1990; Roth and Miller,1992) which suggests that simultaneity of the competitive priorities is possible when based on a sand cone

approach. This approach starts with quality and builds up the other priorities via the chosen path.

CHAPTER ONE: INTRODUCTION

1.1Background

Environmental management concerns are becoming more and more prominent in business due to the continued increase in environmental awareness. As a result, companies are today facing increasing demands from various stakeholders concerning the environmental performance of their products and processes. One may however wish to ask whether the environmental demands on industry are justified. We could mention just a few of the incidences that qualify the need such as:

i) The Bhopal Chemical Gas Leak Disaster where over 40 tonnes of highly poisonous methyl isocyanate gas leaked out of the pesticide factory of Union Carbide in Bhopal. Thousands died in the immediate aftermath. At least 10,000 have died in the years that have passed, and 10 more are dying every month due to exposure-related diseases,

ii) KEL Industries in Thika which due to lack of emission controls was producing sulphuric acid fumes leading to acidic rain. The aftermath was extensive corrosion of iron structures and health problems related to respiratory diseases (Kiambu District Environmental Committee 1992),

iii) The serious public health crisis resulting from the hazardous waste disposal at the love canal, New York (L.M. Gibbs, 1998), and ;

iv) The climate change, global warming, acid rain and skin cancer due to the depletion of the ozone layer. Further, industrial inefficiency plays a major role in environment pollution. The problem is further compounded by motorized transportation, wasteful consumption and some modern agricultural practice (Asadullah Khan, 2000),

More than a century of industrial development has come at a price: global warming, ozone depletion, air and water pollution, soil erosion, and deforestation are widely recognized as global environmental problems demanding immediate solutions. Government environmental policies and regulation, industry environmental management practices and pro-environmental consumer behaviors are some of the methods that can help alleviate these problems (Ottman, 1993).

According to Sinding (2000), firms not only face the deterministic elements of public environmental regulation, but also the additional demands from stakeholders and society at large. Consumers are asking for green products, the public places growing demand on firms' environmental performance, employees and neighbourhood residents are concerned about the health and safety aspects of production while non-governmental organisations are running campaigns for sustainability. Individuals are now stressing the importance of the natural environment, with surveys in the US indicating strong willingness to pay more for products that are safe to the environment, (Rosewiscz, 1990). Shareholders reflect a similar trend, recommending that top corporate priorities be the cleaning up of the environment and safer production. Larger dividends were ranked third

(Epstein ,1991). Consequently, environmental issues have the potential to play a pivotal role in the determination of a firm's competitive priorities.

Klassen and McLaughlin, (1996) observe that: '' environmental management encompasses all efforts to minimise the negative environmental impact of the firm's products throughout their life cycle''. Consequently, according to Corbett and Wassenhove, (1993) '' the range of environmental issues confronting managers is extremely broad, and their impacts potentially huge. Because of their complexity and the speed with which environmental issues evolve, no firm can afford to treat them in an adhoc fashion'' Firms therefore need to internalise and operationalise environmental management. Internalisation of environmental issues means that whenever an environmental issue crops up, the firm ''knows instinctively'' how to deal with it in a way that is both efficient and consistent with its long-term goals. Sanyal and Neves (1991) summarise environmental issues and outcomes that arise from internalisation (see Table 1.1 below,).

Table 1.1 Environmental Issues and examples of Corporate behaviour Coebett,C.J., (1993),

Issue	Social Legitimacy	Public Responsibility	Managerial Discretion
• Industrial Accidents	Comply with local regulations	• Open disclosure policy • Same standards Worldwide • Install effective crisis • Management system	• Turn good safety • Record to commercial use • Be extra cooperative in case of accidents
• Routine Pollution	• Comply • Cut pollution where profitable	• Provide right incentives Within and outside firm to reduce pollution	• Set up "green groups" To involve employees
• Waste disposal	• Make sure waste is properly disposed of	• Actively minimize waste	• Take back customers' waste • Offer waste disposal services
• Product	• Produce as long as legal and profitable • Provide adequate • Safety instructions	• Where possible use environmentally safer substitutes • Actively prevent abuse of product	• Impose own higher standards as suppliers • Use tough standards as source of competitive advantage
• Packaging	Use safe and commercially viable packaging	• Minimize unnecessary Packaging • Take packaging back from customers	• Use environmentally safe packaging as marketing argument

Operationalising environmental programs however present a major challenge. Fortunately, according to Corbett and Wassenhove (1993), there exists a number of analogies between the arising environmental programs and successful operations management concepts such as statistical process control (SPC) just-in-time (JIT), total quality control (TQC), and design for manufacturability (See Table 2 below).

Table 1.2; Environmental Programs and Existing Concepts:

Analogies , Van Wassenhove,L.N(1993),

	Environmental Programs	Existing Concepts
Process	Keeping pollution under control Reduction-of-hazardous inventories	Statistical process control **(SPC)**, Just-in-time **(JIT)**
	Zero waste	Zero defects, total quality control **(TQC)**
	Pollution limits	Production planning with capacity constraints
	Cooperating with customers and suppliers to reduce packaging	Strategic logistics alliances for time-based competition
Product	Product stewardship	After-sales service, user support groups
	Design for environment, design for disposability	Design for manufacturabililty
Management	Waste accounting	Managerial accounting
	Disclosure of environmental data	Disclosure of financial data
	Environmental auditing	Financial auditing

Another key factor Environmentally Conscious Manufacturing is standards. Standards have, for a long time, been closely associated with trade. Agreements on formal standardization are making life easier for buyers and sellers (of goods and services) around the world. Now, markets are becoming global and supply chains can cross many borders. International agreements and Standards, such as ISO 9000 and ISO 14001, can facilitate this cross-border trade. The role of International Standards as the technical foundation for the global market is explicitly recognized in the World Trade Organization (WTO) Agreement on Technical Barriers to Trade (TBT). The TBT Agreement urges governments to make the utmost use of International Standards in order to prevent unnecessary trade barriers (Henri Schwamm, 1997).

Many companies around the world still see standards as restrictive and imposing potential trade barriers. The intention of International Standards is not, however, to introduce more trade barriers, but to overcome trade barriers which currently exist as a result of the current diversity of national standards. Environmental credibility has become a factor in national and international competitiveness. ISO 14001 offers a common, harmonized approach for use among all organizations, wherever they are in the world. Designing processes/equipment to include environmental considerations requires an evaluation of all aspects of a product or service (ideally, from "cradle to grave", although this is not explicitly stated by ISO 14001). It is only through the establishment of an Environmental Management System (EMS) that an organization can, over time, monitor and control these aspects. In other words, an effective program of design for the environment requires an EMS. Implementation of ISO 14001 and subsequent certification can facilitate progress towards increased competitiveness through measurement and innovation, leading to increased profit, more efficient processes, reduced costs and a more credible image.

In Kenya, key players in environmental management are; i) The National Environmental Management Authority (NEMA) which among other things endeavors to ensure compliance to the Environmental Management and Coordination Act, and ii) The Kenya National cleaner Production Center (KNCPC) founded in July 2000 following the First Roundtable on cleaner production and sustainable consumption which was organized in Nairobi by United Nations Environmental Program (UNEP). The center is hosted by Kenya Industrial Research Development Institute (KIRDI) and receives technical support from the United Nations Industrial Development Organisation (UNIDO). So far the center has trained at least 150 industrial establishments, 10 Government departments, four municipalities, 14 Non governmental organisations, consultants, university lecturers and five umbrella organizations.

1.2 The Research Problem

Environmentalism is no longer an issue that is limited to the industrialised countries. With the increasing consumer interests, it is no longer an issue of reluctant compliance with regulatory requirements. Besides, it has increasingly emerged as a potential mechanism for gaining competitive advantage and has become an important aspect of strategic management. Due to globalisation, advancement in technology and deregulation, the effects of environmentalism are now being felt across the board. No one country can claim to be exempted.

