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AN EVALUATION OF THE IMPACT OF ENVIRONMENTAL MANAGEMENT SYSTEMS ON THE ECONOMIC PERFORMANCE OF BUSINESS ENTEPRISES IN SOUTH AFRICA

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Master of Science in Engineering

A research report submitted to the faculty of Engineering and the Built Environment, University of the Witwatersrand, in fulfillment of the requirements for the degree of Master of Science in Engineering.

Johannesburg, 2005

DECLARATION

I declare that this research report is my own, unaided work. It is being submitted for the Degree of Master of Science in Engineering in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

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Motseki Khuto

August 29, 2005

ABSTRACT

This research report focuses on the impact of environmental management systems (EMS) on the economic performance of business enterprises with respect to the three research variables, namely water, energy and raw materials. A systematic sampling technique with a random start and the *K-Value* sampling interval were employed to draw a sample size of 30 enterprises from a list of 240 EMS certified enterprises. However, the response rate ultimately turned out to be only 30 % of the sample size.

The research discovered that EMS programmes that are practised by enterprises under study in South Africa are inefficient, as strategies adopted to cut down on the consumption of the research variables are inefficient. It has further been found that due to unavailability of data, business enterprises failed to consistently and convincingly provide data pertaining to the costs of EMS adoption.

Inefficient strategies in cutting down consumption of research variables are concluded to have led to minimal savings and revenue accruing to the enterprises. This is observed to be a result of the following factors: *not undertaking some research ahead of any action to shed light on the nature and magnitude of responsive measures required for specific problem areas; costly EMS technology and infrastructure; lack of innovativeness in exhausting the full potential value of the research variables; poor EMS practice* etc. Failure to provide data by enterprises is observed to be a result of little value, which enterprises attached to information storage and documentation as well as environmental accounting system, yet they are such crucial components of EMS. This has therefore made impossible to weigh gains against costs to establish whether business enterprises are gaining or losing in their EMS projects.

On the basis of the observed shortcomings, enterprises are advised to have in place a comprehensive EMS database and to conduct some research ahead of any responsive action. The South African government is recommended to intervene by providing an enabling environment for EMS by implementing EMS supporting policies and promoting awareness campaigns. Furthermore, research into the observed problem areas has been recommended in order to get to the bottom of EMS problems in South Africa.

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This research report is written in memory of my late beloved mother,

‘Mamphokotseng Tabitha Khuto

CONTENTS **Page**

DECLARATION i
ABSTRACT.....ii
ACKNOWLEDGEMENTS iii
DEDICATION…….iv
CONTENTS.....v
LIST OF FIGURES……..ix
LIST OF TABLES x
LIST OF ILLUSTRATIONS……x
LIST OF NOMENCLATURE.....xi

CHAPTER ONE

1. INTRODUCTION……...1

1.1 Background to the Statement of the Problem……1
1.2 Statement of the Problem.....4
1.3 Research Objectives.....6
1.4 Research Hypothesis.....6
1.5 Delimitations of the Study.....6
1.5.1 Scope of the Study.....6
1.5.2 Research Variables.....6
1.6 Justification of the Study.....7
1.7 Limitations of the Study.....8
1.8 Structure of the Remaining Part of the Report.....8

CHAPTER TWO

2. LITERATURE REVIEW 9

2.1 Introduction.....9
2.2 Historical Background to Environmental Management 9
2.2.1 Development of Natural Resource Use and Production Patterns 9
2.2.2 Effects of Natural Resource Depletion and Production Patterns 13
2.2.3 Emergence and Development of Environmental Concerns 15

2.3 Understanding Environmental Management 20
2.3.1 Rationale Behind Environmental Management 20
2.3.2 Development of Environmental Management 21

2.4 Understanding Environmental Management Systems 25
2.4.1 What EMS is 25
2.4.2 Natural Environment and Business Enterprise Relations 26
2.4.3 Rationale Behind EMS Adoption 27
2.4.4 Development of EMS Standards.....28
2.4.5 ISO 14001 EMS 29
(i) What ISO 14001 is 29
(ii) Elements of ISO 14001 EMS 29
(iii) ISO 14001 EMS Certification and Accreditation.....32

2.5 EMS and Economic Performance Relations of Enterprises 35
2.5.1 Industrial Ecology and Design for the Environment 35
2.5.2 CSR Contribution in EMS-Economic performance Relations 37
2.5.3 A Critical Analysis of Two EMS-Economic Performance
Relations Case Studies 42
2.5.4 Conclusion 44

2.6 Understanding Environmental Accounting.....45
2.6.1 Environmental Accounting 46
2.6.2 Why Environmental Accounting 46
2.6.3 Accounting for Environmental Costs.....47
2.6.4 Environmental Accounting Tools 50
(i) Present Worth Method 50
(ii) Internal Rate of Return.....52
(iii) Payback Analysis 53

CHAPTER THREE
3. RESEARCH METHODS.....54
3.1 Introduction 54

3.2 Units of Analysis.....54
3.3 Data Collection Methods 54
3.3.1 Secondary Data 54
3.3.2 Primary Data 54
3.4 Data Processing and Analysis.....57
3.4.1 Data Processing.....57
3.4.2 Data Analysis 57

CHAPTER FOUR

4. FINDINGS AND DATA ANALYSIS.....58
4.1 Introduction.....58
4.2 The Impact of the Variable *'Water'* on the Economic
Performance of Business Enterprises.....58
4.2.1 Introduction.....58
4.2.2 Strategies Adopted to Reduce Water Consumption.....58
4.2.3 Total Water Consumption Level Per Year.....60
4.2.4 Water Consumption Rate Per Unit of Production 61

4.3 The Impact of the Variable *'Energy'* on the Economic
Performance of Business Enterprises.....63
4.3.1 Introduction.....63
4.3.2 Strategies Adopted to Cut Down on Energy Consumption.....63
4.3.3 Total Energy Consumption Level Per Year.....65
4.3.4 Energy Consumption Rate per Unit of Production.....66

4.4 The Impact of the Variable *'Raw Materials'* on the
Economic Performance of Business Enterprises 68
4.4.1 Introduction 68
4.4.2 Strategies Adopted to Promote
Efficient Utilisation of Raw Materials.....68
4.4.3 The Extent to which Waste Materials are Utilised 69
4.4.4 Annual Expenditure on Raw Materials 71
4.4.5 Annual Revenue and Savings Gained due to Reuse, Sale

and Recycling of Waste From The Research Variables 72
4.5 Overall Costs and Gains of EMS Adoption.....74
4.5.1 Introduction.....74
4.5.2 Rationale behind Adoption of Certified EMS 74
4.5.3 EMS Financing 77
4.5.4 Impact of EMS Financing on the Economic
Performance of Enterprises.....77
4.5.5 Total Implementation Cost of EMS Adoption.....79
4.5.6 EMS Maintenance Costs per Year in the Research Variable Areas ..80
4.5.7 Year of EMS Certification.....81
4.5.8 Recovery of Funds Invested In EMS Implementation.....82
4.5.9 Documentation of Environmental Costs and Gains Information 84

CHAPTER FIVE

5. SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND AREAS OF FURTHER RESEARCH 86

5.1 Introduction.....86
5.2 Summary of Major Research Findings 86
5.2.1 Findings on the Variable *'Water'* 86
5.2.2 Findings on the Variable *'Energy'*.....87
5.2.3 Findings on the Variable *'Raw Materials'*.....88
5.2.4 Findings on the Overall Cost and Gains of EMS Adoption.....89

5.3 Conclusions 90
5.4 Recommendations 93
5.5 Areas for Further Research.....94

REFERENCES.....96

APPENDICES

APPENDIX A: QUESTIONNAIRES
APPENDIX B: EVALUATION OF COST AND SAVINGS

LIST OF FIGURES

Figure		Page
2.1	Human Perspective	12
2.2	Maslow's Hierarchy of Needs	13
2.3	Potential Benefits Associated with New Technology	24
2.4	Interaction between Business Enterprise and the Environment	27
2.5	Elements of EMS	32
2.6	Linear Industrial System	35
2.7	Closed-Loop (Cyclic) Industrial System	36
2.8	Benefits of Eco-Efficiency and Cleaner Production	37
2.9	The Sustainable Development Journey	39
4.1	Strategies Adopted to Reduce Water Consumption	59
4.2	Strategies Adopted to Reduce Energy Consumption	64
4.3	A Comparison of the Rate in which Waste was dealt with by each Enterprise in the Pre-EMS era as against the EMS	70
4.4	Rationale Behind EMS Adoption	75
4.5	Impact of EMS Financing on the Financial Performance of Enterprises	77
4.6	Total Cost of EMS Implementation	79
4.7	Average Maintenance Cost Per Year	80
4.8	Year of EMS Certification	82
4.9	Recovery of Invested Capital	83
4.10	Documentation of Environmental Costs and Gains	85

LIST OF TABLES

Table **Page**

2.1 Examples of Environmental Costs Incurred by Firms 49

2.2 Alternative A at 10 % Interest Rate 51

2.3 Alternative B at 12 % Interest Rate 52

4.1 Total Water Consumption Pattern Per Year……..61

4.2 Total Energy Consumption Level Per Year 66

4.3 Annual Revenue Gained Owing to Reuse, Sale and Recycling of Waste Materials 73

LIST OF ILLUSTRATION (S)

Illustration **Page**

3.1 Sampling Interval 56

LIST OF NOMENCLATURE

CSR:	Corporate Social Responsibility
DfE:	Design for the Environment
DNA:	Data not Available
DTIE:	Division of Technology, Industry and Economics
EIA:	Environmental Impact Assessment
EMS:	Environmental Management Systems
EPA:	Environmental Protection Agency
HIV/AIDS:	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
IPCC:	Intergovernmental Panel on Climatic Change
IRR:	Internal Rate of Return
ISO:	International Organisation for Standardisation
LCA:	Life Cycle Assessment
MARR:	Minimum Acceptable Rate of Return
NCEDR:	National Centre for Environmental Decision-making Research
n.d.:	No Date
NDEMS:	National Database on Environmental Management Systems
NGO:	Non-governmental Organisation
PoHS:	Puradyn Oil Filtration System
R&D:	Research and Development
SHE:	Safety, Health and Environment
UNEP:	United Nations Environmental Programme
IETC:	International Environmental Technology centre
UN:	United Nations
UNCED:	United Nations Conference on Environment and Development
US:	United States
WSSD:	World Summit on Sustainable Development

CHAPTER ONE

1. INTRODUCTION

1.1 Background to the Statement of the Problem

Environmental management systems (EMS) are an organized system of taking care of environmental aspects of a business enterprise. It is a practice that enables business enterprises to contain the impact of their activities, products and services on the natural environment in an ordered manner. EMS is a system that addresses environmental aspects of business enterprises in a manner that does not compromise the economic performance of business enterprises. It strives to promote both the economic/financial and environmental performances of business enterprises through optimising the input materials from the natural environment, hence sustainable development (South African Bureau of Standards (a), n.d.). EMS is a system that:- provides an outline for practices, procedures and processes to manage the environmental impact of business enterprises; documents such impacts and their mitigation; communicates such impacts to stakeholders; and evaluates environmental performances of business enterprises (Federal Program Division, n.d.). In other words, in the interest of sustainable development, EMS equips business enterprises with a comprehensive environmental management framework to enhance environmental performances of business enterprises through efficient utilisation of natural resources, which translates into positive economic performances of business enterprises.

Sustainable development is therefore the ultimate goal, which environmental management tools such as EMS are geared towards achieving. It is an approach that takes into account the fact that the planet earth on which mankind lives is made up of limited resources, which have to take care of mankind's unlimited needs, thus the inadequate resources the earth is in possession of have to be utilised in a responsible manner. In support of this argument, the Commission on Environment and Development (1987) defines sustainable development as:

> *development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

This simply means that developmental practices of the current generation should not exhaust natural resources to ensure that future generations will likewise inherit a healthy life-supporting environment.

This issue of sustainable development came into being following an awareness of escalating depletion of natural resources and environmental pollution resulting from business enterprises' operations to meet their principal goal of wealth accumulation/profit-making. In line with this argument Badenhorst et al (1997) point out that every business enterprise has a principal reason /objective for existence, and to attain such an objective, it has to pursue other secondary objectives as well that will enable it to get to its primary objective. For example, in a capitalist system, the primary goal of business enterprises is to make profit, but in their profit-making endeavour, enterprises have to pursue other secondary objectives such as responding to people's needs of goods and services. Shetty (1979) substantiates the above argument by outlining the main objectives of business enterprises in their order of importance as follows: (i) profit making; (ii) growth, (iii) market share; (iv) social responsibility; (v) employees well being; (vi) quality of product; and (vii) service to customers. In view of the above arguments it becomes clear therefore that the principal reason for existence of business enterprises is to make profit while other reasons are secondary, thus they are routes leading to the primary goal of profit-making.

In pursuit of business enterprises' primary objective of profit making, entrepreneurs start off with identifying secondary objectives (i.e. responding to needs of the people by providing them with the required goods and services) that will enable them (entrepreneurs) to achieve their primary objective/goal of profit-making. It is important to note that *goods* are a product of natural resources, as they are made up of resources from the natural environment. It is equally important to acknowledge that *services* as well are provided through some form of infrastructure and equipment,

which are also made up of natural resources. To start with, for an enterprise to operate, land upon which it will be located is required as well as the construction of infrastructure i.e. buildings; equipment; and access roads for transportation of required resources, goods and services etc. Following infrastructural needs, depending on the nature of an enterprise, specific raw material, and other inputs such as water and energy for processing and manufacturing of products are essential. It is worth noting that even at the construction of infrastructure stage, inputs such as energy and water (i.e. resources from the natural environment), and other already manufactured resources (i.e. building equipment/materials, which are as well derived from natural resources) are key ingredients in infrastructural development. It is of paramount importance also to highlight that throughout the whole process of business enterprise and the natural environment interaction, starting from the raw material extraction right through to product consumption phase, by-products are generated and disposed of into the environment. In support of the above statements Turner et al (1993) indicate that to provide goods and services to those who need them – business enterprises acquire inputs (raw materials) from the environment and transform them (through the use of other inputs such as energy and water) into products ready for consumption, and in the process dispose of by-products into the environment.

The problem surfaces as consumption of natural resources rises and outpaces regeneration. As a result such natural resources get depleted. Similarly, by-products generated by business enterprises cause environmental pollution, whose complexity and deadliness are due to technological advancements in the field of production. In support of this, Miller and Miller (1991) and Mannion and Bowlby (1992) point out that developments in the agricultural practices (i.e. introduction of engine powered machinery; use of pesticides and fertilisers etc); and industrialization through use of fossil fuel and extraction of more natural resources etc introduced adverse impact on the environment, whose results are evident in environmental problems including acid rain and the depletion of both stratospheric ozone and the natural resource base. Solow (1974) cited in Swanson (1996) refers to this overuse of natural resource in the interest of wealth accumulation as the manipulation of natural resources upon which existence of people is dependent.

Upon the recognition of the adverse impact of unsustainable economic development on the environment, concerns about environmental degradation surfaced. In response to such environmental degradation concerns, environmental management regulations and practices came into being, which since then have gradually been developed from the reactive to the current proactive practices. The introduction of environmental management regulations and practices brought in problems on the part of business enterprises. (NB: such problems will be dealt with in the statement of the problem below).

1.2 Statement of the Problem

It is important to bear in mind that it is a dream of every profit making business enterprise to maximize its returns, thus improve the economic performance of the enterprise. It is equally imperative to note that the world is currently advocating responsible use of natural resources by business enterprises as well as a reduction in the generation of by-products, in order to promote sustainable development. It is also vital to note that the world is advocating adoption of EMS by business enterprises as an essential tool towards achieving sustainable development.

Much as EMS advocates spell out positive contribution of EMS to the economic performance of business enterprises, introducing EMS into daily profit making oriented 'operations' of business enterprises brings in a clash of interest between business enterprises and EMS proponents (i.e. regulators). This is because financial resources are '*misdirected*' from the business enterprises' core objective or priority of making profit to taking care of environmental performances, which is an issue that in the first place never featured in the priorities of business enterprises. The introduction of environmental regulations and EMS in the interest of environmental protection is therefore perceived by business enterprises as an uncalled for environmental load, as it requires them to allocate part of their financial and other business resources to promoting environmental performance. The problem is aggravated by high costs associated with the adoption of current proactive EMS. EMS associated costs are evident amongst others in - *EMS design/planning; implementation; technology procurement; and monitoring and corrective action programs,* as EMS entails

programs such as cleaner production, product stewardship, design for the environment, and training of personnel to execute the EMS program effectively. In support of this argument Gingrich (1995) argues that environmental management practices and regulations are costly projects from which invested capital cannot be recovered, as they simply drain business enterprises' financial resources away from profitable projects

The problem of EMS adoption is quite evident in the developing countries, as they are impoverished and therefore are concerned with their most immediate problems such as famine; health (HIV/AIDS); illiteracy; political instabilities etc which require urgent action ahead of distant problems such as environmental problems. Given the limited resources, specifically financial resources developing countries are operating with, it is quite uphill for them to provide an enabling environment for EMS adoption while at the same time battling to respond to their most basic problems with the limited financial resources they are trying to accumulate. Even the macro enterprises operating in developing countries which can afford to finance their EMS adoption consider it problematic as cost recovery period in developing countries is quite lengthier than the usual time due to the fact that the local market of developing countries is not *'green'* procurement oriented due to their inability to afford the cost of *green'* products. Adopting industrial ecology's closed-loop approach is also a problem as business enterprises that can consume, for example by-products from one company, as their own raw material cannot afford to install technology that will enable them to turn such by-products into their own raw materials. The recycling industry is also poor, and likewise reuse of waste material is minimal. On the basis of these arguments therefore, the question still stands*: are EMS economic benefits evident in the developing countries?* Based on these debates, this research will therefore look into *'the evaluation of the impact of EMS on the economic performance of business enterprises in South Africa'*.

1.3 Research Objectives

The main objectives, which the study is meant to achieve, are as follows:

- To establish the impact of EMS on business enterprises inputs with specific reference to the three research variables, namely *water, energy* and *raw materials* in terms of optimisation of such inputs.
- To evaluate the impact of EMS on business enterprises' cost reduction.
- To establish the impact of EMS on the proceeds of business enterprises.
- To ascertain the nature of EMS projects payback period and its impact on the financial footing of business enterprises.
- To explore ways of promoting the adoption of EMS by business enterprises - given its effect on the economic performance of business enterprises.