Studies carried out on manufacturing in Kenya have focused on areas such as; aspects of strategy formulation and implementation within large private manufacturing companies in Kenya (Aosa,1992), advanced Manufacturing Technologies in Kenya (Mwangi, 2002), and operations strategies applied for the competitiveness of Kenyan large manufacturing firms (Nyamwange,2001). So far no study has addressed the issues that arise from Environmentally Conscious Manufacturing in Kenya. Given the central role that the manufacturing function plays in enabling a firm to gain competitive advantage, the cardinal question that arises is how implementation of environmental management impacts on this important function. This study therefore seeks to address the question: **What are the implications of environmental management on manufacturing strategies of Kenyan firms?**

1.3 Objectives Of The Study

- To document environment management practises among manufacturing firms in Kenya.
- To determine the relationship between environmental management and manufacturing strategy in Kenyan firms.

1.4 Importance Of The Study

Below are possible beneficiaries to whom the results of the study will be of importance;

- The results of the study will provide corporate and operations decision-makers with a basis from which they can make informed strategy and investment decisions in the light of increasing environmental awareness and pressure.
- It will also help to identify environmental opportunities that enhance acquisition of capabilities that could result in competitive advantage.

- The study shall also be of interest to international bodies such as the Global Environmental Facility (GEF) and the United Nations Environment Program (UNEP). The study will be useful in establishing how such bodies can assist the Kenyan manufacturing firms in capacity building for improved environmental management.
- The Kenya Association of Manufacturers will also find the study important in their endeavour to have their members strategically aligned in relation to the emerging environmental and operations management issues.
- Other beneficiaries of the study will include the National Environmental Management Authority (NEMA) whose efforts to enhance the implementation of Environmental Management Coordination Act will be validated by the results of the study.
- The study will also go a long way in ensuring that the Kenyan consumer becomes a recipient of more environmental friendly products. It is hoped that the findings of the study will encourage more manufacturing firms to implement environmentally conscious management strategies.
- The Kenya National Cleaner Production Center (KNCPC) will find the study important in assessing the extent of their impact on Kenyan manufacturing firms.

CHAPTER TWO: LITERATURE REVIEW

2.1 Strategy

A strategy is a description of the manner in which a company or enterprise intends to gain a competitive advantage. Strategies describe actions aimed directly at altering the strength of the enterprise relative to that of its competitors. Strategies should allow the enterprise to gain a relative advantage through measures its competitors will find hard to follow and allow the advantage to be extended even further.

According to Porter (1996), Strategy is creating a fit among a company's activities. The success of a strategy depends on doing many things well – not just a few. The things that are done well must operate within a close knit system. If there is no fit among the activities, there is no distinctive strategy and little to sustain the strategic deployment process. Management then reverts to the simpler task of overseeing independent functions. When this occurs, operational effectiveness determines the relative performance of the organization.

2.2 Manufacturing Strategy

Manufacturing strategy is defined as the pattern of decisions made within a firm's manufacturing function that guide structural and infrastructural investments to support overall firm objectives (Anderson et al, 1989; Hayes & Wheelwright, 1984; Skinner, 1969), although unplanned investments made outside initial strategic formulations must also be included (Wheelwright, 1984). Structural investments include those made in such areas as plant capacity, production equipment, and product technology, and infrastructural investments include those made in production planning, organizational structure, labor practices, training, and performance measurement systems. Implementation encompasses all investments in structural and infrastructural areas and capabilities. These investments have been called manufacturing strategy initiatives (Garvin, 1993), and collectively they result in a manufacturing strategy portfolio.

The central role of the manufacturing function in enabling a company to gain competitive advantage in the marketplace is being increasingly recognized. Previously, manufacturing was viewed as a purely operational consideration in which planning was short-term and very focused. Instead, the manufacturing strategy of a firm should follow from and be integrated with the overall business strategy to be an effective competitive weapon (Sakis and Rasheed, 1995).

It is clear that a manufacturing strategy, like any strategy, revolves around a pattern of choices. The choices or decisions involved are concerned less with individual day-to-day, tactical activities and more with the whole transformation system, that is part of the organization and the resources, competencies and capabilities needed. These choices also embrace changes in the wider competitive environment in which the firm is "embedded". The pattern of decisions tends to be of a medium- to long-term nature and to reflect both the core capabilities and competencies of the company, and how it uses resources and technologies to provide sustainable competitive advantage in its particular market sector.

Conceptually, there are a number of possible types of manufacturing strategy, and some may even be combined. Literature reveals among others the following types that exist in different industry sectors: (Lowson, 2002)

- quick response (QR) or planned product response;
- efficient consumer response (ECR);
- time-based competition (TBC);
- supply network strategy (including supply chain, value chain, and value stream);
- just-in-time (JIT), just-in-time II (JIT II) and vendor-managed inventory (VMI);
- agility in the supply system, agile manufacturing, strategically flexible production or proximity manufacturing;
- virtual organization, virtual logistics;
- strategic outsourcing;
- world-class manufacturing (WCM);
- lean production and lean thinking;
- strategic postponement;
- logistics strategy;
- strategic purchasing, strategic procurement, network sourcing, materials management;
- collaborative planning, forecasting and replenishment (CPFR);
- continuous improvement (CI); and
- e-operations.

2.3 Competitive Priorities Of Manufacturing Strategy

Porter (1996) argues that for any organization, the creation of true economic value (the gap between price and cost to produce) is the bottom-line in terms of their survival or failure. Sustainable competitive advantage can only be achieved by operating at lower cost, by commanding a premium price through differentiation, or doing both. These cost and price advantages can be realised in two ways:

- Operational effectiveness (doing the same things as your competitors but doing them better); and/or

- Strategic positioning (doing things differently from competitors in a way that delivers a unique type of value to customers).

Operational effectiveness includes, for example, better technologies, superior inputs, better-trained employees, more effective management structure, etc., and is the domain of the operations strategy. Strategic positioning on the other hand, includes a different set of features, a different array of services or different logistical services (these aspects are mainly the focus of the wider business strategy, but will also be of some concern for an operations strategy).

According to Porter (1996), simply improving operational effectiveness does not provide competitive advantage. This can only be done by achieving and sustaining higher levels of operational effectiveness than competitors. Best practice tends to be copied quickly! As it becomes harder to sustain operational advantages, strategic positioning becomes all the more important. This goes far beyond the pursuit of best practices which is the quest of the manufacturing strategy. It involves the highly integrated configuration of a tailored value chain - the series of primary activities required to produce and deliver a product or service (inbound logistics, operations, outbound logistics, marketing and sales and after-sales services - the first three again being the province of the manufacturing strategy).

Slack (1991) argues that competitiveness can be achieved through a manufacturing contribution to creating strategic advantage. In this context, the author refers only to a narrow range of operations strategies (those concerned with physical production). Nevertheless, he contends that competitive advantage can be achieved by "making things better, right, fast, on time, cheaply and flexibly". This has a clear resonance for manufacturing strategies, which is considered to have four competitive priorities viz.; quality, dependability, cost and flexibility.

It is generally accepted by operations and manufacturing managers (Fitzgerald et al, 1991) that operations management performance has a major impact on product cost, product quality, and dependability. In an attempt to provide a better understanding of the operations manufacturing function, Skinner (1969) developed the traditional tradeoffs framework which suggests focused plants depending on the competitive priority. The tradeoffs concept drew a lot of debate out of which the simultaneity or the cumulative school was born (Ferdows and De Meyer, 1990). Empirical studies suggest that simultaneity is possible based on a sand cone approach. This approach starts with quality and builds up the other priorities via the chosen path eg quality, dependability, speed of delivery, cost, flexibility and innovation (Noble 1995), or quality-dependability-flexibility-cost (Roth and Miller 1992) or quality-delivery-market scope-flexibility-cost (Fedows and De Meyer 1990).

Basing his argument on the productivity frontier, Michael Porter (1996) argues that tradeoffs will exist only on the productivity frontier. The productivity frontier is the sum of all existing best practices of a firm at any given time. Tradeoffs are only possible if the productivity frontier was static. However, the productivity frontier is dynamic. Through creativity and innovation, world class organisations keep on pushing the frontier into new horizons all the time. Terry Hill (1993), however, argues that tradeoffs do not exist. Factors leading to excellent performance in one priority also lead to excellent performance on the other priorities. This means that world class companies are able to out perform their competitors on every aspect of performance. He further suggests firms can only remain at the frontier through innovativeness, which is the order winner for world class organisations. The competitive priorities of quality, cost, flexibility and dependability are only mere order qualifiers for firms.

2.4 Elements Of Environmentally Conscious Manufacturing Strategy

The key elements of environmentally conscious manufacturing are the environmental technologies and the three Rs of environmentally conscious manufacturing namely: reduce, remanufacture, and reuse/recycle. Together, these strategies can result in less consumption of non-replenishable resources and considerably lower levels of pollution.

In this section, we will discuss each of these environmentally responsible approaches to manufacturing and the related technologies.

Environmental management affects both structural and infrastructural components of operations as it involves choices of product and process technology and underlying management systems. Product technology includes use of recycled raw materials or post-consumer recycling. Process technology involves more efficient production systems. Environmental management is therefore a significant part of manufacturing strategies (Sakis and Rasheed, 1995).

2.4.1 Environmental Technologies

Classification of environmental technologies is a necessary first step in the process of characterizing them. Shrivastava (1995) proposed classifying environmental technologies into five themes based on their general management orientation: design for disassembly, manufacturing for the environment, total quality environmental management, industrial ecosystems, and technology assessment. However, according to (Waybark & Klassen, 1999) these themes are difficult to measure over time, cannot be easily overlaid onto existing manufacturing strategy research, and include aspects of both strategy development and implementation.

Instead, other research supports a more straightforward typology for characterizing environmental technologies as belonging to three general categories: pollution prevention (Cairncross, 1992; Freeman et al., 1992; Schmidheiny, 1992), management systems

(Dillon & Fischer, 1992), and pollution control (Hart, 1995). These categories are discussed below.

a) Pollution prevention technologies.

This category is defined as structural investments in operations that involve fundamental changes to a basic product or primary process. These technologies reduce or eliminate pollutants by using cleaner alternatives than those currently in place (Freeman et al., 1992). Pollution prevention technologies can be further characterized as product or process adaptation, although the two are related. Product adaptation encompasses all investments that significantly modify an existing product's design to reduce any negative impact on the environment during any stage of the product's manufacture, use, disposal, or reuse. Process adaptation refers to fundamental changes to the manufacturing process that reduce any negative impact on the environment during material acquisition, production, or delivery (Waybark & Klassen, 1999).

Some management systems, such as improved housekeeping practices, might be considered to be pollution prevention (Freeman et al., 1992; Hart, 1995) or to be parts of implementing product or process adaptation. The emphasis here is the physical product and/or process change. This definition reflects the structural/infrastructural distinction made in manufacturing strategy research, which has earned broad theoretical and managerial acceptance in operations management (Hayes & Wheelwright, 1984).

Pollution prevention technologies can provide net benefits because of their potential to improve environmental performance up-front rather than as an afterthought (Porter & van der Linde, 1995; Schmidheiny, 1992). The fundamental rethinking of a product or manufacturing process also places fewer constraints on the means of achieving environmental improvement, thereby offering greater opportunity for innovation. Parallels can be drawn to current views on quality management, in which the failure costs associated with controlling and repairing poor quality far outweigh the costs of prevention and better design (Juran, Gryna, & Bingham, 1988; Klassen & McLaughlin, 1993). Because the implementation of pollution prevention technologies depends on organizational and knowledge-based resources, greater competitive advantage is expected during periods of uncertainty due to high industry growth (Russo & Fouts, 1997), new environmental regulation (Dean & Brown, 1995), declining availability of natural resources, or increased external stakeholder pressure (Hart, 1995).

Different technology portfolio compositions also have potential implications for environmental performance. If such performance is broadly defined as reducing any environmental impact (Shrivastava, 1995), all environmental technologies, by definition, have some positive impact. However, pollution prevention technologies are expected to significantly reduce the total quantity of harmful pollutants released into the environment and disposed of (Freeman et al., 1992; Schmidheiny, 1992). Pollutants are not merely transferred from one medium to another (for instance, from the air to solid waste); instead, their generation is avoided.

b) Management systems.

Monitoring, internal and external reporting, and related compliance systems are examples of management systems (Little, 1989; Marguglio, 1991). Environmental management systems are infrastructural investments that affect the way manufacturing is managed. They also include efforts to formalize procedures for evaluating environmental impacts during capital decision budgeting, to increase outside stakeholder involvement in managing operations, to increase employee training for spill prevention and waste reduction, to establish an environmental department, and to develop new procedures for cross-functional coordination. These systems function to both control and prevent environmental degradation.

c) Pollution control technologies.

Like pollution prevention technologies, these are structural investments. However, in contrast to prevention technologies, pollution control technologies treat or dispose of pollutants or harmful by-products at the end of a manufacturing process, either immediately or later. To accomplish this, a plant must add operations or equipment to the end of an existing manufacturing process, thereby leaving the original product and process virtually unaltered. Pollution control technologies can be further characterized as either remediation or end-of-pipe controls. Remediation refers to cleaning up environmental damage caused by crises or past practices, and it is often driven by regulation or by improvement in scientific understanding of environmental damage. End-of-pipe controls refer to using equipment that is added as a final process step to capture pollutants and wastes prior to their discharge (Walley & Whitehead, 1994).

In contrast to pollution prevention, pollution control does not usually reduce the total quantity of harmful pollutants either released into the environment or disposed of, thus also posing future liabilities (Freeman et al., 1992; Schmidheiny, 1992). Any environmental benefit offered by pollution control technologies is limited to reducing the risk associated with a specific pollutant, either transferring it from a less secure medium to a more secure one (for instance, from air emission to solid waste) or converting it to a more benign substance. Thus, no significant change in the quantity of pollutants is expected.

2.4.2 Waste Reduction

Reduction refers to efforts undertaken by manufacturing firms to minimize waste. The initial impetus for waste reduction came from legislative and governmental initiatives in this direction. The main emphasis in waste minimization is on source reduction. This includes products, processes, and technologies that will reduce "in-process" waste streams as distinct from "end-of-pipe" waste. Source reduction activities include:

- input changes;
- operational improvement that leads to loss prevention;
- production process changes;
- product reformulation;
- inventory control; and
- administrative and organizational activities such as training.

Many of the recent practices, philosophies, and approaches to manufacturing management such as Total Quality Management (TQM) and Just-In-time (JIT), can also result in the reduction of in-process waste streams. The role of TQM in ECM practices has been discussed by a number of authors, such as Willig (1994), and is practiced by a number of organizations. Eliminating wastes and continuous improvement are basic tenets of the TQM philosophy. The TQM objectives of quality at the source and defect reduction have direct implications for total waste reduction. While scrap reduction directly results in less waste, defect reduction indirectly does the same by minimizing the need for rework and the consequent consumption of additional energy.

TQM tools such as concurrent engineering can be used at various levels of analysis to cut waste. Concurrent engineering is a systematic approach to the integrated and simultaneous design of products and related processes, including manufacture, marketing, and support. Requiring close coordination among various functional areas, it results in benefits that go well beyond the reduction of waste. It also requires the consideration of manufacturing cost, quality control, production scheduling, marketing (including packaging and point of sale), user requirements, disposal, recycling, remanufacture, and disassembly characteristics (Sarkis et al, 1995).

The objective of concurrent engineering is the simultaneous consideration of the life cycle impacts during preliminary system design along with the immediate considerations of functionality. One of the goals of TQM is to simplify the design of products. Not only does it lessen the variety of items in the inventory, but it may also result in less work, energy, and time that are usually associated with the production process. In addition, Wheeler (1992) has found that companies that have achieved environmental excellence use continual benchmarking and do not deviate from their goals.

Just-in-time (JIT) inventory practices can also lead to waste reduction. Because fewer materials, components, and parts are held in inventory, there is less potential for waste. Other developments and approaches that can lead to waste reduction include additive fabrication processes (instead of subtractive), databases that help identify less hazardous substitutes, and waste monitoring technologies that reduce leakage into the environment (Willig, 1994).