1.4 Research Hypothesis

The hypothesis to be tested by the study reads as follows;

- Implementation of EMS impacts positively on the economic performance of business enterprises.

1.5 Delimitations of the Study

1.5.1 Scope of the Study

This research will basically focus on the relationship between EMS and financial performance of business enterprises that have adopted certified EMS in South Africa.

1.5.2 Research Variables

Efficient utilization of inputs, namely *water, energy and raw material*s by business enterprises contributes not only to positive environmental performance of business enterprises, but to their economic/financial performance as well, as optimisation of such inputs reduces demand for such resources by business enterprises from the natural environment and similarly enhances the economic/financial performance of enterprises. Equally, inefficient use of such resources also impacts negatively on both the environmental and economic/financial performances of enterprises (World Bank, 2000).

It is quite important to note that there is a wide spectrum of factors that can contribute either positively or negatively towards the economic performance of enterprises, based either on the efficiency or inefficiency of EMS systems employed in different enterprises. However, based on the World Bank's (2000) arguments above, this research will be confined to the following three input variables alone: *water, energy, and raw materials.* This research will focus on the costs associated with these variables in terms of technology procurement, installation services and maintenance costs; and the savings and revenue accruing to the company as a result of these variables alone.

1.6 Justification of the Study

It is crucial to note the following: (i) *the world is advocating sustainable development to protect the environment in the interest of both the present and future generations; (ii) the primary goal of business enterprises is to promote their economic performance; and (iii) undertaking EMS (a vehicle towards sustainable development) is an exercise associated with high financial implications.* On the basis of these arguments it becomes imperative to evaluate the relationship between the economic and environmental performances of enterprises that have adopted certified EMS in South Africa. Interest in this area of study has been ignited by the fact that EMS adoption is an undertaking that requires massive resources, especially financial resources, which are a corner stone in availing other essential resources. Based on the fact that: the principal goal of business enterprises' existence is to make profit, and that EMS is an exercise that requires the very financial resources which business enterprises are after, it has therefore become an area of interest to investigate the impact of EMS on enterprises' bottom line i.e. their economic performances.

This study will be beneficial to business enterprises, the government of South Africa, the worldwide community, as the study will recommend strategies for reform to ensure that EMSs do not have a negative effect on economic/financial performances of business enterprises, especially in the developing countries where EMS and its support tools are at their infancy and therefore, not yet fully entrenched.

1.7 Limitations of the Study

Due to the fact that this is an academic research paper, the sample size of the study was too small, therefore not very representative of all EMS certified enterprises in South Africa. The misrepresentation of certified EMS business enterprises in South Africa was further aggravated by the fact that out of a sample size of 30 business enterprises only 30% of them responded to the questionnaire while 70% of them became uncooperative and therefore, did not respond, yet they had promised to do so.

Furthermore, it is important to note that although the research variables (i.e. *water, energy and raw materials)* to which the study was confined are essential in measuring the economic performance of EMS certified business enterprises, there are other equally important variables such as: *market share; reduced regulatory cost; improved community relations etc,* which are not covered by the study, yet their contribution in the economic performance of business enterprises is likewise very crucial. The omission of such variables therefore, may distort a true picture of the impact of EMS on the economic performance of business enterprises. It was also difficult to quantitatively establish the impact of EMS on the economic performance of business enterprises, as all business enterprises were unable to provide the required information consistently due to unavailability of such information. Only further research in the field of EMS and economic performance relations that can take care of the highlighted limitations can prove whether or not these results are typical of a South African situation.

1.8 Structure of the Remaining part of the Report

Chapter two consists of the literature review. This chapter is intended to demonstrate some understanding of the concept of EMS and its relations to the economic performance of business enterprises. This chapter looks critically into the work of other authors in this field. Chapter three deals with research methodology, where it outlines how data was collected, processed and analysed. Chapter four focuses on the presentation of findings and their analysis, and finally chapter five covers the summary of major research findings; conclusions; recommendations; and areas for further research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter is going to review the literature behind environmental management systems (EMS) in order to get a broader picture of EMS and its relationship with business enterprises in as far as the economic performances of the business enterprises are concerned. This will explore aspects pertaining to EMS ranging from the historical background of environmental management through its developmental stages up to the present proactive EMS, where the actual impact of EMS on the economic performance of business enterprises will be looked into.

2.2 Historical Background to Environmental Management.

Consumption of natural resources and means of production developed over time, and this development ultimately led to the tragic stage, which the natural environment is currently at. Based on this statement, a picture on how the transition came about will be given as well as the surfacing of environmental concerns (which warned against the disastrous situation the planet earth is heading for).

2.2.1 Development of Natural Resource Use and Production Patterns

Natural resource consumption patterns differ on the basis of various and changing needs of the community owing to societal development. Here focus will be on natural resource consumption and production patterns of the three phases of societal development, namely the *hunter-gatherer society, the agricultural society, and the industrial society.*

Hunter-Gatherer Society

The hunter-gatherer society can be referred to as the initial phase of society whose natural resource consumption pattern was based on hunting wild animals and collecting wild plants to satisfy their needs for food, clothing and shelter. In support of this argument Swanson (1996) indicates that for many millennia in the past, people lived as hunters and gatherers who depended solely on a capital base that was exclusively natural for their goods and services. In addition to this, Krusche (n.d.) indicates that the hunter-gatherer society needs were merely to keep them (hunter-

gatherer society) alive as well as to strengthen any labour requirements, since work was entirely labour intensive. Krusche (n.d.) further points out that the society was characterised by a small population size and mobility that was able to move from one area to another in response to *demand for food* and *other resources* following consumption of resources in the inhabited region. This practice of migration gave previous habitats adequate time to recover their natural resources prior to being inhabited again. However as the population grew, demand for more food rose as well. Pressure for more food and other goods and services therefore gave birth to agricultural practices.

Agricultural Society

In response to the rising demand for food and other basic needs, mankind developed other natural resource manipulative strategies to meet rising societal needs, thus embarking on agricultural practices. Sadr (1991) and Smith (1992) indicate that initially agricultural society was characterised by '*nomadic pastoralism'*, which involved taming of animals and subsistence land cultivation. This society was characterised by labour intensive cultivation of small areas, and mobility from one region to another in search of the still productive regions for both human beings and animals. However, due to further population growth and simultaneous rising demand for food (goods and services), mankind had to develop agricultural practices further.

Development in agricultural practices introduced implements such as animal drawn ploughs which promoted cultivation of larger areas by a few and resulted in large-scale production, hence food surplus. The society was characterised by settlement in one area to manipulate the environment to meet the ever-increasing human needs for food (Board of Curators, 1995 and Montgomery County Public Schools, n.d.). A settled life style resulted in accelerated population growth due to absence of mobility, hence further rise in demand for food. Demand for more food resulted in the expansion of cultivated land to include land that was initially regarded worthless. This practice coupled with the ever-rising demand for more food due to population growth resulted in stretching the cultivated land beyond its capacity, and a subsequent drop in agricultural produce (Krusche, n.d.)

In response to such a decline in agricultural yield, mankind further introduced more advanced technology such as *machinery; fertilisers; pesticides; engine powered reapers; threshing machines; advanced animal breeding etc*, which reinvigorated the land and animals' production capacity to enhance economic returns. These advanced farming practices did/do not only result in increased food production and considerable surplus beyond producers' food requirements, but in environmental degradation as well. It also resulted in significant inequality, as those who afforded new technology became wealthier while those who could not afford it became poorer, and in turn became farm workers and also sought employment in the industrial sector. This drop in agricultural yield therefore gave rise to the industrial society (Coursework Bank, 2001).

Industrial Society

The industrial revolution was marked by the emergence of factories and industries in the urban areas of the countries. Work opportunities surfacing in factories and industries resulted in rural-urban migration, as people went to work in such factories and industries in urban areas. This was fuelled by the already deteriorating agricultural produce, which could not meet the needs of the growing poor population, as subsistence farmers could not afford the cost of new agricultural technology (Coursework Bank, 2001). Technological development in the industrial revolution introduced amongst others invention of steam engines; electric power; railway roads; advances in transport; and improved communication (telephones, radios etc) (Rempel, n.d.).

These developments in natural resource consumption reflect a paradigm shift in the means of production, which alarmingly escalates consumption of natural resources to provide goods and services in response to the needs of the society. Technological development in the agricultural and industrial sector skyrockets the consumption of natural resources and similarly disposes of large quantities of waste and by-products into the environment. This high consumption of natural resources and high amounts of waste disposed of result in natural resource depletion and environmental pollution respectively. In support of this argument the President's Council on Sustainable Development (n.d.) gives the late 1980s statistics of industrialised countries consumption of some world's natural resources as follows: *85 per cent of aluminium*

and synthetic chemicals; 75 per cent of timber and energy; 68 per cent of meat, fertilisers and cement; and half of the world's fish and grain. The President's Council on Sustainable Development (n.d.) further states that industrialised countries are leading in the emission of world's hazardous chemicals, as 96 per cent of radioactive waste and nearly 90 per cent of ozone depleting chlorofluorocarbons is generated by them.

This pattern of natural resource consumption is reflective of a self- centred approach in pursuit of wealth accumulation, as individual people and individual countries are only concerned about their own personal gains and not taking into account the rest of the community/world and the repercussions of their consumption patterns on the whole ecosystem.

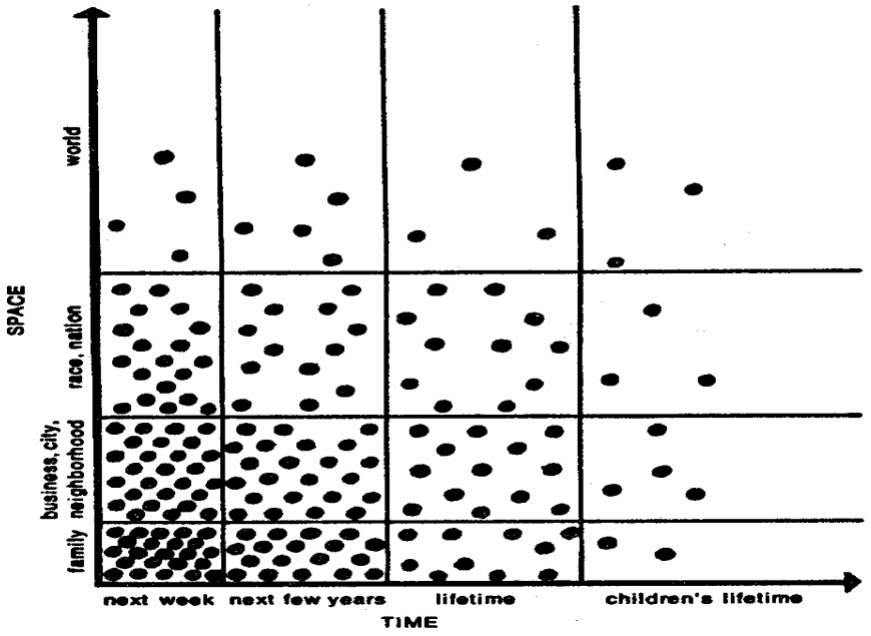


Figure 2.1: Human Perspective (Man's Tendency in Responding to Problems with respect to Time and Space)

Source: Meadow et al (1972)

This pattern of thinking is elucidated by Meadows et al (1972), as they categorise people in the following manner: (i) *the majority of people* dedicate their time and effort only to matters concerning themselves and their families, and responding to their immediate problems; (ii) *only a few people* respond not only to their problems

alone, but to the community problems as well and that; (iii) *only a very fewer* people are concerned about global issues. On the whole, the wider the space and the longer the time related to the problem, the fewer the people worried about its solution. This is illustrated in Figure 2.1.

This practice of self-centredness in wealth accumulation subsequently gives rise to the ever-widening gap between the wealthy minority and the poor majority, as well as adverse impact on the environment. However, it is rational for the poor to be self-centred, since according to Gwynne's (1997) '*Maslow's hierarchy of needs' (Figure 2.2),* the needs of the poor are at the physiological level. Meaning, their needs are basic in nature while the needs of the rich are at the self-actualisation stage, This means that self-centredness of the 'well off' is a matter of prestige and showing off how wealthy they are, as they have passed the other stages of needs, namely the *physiological, social, love, and self-esteem.* It is so, since lower needs have to be met prior to meeting the higher ones. This high consumption of natural resources and the associated environmental destruction is therefore an insensitive and inconsiderate act on the part of the wealthy countries/people, as their acts are intended for prestigious needs (NB: this matter is well captured under 2.2.3). This pattern of natural resource consumption results in adverse impacts whose effects are discussed in section 2.2.2.

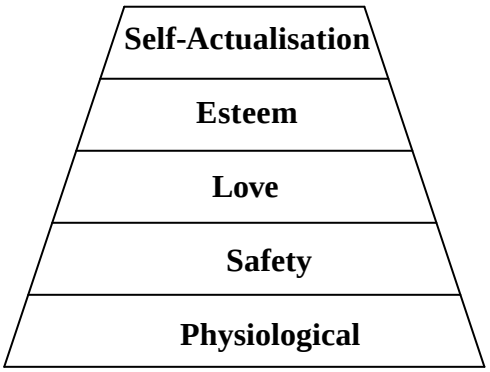


Figure 2.2: Maslow's Hierarchy of Needs
Source: Gwynne (1997)

2.2.2 Effects of Natural Resource Depletion and Production Patterns

The Ecosystem is a life supporting systems to all its inhabitants through the invaluable services it provides to them. To mention a few, the ecosystem provides water; food; sustains a genetic collection; pollinates crops; runs the hydrological

cycle; regulates concentration of gases in the atmosphere; maintains the conservation and restoration processes of soil; contains pollution and absorbs waste; and enables photosynthesis (de Groot, 1992 and Folke, 1991).

The ecosystem's support system and the diversity of life on earth is endangered mainly by introduction of destructive alien species in the communities, as well as the disintegration and loss of habitat through developmental activities of mankind such as land clearing; logging; ploughing; blasting; excessive use of fossil fuels; and extreme application of pesticides and herbicides (Ehrlich et al, 1992 cited in Baskin, 1997). In addition to this, Dawson (1992) and the World Resource Institute (1997) cite some examples of the effects of developmental activities as follows: *increased concentration of green house gases and subsequent global warming, which in turn gives rise to excessive heat that raises sea levels and exposes organisms to heat that is beyond their tolerance level (hence their extinction); acid rain- that destroys vegetation; biodiversity destruction – that gives rise to extinction of some species; climate and weather change etc.*

This issue is further maintained by the World Resource Institute (1997) as it states that mounting demand for energy and fossil fuel from industrial and agricultural practices results in large amounts of pollutants whose effects are evident in poor human health as well as damage to terrestrial and aquatic ecosystems. For example, the Ecological Society of America (2000) states that acid rain emanating from fossil fuels combustion and other industrial activities wipes out natural vegetation causing desertification and kills aquatic life, as aquatic organisms cannot cope with the eutrophic and acidic state of water.

Above all, Landberg and Keissling (1994) state that the effect of environmental degradation (i.e. through extreme extraction of natural resources, harsh land use etc) is not only on the ecosystem's services but on its resilience as well. In other words environmental pollution weakens the ecosystem.

On the whole, given the extremely important services the ecosystem provides to its organisms, clearly, mankind's manipulation of the planet earth has interfered with and gradually weakened the ecosystem's support system to its organisms. In response to

mankind's interference the earth is taking revenge, as it is increasingly becoming uninhabitable. Unfortunately the earth's avenge is not experienced by mankind alone, but by all organisms of the ecosystem.

2.2.3 Emergence and Development of Environmental Concerns

Upon recognition of the adverse impact of the societal development practices and their effects on the environment, initial concerns about environmental degradation surfaced from some parts of the world. One of the earliest concerns amongst others is the Engels' (1889) quotation cited in Hewitt et al (1992:280), which states;

> *We ourselves are part of nature, and what is involved in this mastery and conquest is going to have its effect on us. Let us not flatter ourselves overmuch on account of our human victories over nature. For each such victory, nature takes revenge on us. …we belong to nature and all-over mastery of it consists in the fact that we have the advantage over other creatures of being able to learn its laws and apply them correctly.*

More vocal environmental concerns, which have brought environmental issues high on the agenda to-date, can be traced as far back as four decades when several interest groups and the United Nations echoed environmental concerns much more strongly. In support of this argument Hewitt et al (1992) point out that modern environmentalist movements began in the late 1960s and early 1970s when pressure groups such as ***'Friends of the Earth'*** amongst others surfaced, advocating environmental protection.

In their warnings against environmental degradation, Friends of the Earth (1972) state that mankind tends to consider himself not as part of nature, but as its master who can manipulate it in whatever way he/she wishes without getting endangered. Man's activities are leading to his/her and other organisms' invasion by deserts; rising sea levels etc owing to environmental degradation. The only way to avert environmental and ecological tragedy is to transform the materialist and consumerist values of industrialized communities. This can be achieved by taking into account the earth's capacity to sustain the current levels of economic development; use of natural

resources; and the destruction of the whole ecosystem by means of industrial pollution and advanced agricultural practices.

In as far as international action is concerned with respect to the fight against environmental degradation, Hewitt et al (1992) states that the forecast of future environmental catastrophe reached the top of the agenda in 1972 with the two most considerable events, namely the publication of the Meadows' et al ***'Limits to Growth'*** and the Stockholm United Nations (UN) Conference on Human Environment respectively.

Meadows et al (1972) strongly warned that should action not be taken against the rapid growth rate in pollution; population; industrialisation; means of food production; and natural resource depletion, the earth's growth limits would soon be reached. This will result in an irreversible damage to the life supporting system of the planet.

Amongst other UN initiatives in environmental protection, Evans (2002) gives examples of the following:

- The 1972 UN conference on Human Environment in Stockholm that sanctioned a declaration of 26 principles about sustainable development and environmental impact assessment (EIA).
- The 1987 Brundtland Commission report that highlighted the critical value of sustainable development and EIA to the well being of both the present and the future generations,
- The 1992 UN Conference on Environment and Development (UNCED) in Rio de Janeiro that reaffirmed a declaration of 27 principles that were basically on sustainable development and EIA, as well as Agenda 21 that outlined an environmental management programme for the immediate future and for the 21st century.