2.4.3 Re-Manufacturing

Re-manufacturing refers to the repair, rework, or refurbishment of components and equipment for either sale or internal use. The remanufacturing process basically includes the disassembly of components, inspection and testing of the re-manufacturable components, incorporation of any new improvements, and reassembly of components with newer systems. The product is assembled, finished, tested, packaged, and distributed in the same manner as new products.

Remanufacturing has a number of implications for ECM. If pursued on a large scale, it can significantly reduce both the consumption of raw materials and pollution resulting from discarded used components and subassemblies. The major differences between manufacturing and remanufacturing, writes Garvin (1992), arise as a consequence of using worn-out, discarded, or defective products as a primary materials source. This factor affects not only the production process employed but also the contractual relationship with customers, who are also suppliers. The incoming material is known to be defective in some way. The production of reliable products from parts of unknown quality is one of the greatest tests of a remanufacturer's skills. Corporations such as Xerox and Siemens have incorporated the remanufacturing concept into their design strategies and today offer customers the possibility of returning expired equipment. IBM's remanufacturing efforts involve designing products with modular components. When expired products are returned, each individual system component is converted to other uses, thereby reducing waste (Sarkis and Rasheed, 1995).

2.4.4 Recycling and Reuse

Most of the raw materials used in manufacturing can be recycled, although in many cases it may be difficult to pass on the costs associated with doing so. Solid waste materials such as paper, glass, plastics, and metals are abundant, with more and more being stored in landfills daily. More than 100 million tons of non-perishable wastes are buried in landfills every year, with at least 78 million tons being made up of recyclable materials. This includes 50 million tons of paper, 12 million tons of glass, 11 million tons of plastics, and million tons of aluminum. With mandatory recycling laws in many states, the availability of recyclable material is steadily increasing every year (Sarkis and Rasheed, 1995).

Although the terms "recycling" and "reuse" are used interchangeably, there is a slight distinction between the two. If a material can be used with minimal treatment, the term reuse is more appropriate, whereas a material that has undergone a significant amount of treatment may be considered to be recycled. For example, when a beer producer cleans and refills bottles, it is a case of reuse. But when glass bottles are crushed and used for making asphalt, it is a case of recycling. Reuse mostly takes place within an organization. Recycling typically involves an outside firm that takes materials from' disposed products and transforms them back into virgin materials for manufacturing. In such industries as aluminum cans and steel, recycled materials may constitute as much as 25 percent or more of all raw materials used.

From a procurement perspective, selection processes for suppliers and vendors need to include the criteria of being able to supply environmentally friendly products, especially those that make use of recycled materials. The computer division of American Airlines has switched to 100 percent recycled paper. Consumer Reports and several telephone companies are moving in the same direction. Coca-Cola has entered into an alliance with Hoechst Celanese, its supplier of plastic bottles, and has underwritten a large part of the R&D expenses to develop a bottle containing 25 percent recycled plastic (Sarkis and Rasheed, 1995). Such instances of coordination and cooperation with suppliers are becoming more and more common in the recycling arena.

Although the availability of recycled materials is not a problem, two basic issues that need to be addressed before they are widely accepted commercially are cost and quality.

The issue of the quality of products using recycled materials is partly substantive and partly perceptual. In some cases, the quality of recycled materials is already superior to that of virgin materials. For example, recycled-content paper is believed to perform better in photocopiers and laser printers. In many other cases, the quality of recycled materials is steadily improving. Even when the quality is lower, for many applications of a given product it is still considered acceptable.

Customer perception is the problem in the case of many other products. For example, plastic lumber, which can be made from recycled plastic, is in many ways superior to wood because it does not rot or splinter and has almost no maintenance cost. But in customers' minds, wood is superior to plastic. It would take considerable effort in terms of advertising and customer education to overcome these perceptual problems (Garvin, 1992).

2.5 Manufacturing Strategy, Environmental Awareness And Their Integration

2.5.1 The Stages of Manufacturing Strategy Integration

The framework presented by Wheelwright and Hayes (1984) is a widely recognized model that defines four stages of manufacturing strategy integration. This framework is summarized as follows:

Stage I; Internally neutral: goal is minimization of manufacturing's negative impact.

Stage II; Externally neutral: goal is to follow industry practice. Capital investment used to achieve scale advantages.

Stage III; Internally supportive: goal is support of corporate strategy with a formulated manufacturing strategy.

Stage IV; Externally supportive: goal is provision of strategic manufacturing capabilities resulting in corporate-level strategic opportunities.

By expanding this manufacturing strategy framework to include EM, a framework may be drawn that strategically evaluates the complementary alignment of operational effectiveness and environmental management effectiveness. While it is safe to assume that very few companies fit squarely within a single stage, one can assume that the stages form a strategic continuum from reactive, simply responding to the mandates of corporate strategy, to proactive, providing guiding capabilities for restructuring corporate strategy (Newman and Hanna, 1996).

Stage I organizations simply attempt to minimize manufacturing's negative potential. Manufacturing, in this stage, is called on to be at best internally neutral. Manufacturing is not expected to make a positive contribution. Controls are put into place to monitor each process closely. If any strategic considerations do arise, outside experts are called in since manufacturing personnel are not perceived as strategic thinkers. Reasons for adopting the stage 1 view of manufacturing include perceived simplicity of manufacturing processes and/or perceived lack of manufacturing's ability to impact on the competitive position.

Manufacturing operations within a **stage II** organization are assigned a goal of external neutrality. They must strive to achieve parity with competing manufacturers.

Organizations benchmark competitors' process capabilities. Processes are then improved to reach competitors' capabilities. Economies of scale are manufacturing's primary contribution to competitive advantage. Top managers of these firms typically use capital investment (or divestment) as a means of obtaining temporary competitive advantage.

Stage III organizations expect manufacturing to support corporate goals. Manufacturing assumes an internally supportive role by formulating its own strategy and operating policies that support the corporate strategy. Assuming a top-down strategy formulation approach, operating at this level necessitates increased corporate-level involvement on the part of senior manufacturing management. Manufacturing management must have a clear understanding of the nature of the competitive advantage sought by the corporation.

Finally, manufacturing in **stage IV** organizations assumes an externally supportive strategic position. These organizations view manufacturing as a source of competitive advantage that extends beyond the economy of scale benefits of capital equipment investments. Managers are constantly assessing new manufacturing technology that might contribute new capabilities that could lead to new market opportunities. Functional barriers are reduced and competitive strengths are gained through the integration of functional strategies. For stage IV organizations, understanding the competitive advantage gained through integrated, multifunctional thinking drives corporate strategy (Newman and Hanna, 1996).

2.5.2 The Stages of Strategic Environmental Awareness

Based on empirical findings, Winsemius and Guntram (1992) defined four stages of environmental awareness as follows:

Stage I; Reactive: environmental management is a staff-level function. Goal is legal compliance.

Stage II; Receptive: environmental management is a line-level function. Goal is optimization of existing conditions, including some process redesign.

Stage III; Constructive: cradle-to-grave approach to products, and acceptance of responsibility for products even after their sale. New co-operation with suppliers, customers and competitors, and a striving for technological or organizational breakthroughs.

Stage IV; Proactive: management incorporates environmental challenge as an element of quality management. Goal of zero emissions.

Similar to the stages of manufacturing strategy integration described in the last section, the stages described here also form a continuum from a reactive stance, with a goal of regulatory compliance, to a very proactive position where environmental concerns play a major role in the formulation of manufacturing and corporate strategy. Like Wheelwright and Hayes' model, these stages should be viewed as a continuum and not mutually exclusive (Newman and Hanna, 1996).

In **stage I**, responses to government policies take a defensive posture. Companies tend to dig in their heels and do only what is required. These companies will use specialists to implement "end of pipe" or "add on" solutions while seeking to minimize response costs.

Stage II organizations begin to give line managers environmental responsibilities. Their goal is to respond as efficiently as possible to government regulations through optimizing existing conditions and minor process redesign.

Constructive responses, in **stage III**, look beyond their process alone using a "cradle to grave approach" to accept responsibility for their products. Industry-wide co-operation is pursued in an attempt to generate quantum leaps in environmental capabilities to meet today's challenges.

Proactive organizations in **stage IV** internalize the environmental challenge as an element of quality management and strategic decision making. They attempt to develop a vision which inspires all elements of the company to overcome societal environmental challenges of today and tomorrow. They also use these advances to "raise the playing field" to society's long term benefit and to their competitive advantage in the short term (Newman and Hanna, 1996).

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Research Design

The study is a cross-sectional survey that sought to explore the impact of environmental management on manufacturing strategy for Kenyan Manufacturing firms.

3.2 Population and Sample

The population of the study was the manufacturing firms operating in Kenya that are practising cleaner production through collaboration with the Kenya National Cleaner Production Centre (KNCPC), a United Nations project hosted by the Kenya Industrial Research Development Institute (KIRDI). The firms collaborating with (KNCPC) total to 47 manufacturing firms (see appendix IV for the list). These firms are spread out in Nairobi, Thika, Mombasa, Nakuru and Webuye. The firms are drawn from ten sub-sectors viz: Textiles, Spinning, leather, metal, chemical, paper, edible oils, brewing, foods and canning. The firms are therefore representative of the Kenyan manufacturing sector. The study was a census of the 47 firms collaborating with KNCPC as at 30th September 2003. Sampling was not necessary.

3.3 Data Collection

The study made use of primary data collected through a questionnaire (appendix II) with both open and closed-ended questions. The closed-ended questions enabled the collection of quantitative data for analysis; while the open-ended questions were used in collecting qualitative data on the respondent's view of environmental management issues in manufacturing.

The questionnaires were administered to factory managers and operations managers who are best placed to provide details regarding the operations of the companies. A majority of the firms were in Nairobi, Thika and Nakuru. The ''drop and pick later'' method backed by telephone follow up was used for these firms.

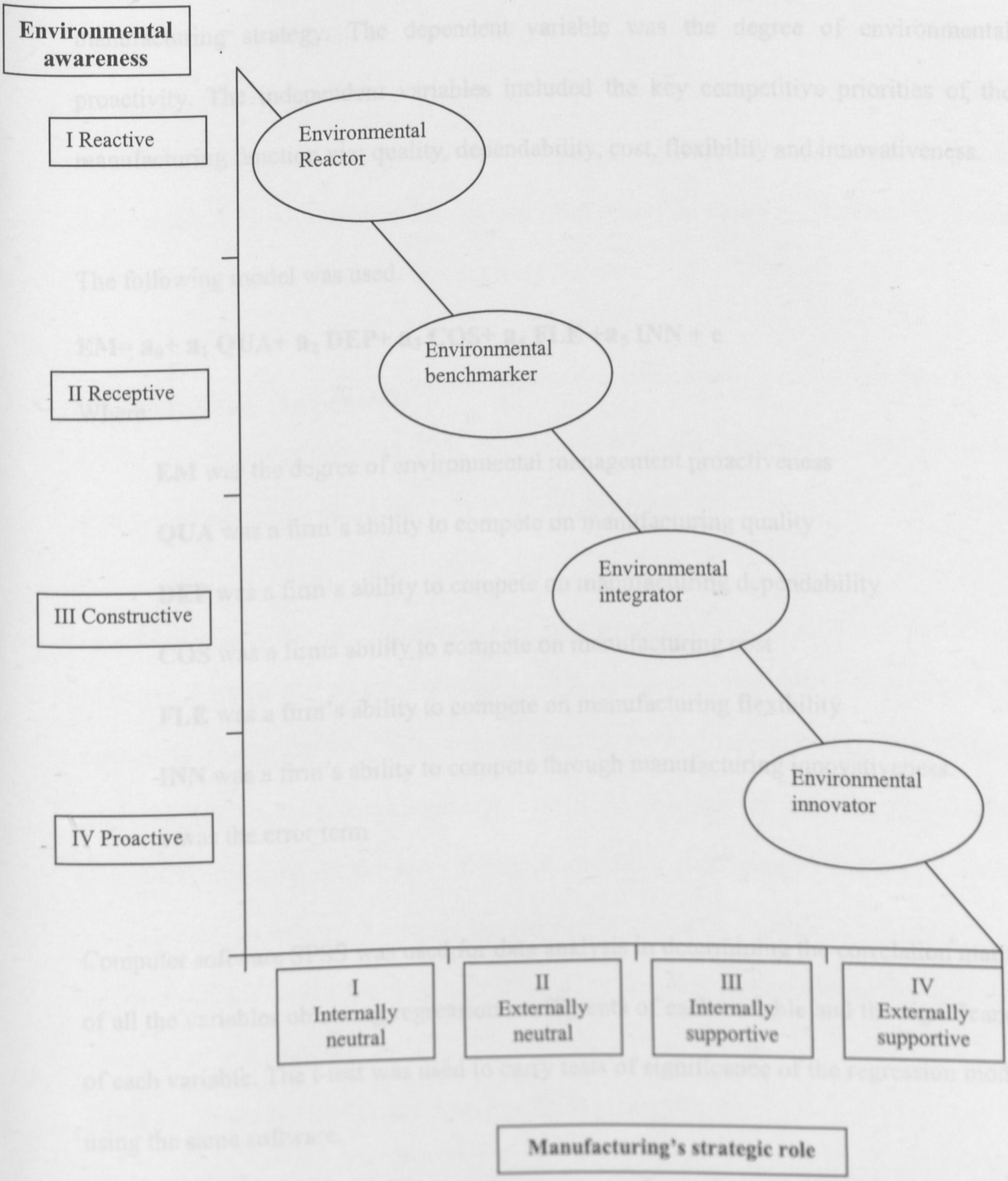
3.4 Data Analysis

The data collected was edited for accuracy, uniformity, consistency and completeness and arranged to enable coding and tabulation before final analysis.

Data was analysed through descriptive statistics. The descriptive statistics included use of tables, percentages and proportions in order to show the relationship between the variables collected across the firms covered by the study.

The Newman and Hanna (1992) framework for eco-manufacturing strategic integration which blends Winemius and Guntram (1992) environmental awareness model and Wheelright and Hayes (1984) manufacturing model was used to map the Kenya manufacturing firms (See figure 3.1 below). The survey results were applied on the framework to establish existence of synergies between the stage of environmental awareness and the effectiveness of the manufacturing function.

Figure 3.1; The Newman and Hanna Framework for Eco-Manufacturing Strategic Integration



Multiple regression analysis and correlation were undertaken to examine the relationship between the degree of environmental proactivity and the key elements of the manufacturing strategy. The dependent variable was the degree of environmental proactivity. The independent variables included the key competitive priorities of the manufacturing function viz; quality, dependability, cost, flexibility and innovativeness.

The following model was used.

$$EM = a_0 + a_1 QUA + a_2 DEP + a_3 COS + a_4 FLE + a_5 INN + e$$

Where:

EM was the degree of environmental management proactiveness

QUA was a firm's ability to compete on manufacturing quality

DEP was a firm's ability to compete on manufacturing dependability

COS was a firms ability to compete on manufacturing cost

FLE was a firm's ability to compete on manufacturing flexibility

INN was a firm's ability to compete through manufacturing innovativeness.

e was the error term

Computer software SPSS was used for data analysis in determining the correlation matrix of all the variables obtaining regression coefficients of each variable and the significance of each variable. The t-test was used to carry tests of significance of the regression model using the same software.

CHAPTER FOUR: DATA ANALYSIS AND FINDINGS

4.1 Years of Operation

The years of operation are the number of years the firm has been in operation. Most of the companies surveyed have been in operation for more than 20 years. The oldest company was 62 years in operation while the youngest had operated for 5 years. Most of the companies in the leather industries had been operating for over 50 years. The mean years of operation for the 26 companies were 30 years.