Some other key UN initiatives are a conference on environment in Nairobi Kenya and a World Summit on Sustainable Development (WSSD) that was held in Johannesburg in 2002.

These UN initiatives highlight amongst others, causes of environmental degradation, for example, chapter four of Agenda 21, cited in UN Commission on Sustainable Development (1998:3) states that:

> *The major cause of the continued degradation of global environment is the unsustainable pattern of consumption and production, particularly by industrialised countries.*

The contribution of developed countries in the exacerbation of environmental degradation is further highlighted by the World Commission on Environment and Development (1987), as it states that global economic trend takes a lot of resources out of the poor countries than it puts back. The developing countries are heavily indebted in loans from the developed countries. This debt crisis results in overexploitation of natural resources by debtors (i.e. developing countries) in order to service their financial commitments.

Against the current economic development relations between the developing and the developed countries cited above, Sachs (2002) in his World Bank address on ***'The Economics of Sustainability***', strongly underscores the point that rich countries should assist the poor countries to graduate from the state of impoverishment. So, there should be a complete removal of developing countries' debts in order to rescue them from sinking deeper into poverty traps. Sachs (2002) further points out that the poor countries cannot even afford to pay for their own health. This in simple terms means that, poor countries cannot even address their most immediate needs, such as fighting HIV/AIDS pandemic, poverty, illiteracy etc, so what more about the distant tragedies such as environmental invasion? Obviously, if poor countries are not helped out of the immediate problems they are faced with, they will simply pay lip service to the world with regard to distant problems such as environmental degradation.

It is only through joint effort by the entire world that environmental problems can be addressed, hence the equilibrium state that is essential for man's survival (Meadow et al, 1972). The current self-centred approach of natural resource consumption in the interest of wealth accumulation is what Hardin (1968: 1243-1248) termed ***'the Tragedy of the Commons'.*** This pattern of natural resource consumption emanates from freedom to use common resources as one wishes for individual interest of wealth accumulation on the one hand, whose negative impact on the other hand indiscriminately affects the whole ecosystem and its organisms. From a look of things, it becomes obvious that concerted effort in environmental protection is strongly advocated by UN and others since negative consequences of self-centred approach in wealth accumulation do not only affect those individuals pursuing such developmental activities, but also affect the whole world.

Contrary to the UN and other environmental advocates' call for joint effort in environmental protection, some countries still show their unwillingness to cooperate in the fight against environmental degradation. Goldstein (1999) cites United States' defiance to ratify the biodiversity treaty for fears that it would limit its exclusive rights in biotechnology. Friends of the Earth (1972) as well (though it was in the early 1970s) blame countries like Japan and Union of Soviet Socialist Republics, who against the Whaling Commission concern over the extinction of great blue whale continued killing such fish in their own personal interest to make profit.

Furthermore during the Rio Conference in 1992, developing countries promised to foster economic growth through cleaner means. In support of this initiative, industrialised countries pledged to assist developing countries to that effect. However, contrary to the promises, two years following the 1992 Rio de Janeiro Conference, the World Commission on Sustainable Development, charged with the responsibility to monitor the state's conformance to promises and agenda 21 execution, reported that developed countries were only aiding developing countries with half of the financial aid they had pledged to offer for sustainable development (Goldstein, 1999). Industrialised countries' failure to adhere to promises therefore, held back sustainable development progress in the developing countries right through the 1990s (Miller and Miller, 1991).

Further resistance to joint effort in the battle against unsustainable development was established during the WSSD, as it was discovered that no recognisable strides had been made with regard the implementation of Agenda 21 since the Rio de Janeiro summit. It was established that countries had failed to abide by their commitments owing to wealthy countries' fears of inhibiting their ability to accumulate more wealth by restricting their current economic development practices. There were also tense debates between states around issues, such as *climate change, poverty eradication, energy* etc. For example, the United States clearly echoed its condemnation on urging states to ratify the Kyoto Protocol, since it does not accept it. However, agreements were reached whose impact will not be very significant on improving the lives of the poor and ecosystem at large. The problem emanates from the fact that countries, which benefit most from current economic development practices have the upper hand in international discussion such as WSSD (Hallmann, n.d.). In such situations, one wonders whether there will ever be cooperation towards doing justice to the environment, which is providing invaluable services to organisms of the ecosystem including mankind him/herself. Such unwillingness to cooperate by economically powerful countries like US forces people to doubt the credibility of EMS with respect to the alleged positive returns.

However, based on Maslow's Hierarchy of Needs (Figure 2.2), it does not mean that poor countries are as well unwilling to address distant problems (i.e. environmental problems), but are unfortunately stuck with more immediate and most basic problems which are currently the most essential for their survival. It is only the insensitivity on the part of developed countries that are unwilling to cooperate simply to accumulate more wealth at the expense of the whole world to meet their own individual luxurious needs. This practice further widens the gap between the poor and the rich as well as to escalate environmental pollution.

Another point is the misappropriation of financial resources to fund conflicts in the interest of self-centred wealth accumulation. Such behaviour destabilises the world, therefore should be ceased, and such funds be directed to more meaningful relief programs in the poor countries. In this regard, Sachs' (2002) argument that *poor countries should be helped out of the poverty stage to climb up the hierarchy needs* becomes valid, as this will empower the poor and enable them to cooperate with other

nations in addressing distant global problems. Hence contrary to Meadow's et al *'Human Perspective'* (Figure 2.1), there will be a paradigm shift from the present pattern where the majority of people focus on their immediate individual problems to a situation where the majority will focus on the community and global issues, as the majority of people will have risen above the poverty line which kept them short sighted i.e. focussing only on their immediate problems. This is how a concerted effort in environmental management advocated by United Nations and others could be achieved.

2.3 Understanding Environmental Management

The main aim of this section is to look into the rationale behind the introduction of environmental management, and to give a transitional development in environmental management.

2.3.1 Rationale Behind Environmental Management.

Industrial revolution in the 1750 and 1850 led to 'rural-to-urban' migration that resulted in massive volumes of waste generation in the urban environments. A rise in domestic solid waste generation owing to population explosion together with massive waste from industrial manufacturing processes boomed the waste generation quite dramatically. This therefore resulted in increased waste generation that posed a severe threat to human health and the environment, which subsequently sparked and increased awareness of the link between health and the environment (British Medical Association, 1991; and Reeds, 1994 cited in Williams, 1998).

The most prevalent waste disposal practice in the old days was dumping waste into illegal dumpsites, which were not properly managed, and therefore became a breeding place for disease carrying pathogens (McBean et al, 1995). In response to the health and environmental threats, environmental management was introduced with a view to change the communities' style of natural resource consumption and production patterns to optimise resource use; to reduce adverse environmental and social (human health) impact; and to encourage and provide an enabling environment for more

sustainable consumption and production patterns that are environment and human health conscious (United Nations Commission on Sustainable Development, 1998).

The above argument in other words means that environmental management was introduced in response to the tragic state the environment is heading for as a result of unsustainable economic developments, which discharge pollutants into the environment. The need for environmental management can therefore be said to have emerged in response to the planet earth's signals of hostility towards its organisms, as an indication of intolerance with mankind's developmental activities

2.3.2 Development of Environmental Management

Environmental protection is not a new phenomenon which can be said to have begun following the UN intervention to rescue the environment from extinction, as for example, McBean et al (1995) state that the first half of the twentieth century witnessed introduction of improved landfill sites, with site planning and site management though this took place in a very few areas, as many local authorities had minimum engineering design, and therefore open space dumps were still widespread in most countries. Upon reaching their maximum capacity, these improved landfills were covered with a slight layer of soil without taking into account the effects of leachate and landfill gas. McBean et al's (1995) argument here provides an insight into the issue that initially, waste and by-products management efforts focussed on solid waste alone, as leachate (water pollution) and landfill gas (air pollution) for instance, were not taken care of in the early days of environmental management. In addition to this, Harrop and Nixon, (1999) point out that in the past, development projects were assessed on the grounds of affordability in terms of financial and technical resources, and political will alone, as the likely environmental, health, and social impacts of development projects were not taken into account.

EIA as it is stipulated in the United States' National Environmental Policy Act of 1969 only emerged in the US as a managerial instrument in the late 1960s and early 1970s. It surfaced as an endeavour to foresee, determine and gauge the socio-economic and biophysical changes that may result from proposed projects. It has since then developed and spread into other societies across the globe (Jónsdóttir, 1999). EIA was then adopted by other countries such as Canada in 1973; Australia in

1975, etc. Macleod (n.d.) further points out that in 1985 EIA was made mandatory by the European Community Directive 85/337, and subsequently it then became adopted across the European Community than it was before (Therivel et al, 1992 cited in Macleod, n.d.)

A concerted effort by nations in environmental management and adoption of a wide range of environmental regulations legislations incepted in 1972 under the auspices of the UN (Environmental Information System, n.d.). In support of this argument, the International Association of Universities (n.d.) cites the 1972 Stockholm Conference on Human Environment principles 21 and 22 respectively as follows:

Principle 21

> *States have, in accordance with the Charter of the United Nations and the principles of Environmental law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or of areas beyond the limits of national jurisdiction.*

Principle 22

> *States shall cooperate to develop further the international law regarding liability and compensation for the victims of pollution and other environmental damage caused by activities within the jurisdiction or control of such states to areas beyond their jurisdiction.*

Much as the 1972 Stockholm Conference on Human Environment initiated the development of comprehensive international action against global and regional environmental degradation and promoted environmental law to the greatest heights to date, environmental law on its own is however inadequate for attainment of sustainable development. Its inadequacy is further weakened by the fact that

international treaties and protocols transpiring from the UN initiatives are only mandatory to the states willing to comply with them. However, a paradigm shift from the reactive mode to the current state to risk and liability management mode of business style would provide a solution. Science and technology are therefore an essential tool in providing assistance towards environmental problems (Evans, 2002). This in other words means that just as science and technology did provide solutions to shortage of food supplies (owing to increased population and subsequent land resource overuse) during the hunters-gatherers and agricultural societal development phases, science and technology should in the same manner provide solutions today. This poses a challenge to science and technology for invention of cleaner production to complement environmental regulations.

In defining cleaner production, the United Nations Environment Programme Cleaner Production (1998:1) cites the International Declaration on Cleaner Production where it refers to cleaner production technology as:

> **…** a *continuous application of an integrated, preventive strategy applied to processes, products and services in pursuit of economic, social, health, safety and environmental benefits.*

In addition to this, the Cleaner Production Status Report (2002) states that cleaner production programme was initiated by the Division of Technology, Industry and Economics (DTIE) of the United Nations Environment Programme (UNEP) in 1989 and in the early 1990s. It is a programme that calls for means of production that result in increased yield; reduced resource consumption and waste; and reduced risk to the environment. Cleaner production was strongly underscored at the Rio de Janeiro 1992 UNCED as an imperative vehicle towards sustainable development. This is further emphasised by the Non-Governmental Organisations (NGOs) Café (n.d.), as it cites chapter 30 of agenda 21 where it states that efficient utilization of natural resources and production of less waste is a crucial step towards sustainable development and improved company benefits, which can be achieved through technological innovations (see Figure 2.3).

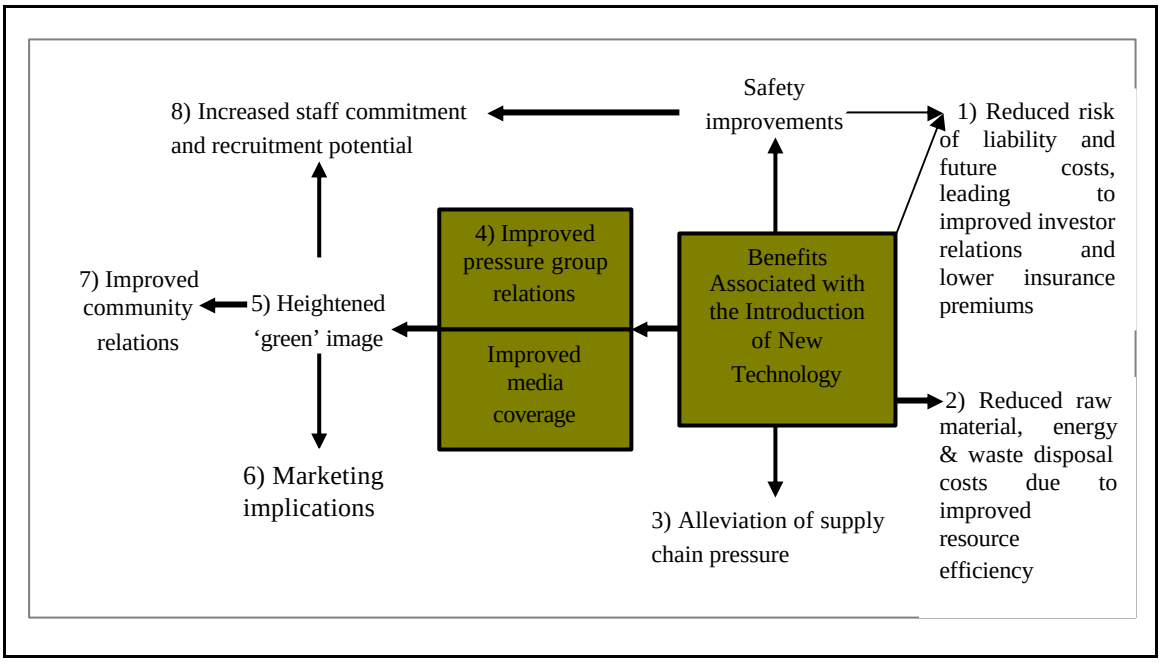


Figure 2.3: Potential Benefits Associated with New Technology.
Source: Welford and Gouldson, (1993).

Given that cleaner production was embarked upon in 1989 and in the early 1990s as indicated above to complement other already in place environment protecting practices such as legislations, EIA etc, it becomes clear that such initial efforts were being recognized as inefficient. In support of this statement, the World Bank Group (1998) states that upon the recognition of ineffective performance of the end-of-pipe and regulatory frameworks alone, concentration is now shifting to backing such ineffective approaches with introduction of incentives, production efficiencies, and management improvements i.e. introduction of a wide spectrum of approaches under the umbrella term *'environmental management systems'*, which include amongst others cleaner production and eco-efficiency.

From the various arguments above, it becomes evident that environmental management came into being in response to unsustainable natural resource consumption and production patterns whose adverse impact posed a threat to both human health and the environment. It also becomes evident that environmental management practices changed over time (i.e. with the introduction of environmental law and regulations; EIA; new technology etc) in response to the increasingly

complex nature of waste and by-products generated owing to growing unsustainable consumption and production patterns. It was therefore rational for environmental management tools to develop from the reactive practices to the present proactive environmental management systems, as previous initiatives on the one hand were becoming inefficient, and the environmental status on the other hand was deteriorating further. It has also been observed that UN driven joint efforts have been very important with specific reference to taking care of air and water pollution, since these two types of pollution do not observe international boundaries.

On the basis of these arguments, it is concluded that in the interest of sustainable development, augmentation of environmental management practices is extremely essential to match the increasingly lethal and complex by-products. However, the greatest challenge is to ensure that newly introduced environmental management techniques fall within the means of all the world's nations, if environmental management is to succeed.

2.4 Understanding Environmental Management Systems

The aim of this section is to shed light on what EMS is; environment and business enterprise relations; what motives adoption of EMS by business enterprises; and the development of environmental management series of standards including the implementation procedures of ISO 14001 EMS standard.

2.4.1 What EMS is

As its name says, EMS is a management approach that involves a wide spectrum of management tools to comprehensively respond to environmental problems while similarly taking into account the economic and social development issues. In support of this argument, the UNEP International Environmental Technology Centre (IETC) (n.d.) cites ISO definition of EMS, which refers to EMS as:

> *the part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes, and resources for*

developing, implementing, achieving, reviewing and maintaining the environment policy.

From the EMS definition above, one can refer to EMS as the Pandora's box, as like the Pandora's box, EMS employs a variety of tools to achieve its goal, which in this case is to effectively strike a balance between the business enterprises' bottom line; social development and environmental performances. In support of the notion of employing a variety of tools in solving a problem, Dale (2003) states that no one tool or technique should be used in isolation if improvement is to be achieved. Dale (2003) further points out that a warrior is not supposed to have any single preferred weapon, as for example, if one has a hammer as his/her only tool, all problems irrespective of their nature will look like nails.

An effective EMS promotes efficient use of natural resources with reduced adverse impact on the environment, which does not compromise enterprises' bottom line (UNEP IETC, n.d.). In other words EMS recognises and strives for the maintenance of a healthy precious relationship between the business sector, social development and the environment, as it (EMS) pursues environmental protection that does not hamper both the economic and social developments.

2.4.2 Natural Environment and Business Enterprise Relations

The interaction between the business enterprise and the environment is well captured by Badenhorst et al (1997) as they point out that a business enterprise obtains inputs (i.e. raw material, labour etc) from the environment and the community within which it operates, and processes the inputs into goods and services for that same environment/community. Thus, the environment (encompassing the community) and business enterprises are interdependent on each other. In a nutshell, this interdependence between a business enterprise and its environment clearly shows that no business can exist without the environment/community, as the business produces goods and services for the community. Likewise the community cannot survive without goods and services that business enterprises produce in response to the needs of the community. For environment-business enterprises interaction see Figure 2.4, where inputs from the natural environment enter the enterprise for processing into products.