4.2 Company Ownership

Of the 26 companies surveyed, 73% were owned by locals, 19% were jointly owned by foreigners and locals and the rest 11% by foreigners only.

4.3 Number of Products Produced and Product Market

Majority of the firms were producing up to 10 products as represented by 69% of the total number of firms. The rest 31% were producing above 10 products. Of the 26 firms surveyed, 69% of them were producing both for the foreign and local market. The rest 31% were producing for the local market alone. Firms producing for the export market had adopted more environmental management strategies especially to conform to international standards than those operating in the domestic market alone. This is clearly shown in table 4.1 below.

Table 4.1 Product Market and Average ECM strategies

Product market	Number of firms	Average degree of ECM
Domestic	8	38
Both domestic and foreign	18	43
Totals/overall average	26	41

4.4 Annual Company Turnover

The annual company turnover was measured in million Kenya shillings. Majority of the firms surveyed were having an annual turnover of up to 500 million as represented by 84.6 of the total 26 firms. The rest 15 % were having an annual turnover of above 1 billion.

4.5 Company Mission

Majority of the firms indicated they had a company mission as represented by 62% of the total 26 firms. The rest 38% did not have a company mission. Among the firms who indicated they had mission statements, some had no written down missions, they were only interpreting their goals and targets as their mission statements. In addition none had any indication of the environmental conservation within the company mission. All surveyed firms said they considered the manufacturing function as important in enhancing their competitiveness.

4.6 Type of Manufacturing Process and Types of Products Manufactured

Majority of the firms surveyed were using more than one manufacturing process. Line processing was the most widely used mode of processing followed by batch and finally continuous method. None of the firms was using job processing alone but was always combined with other modes of processing.

Majority of the firms surveyed were in the textiles industry as represented by 23% of the 26 firms. The next major categories were in chemicals, petroleum, rubber and plastics industry, leather, metal, foods and paper industry in that order. The industry that had more environmental problems was the leather industry especially because of the by-products of the industry. Observations showed that their environmental management demands were higher.

4.7 Competitive Priorities of Firms

All the firms surveyed were competing on cost, flexibility, dependability, quality and innovation. Quality was the major competitive strategy to most of the firms. It was followed by cost, dependability, flexibility and finally innovation which was the least competitive priority among the firms surveyed. This agrees with empirical studies by (Noble, 1995; Ferdows and De Meyer,1990; Roth and Miller,1992) which suggests that simultaneity of the competitive priorities is possible when based on a sand cone approach. This approach starts with quality and builds up the other priorities via the chosen path. Table 4.2 below represents the extent to which each of the priorities is considered competitive:

Table 4.2 Competitive priorities of firms

Competitive priority of firm	% of firms that consider it a competitive strategy	% of firms that do not consider it a competitive strategy
Quality	92.3	7.7
Cost	73.1	26.9
Flexibility	69.3	30.7
Dependability	69.3	30.7
Innovation	61.5	38.5

4.8 ECM Awareness and Adoption

All the surveyed firms were aware of environmental management and were also adopting it in varying degrees. All the surveyed firms were participants of activities of the KNCPC and this explains the total awareness of ECM. Majority of the firms had adopted the environmental management practices for a period of less than 6 years as indicated by 69% of the 26 firms surveyed. The rest 31% had adopted the ECM for more than 6 years.

4.9 ISO 14000 Certification, Reasons and Efforts of Certification

Of the total 26 firms surveyed only 2 of them were ISO 14000 certified. The rest 24 firms were not certified. The main reason for certification among the certified firms was to fulfill international standards for export and improve competitiveness. Others were for social responsibility, to improve the environment and also to comply with the Environmental Act.

Most of the firms who were not certified had no efforts to ensure certification. Some of the efforts made to achieve certification included; emphasizing on cleaner production, getting Kenya Bureau of Standards marks of quality, conducting environmental audits, putting internal control systems into place, putting new effluent systems while others had contacted environmental assessors.

4.10 Impacts of ECM

The survey sought to know how implementation of ECM strategies had impacted on quality of products, flexibility, cost, lead times, reliability, product features, volume variability, capacity, innovation and profits of the firm. Majority of the firms surveyed indicated that ECM had a positive impact on quality, cost, reliability, product features, innovation and the profits. Most firms indicated that ECM had no impact on flexibility, lead times, volume variability and capacity of the firm. This information is summarized in table 4.3 below.

Table 4.3 Impacts of ECM

Competitive Priority	A	B	C	D	E
Quality	61.5	34.6	3.8		
Dependability	50.0	26.9	23.1		
Cost	46.2	23.1	11.5	19.2	
Profits	38.5	38.5	15.4	3.8	3.8
Prod features	42.3	26.9	26.9		3.8
Innovation	42.3	19.2	34.6	3.8	
Lead times	26.9	30.8	42.3		
Flexibility	26.9	26.9	46.2		
Capacity	30.8	23.1	34.6	7.7	3.8
Volume variability	30.8	19.2	42.3	3.8	3.8

A- % of firms where ECM had very positive impact on CP

B- % of firms who said ECM had positive impact on CP

C- % of firms who said ECM had no impact on CP

D- % of firms where ECM had negative impact on CP

E- % of firms where ECM had very negative impact CP

We would also like to document the following additional benefits were identified in the study.

- Improvement in the quality of air in environment and also leads to cleaner environment
- Reduction of paint deposits on buildings especially those in chemical industry
- Reduced employee medical costs due to better working conditions hence improving their welfare.
- Reduced wastage of materials and labour resources hence increasing production efficiency.
- Enhances occupational safety and prevents fire hazards.
- Helps in training of employees to produce better quality goods.
- Increases the environmental responsibility on workers.
- Enables the firms to compete in foreign markets.
- Helps the firms to comply with National Environmental legislation.
- The processes used in production become more user friendly.
- Reduces noise pollution in factory.
- Increases social responsibility and improves company's image.
- Leads to good neighbouriness especially if odour pollution is reduced.

4.11 Significance of Challenges Faced in Preventing Adoption of ECM

Firms face various challenges when trying to adopt ECM strategies. Some of the challenges were very significant in preventing the firms from adopting ECM strategies while some were not very significant. Technical challenge was the most significant to all the firms surveyed. It was followed by lack of appropriate technology skills deficiency, poor infrastructure, lack of political will, lack of appreciating resulting benefits and inadequate legislation.

The study identified the following additional challenges faced by the Kenyan manufacturing firms.

- It's costly
- Increased cost of training employees
- Poor record keeping in most companies is an internal hindrance.
- Poor drainage systems and sewerage systems in most localities where firms are operating.
- Un-uniform legislation by different stakeholders, for example, NEMA, MOW and Municipal Councils have different standards.
- Resistance to change by some employees.
- Employees do not adhere to set guidelines.
- It is hard to identify better ways of producing in an environmental conscious method
- The government puts a lot of pressure on the firms instead of facilitating the ECM.

4.12 Environmental Management Practices

The table below summarises the different environmental Management strategies used and the frequency of use by the firms surveyed.

Table 4.4 Environmental Management Practices

ECM Practise	A	B	C	D
Pollution Prevention	65.4	26.9	3.8	-
Pollution Control	50	30.8	11.5	-
Repair	30.8	19.2	15.4	-
Rework	19.2	26.9	19.2	-
Refurbishment	19.2	23.1	7.7	3.8
Recycling/Reuse	53.8	11.5	15.4	4.7
Input Changes	34.6	34.6	-	-
Improved Operations	61.5	34.6	16	3.9

A- % of firms that Always Use practice

B- % of firms that Occasionally use practice

C- % of firms that Rarely Use practice

D- % of firms that are introducing practice

The Environmental Management Practices used by each firm were varying. Majority of firms make use of pollution prevention, pollution control, recycling and operational improvements. Repair, rework and refurbishment are the least used environmentally conscious strategies.