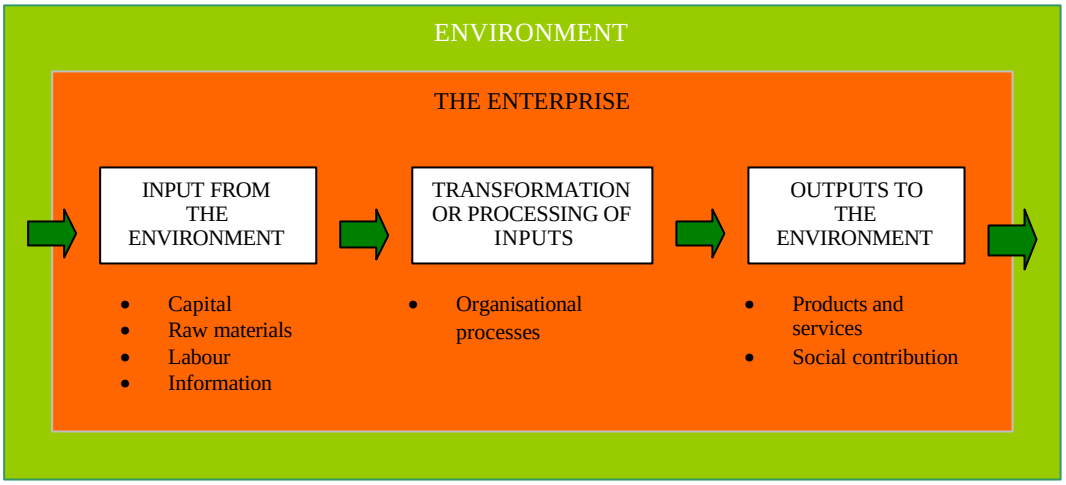


Figure 2.4: Interaction Between the Business Enterprise and the Environment

Source: Badenhorst et al (1997)

Over time, the environment-business enterprises interaction brought in environmental problems owing to the escalating natural resource extraction from the environment that outpaces regeneration, and the recognition of the fact that *'outputs to the environment'* are not only *'products and services'* and *'social contribution'*, as Figure 2.4 illustrates, but include by-products as well. This is supported by the World Bank (2000), as it highlights the most lethal component of the outputs, namely the ***by-products*** that are dumped, discharged and/or emitted into the environment. Based on the adverse impact of by-products on the environment, the World Bank (2000) further asks the question **'Is industrial pollution the price for development?**'

In response to environmental pollution/destruction, environmental management came into being to protect the environment. As indicated in section 2.2.2 environmental management went through modifications up to the proactive EMS approach, which is currently a 'buzz *word'* in the field of environmental management. Russo and Fouts (1997) state that EMS can curb environmental degradation, as it promotes raw material optimisation and cuts down on waste generation at source. It is therefore a system that can maintain healthy environment-business enterprise relations.

2.4.3 Rationale behind EMS Adoption

Adoption of EMS is driven by a number of factors including benefits associated with EMS and pressures exerted on business enterprises by stakeholders. Business

enterprises adopt EMS in order to respond to the regulatory, market, and social pressures, which an effective EMS manages to translate into economic benefits (US Department of Public Policy, 2003). Responding to regulatory, market and social pressures by addressing the environmental impact of business enterprises on the environment through EMS brings in increased revenue and cuts down on input material costs on the part of business enterprises. This becomes evident as business enterprises optimise their input materials through recycling, reusing and sale of waste materials generated out of the input materials. EMS also promotes cleaner production, and thus reducing regulatory fines, permitting costs, remediation costs, worker compensation costs, insurance costs, lawsuit costs etc. Furthermore, EMS enhances the image of business enterprises, which in turn results in hiking markets for EMS certified organisations (Transformation Strategies, n.d.)

2.4.4 Development of EMS Standards

Standardised EMS began with the British BS7750, which emerged in 1992, followed by EMAS, which was established and formally launched in 1995 by the European Union Council Regulation for use by the European Union Member States (Quality Network, n.d.). The emergence of a need for international EMS standards gave rise to the establishment of the International Organisation of Standardisation (ISO), whose role in this particular context is specifically to develop international standards in the field of environmental management, namely the ISO 14000 series of standards [Environmental Protection Agency (EPA), n.d.]. A process of synchronization has been in progress facilitating mutual acceptance of BS 7750 and EMAS with ISO 14001 EMS standard (World Bank Group, 1998).

ISO 14000 refers to a series of voluntary international standards in the field of environmental management. Encompassed in the ISO 14000 series are the ISO 14001 EMS standard and other standards in the areas of environmental auditing, environmental performance evaluation etc (Business Information, n.d). *(NB: for purposes of this research, other standards of ISO 14000 series will be ignored, as focus will incline to ISO 14001 EMS standard alone).*

2.4.5 ISO 14001 EMS

The aim of this part is to briefly look into ISO 14001 EMS, and give the requirements, which an organisation has to meet in order to achieve ISO 14001 EMS standard.

(i) What ISO 14001 is.

ISO 14001 is a voluntary formal EMS that was established in 1996. It is a standard that calls for the implementation of a series of practices and mode of operandi that collectively meet its standards. ISO 14001 EMS is a continuous improvement standard of environmental performance that adopts a '**Plan-Do-Check-Act'** approach whose intention is to develop an orderly management system that addresses negative environmental impact of the company [National Centre for Environmental Decision-Making Research (NCEDR), 1998].

ISO 14001 gives freedom to a business enterprise to make a discretion on what its EMS should cover, thus ISO 14001 does not dictate what a business enterprise EMS should include, provided its EMS reflects an obligation to conform to environmental policy; identifies and responds to environmental aspects and impacts; complies with legislation; and puts in place and monitors specific objectives and targets (Batts, n.d.)

(ii) Elements of ISO 14001 EMS

According to Iowa Department of Natural Resource (n.d.); Batts (n.d.) and NCEDR (1998) ISO 14001 EMS is made up of a number of elements, which are grouped under five categories, namely: e*nvironmental policy; planning; implementation and operation; monitoring and corrective action; and the management review*- which are explained below (also see Figure 2.5).

Environmental Policy:

- This is a phase where management develop a statement of commitment to meeting all applicable environmental legislations; preventing pollution; and executing an EMS that strives for continuous improvement. Environmental policy sets a basis for other elements as well as to set goals for environmental performance against which performance will be evaluated.

Planning:

- *Environmental Aspects*: this is where an organisation establishes environmental aspects of its activities, products and services to identify those whose impacts on the environment are significant. This is a very important event, as it forms a basis around which strategies to curb environmental destruction can be built.
- *Legal and Other Requirements*: an organisation here establishes and ensures access to all relevant pieces of legislation and other requirements which it has to comply with.
- *Objectives and Targets:* an organisation sets documented objectives and targets in line with the policy; environmental aspects; legal requirements; financial and business requirements; and other parties' interests.
- *Environmental Management Programme*: an organisation develops an action plan, which will enable it to achieve the objectives and targets.

Implementation and Operation:

- *Structure and Responsibility:* here an organisation clearly defines roles, responsibilities as well as who is in charge of, say a particular task(s) for the execution of effective environmental management.
- *Training, awareness and competence:* an organisation conducts a training needs assessment and ensures that it offers introductory training to all its staff, and further training for those whose duties have impact on the environment. This is meant to ensure that employees are competent in undertaking environmental management responsibilities.
- *Communication:* an organisation should maintain effective communication procedures on information pertaining to the organisation's environmental performance for both internal and external consumption.
- *EMS Documentation: a*n organisation should keep a record of information pertaining to its environmental management issues. This will enable the organisation to evaluate its performance with ease - be it environmental, social or economic performance.

- *Document Control:* an organisation should maintain proper control of information. Thus information should be kept in a manner that can easily be accessed; not misplaced; and be properly managed
- *Operational Control:* an organisation should develop procedures for undertaking environmental activities appropriately to avoid deviations from proper procedures, as this would derail the operation from achieving the goals. Operational control should be a target specifically for activities whose impacts on the environment are quite significant and adverse.
- *Emergency Preparedness and Response:* an organisation should establish potential emergencies and accidents, and develop procedures for prevention and addressing such incidents should they occur.

Checking and Corrective Action:

- *Monitoring and Measurement:* an organisation should develop documented procedures to monitor and measure frequently key operational activities and track their performance. This exercise helps to ensure that operations are still on the right track with respect to the objectives and targets.
- *Non-conformance and Corrective and Preventive Action*: an organisation should establish procedures for identifying non-conformance as well as undertaking corrective action, and preventing such incidences from reoccurring.
- *Records***:** an organisation should properly keep records of its environment related issues. Records should be coded to ease reference and linking with appropriate activities.
- *EMS Audit:* an organisation should develop procedures and practices for sporadic verification that EMS operations are still in line with ISO 14001 standards.

Management Review:

The management at its discretion should review the EMSs to ensure their effectiveness. Management undertake this review to look into areas (be they the policy, objectives or any other elements) that may perhaps require some adjustment for continual improvement, as per EMS audit results.

It should be noted that an organisation should reflect ISO 14001 EMS readiness (i.e. reflect the above EMS elements) ahead of getting certified by an accredited body, thus it should have an EMS that is already of ISO 14001 standard in place prior to assessment by an accredited certifier.

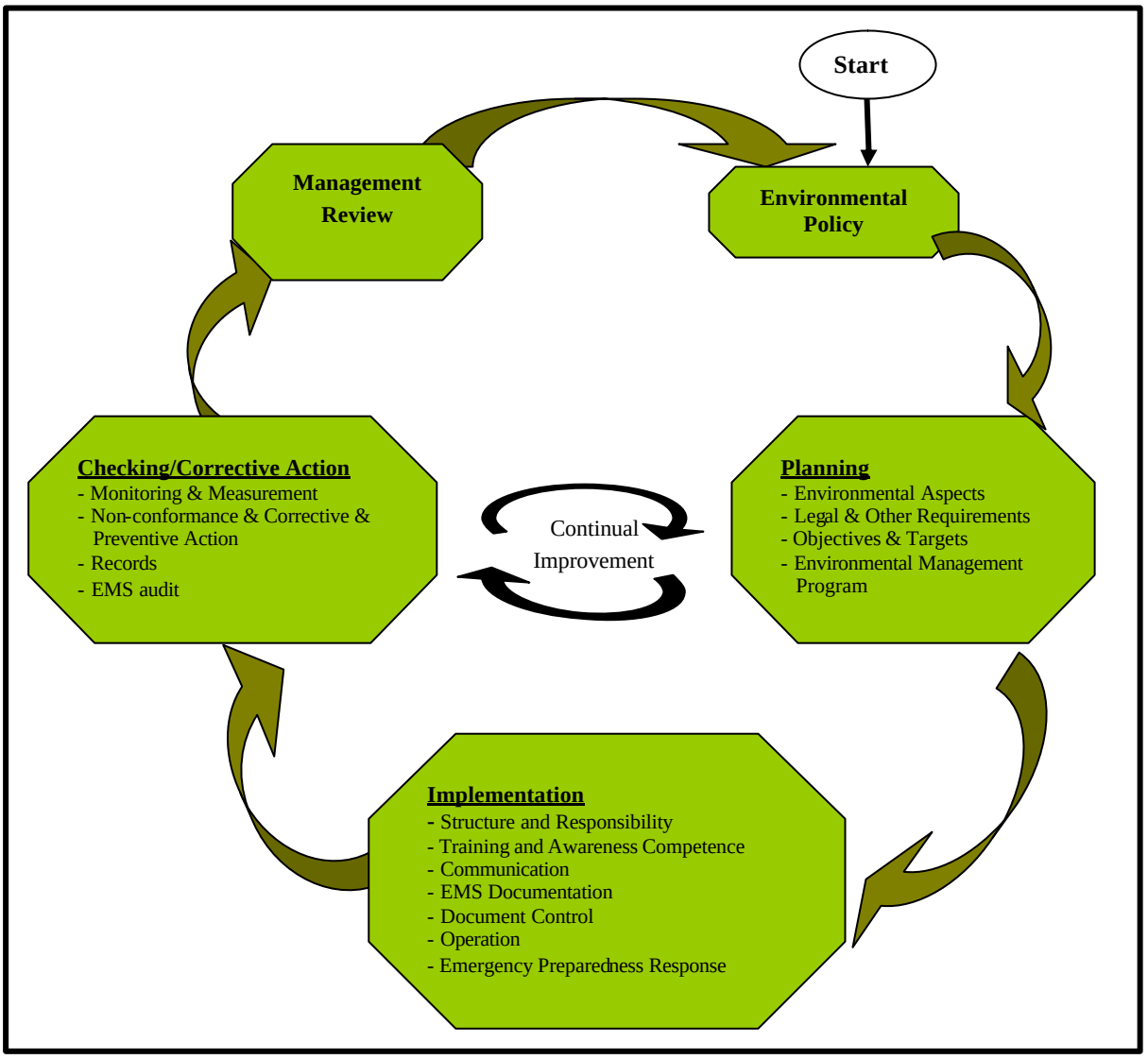


Figure 2.5: Elements of EMS

Source: Iowa Department of Natural Resources, (n.d.)

(iii) ISO 14001 EMS Certification And Accreditation

ISO 14001 certification and accreditation refer to a status in which an organisation has been issued with a certificate as proof that it has been subjected to an intensive ISO 14001 assessment by a recognised accredited certifier, and therefore it is certified

to have met all the requirements of ISO 14001 EMS standard. In support of this argument, the World Bank Group (1998) states that an ISO 14001 EMS certification means that a competent accredited certifier has examined an organisation's EMS, and has therefore formally awarded it a certificate as a token of confirmation that such an organisation has implemented an EMS that is in line with the ISO 14001 requirements.

ISO 14001 certification is a hectic process that involves a questionnaire filling process by an organisation seeking certification and submission of the questionnaire to an accredited certifier. The questionnaire filling exercise enables the certifier to study the nature of expertise and time required: to undertake an inspection of the applicant's EMS; to develop a quotation for certification; on-going surveillance; and reassessment. Following acceptance of the charges associated with the exercise by the applicant, inspection commences, which takes sometime depending on the size and nature of the organisation seeking certification. It becomes a phased process that involves undertaking corrective action by the applicant where need be, and then followed by reassessment by the certifier. Finally when the certifier is satisfied that the EMS is up to the ISO 14001 standard, it grants a certificate (Complete Integrated Certification Service, n.d.). However, the ISO 14001 EMS standard does also provide for self-declaration, whereby an organisation declares itself compliant with ISO 14001 following an internal audit (Defence Environmental Network and Information Exchange, n.d.)

This self-declaration is a rather controversial route towards getting ISO 14001 certified which lacks transparency and therefore discredits the image of ISO 14001 EMS status. If ever ISO 14001 is to make it in the world of environmental management, it should do away with self-certification. Coupling self-certification with what Batts (n.d.) indicated in section 2.4.5 (i) that '*ISO 14001 does not dictate what should be included in EMS*' further tarnishes the credibility of ISO 14001, as in the self-assessment exercise, there is no evidence and verification of compliance with ISO 14001 standard and its elements. In support of this argument, the World Bank Group (1998) points out that there is a considerable doubt about whether or not the self-certification approach will gain support, especially because ISO 14001 requirements have some legal and commercial implications.

It has been observed that EMS is undermined by a number of factors, such as its nature of being a voluntary exercise as well as its nature of not dictating what EMS should entail. Voluntary adoption of EMS delays the process of action against environmental degradation. A non-dictating nature of what a company's EMS should entail results in inconsistent EMS practices, and EMS's heavy reliance on individual countries' environmental legislations. This undermines EMS, as in some countries environmental laws might not be good enough or non-existent altogether. In the case where such laws exist, law enforcement may be extremely weak.

On the whole, EMS is a good initiative to curb environmental degradation, as it is equipped with various tools to enable it to circumvent all sorts of impediments on the path towards sustainable development. However, there are a number of challenges that inhibit business enterprises from getting ISO 14001 certified. As it is reflected above in the *'EMS definition; elements of ISO 14001*; and *the certification and accreditation processes'*, it becomes clear that implementing ISO 14001 EMS is quite a mammoth task that requires massive resources to make its implementation effective and a reality. It requires a lot of *time, commitment and various resources such as competent human resources, infrastructure, and financial resources*. It therefore becomes a bit uphill for financially unstable organisations to embark on this exercise, as it requires a considerable amount of resources, which affect the organisation's bottom line. This is maintained by Walley and Whitehead (1994) as they put a very strong statement that rescuing the environment from destruction negatively affects business enterprises. The World Bank Group (1998) also points out that, based on different individual EMS designs and considerable costs associated with ISO 14001implemetation and certification exercises, most large companies take sometime prior to deciding to get certified.

On the basis of the above arguments, it is therefore concluded that for EMS to be more effective ISO should take into account loopholes such as countries' weak law enforcement; self-certification etc since they undermine the credibility of EMS. Furthermore, it is concluded that EMS is an essential tool, and for it to be effective it requires a lot of time, commitment and other various resources. Following this discussion on EMS, it therefore becomes necessary to explore the relationship between EMS and enterprises' economic performance.

2.5 EMS and Economic Performance Relations of Enterprises

The main idea of this section is to look into the relationship between EMS and the economic performance of business enterprises. This relationship will be looked at firstly, by paying attention to only two EMS tools, namely industrial ecology and design for the environment. Secondly, looking at the role of corporate social responsibility (CSR) in EMS-Economic performance relations, which will also cover *'green'* procurement decisions. This will be followed by cleaner production and innovativeness. Then, a critical analysis of two *EMS and economic performance relations case studies,* and finally the conclusions.

2.5.1 Industrial Ecology And Design For The Environment

Garner and Koeleian (1995); Ayers and Ayers (1996); Allenby (1999) state that industrial ecology explores the relations between different industrial processes as well as the interaction between industrial systems and the ecological systems with a view to transform the linear nature of industrial systems (see Figure 2.6) to a closed-loop cyclic natural ecological system like process, where the by-products and waste are reused as inputs for production of other products (see Figure 2.7). In this sense, industrial ecology enables EMS not only to cut down on pollution and waste, but to reduce the throughput as much as possible as well (Pratt and Shireman, n.d.).

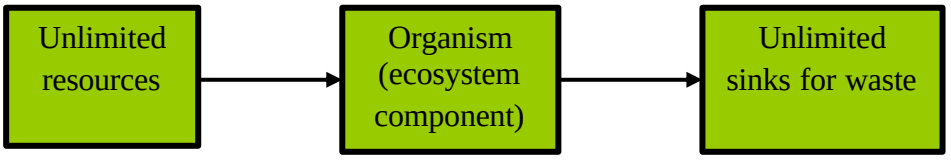


Figure 2.6: **Linear Industrial System**

Source: Allenby, (1999)**.**

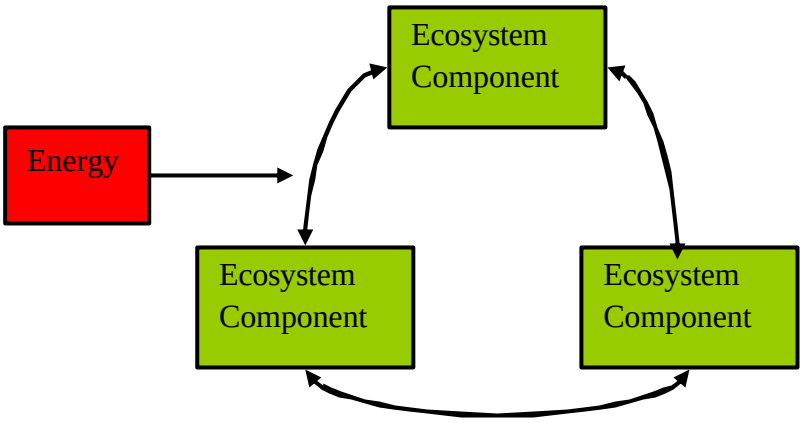


Figure 2.7: Closed-Loop (Cyclic) Industrial System

Source: Allenby, (1999).

Design for the environment (DfE) is also an essential tool in EMS-economic performance interaction, as it orderly integrates environmental aspects into product design to improve EMS-economic performance relations of business enterprises. It takes into account all environmental implications of the throughput throughout their life cycles. Thus DfE produces products that are repairable, reusable and recyclable (Minnesota Office of Environmental Assistance, 2001). In other words, DfE manufactures competitive products that are environmental friendly.

Given the crucial roles that industrial ecology and DfE play in EMS, it therefore becomes clear that their contribution in EMS- economic performance relations is quite crucial and enormous, as benefits are evident in both environmental and economic terms as well as cost reduction from resource acquisition phase right through to the post usage stages i.e. reuse, and recycling. In support of this argument Australian Academy of Science (n.d.) states that EMS and cleaner production benefits accrue to the environment (owing to a reduction in natural resources demand by business enterprises and a cut down on the generation of by-products); community development (due to corporate social responsibility and risk management); and the business enterprises in terms of positive economic performances [resulting from a number of factors including savings and revenue due to optimisation of input materials; reduced waste disposal costs; by-products' sale etc (See Figure 2.8)].

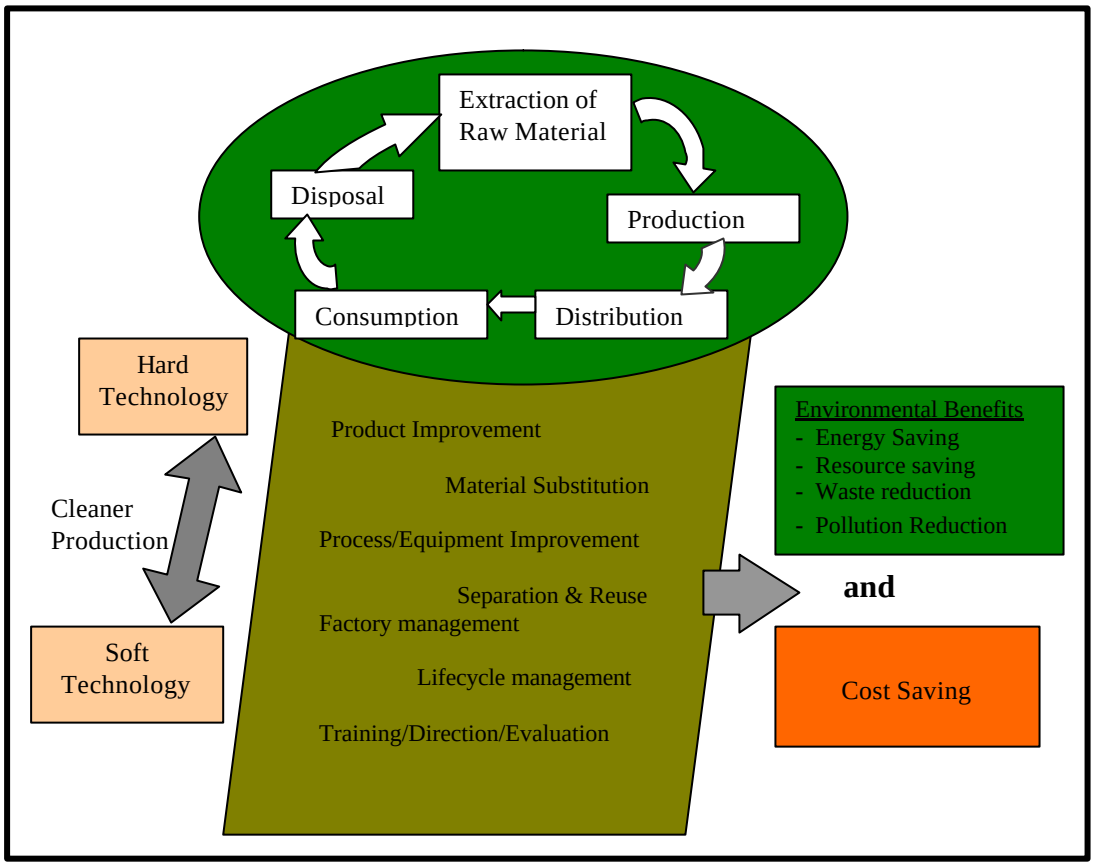


Figure 2.8: Benefits Of Eco-Efficiency And Cleaner Production

Source: Global Environment Centre Foundation, (n.d.).

2.5.2: CSR Contribution in EMS-Economic Performance Relations

As indicated above that EMS benefits accrue not only to the environment and economic performance but to community development as well. This aspect of community development is taken care of through CSR of enterprises, where business enterprises extend their hands further than the environmental and economic aspects to also cover developmental activities of the community and as well as to guard against the business enterprises' potential impact on the environment. In support of this argument, the Mediterranean Development Forum (2002) refers to CSR as business enterprises' commitment to adapting to stakeholders interest i.e. embarking on community development projects and guarding against the enterprises' potential risk on the community.

However, business enterprises fail to engage in the management of their environmental impacts (i.e. they fail to embark on CSR). In pursuit of environmental protection therefore, regulators intervene with environmental regulations to ensure that business enterprises manage their environmental impacts. EMS influenced environmental regulation encourages regulators (governments) to adopt both formal and informal kinds of regulations, where formal regulation refers to direct regulation by law while informal regulation refers to indirect regulatory measures (such as economic policies etc) as well as public awareness programs to enlighten the community on environmental degradation associated risks it is exposed to by business enterprises that do not manage their environmental impacts. Following awareness raising programs, regulators facilitate the communication of enterprises' reliable and easily comprehended environmental performance information to the public and market agents. This therefore introduces a new stakeholder (community, market agents, government) model for pollution prevention, where the *'community'* demands cleaner production, which does not expose it to health hazards while *'market agents'* such as customers (*boycott non-environment friendly business enterprises)* and bankers *(attach some environmental responsibility to loans)* (World Bank, 2000 and ISOa, n.d.).

In response to a concerted stakeholder pressure, several business enterprises have formulated corporate philosophies that encompass the social, environmental and economic issues, and observe a wider corporate citizenship and corporate stewardship perspective in respect of the environment than was before (Pratt and Shireman, n.d.). A number of corporate decision-makers are aware of the increased legal liability that companies encounter if they do not adhere to environmental regulations. To limit the liabilities, many corporate executives then put in place stringent risk management measures at the top of the management agenda. The business enterprises' executives have increasingly gone beyond perceiving environmental compliance as an essential evil, but view it as an opportunity from which proceeds can be earned (Cohen, 1994; and Allenby and Richard, 1994). This in other words means that managing the business enterprises' associated safety, health and environmental (SHE) risks saves the enterprise lots of funds, which would be spent on SHE risks had such risks not been guarded against.

In support of enterprises' risk management, the World Business Council for Sustainable Development (1997) maintains that to pave the way for sustainable development, business enterprises should handle risk and uncertainty as their day to day management challenges, as it results in both positive environmental performance as well as economic performance (see Figure 2.9)

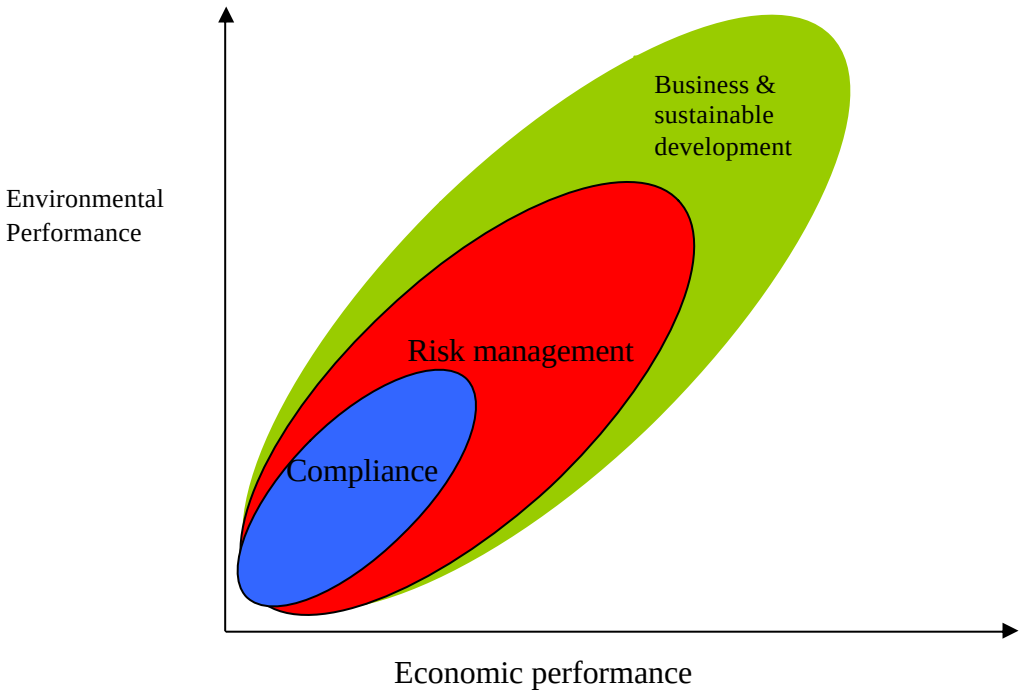


Figure 2.9: The Sustainable Development Journey (Path Towards Sustainable Development)

Source: International Institute for Sustainable Development (2002)

There is wide evidence that business enterprises that concurrently manage their economic, social and environmental performances reap financial benefits more than those that do not (Russo and Fouts, 1997; and ISOb, n.d.). In addition to this argument the GeoDelft (n.d.) lists some benefits of EMS CSR and risk management as follows: - improved enterprises reputation and stakeholder relationships; increased market share (or 'green' procurement decisions) owing to integration of customers' environmental preference; minimised regulatory compliance costs etc.

Against the positive contribution of CSR to community development, Caulkin (2002) indicates that CSR is sometimes misused, as it is employed as a tool that silences the

community from complaining about the business enterprises' irresponsible economic development practices, as business enterprises fund off-site projects. In this sense, enterprises gain improved image by turning the attention of the community away from their (enterprises') social and environmental malpractices.

Contrary to the notion of *'increased green procurement'*, it is stated that *'green procurement'* is a far-fetched practice, since the majority of customers take into account price, quality, brand image, after-sales service etc prior to environmental issues. On the whole, only a few customers are environmentally aware, and the majority is not aware, and will therefore not even bother to be aware, especially if green products are costlier than other products. However, there are some exceptional cases in Scandinavian countries, Netherlands, and Germany where environmental issues are considered imperative in procurement decisions (Batts, n.d.). For green procurement decisions to be promoted therefore (i.e. ensuring that more customers buy into the issue of environment oriented purchasing decisions), business enterprises are faced with a strong challenge of producing products that are less costly than their rival products (Welford and Gouldson, 1993). Emphasising the importance of customers in the promotion of a product (*'green'* products in this case), Dale (2003) states that a customer is central to the existence of business enterprises, hence customer faithfulness and retention is the principal measure of the success of business enterprises, as customers have freedom of choice to purchase from other competitors who meet their expectations. A company that fails to meet the needs and expectations of its customers will experience a collapse in market share and return on assets.

Given that for sustainable development to be achieved, the world's nations irrespective of individual economic status have to join hands to build a sustainable world, it is quite essential therefore that *'green'* products and services are targeted for the whole world's population/customers, not just for the wealthy minority who can afford costly products. Producing costly *'green'* products and services undermines sustainable development initiatives, as the majority of the population/customers i.e. developing countries inhabitants are poor *(therefore cannot afford costly 'green' products and services)* and unlearned *(therefore unaware of environmental issues etc)*. In this way they are deprived of the opportunity to taking part in the battle against unsustainable development efforts as well as to support *'green'* business

enterprises, since they cannot afford such costly 'green' products and services. In sharing Welford and Gouldson's (1993) sentiments on *'producers' challenge to produce affordable green products and services'*, it is worth underscoring that the challenge ahead of the drivers of sustainable development is quite enormous to ensure that *'green'* products and services indiscriminately target the whole world's customers alike. This therefore calls for a non-discriminatory all stakeholder effort which encompasses even the views of the poor stakeholders (customers), as the present EMS influenced stakeholder effort/pressure [as advocated by the world Bank (2000) above] seems to have sidelined the expectations and contribution of the poor in as far as 'green' products and services are concerned.

On this issue of costly 'green' products and services, Cohen (1994) introduces a very important and worth noting issue that even though a good number of US consumers portray environmental consciousness and green procurement orientation, they are unwilling to pay more for 'green products'. The big question therefore is - *what more about the poor communities in the developing world, if the US consumers as well are reluctant to incur additional costs for 'green' products and services?*

Over and above the issue of increased 'green' purchasing decisions, EMS and its regulations also encourage creativity and competitive advantage, which translate into improved economic performance, as in response to environmental regulations, innovative production gets promoted, hence efficient use of resource and production of more competitive products (Porter, 1991). Waste prevention results in surprising innovations and financial gains (King and Lennox, 2001). Current developments in environmental management have moved from mere compliance to competitiveness. Environmental management spurred competitive advantage is increasingly getting entrenched in a number of corporate leaders (Cohen et al, 1997). Evidence on this issue of competitive advantage, is provided by Monsanto (1991) cited in Cohen et al (1997) quoting the chief executive officer (CEO) of Monsanto Company saying:

> *Monsanto's ability to develop new products, enter new products markets, sell … current products and operate our - manufacturing facilities profitability depends upon continuous improvement in environmental performance.*

On the contrary, environmental management regulations are a burden that misdirects financial resources to unviable investments (i.e. environmental management projects) from which invested funds cannot be recouped. (Mahaptra, 1984; and Walley and Whitehead, 1994). This means that much as environmental management practices (regulations) encourage innovativeness, the underlying problem is, EMS start up costs are high, for example massive funding is required in the areas of research and development, infrastructure, implementation etc to explore cleaner production avenues. Consequently, financially weak business enterprises get stuck in the non-proceeds yielding compliance stage since they cannot afford the costs of going beyond compliance. Based on this argument, EMS and environmental regulations remain a burden. Furthermore, financially weak enterprises may also have brilliant innovative ideas but fail to implement them due to lack of financial resources to convert such ideas into practice.

2.5.3: A Critical Analysis of Two EMS-Economic Performance Relations Case Studies

Nuhoglu's (n.d.) study on *Financial Performance in Environmentally sensitive Companies in an Emerging Market in Turkey* looked into EMS-economic performance relations of 15 companies that had won awards of environmental consciousness, and other environmentally insensitive companies. The aim of the study was to look into the relations between EMS and the companies' economic performances by paying attention to causality of the relations. The hypothesis tested was that a financially stable company is able to take care of the environment, and that its environmental sensitivity then boosts the financial performance further.

The first stage of data analysis focussed on the 15 award winning companies, where it was discovered that there were negative relations between the environmental performance and financial performance. The second stage compared the economic performance of environmentally sensitive and the insensitive companies, where it was established that the economic performance of the two sets of companies performed in the same manner with respect to profitability, return on assets, and return on equity. These findings were attributed to macro economic crisis that Turkey experienced during the period of the study. Thus receiving environmental sensitivity awards had

no positive contribution in the financial performance of the environmentally sensitive companies.

This study raises a very important point that in poor economic conditions, EMS associated economic benefits are non-existent. However, weaknesses spotted in this study are that the author neither says anything about causality in the conclusion nor mentions how the hypothesis tested, be it positively or negatively. Much as it is difficult to establish causality, the author should have on the methodology part drawn the sample from two sets of companies characterised by financial stability and financial instability respectively to obtain rather better results. There is no mention of financial backgrounds of the two sets of companies under study.

However, contrary to Nuhoglu's findings of negative relations between environmental and financial performance, Klassen and McLaughlin (1996) found positive returns to companies owing to environmental awards, as they established that manufacturers who, adopt EMS, manage their environmental impacts; recycle waste etc can improve their market or overpower competitors that fail to embark upon sound environmental performance.

In O'Sullivian (2003) study whose focus was on est*ablishing environmental and economic implications of introducing new technology i.e.* Puradyn Oil Filtration System (POFS) in an offshore sector, the aims of the study were:

- *To conduct a life cycle assessment (LCA) for the hydraulic machinery with and without the POFS and to compare the input and output inventories of each setting to measure the net benefits, and*
- *To identify barriers associated with adoption of new technology.*

The POFS is some form of cleaner technology that is claimed to improve efficient use of oil; reduce waste; cut down on oil change requirements quite drastically; and extend the lifespan of machinery.

In this study, both aims of the study were not met. For the first aim, it has been observed that neither time for the study (which was one year) nor the financial resources were adequate for the study, given that the LCA methodology adopted is a very lengthy exercise that requires adequate time and financial resources to touch on all the sources of information satisfactorily. Setting boundaries to an LCA process is another limiting factor, as it sets aside some important factors from which relevant information can be obtained. The net benefits of POFS adoption could have still been established by simply confining the research to the comparison of two sets of companies (i.e. those with POFS and those without it) without necessarily adopting a lengthy LCA approach. On the part of the second aim, *to identify barriers associated with the adoption of new technology*, observed weaknesses are; - the way questionnaires were administered to respondents i.e. in a two phased process was bound to yield poor responses, as the author received only two responses. To start with, responding to a questionnaire is an exercise that most people dislike, so sending a questionnaire covering only the first aim alone and another one later taking care of another aim becomes a demanding exercise that consumes people's precious time. The researcher should have put all the questions in one questionnaire. Personal interview could have as well yielded better results than e-mailing questionnaires, as respondents tend to ignore e-mail messages (which were used in the study) especially if they consider the study to be non-value adding to their organisation.