Table 4.5, Stages of Environmental Awareness

Stage	Frequency	Percentage
Reactive	0	0
Receptive	2	7.7
Constructive	16	61.5
Proactive	8	30.8
Total	26	100

All the firms surveyed exhibited some degree of environmental awareness though at varying levels. This can be explained by the fact that the firms surveyed were participants of activities of the Kenya National Cleaner Production Centre. Majorities of the firms have practised ECM for a period of less than 6 years. 35 % of the firms has practised ECM for less than 3 years, while 35% has practised for a period of 3-6 years, 19% for 6-10 years and the rest 11.5 for more than 10years. Most of the firms surveyed were in the constructive stage as represented by 61% of the firms. 31%were proactive and 8% receptive. None were reactive.

4.13 Manufacturing Strategy Integration

The framework presented by Wheelwright and Hayes (1984) is a widely recognized model that defines four stages of manufacturing strategy integration. This framework is summarized as Stage I; Internally neutral: goal is minimization of manufacturing's negative impact. Stage II; Externally neutral: goal is to follow industry practice. Capital investment used to achieve scale advantages. Stage III; Internally supportive: goal is support of corporate strategy with a formulated manufacturing strategy and, Stage IV; Externally supportive: goal is provision of strategic manufacturing capabilities resulting in corporate-level strategic opportunities.

Table 4.6, Manufacturing Strategy Integration

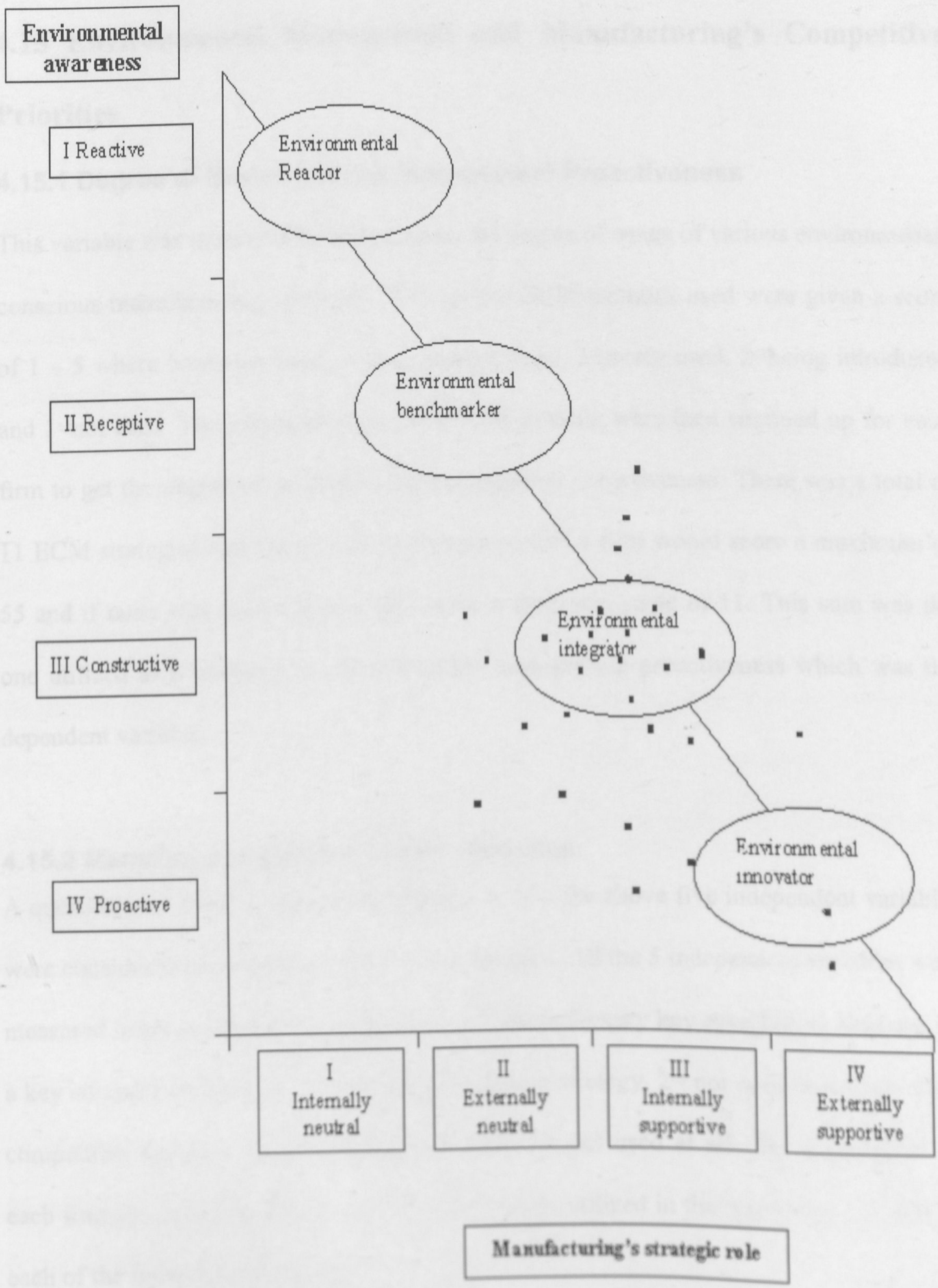
Manufacturing Strategy Integration	Frequency	Percentage
Internally Neutral	0	0
Externally Neutral	6	23.1
Internally Supportive	17	65.4
Externally Supportive	3	11.5
Total	26	100

The majority of the firms surveyed were internally supportive as represented by 65% 0f the total firms surveyed. 23% of the firms were externally neutral and the rest 12% externally supportive.

4.14 Eco-Manufacturing Strategic Integration

Respondents were asked to indicate which stage of manufacturing integration and which stage of environmental management best describes their company. There was no apparent relationship between industry, company size or process type and the position on the Newman and Hanna (1992) framework for eco-manufacturing strategic integration which blends Winemius and Guntram (1992) environmental awareness model and Wheelright and Hayes (1984) manufacturing (See figure 4.1 below)

Figure 4.1: Scatter on Newman and Hanna Framework



4.15 Environmental Management and Manufacturing's Competitive Priorities

4.15.1 Degree of Environmental Management Proactiveness

This variable was measured by summing up the degree of usage of various environmental conscious-manufacturing strategies. The various ECM methods used were given a score of 1 – 5 where 5=always used, 4=occassionaly used, 3=rarely used, 2=being introduced and 1=not used. The scores given in each ECM strategy were then summed up for each firm to get the degree of environmental management proactiveness. There was a total of 11 ECM strategies and hence if all were always used a firm would score a maximum of 55 and if none was used a firm would score a minimum score of 11. This sum was the one utilized as a measure for environmental management proactiveness which was the dependent variable.

4.15.2 Manufacturing's Competitive Priorities

A question was asked to gather information on how the above five independent variables were considered important as competitive strategies. All the 5 independent variables were measured using scores that ranged from 1 – 5 where 5= very key competitive strategy, 4= a key competitive strategy, 3= average competitive strategy, 2= not considered important competitive strategy but used occasionally and 1= not used at all. The score given by each firm for each competitive strategy was the one utilized in the regression analysis for each of the independent variables.

From the regression analysis, the relationship between Environmental Management and Manufacturing Strategy Competitive Priorities is as shown below.

Table 4.7: Regression Results

EM =	42.92	- 0.996QUA	+ 0.159DEP	– 1.336COS	– 1.077FLE	+ 3.239INN
Standard Error of Estimate	10.42	1.545	1.359	2.52	2.52	1.404
Level of significance	0.001	0.697	0.908	0.487	0.497	0.032
t- values	4.119	-0.395	0.117	-0.709	-0.697	2.307

The coefficient of determination R^2 was 0.229 with a standard error of estimate of 6.401.

An R2 of 0.229 shows that 22.9% of the variations in the degree of environmental management proactiveness is explained by variations in importance of quality, dependability, cost, flexibility and innovation as competitive priorities of manufacturing firms. Innovation was the most significant estimator of the degree of EMP at 96.8% confidence level. It is also significant as shown by the high t-value of 2.307.

Correlation results were consistent with the regression results. The importance of innovation as a competitive strategy showed a strong relationship with the degree of EMP as compared to the other four variables. The correlation coefficient is 0.325.The relationships are represented in the correlation matrix below:

Table 4.8: Correlation Results

	A	B	C	D	E	F
Degree of environmental management proactiveness	1.000	-0.047	0.054	-0.060	0.034	0.325
		0.818	0.79	0.771	0.870	0.105
Importance of cost as competitive strategy	-0.047	1.000	0.615**	0.765**	0.401*	0.604**
	0.818		0.001	0.000	0.043	0.001
Importance of dependability as competitive strategy	0.054	0.615**	1.000	0.708**	0.529**	0.602**
	0.792	0.001		0.000	0.005	
Importance of flexibility as competitive strategy	-0.060	0.765**	0.708**	1.000	0.433*	0.589**
	0.771	0.000	0.000		0.027	0.002
Importance of quality as competitive strategy	0.034	0.401*	0.529**	0.433*	1.000	0.484*
	0.870	0.043	0.005	0.027		0.012
Importance of quality as competitive strategy	0.325	0.604**	0.602**	0.589**	0.484	1.000
	0.105	0.001	0.001	0.002	0.012	

**correlation is significant at 0.001 significance level

* correlation is significant at 0.05 significance level

The upper values are the correlation coefficients while the lower values are the levels of significance.

A- Degree of environmental management proactiveness

B- Importance of cost as competitive strategy

C- Importance of dependability as competitive strategy

D- Importance of flexibility as competitive strategy

E- Importance of quality as competitive strategy

F- Importance of quality as competitive strategy

From the regression results, the independent variables were able to explain at least 23% of the variations in the degree of EMP with a standard error of estimate of 6.401. Competitive priorities of a firm can play a role in determining the level of environmental management proactiveness but there are also other factors that play a role. These include political will and government legislation, deficiency of skills, technical difficulties/lack of appropriate technology, and poor infrastructure among other challenges.

5.1.2 ECM Strategies and Environmental Management Proactiveness

There was a positive correlation between most of the challenges encountered in adopting ECM strategies and the degree of environmental management proactiveness. From the correlation matrix, the most significant challenge was the lack of political will, followed by resistance to change, type of ownership of firm, government policies, inadequate legislation, absence of public pressure, technical difficulties, lack of appreciation of resulting benefits, skills deficiencies, poor infrastructure, and lack of appropriate technology in that order.

Our evidence from the Kenyan manufacturing firms indicate that a host of others factors influence the adoption of environmentally conscious manufacturing strategies. It is however clear that Kenyan manufacturing firms are moving towards greater environmental awareness and responsibility.

APPENDIX I List of Firms Collaborating with KNCPC

	FIRM	LOCATION
1.	BAT Kenya Ltd	Nairobi
2.	Bedi Investments Ltd	Nakuru
3.	Bidco (K) ltd	Thika
4.	Broadway Bakeries	Thika
5.	Brookside Dairy Ltd	Ruiru
6.	Bullies Tanneries Ltd	Thika
7.	Cartubox Industries Ltd	Thika
8.	Carnaurd Metal Box Ltd	Thika
9.	Cilio Del Monte (K) Ltd	Thika
10.	Coil Products (K) Ltd	Mombasa
11.	Cook 'n' lite Ltd	Mombasa
12.	East African leather Factory Ltd	Nakuru
13.	Flamingo Bottlers	Nakuru
14.	Flamingo Paints Ltd	Nakuru
15.	Geniterns Ltd	Nairobi
16.	Haco Ltd	Nairobi
17.	Kapa Oil Refineries Ltd	Nairobi
18.	Kapi Ltd	Nairobi
19.	Kenya Breweries	Nairobi
20.	Kel Chemical Industries Ltd	Thika
21.	Kenya Paper Mills	Thika
22.	Kenya Vehicle Manufacturers	Thika
23.	Kenblest Bakeries Ltd	Thika
24.	Leather Industries of Kenya Ltd	Nakuru
25.	Londra Ltd	Nakuru
26.	Lamsons Industries Ltd	Nakuru
27.	Mabati Rolling Mills	Mombasa
28.	Mega Spin Ltd	Nakuru
29.	Menegai Oil Refineries	Nakuru
30.	Nakuru Fibres Ltd	Nakuru
31.	Nakuru Industries Ltd	Nakuru
32.	Nakuru Tanners Ltd	Nakuru
33.	Njoro Canning Factory Ltd	Nakuru
34.	Oil Crop Development	Nairobi
35.	Pan Paper Mills	Webuye
36.	Palmac Oil Refineries Ltd	Mombasa
37.	Pwani Oil Products Ltd	Mombasa
38.	Pyrethrum Board of Kenya	Nakuru
39.	Rosin (K) Ltd	Nakuru
40.	Spin Knit Ltd	Nakuru
41.	Spinners and Spinners	Ruiru
42.	Spin Knit Dairy Ltd	Nairobi
43.	Tetra Pak Ltd	Nairobi
44.	Thika Cloth Mills	Thika
45.	Twiga Chemical Industries Ltd	Nairobi
46.	United Textiles Industries	Nairobi
47.	Valley Bakery Ltd.	Thika

Part III Environmental Consciousness and application

1. Have you heard of environmentally conscious manufacturing, or cleaner production, or green manufacturing?

   Yes [ ]

   No [ ]

2. Has your organisation adopted environmentally conscious manufacturing?

   Yes [ ]

   No [ ]

3. For how long has your organisation made use of environmentally conscious manufacturing?

   Below 3 years [ ]

   3 to 6 years [ ]

   6 to 10 years [ ]

   Over 10 years [ ]

4. Is your organisation ISO 14000 certified?

   Yes [ ]

   No [ ]

   If yes, what factors led your company to seek certification?

   ....

   ....

   ....

   If no, please summarise any current efforts towards achieving the certification?

   ....

   ....

   ....

   ....

   ....

   ....

- Volume variability [ ]
- Capacity [ ]
- Innovation [ ]
- Profits [ ]

b) Indicate other benefits of adopting Environmentally Conscious Manufacturing

i)……………………………………………………………………………………

ii)……………………………………………………………………………………

iii)……………………………………………………………………………………

iv)……………………………………………………………………………………

v)……………………………………………………………………………………

vi)……………………………………………………………………………………

7. a) Listed below are some of the challenges which prevent manufacturing firms from adopting Environmentally Conscious Manufacturing. Please tick ( ) in the appropriate box to indicate the extent to which you consider these challenges significant.

	Very Significant	Moderately Significant	Not Significant
• Technical difficulties	[ ]	[ ]	[ ]
• Skills Deficiencies	[ ]	[ ]	[ ]
• Government Policies	[ ]	[ ]	[ ]
• Lack of Political will	[ ]	[ ]	[ ]
• Poor Infrastructure	[ ]	[ ]	[ ]
• Ownership	[ ]	[ ]	[ ]
• Absence of public pressure	[ ]	[ ]	[ ]
• Resistance to change	[ ]	[ ]	[ ]
• Lack of appropriate Technology	[ ]	[ ]	[ ]
• Lack of appreciation of Resulting Benefits	[ ]	[ ]	[ ]

- Inadequate legislation [ ] [ ] [ ]

b) Please list any other challenges faced while implementing Environmentally conscious Manufacturing.

i……………………………………………………………………………………

ii……………………………………………………………………………………

iii……………………………………………………………………………………

iv……………………………………………………………………………………

v……………………………………………………………………………………

8. Please indicate how helpful each of the following organisations has been in relation to your implementation of environmentally conscious Manufacturing.

	Very Helpful	Moderately helpful	Not Helpful
UNEP	[ ]	[ ]	[ ]
KNCPC	[ ]	[ ]	[ ]
NEMA	[ ]	[ ]	[ ]
MENR	[ ]	[ ]	[ ]
KEBS	[ ]	[ ]	[ ]
GEF	[ ]	[ ]	[ ]

Where:

UNEP: United Nations Environmental Programme

KNCPC: Kenya National Cleaner Production Centre

NEMA: National Environmental Management Authority

MENR: Ministry of Environment and Natural Resources

KEBS: Kenya Bureau of Standards

GEF: Global Environmental Facility