2.5.4: Conclusion

From the perspectives of various authors presented above, the researcher has observed that EMS-economic performance relations are a controversial subject, since there are contradictory results from their various studies as reviewed above. However, it has been observed that a number of EMS tools including amongst others, industrial ecology; DfE; environmental performance reports of business enterprises; environmental awareness campaigns etc play an important role in positive EMS-economic performance relations. CSR as well is quite vital in contributing towards EMS-Economic performance positive relations, as it leads to improved enterprises' market share; improves stakeholder relations; cuts down on regulatory compliance costs etc, which translate into positive economic performance. However, it is equally important to note that these contributory factors (i.e. stakeholder concerted effort;

increased market share; adoption of industrial ecology and DfE etc) are highly determined by a number of factors such as government policies; nature of the market; level of environmental awareness etc, but above all availability of financial resources which are a cornerstone in ensuring the availability of any other necessary resources and contributory factors. Furthermore, EMS-economic performance relations controversies are also influenced by amongst others weak law enforcement in some countries, as EMS effectiveness depends on the legislation of individual countries. One other important observation made is that most of the literature on EMS-economic performance relations is developed nations' based or inclined. This could imply that EMS is a developed countries' coined initiative.

On the basis of the above arguments, it is concluded that it is quite imperative to avoid adoption of sweeping statements i.e. *EMS adoption yields positive returns or EMS implementation results in negative economic performance*, as these studies are conducted in different settings whose conditions may or may not support EMS, thus statements should be setting specific. This argument is maintained by Griffin and Mahon (1997) as they state that there is no conventional and useful definitions of either corporate social performance or environmental performance, it is therefore not a good idea to consider findings from any particular research applicable across all settings. In addition to this McWilliams and Siegel (2000) argue that some studies may leave out key variables that are essential determinants of EMS contribution to positive economic performance of enterprises.

In order to make informed EMS (pollution prevention) investments, it is important to be guided by some form of environmental accounting techniques. To this end, the next section will focus on environmental accounting.

2.6 Understanding Environmental Accounting

This section is intended to shed some light on the concept of environmental accounting; the justification of its introduction in the field of environmental management; how environmental accounting as a concept enables business enterprises to account for environmental costs; and some tools that environmental

accounting employs to provide relevant information that facilitates informed investment decisions.

2.6.1 Environmental Accounting

Environmental accounting as a concept is an accounting tool that enables a business enterprise to account for all the costs it incurs as well as the revenue it receives owing to environmental management related activities to enable business enterprises to judge whether their environmental management projects are profitable or not.

Environmental accounting is an accounting system that: assists business enterprises that have implemented sound environmental management systems in pursuit of sustainable development to identify all environmental management induced costs that a business enterprise incurs; enables business enterprises to recognize financial benefits accruing to them due to implemented environmental management activities; provides the best possible quantitative measurement strategies i.e. in monetary or physical terms; and communicates the results of the measurement systems to the entrepreneurs and other stakeholders for decision making (Japanese Ministry of Environment – Japan, 2002).

2.6.2 Why Environmental Accounting?

First of all, it is important to recall that most business enterprises are profit-making entities, thus their primary reason for existence is to make profit, which then translates into wealth accumulation. Business enterprises pursue their objective of wealth accumulation through natural resources acquisition, and processing those natural resources into goods and services for consumption by the community (see Figure 2.4).

Underscoring the justification of environmental accounting in environmental management projects, the American Institute for Pollution Prevention (1993) argues that previously, pollution prevention justification was based on legal pressures (encompassing fines and penalties) that legislations exert/ed on non-compliant entrepreneurs. This justification resulted in many uninformed decisions, which quite often channelled funds to unprofitable projects as against profitable ones. Today through the employment of environmental accounting, EMS projects are able to justify their request for funding on the basis of their viability, as environmental

accounting furnishes entrepreneurs, investors and market agents with information pertaining to the viability or non-viability of a pollution prevention project ahead of embarking upon such a project. In addition to this, Kennedy (1998) states that total cost accounting, which can be regarded as an instrument in environmental cost accounting can enable an environmental professional to sell and win funds for environmental projects against other projects competing for same funds. This is based on the fact that, environmental cost accounting can clearly display the costs and gains associated with environmental projects to enable management to make informed decisions.

Given that the primary objective of investors is to make profit, and that environmental accounting enables investors to make informed investment decisions, it therefore becomes clear that environmental accounting is central to ensuring investment in feasible pollution prevention projects that yield positive economic returns.

2.6.3 Accounting for Environmental Costs

Given that business enterprises' environmental responsibility extends into the CSR as reflected in section 2.4.2 above, the scope of environmental costs now widens, as business enterprises now have to incur costs that they never took care of before, as over and above regulatory requirements, business enterprises strive for improved relations with the community. It has therefore become a rather complex exercise to identify environmental costs and monetary benefits associated with environmental management programs, as some are hidden within other operating overheads while some are overlooked and others are unquantifiable.

Environmental costs that a business enterprise incurs may be spread across all the five accounting systems cost categorisations, namely: (i) *direct material and labour; (ii) manufacturing or factory operating cost (such as: rent, property tax, repairs and maintenance, insurance etc); (iii) sales; (iv) general and administrative overheads; and (v) research and development* (EPA, 1995). However, the EPA (1995) highlights all possible environmental costs in Table 2.1 below, where:

Conventional costs: refer to costs of raw materials, capital goods, utilities, and supplies that are ordinarily taken care of in cost accounting and capital budgeting, but are however not normally regarded as environmental costs.

Potentially hidden costs -display a number of environmental costs that are likely not to receive managers attention; namely *'upfront environmental costs'* i.e. costs which a business enterprise suffers ahead of the process operation such as siting, and research and development, design of environmentally preferable products or processes; **'***regulatory and voluntary environmental costs'* ***i.e.*** costs which a business enterprise incurs that are regulatory (i.e. waste management, protective clothing etc) and voluntary (reports, support to environmental groups etc); and *'back-end environmental costs'* i.e. costs suffered at the end of a project, such as post-closure care of a filled landfill.

Contingent Costs – cover incidental costs, which a business enterprise is likely to incur such as personal injury, damages and fines and penalties.

Image and Relationship Costs: these cover relations related activities i.e. owing to corporate responsibility of business enterprises; and costs incurred for pollution prevention award winning programs.

Potentially Hidden Costs		
Regulatory	**Upfront**	**Voluntary**
		(Beyond Compliance)
Notification	Site studies	Community relations/ outreach
Reporting	Site preparation	Monitoring/testing
Monitoring/Testing	Permitting	Training
Studies/modelling	R&D	Audits
Remediation	Engineering and procurement	Qualifying suppliers
Recordkeeping	Installation	Reports (e.g. annual
Plans	**Conventional Costs**	environmental reports)
Training	Capital equipment	Insurance
Inspections	Material	Planning
Manifesting	Labour	Feasibility studies
Labelling	Supplies	Remediation
Preparedness	Utilities	Recycling
Protective equipment	Structures	Environmental studies
Medical surveillance	Salvage value	R&D
Environmental insurance	**Back-End**	Habitat and wetland protection
Financial assurance	Closure/decommissioning	Landscaping
Pollution control	Disposal of inventory	Other environmental projects
Spill response	Post-closure care	Financial support to
Storm water management	Site survey	environmental groups and/or
Waste management		researchers
Taxes/fees		
Contingent Costs		
Future compliance costs	Remediation	Legal expenses
Penalties/fines	Property damage	Natural resource damage
Response to future releases	Personal injury damage	Economic loss damages
Image and Relationship Costs		
Corporate image	Relationship with professional	Relationship with lenders
Relationship with customers	staff	Relationship with host
Relationship with investors	Relationship with workers	communities
Relationship with insurers	Relationship with suppliers	Relationship with regulators

Table 2.1: Examples Of Environmental Costs Incurred By Firms

Source: Environmental Protection Agency, 1995.

2.6.4 Environmental Accounting Tools

Environmental accounting employs all financial analysis principles to account for both costs and revenue generated from environmental management program. However, in this particular case only three project feasibility evaluation techniques will be dealt with, namely the *'present worth method; internal rate of return; and payback period'*. As for an illustration of how environmental accounting analyses costs and revenue a business experiences, only the present worth evaluation technique will be employed to demonstrate it.

Pilcher (1992) and Kennedy (1998) state that, the primary objective of investment evaluation techniques is to look into both the cash inflows and outflows resulting from an investment and its operations. They further explain the above three project viability evaluation techniques as follows:

2.6.4 (i) Present Worth Method

The present worth method covers to discount (at a specified interest rate) all cash inflows and outflows that a business enterprise experiences in a specified life span of a project. These cash flows are then compared, and their resulting difference is referred to as the *net present worth*, which then becomes a determining factor whether or not a project is worth investing in. Discounting the future cash flows to their present worth enables investors to compare two projects over time; adjust for inflation; loan payment etc. This yields a more precise assessment of the project's worth. (For a brief illustration of costs evaluation using the present worth method see Demonstration 2.1 below while for a detailed illustration see appendix B).

Demonstration 2.1: How the Present Worth Project Assessment Technique works.

Supposing an investor is supposed to choose between two pollution prevention alternatives to meet regulatory requirements of emissions- where:

Alternative A requires from the investor an investment capital of R20, 000 where the investor will receive revenue of R10, 000; R8, 000; R11, 000; and R6, 000 for the

next four years respectively at 10 per cent interest, while **alternative B** requires from the investor an investment capital of R24, 000 where the investor receives revenue of R12, 000; R10, 000; R13, 000; and R10, 000 for four years respectively at 12 per cent interest.

To get the present values of the yearly revenues for each **alternative** for a period of four years, the following formula applies:

$$PV = \frac{FV}{(1 + r)^t}$$

Where: **PV**= present value
FV= future value of both cash flows received in a specified time scale
r = the discount rate
t = time scale (period).

In the case of these two *alternatives* above, over a period of four years the equation will look as follows;

$$PV = \frac{FV}{(1+r)^1} + \frac{FV}{(1+r)^2} + \frac{FV}{(1+r)^3} + \frac{FV}{(1+r)^4}$$

whose results are reflected in Table 2.2 (labelled alternative A), and Table 2.3 (labelled alternative B) respectively.

Year	**Future Value**	**Present Value**
0		- R 20, 000 (Capital)
1	R10, 000	R 9, 091
2	R8, 000	R 6, 612
3	R11, 000	R 8, 265
4	R6, 000	R 4, 098
Net Present Value		**R 8, 066**

Table 2.2: Alternative A at 10 % Interest Rate

Year	Future Value	Present Value
0		- R24, 000 (Capital)
1	R12, 000	R10, 714
2	R 10, 000	R7, 972
3	R 13, 000	R9, 253
4	R 10, 000	R6, 355
Net Present Value		**R10, 294**

Table 2.3: Alternative B at 12 % Interest Rate

Based on the above analyses of **alternatives A and B,** an investor will go for **alternative B**, as its net present value brings in more lucrative returns of **R10, 294** in meeting the specified emission levels in a period of four years as opposed to **alternative A** whose returns are **R8, 066**. In a nutshell, it becomes clear therefore how project evaluation techniques assist investors in making informed decisions, as the analysis of the two pollution prevention projects above reflect information necessary for an investor to make informed decisions as to which project to embark on. Decisions of investing in a project is therefore based on information that shows which pollution prevention is worth investing in, taking into account the fact that the interest of business enterprises is in making profit.

2.6.4 (ii) Internal Rate of Return (IRR)

It is the rate at which the project pays back the initial capital invested in it. Or it can be referred to as a rate of return charged on the outstanding project balance of the investment such that at the end of the project the unrecovered project balance will be zero. Normally, corporations have a minimum acceptable rate of return (MARR), which is the lowest rate a company can accept on an investment. What is required in this technique is to get the IRR, which in comparison to the MARR will determine whether the project is accepted or rejected. If the IRR is greater than the MARR the project is viable, but if the IRR is less than the MARR the project is rejected.

2.6.4 (iii) Payback Analysis

The payback analysis measures how long a project will take to recoup the invested capital. A project that takes the shortest time to recover capital invested is normally regarded as the best investment. The faster the period of invested capital recovery, the faster it will enable reinvestment and cut down the loss of value resulting from inflation.

Given the activities involved in undertaking an environmental accounting exercise, it becomes obvious that environmental accounting is a very tedious and complex exercise that requires proper documentation of all activities undertaken, purchases made, maintenance costs etc in order to attach a corresponding cost to it for accounting purposes. This exercise similarly calls for trained personnel to efficiently perform the accounting task; and information management systems for proper keeping of information to ensure that every single activity is documented and accessed by authorised personnel through proper channels. It is also worth noting that all the resources required to make environmental accounting an efficient tool require financial resources, for example, information management system will require computers; some relevant computer software; installation services; trained personnel to man the information management department, maintenance costs etc. It is also important to note that, some costs and benefits are intangible, therefore not easy for environmental accounting to capture them. However, over and above all the hurdles associated with environmental accounting, it is an imperative tool for successful implementation of environmental management projects.

In conclusion, despite the intangible costs and benefits which environmental accounting cannot capture, on the whole it is a very imperative project evaluation tool that should be employed by entrepreneurs to avoid the problem of investing funds in infeasible projects. This statement is maintained by the Design for the Environment Program (n.d.) as it states that environmental accounting is essential in environmental management projects, as it ensures that even the often hidden environmental costs are well taken care of. However, the problem still lies with intangible costs and benefits, but they should however be assessed qualitatively.

CHAPTER THREE: RESEARCH METHODS

3.1 Introduction

The aim of this section is to give a picture of how the research was conducted. This will cover units of analysis; data collection methods; and data processing and analysis methods.

3.2 Units of Analysis

Units of analysis in this study were business enterprises that have acquired ISO 14001 EMS certification.

3.3 Data Collection Methods

Data were collected from both the secondary and primary sources of data.

3.3.1 Secondary Data

Secondary data were gathered in the form of literature review from the internet; the University of the Witwatersrand Libraries; the National Environmental Secretariat library in Lesotho; and other environment related documentation from the Department of Environmental Affairs and Tourism (DEAT) in South Africa.

3.3.2 Primary Data

Primary data were collected by means of questionnaires from the units of analysis outlined in section 3.1.

(i) Questionnaire Structure

The questionnaire focused on three research variable areas outlined in section 1.5.2 (i.e. water, energy and raw materials) to assess their impact on the economic performance of enterprises in order to achieve the study objectives listed in section 1.3. The questionnaire was divided into four sections in the following manner:

- *A section pertaining to the variable water*, which looked into strategies that enterprises have adopted to cut down on water consumption; total water consumption per year; and water consumption per unit of production. On the

basis of the responses from this section the impact of the variable water on the economic performance of enterprises was determined.

- *A section focusing on the variable energy.* This section looked into the following areas: strategies that enterprises have employed to reduce energy consumption; total energy consumption per year; and energy consumption per unit of production. Responses from this section were used to determine the impact of energy on the economic performance of enterprises.

- *A section on the variable raw materials*. This section looked into the following areas: strategies employed by the enterprises to promote efficient utilization of raw materials; the extent to which waste materials are utilized to reduce waste generation; annual expenditure on raw materials; and annual revenue and savings reaped from reuse, recycling and sale of waste materials. Based on the responses from this section, the impact of raw materials on the economic performance of enterprises was established.

- *A section on the overall costs and gains of EMS adoption*. This section looked into amongst others: factors that influenced EMS adoption and their varying degrees of influence; how enterprises financed their EMS adoption exercises and the impact of EMS financing on the economic footing of the enterprises; total EMS implementation costs etc. Responses from this section were used to facilitate comparison between costs and gains to establish the impact of EMS implementation on the economic performance of enterprises.

(NB: for a comprehensive picture of questionnaires with responses see Appendix A)

(ii) Sampling Methods

In this research, a systematic sampling technique with a random start was adopted to draw a sample from a list of 240 EMS certified enterprises in South Africa as per the South African Bureau of Standards website (South African Bureau of Standards (b), n.d.). These EMS certified enterprises were assigned continuous numbers starting from one up to 240, where the sampling interval (i.e. 8 as per Illustration 3.1) also

known as the **k – value** was employed to systematically draw a sample of 30 business enterprises from a list of 240 ISO 14001 certified business enterprises. To eliminate any possible human bias or sampling error in the selection of the first sample, the first sample was selected randomly from the first lot of the k elements. Then, from that first randomly selected element, every k^{th} element following it was included in the sample. This systematic sampling method was employed since the units of analysis are homogeneous. They are homogeneous in the sense that they are enterprises that have adopted certified EMS. In support of the homogeneous systematic sampling technique, Rubin and Babbie (1997) indicate that the basic theory of sampling distribution states that a homogeneous population results in smaller sample errors than does a heterogeneous one.

$$\text{Sampling Interval} = \frac{\text{Number of Business Enterprises}}{\text{Sample Size}}$$

$$= \frac{240}{30}$$

$$= 8$$

Illustration 3.1: Sampling Interval (K-Value)

Source: Adopted from Rubin and Babbie (1997)

(iii) Questionnaire Administering Process

Questionnaires were sent together with a letter of support from Head of School and a study overview to business enterprises by means of electronic mail (e-mail) system. E-mails addresses of enterprises were found from their profiles as outlined by the South African Bureau of Standards (South African Bureau of Standards (b) n.d.). This was followed by a telephonic conversation with contact persons in each enterprise to ensure that such questionnaire had been received and would be responded to. All sample enterprises promised to respond to the questionnaire without any problem. However, things did not turn out the way they were expected, as after a number of follow-ups only 30% of sample enterprises responded to the questionnaires after follow up operations. NB: Further follow-ups were made to try and seek some clarity

on unclear responses forwarded to me by some respondents, but never succeeded, hence such data were discarded, as it will be noticed in Chapter Four.

3.4 Data Processing and Analysis

3.4.1 Data Processing

Data were processed by means of computer programmes known as Microsoft word for creation of tables to convert qualitative data into quantitative data (i.e. frequencies and percentage) and Microsoft Excel for displaying the frequencies and percentages of the results in the form of pie and bar charts. Since the percentages obtained while processing the data were in decimal figures, they were rounded off to the nearest unit (for example, 52.5% was rounded off to 53% while 52.4% was rounded off to 52%).

3.4.2 Data Analysis

Processed data were used to quantitatively and qualitatively analyse data to achieve the research objectives. Quantitative data as a numerical representation of observations/results was used to unfold and explain the phenomena of the findings with respect to the research objectives. Likewise, qualitative data as a non-numerical assessment of the results was used to construe findings to establish their fundamental meanings and behavioural patterns with respect to the research objectives.

CHAPTER FOUR: FINDINGS AND DATA ANALYSIS

4.1 Introduction

The aim of this chapter is to present the findings of the study as well as to give a comprehensive analysis of the characteristics and patterns of the findings. To achieve this, the findings from the three research variables namely - *water, energy and raw materials* - with specific reference to their costs and returns will be presented and analysed to give a clear picture of their impact on the economic performance of business enterprises under study. This will be dealt with firstly by looking at the impact of water on the economic performance of business enterprises. Secondly, by focussing on the impact of energy on the economic performance of business enterprises. Thirdly, by paying attention to the impact of raw materials on the economic performance of business enterprises, and lastly by dealing with the overall costs and gains of EMS adoption resulting from the research variables.

4.2 The Impact of the Variable *'Water'* on the Economic Performance of Business Enterprises.

4.2.1 Introduction

Water is a very critical input in the production process of any enterprise, as it is used for various purposes ranging from domestic related purposes (i.e. drinking, bathing, lavatory purposes etc) to the actual production processes. Its consumption in most production enterprises is therefore quite high. However, efficient use of the input '*water'* in the production process can cut down on water consumption and the related costs quite enormously, and consequently, savings can accrue to enterprises. Similarly, inefficient use of water will give rise to high water consumption and the associated costs. Based on these statements therefore, water consumption was looked into to ascertain the nature of its impact on the economic performance of business enterprises.

4.2.2 Strategies Adopted to Reduce Water Consumption

This issue was looked into to establish the techniques, which enterprises have adopted to cut down on water consumption. In this particular issue, enterprises were provided

with four techniques/strategies, namely: (i) *recycling and reuse; (ii) water consumption balance/monitoring systems; (iii) water consumption targets; and (iv) awareness campaigns* - from which each enterprise was requested to indicate the strategies it has adopted to reduce water consumption. Figure 4.1 presents the results, where on the one hand the most commonly adopted strategy was discovered to be '*water consumption balance/monitoring systems'*, which has been adopted by 67% of enterprises. This is a system where water consumption is monitored through monthly water consumption bills, inspection of water pipes network for identification of leakages and so on to observe irregularities. On the other hand, the least adopted strategy was found to be '*awareness campaigns'* on how to reduce water consumption, as it was adopted by 22 % of enterprises. For a more comprehensive picture of the results refer to Figure 4.1.

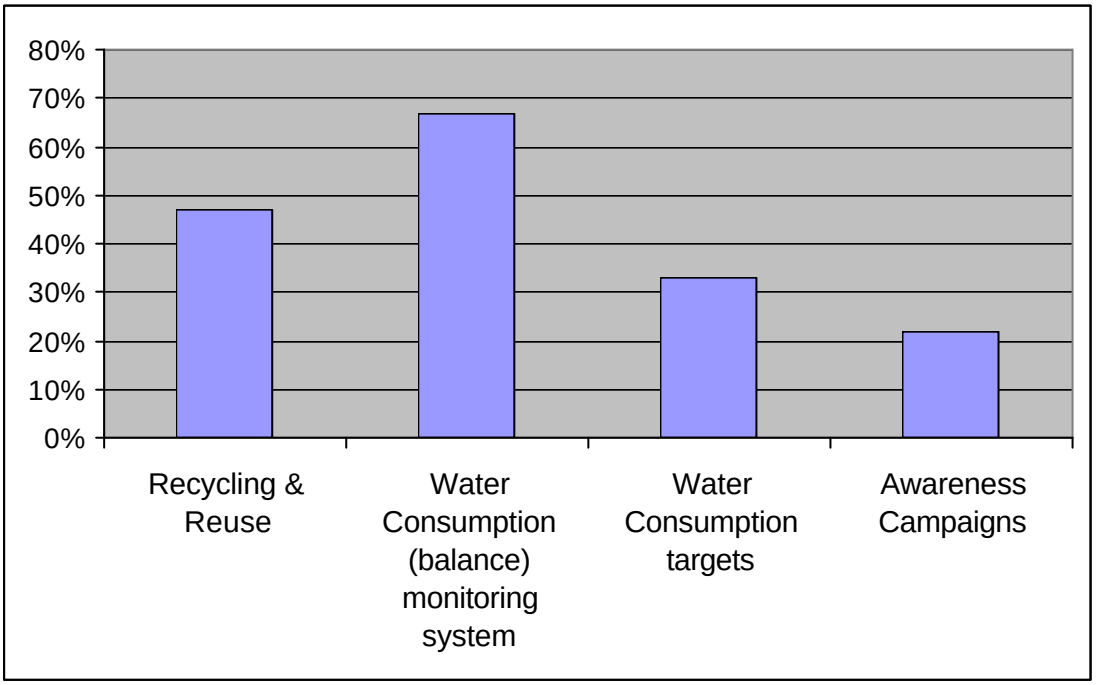


Figure 4.1: Strategies adopted to reduce Water Consumption by a Sample size of nine EMS certified Enterprises in South Africa in June-July 2004.

Figure 4.1 conveys information that *'awareness campaigns'* tool is the least utilised strategy. This indicates a poor EMS system, as EMS is a system that is supposed to effectively communicate the strategies it has adopted to keep employees and stakeholders abreast of such strategies. *'Awareness campaigns'* are an essential tool

that is not only affordable, but also enlightens employees on the rationale behind, say water consumption in this particular case. It is a strategy that complements other strategies i.e. other strategies cannot be effective without *'awareness campaigns'*. In a nutshell, '*awareness campaigns*' was supposed to have been adopted by all enterprises to beef up/sharpen other strategies that are adopted by enterprises.

The other underutilised strategy is *'water recycling and reuse'*, which is adopted by 44% of enterprises. This strategy is considered to be under-utilised because according to the World Bank (2000), different uses of water require different qualities of water, and therefore, *'water recycling and reuse'* can effectively promote efficient utilisation of water through a well-designed network of water pipes for different qualities of water. It has however, been observed that *'water recycling and reuse'* strategy underutilisation could be a result of costs associated with technology requirements for such a strategy.

4.2.3 Total Water Consumption level per Year

Water consumption was looked into to compare the average water consumption rate by individual business enterprises per year before and after EMS adoption to establish whether the water consumption pattern has increased or decreased. (NB: the acronym **'DNA'** in Table 4.1 means **'Data not Available',** and that such acronym will be adopted with the same meaning throughout the paper).

In response to this issue, it was discovered that the results were rather mixed and therefore confusing as Table 4.1 portrays total water consumption status during EMS era in relation pre EMS era as follows: 44% of enterprises experienced an *'increased'* total water consumption level per year in the EMS era; 33% of enterprises did not provide data, therefore, their water consumption status in the EMS era was '*unknown'*; and lastly 22% of enterprises experienced a '*decreased'* total water consumption level per year in the EMS era.

Company (Enterprise)	**Pre - EMS era**	**EMS era**	**Water Consumption Status in EMS era against the Pre-EMS era.**	**Water consumption status in EMS era in % form**
Company A	DNA	DNA	Unknown	
Company B	1023 kl	700 kl	Decreased	
Company C	DNA	DNA	Unknown	
Company D	180 066 kl	503 400 kl	Increased	
Company E	972 kl	1095 kl	Increased	
Company F	334 811 kl	265 315 kl	Decreased	
Company G	150 000 kl	900 000 kl	Increased	
Company H	2,1 million kl	2,7million kl	Increased	
Company I	DNA	DNA	Unknown	
Total number of Companies with ***'Increased'*** water consumption status in the EMS era			**4**	**44%**
Total number of Companies with ***'Decreased'*** water Consumption status in the EMS era			**2**	**22%**
Total number of Companies with ***'Unknown'*** water status in the EMS era			**3**	**33%**

Table 4.1: Total Water Consumption Pattern per Year by a Sample Size of nine Enterprises in South Africa in June-July 2004

4.2.4 Water Consumption Rate per Unit of Production

The matter of water consumption rate per unit of production was investigated to construe the *'mixed'* total water consumption level results per year, which are reflected in Table 4.1 as well as to compare water consumption rate per unit of production before and during EMS periods to establish what the status in the EMS era is. In response to this issue, all the enterprises pointed out that their water consumption rate per unit of production has *'decreased'* during the EMS period as opposed to the pre-EMS period.

A *'decreased'* water consumption rate per unit of production in the EMS era therefore means that the 44% of enterprises in Table 4.1 whose total annual water consumption has *'increased'* in the EMS era is simply a direct influence of growth, which the enterprises have experienced in terms of size and production capacity, and therefore, demand more water for increased production. This in simple terms, means that expansion of the enterprises and demand/need for more water for production of more goods and services for the community **does not necessarily mean increased** water consumption per unit of production at all, but rather means increased total water consumption per year owing to growth in production capacity. In actual fact, water consumption has dropped, but it is rather overshadowed by increased total water requirements for increased production purposes. Had the enterprises not experienced growth in production capacity, a drop in total water consumption per year would be clearly/obviously evident.

On the issue of 22% of enterprises in Table 4.1 whose total annual water consumption level has *'decreased'* in the EMS era, it is observed that this drop in total water consumption level per year is a result of efficient water usage, which is coupled with little if not nothing in terms of growth in size and production capacity. In such cases, common sense dictates that such enterprises should experience a drop in total water consumption per year based on the fact that their water consumption rate per unit of production has dropped and that they have not grown any bigger.

As for the 33% of enterprises whose water consumption status in Table 4.1 is *'unknown'* owing to unavailability of data, yet in section 4.2.4 all enterprises stated that their water consumption rate per unit of production had dropped, it is difficult to assess whether such companies have experienced growth in terms of production capacity. However, the fact that their water consumption rate per unit of production has dropped in the EMS era as opposed to the pre-EMS era, it becomes clear that a reduction in their water consumption rate per unit of production is a direct effect of EMS adoption by the enterprises.

On the whole, although enterprises do not seem to have invested much in water consumption reduction strategies as reflected in Figure 4.1, a drop in water

consumption per unit of production however, means some savings accruing to enterprises, thus a positive impact in the economic perfo rmances of the enterprises.

4.3 The Impact of the Variable *'Energy'* on the Economic Performance of Business Enterprises

4.3.1 Introduction

Energy is a very essential input in the production process, as it is required to transform raw materials from the raw state to usable goods. Efficient use of energy can of course contribute to positive economic performance of enterprises. Likewise, inefficient use of energy can contribute to the negative economic performance of enterprises. On these grounds therefore, the issue of energy utilisation was investigated to establish the nature of its contribution to the economic performances of enterprises.

4.3.2 Strategies Adopted to Cut Down on Energy Consumption

This aspect was investigated to establish the strategies enterprises have employed to reduce energy consumption. Just as is the case in section 4.2.2, in this particular case as well, enterprises were provided with five energy saving strategies, namely: (i) e*nergy efficiency targets; (ii) energy survey – determining the biggest consumer; (iii) energy consumption balance/monitoring systems; (iv) awareness campaigns;* and *(v) Gas to electricity conversion technology* - from which they were requested to indicated the strategies the respective enterprises have adopted for energy consumption reduction.

Figure 4.2 below shows the mostly adopted strategy as '*energy consumption balance/monitoring systems'*, as it has been adopted by 67% of enterprises while the least utilised strategies are reflected as '*energy surveys'* and '*gas to electricity conversion technology/plant'*, where each strategy forms 11% of enterprises. It is important to note that none of the enterprises have adopted all the five strategies.

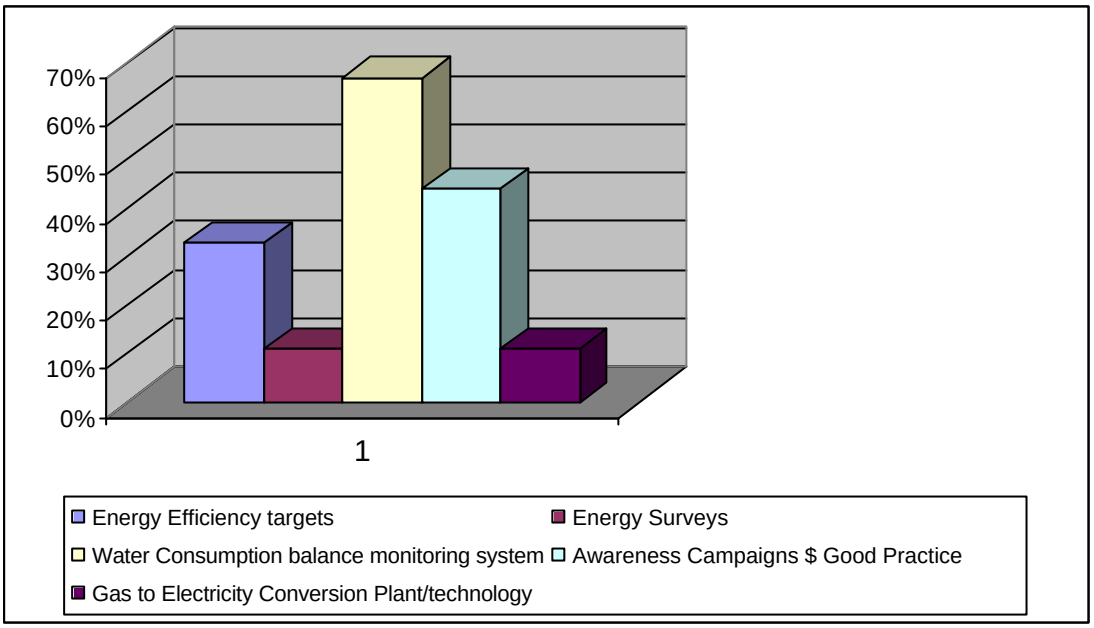


Figure 4.2: Strategies adopted to reduce Energy Consumption by a sample size of nine Enterprises in South Africa from June – July 2004.

The results conveyed by Figure 4.2 are according to the researcher quite amazing, as for example the most crucial strategies *(i.e. energy surveys – determining the biggest areas of energy consumption)*, which ought to have been adopted by every enterprise are the least utilised strategies, as they are practised by 11% of enterprises. The *'energy survey'* strategy would have been very useful for all enterprises in providing them with relevant information to enable the respective enterprises to apply appropriate strategies at the required magnitude, in the right areas of energy consumption. It is important to note that, it is impossible to manage any operation without relevant information i.e. managing energy consumption rate without proper information is not an effective strategy at all. As for poor adoption of *'gas to electricity conversion technology/plant'*, it is observed to be a result of high costs associated with such technology – meaning that use of high technology to promote energy efficiency has not yet been fully explored by enterprises due to its costs.

The use of *'awareness campaigns'* is one other area that is very crucial, yet under-utilised by the enterprises as it is adopted by only 44% of the enterprises. Given that this strategy is supposed to complement all other strategies, it ought to have been utilised by all the enterprises. Failure to do so therefore means that employees and

stakeholders are not at the height of the rationale behind energy consumption reduction strategies.

On the whole, energy consumption reduction strategies adopted by the majority of the companies are not up to the required standard, as some companies have failed to adopt the most essential strategies.

4.3.3 Total Energy Consumption level per Year

Just as in the total annual water consumption level in section 4.2.3, total energy consumption level per year was also investigated to compare the average rate of energy utilisation by the enterprises per year before and after EMS adoption. This issue was looked into to also establish whether or not energy consumption per year has increased or decreased. (Please recall that '**DNA'** stands for '**data not available'**, and that enterprises/companies that did not provide data for both the pre-EMS and the EMS eras have been categorised under *'unknown'* status, since their data were incomplete).

In response to this issue, Table 4.2 shows that: energy consumption status of 56% of enterprises was ***'unknown'*** due to unavailability of their data; and that energy consumption of ***'increased'*** and ***'decreased'*** statuses respectively formed 22% of enterprises. It is important to note that failure of enterprises to provide data inhibited proper data analysis.

Company (Enterprise)	**Pre-EMS era**	**EMS era**	**Energy Consumption Status in EMS era against the Pre-EMS era**	**Energy consumption status in EMS era in % form**
Company A	DNA	DNA	Unknown	
Company B	2 458 units (kwh)	2 228 units (Kwh)	Decreased	
Company C	DNA	DNA	Unknown	
Company D	56 580 units (Kwh)	77 171 units (kwh)	Increased	
Company E	28 992 units (kwh)	32 256 units (kwh)	Increased	
Company F	36 991 units (Kwh)	28 168 units (Kwh)	Decreased	
Company G	DNA	180 000 units (kwh)	Unknown	
Company H	24 million units (GJ)	28 million units (GJ)	Increased	
Company I	DNA	DNA	Unknown	
Total number of Companies with ***'Increased'*** energy consumption status in the EMS era			3	33%
Total number of Companies with ***'Decreased'*** energy consumption status in the EMS era			2	22%
Total number of Companies with ***'Unknown'*** energy consumption status in the EMS era			4	44%

Table 4.2: Total Energy Consumption level per Year by a sample size of nine Enterprises in South Africa from June – July 2004

4.3.4 Energy Consumption rate per Unit of Production

This matter of energy consumption rate per unit of production was looked into to establish a clear picture of what the results in Table 4.2 mean as well as to compare

the rate of energy use per unit of production before and during EMS periods. In response to this issue, all enterprises stated that their energy consumption rate per unit of production has dropped during the EMS era as opposed to the pre-EMS period.

A decline in energy consumption per unit of production in the EMS era, gives an explanation of how *'increased'* total energy consumption per year, which is reflected by 33% of enterprises in Table 4.2, came about. It is observed to have surfaced, as a direct result of growth the companies experienced in terms of size and production capacity, hence demanded more energy. This means that expansion/growth of companies and need for more energy for production of more goods and services **does not necessarily mean increased** energy consumption per unit of production, but increased total energy consumption per year owing to growth in production capacity. It is important to note that in actual fact energy consumption has dropped, but it is rather eclipsed by increased total energy requirements for increased production purposes. It is further crucial to note that, had the enterprises not experienced growth in production capacity, a drop in total energy consumption per year would be clearly evident/visible.

A drop in energy consumption per unit of production during the EMS era is further observed to interpret *'decreased'* total energy consumption per year, reflected by 22% of enterprises in Table 4.2, as a result of efficient energy usage coupled with little if not nothing in terms of growth in production capacity of enterprises. Thus, EMS strategies in the reduction of energy consumption coupled with no growth in production capacity, total energy consumption per year has dropped. In such cases, it makes sense that such enterprises should experience a drop in total energy consumption per year, based on the fact that their energy consumption rate per unit of production has dropped and that they have not grown any bigger.

On the issue of 44% of enterprises whose energy consumption status in Table 4.2 is *'unknown'* due to unavailability of data, yet in section 4.3.4 all enterprises stated that their energy consumption rate per unit of production had dropped, it is difficult to assess whether such companies have experienced growth in terms of size and production capacity. However, the fact that their energy consumption rate per unit of production has dropped in the EMS era as opposed to the pre-EMS era, it becomes

clear that a reduction in their energy consumption rate per unit of production is a direct effect of EMS adoption. Although the companies have not provided data, therefore their energy consumption status during EMS era was regarded as 'unknown', a mere reduction in energy consumption per unit of production during the EMS period therefore means there are some savings accruing to enterprises owing to EMS adoption though they cannot be quantified.

4.4 The Impact of the Variable *'Raw Materials'* on the Economic Performance of Business Enterprises

4.4.1 Introduction

Raw materials are key in the production of goods and provision of services in meeting the needs of the community, as they are the actual inputs that are converted into goods for consumption. Utilisation of some goods, in turn then makes provision of services possible. Given the importance of raw materials therefore, in meeting the needs of the community, it becomes imperative to ensure that raw materials are utilised in a sustainable manner to avoid their depletion, since raw materials will forever be essential requirements in meeting the needs of the community. It is critical to note that in pursuit of sustainable development through optimisation of raw materials, business enterprises can reap economic spin offs. Similarly, inefficient utilisation of raw materials will result not only in the loss of economic benefits, but in accelerated exhaustion of raw materials as well. On the basis of these arguments, utilisation of raw materials was therefore looked into to assess their impact on the economic performance of enterprises.

4.4.2 Strategies Adopted to Promote Efficient Utilisation of Raw Materials

This aspect was investigated to establish the approaches that enterprises have employed to promote efficient utilisation of raw materials. In response to this issue, all enterprises pointed out that they '*reused and sold*' some waste materials to promote efficient utilisation of raw materials. Over and above this only 11% of enterprises stated that they also *'recycled'* some waste materials. These responses mean some reduction in waste generation, as some waste was utilised in other ways.

Though the study indicates that, *'recycling'* is explored by only 11% of enterprises under study, this low percentage of *'recycling'* is observed to be a result of the fact that, in most cases the nature of business of waste generating enterprises is not to *'recycle'*, but to produce their business products. As a result waste recycling is undertaken by other enterprises whose nature of business is solely to recycle waste materials, but unfortunately such enterprises did not fall within the sample size of the study.

4.4.3 The Extent to which Waste Materials are Utilised

Efficient use of raw materials means ensuring that the potential value of a resource is utilised to the fullest. This can be achieved through 'reuse, *sale and recycling'* of waste material to ensure that an input is never disposed of prior to exhausting its full potential value. Efficient EMS therefore, is a tool that can ensure that '*reuse, sale and recycling'* of waste materials contribute quite substantially to the economic performance of the enterprise by cutting down on disposal costs and accumulating savings. Likewise, absence of EMS practice can result in loss of revenue and savings, as raw materials will be disposed of as waste prior to exhausting their full potential value. On the basis of these arguments, the manner in which waste was dealt with by enterprises was therefore looked into to compare the difference between waste usage in the pre-EMS era and during the EMS era. Figure 4.3 presents the results. (NB: 'W*aste disposal'* has been added as another form of dealing with waste to establish the extent to which enterprises dispose of waste material)

From the results in Figure 4.3, the following pattern in which enterprises dealt with waste is observed: a pattern of very little growth in the *'waste reuse'* area from some companies and absolutely no growth at all in others in the EMS era as opposed to the Pre-EMS era; a relatively better growth in the area of *'waste sale'* in the EMS era against the pre-EMS era; and a general drop in 'waste disposal' rate, although on the whole, waste disposal is still the most dominant waste utilisation strategy practised by the enterprises. It is further observed that a rise in *'waste sale'* could be closely linked to 'waste recycling', as it is highly likely that waste is actually sold to the recycling enterprises.

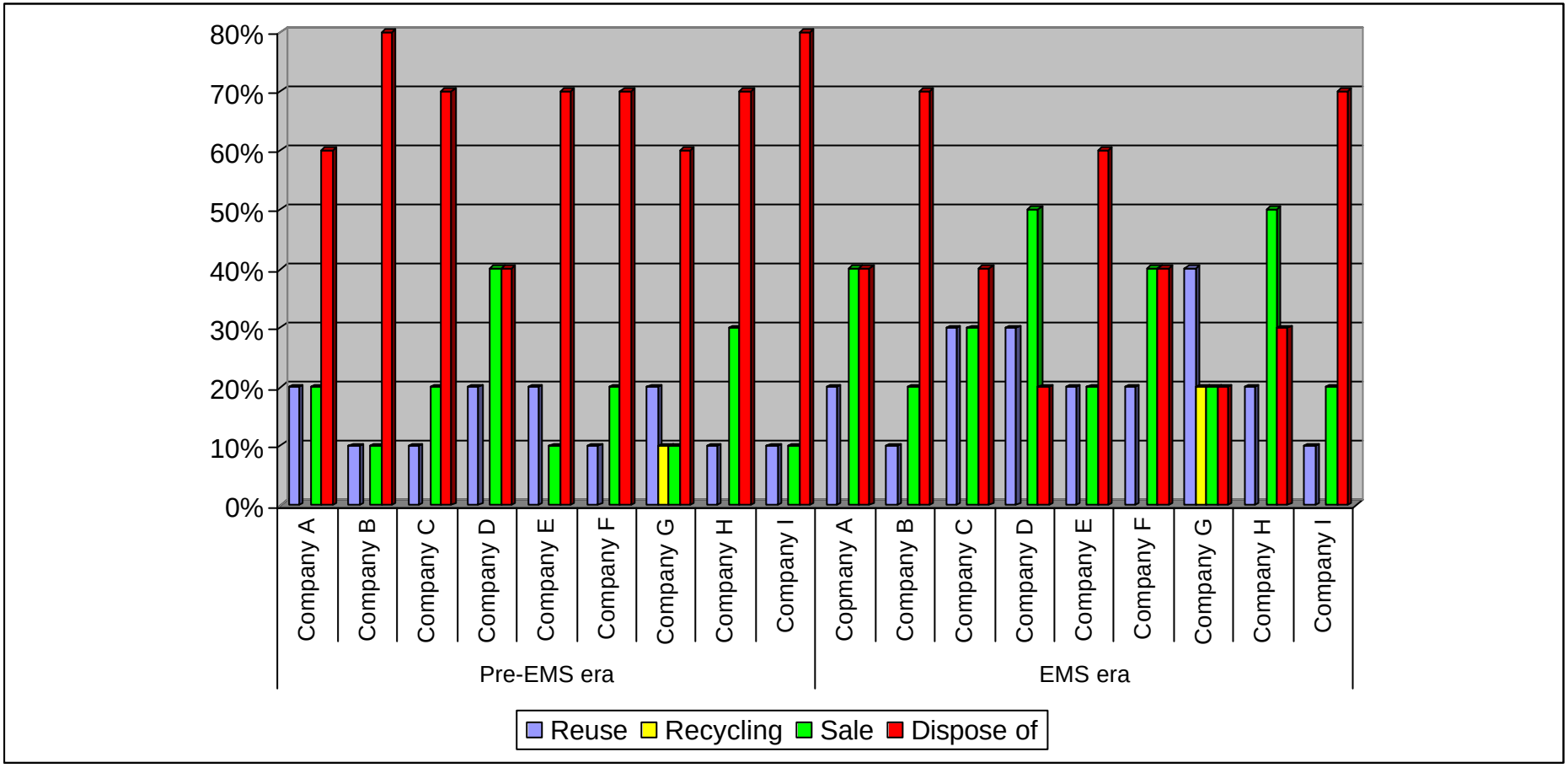


Figure: 4.3: A Comparison of the Rate (the Manner) in which Waste was dealt with by each Enterprise in the Pre-EMS era as against the EMS era by a sample size of nine Enterprises in South Africa in June – July 2004

The prominence of 'waste disposal' as the top most strategy in dealing with waste, further gave a signal that the enterprises have not yet utilised the full potential value of raw materials. However, the fact that the second prominent waste utilisation strategy is '*waste sale'* indicated injection of some revenue into enterprises emanating from *'sale of waste'* as well as a reduction in waste disposal costs. Little '*waste reuse'* practised by enterprises as well contributed to the savings the enterprises reaped owing to EMS adoption, and so is *'recycling'* to one enterprise that practices it amongst those under study whose nature of business is partly to recycle (See Figure 4.3).

The low *'reuse, sale* and *recycling'* of waste materials in South Africa as depicted by Figure 4.3 is observed to be a result of poor design for the environment, which means products are not designed in a manner that will enable *reuse, sale* and *recycling* of such products following the end of their life period. This is due to the absence of enabling tools, such as, proper planning systems; innovativeness; infrastructure; and research into cost effective and efficient *reuse, sale, and recycling* of waste materials techniques as well as cost effective waste recovery systems of reusable, saleable, and recyclable materials.

However, much as *'disposed of waste'* was the most dominant approach, it is quite evident that the '*sale, reuse, and recycling'* of some waste did generate some revenue which would otherwise be lost. Thus, although the *'reuse, sale* and *recycling'* of waste utilisation strategies were outperformed by '*waste disposal'*, there was evidence of some little degree of savings and cost reduction, which enterprises reaped. This means that to some minimal extent, utilisation of the potential value of raw materials has increased a little bit beyond what it was prior to EMS adoption.

4.4.4 Annual Expenditure on Raw Materials

This aspect was investigated in order to compare the cost of raw materials before and after the adoption of EMS by enterprises. Unfortunately, all enterprises could not provide the required data in this regard, as they pointed out that data pertaining to the cost of raw materials for both the pre-EMS and EMS eras were not available. Failure of enterprises to provide data is observed to be indicative of poor environmental accounting systems that the enterprises have employed. It is also believed that

documentation and information storage systems of the enterprises were very poor, and therefore very difficult for personnel assigned to respond to the questionnaire to access poorly stored information.

Much as the enterprises have failed to provide data pertaining to the annual expenditure on raw materials, it is assumed that the cost of raw materials for all enterprises is reduced in the EMS era as opposed to what it was in the pre-EMS era. This is based on the fact that in the EMS era, waste utilisation strategies (i.e. *reuse, sale and recycling of waste)* adopted by enterprises have to some little degree enhanced utilisation of raw materials. This has to some extent: reduced demand for raw materials; effected a drop in the cost of raw materials; and improved savings. On the basis of this argument, it is observed that in the circumstances where business enterprises experienced higher annual expenditure on raw materials in the EMS era, could only be as a result of either one or both of the following factors: (i) a hike due to growth of enterprises in terms of size and production capacity, and therefore a need for more raw materials to produce more goods and services, and/or (ii) a rise in the cost price of raw materials from suppliers.

4.4.5 Annual Revenue and Savings Gained Due to Reuse, Sale and Recycling of Waste from the Research Variable Areas.

Since *'reuse, sale and recycling'* of waste generate some revenue and savings, this matter was investigated to measure the magnitude of their contribution to the economic performance of enterprises in both the Pre-EMS and EMS eras. Table 4.3 presents the results, where all enterprises were considered to have not provided data, since even those that have provided data for only one era, their data were not helpful at all in comparing annual revenue and savings for the respective periods as well as in extrapolating the magnitude of the contribution of waste materials to the economic performance of enterprises.

Names of Companies	ERA	
	Pre-EMS era	EMS era
Company A	DNA	DNA
Company B	DNA	DNA
Company C	DNA	DNA
Company D	DNA	R3, 306 181
Company E	DNA	DNA
Company F	DNA	DNA
Company G	DNA	Millions of Rands
Company H	DNA	R90 000 000
Company I	DNA	DNA

Table 4.3: Annual Revenue & Savings Gained Owing To Reuse, Sale & Recycling of Waste Materials by a sample size of nine Enterprises in South Africa in June – July 2004

Table 4.3 portrays a uniform pattern of poor documentation and information storage in all enterprises in the pre-EMS era, as none of the enterprises managed to provide the required data. The pattern seems to change slightly in the EMS era, as only two enterprises (i.e. enterprises labelled **'D'** and **'H'**) managed to provide the required data. However, proper documentation of events by such companies is still questionable, since in section 4.3.3 (i.e. annual expenditure of raw materials) all enterprises failed to provide the required data. As for the company labelled **'G'**, it is considered to have failed to provide data for both eras, since the data it has provided was not in the required format, and therefore not useful. The qualitative data provided by this company is observed to be a smart way of trying to cover up poor data storage by the enterprise.

It has also been observed that the difficulty in providing the required data could be emanating from the fact that due to poor environmental accounting systems,

enterprises cannot be able to isolate savings and revenue emanating from *reused, recycled* and *sold* materials alone from the total income earned by the enterprises.

In a nutshell, given that the results in Figure 4.3 indicated that at least to some extent waste material is *'recycled, reused and sold'*, though in varying degree, it is believed that enterprises reaped some savings and revenue from *recycled, reused and sold* waste materials, although their magnitude cannot be determined as a result by failure of enterprises to provide data.

4.5 Overall Costs and Gains of EMS Adoption.

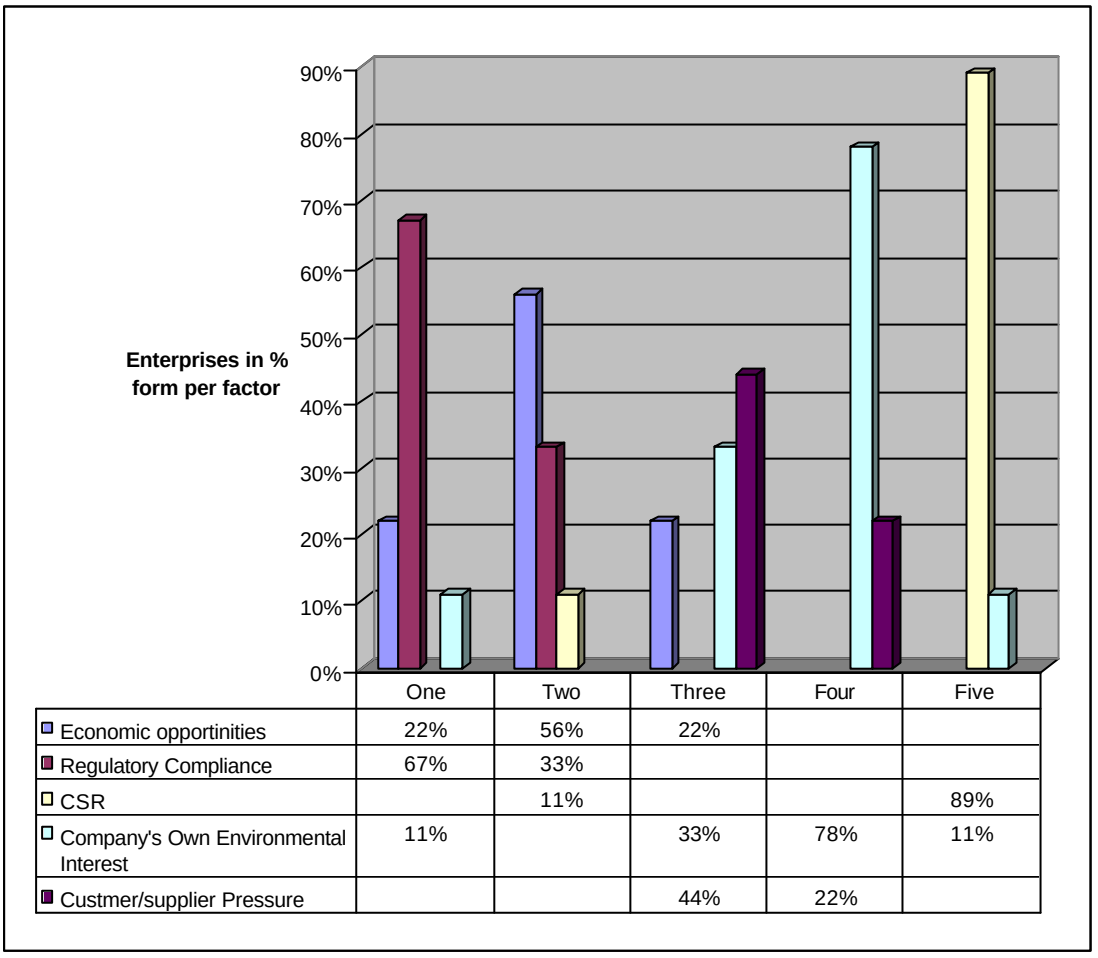
4.5.1 Introduction

General costs and gains related information, which enterprises experienced as a result of EMS adoption with specific reference to the three research variable areas under study was investigated. Information collected from the investigation was used to extrapolate the impact of EMS on the economic performance of enterprises. Of importance to note, is that some areas that were investigated in this section may not sound cost/gain related as such, but were looked into as their investigation was crucial in providing a clear picture of costs and gains that enterprises experienced.

4.5.2 Rationale Behind Adoption of Certified EMS

EMS adoption in different enterprises is driven by a number of factors with varying degrees of importance. It was therefore found imperative to establish the factors that influenced EMS adoption by the respective enterprises. Furthermore, given that the factors influencing EMS adoption differ in terms of their influence, it was also considered crucial to establish their respective varying degrees of influence with a view to discover a general order of their influence across all enterprises, and their relationship with the impact of EMS on the economic performance of enterprises. In this issue, enterprises were provide with five factors, which influence EMS adoption, namely: *(i) economic performance; (ii) regulatory compliance; (iii) corporate social responsibility (CSR); (iv) company's own environmental interest; and (v) customer/supplier pressure,* from which they were requested to rate their responses in

their order of influence on the decision of the company to adopt EMS. The rating system was used in the following manner: rating *'one'* represented the most influential factor while rating 'five' meant the least influential factor. Thus in other words, as the ratings (numbers) ascend, their influence diminishes (see Figure 4.4 for the results).



	One	Two	Three	Four	Five
Economic opportinities	22%	56%	22%		
Regulatory Compliance	67%	33%			
CSR		11%			89%
Company's Own Environmental Interest	11%		33%	78%	11%
Custmer/supplier Pressure			44%	22%	

Figure 4.4: Rationale Behind EMS Adoption by a sample size of nine Enterprises in South Africa in June – July 2004

Figure 4.4 shows that the rating *'one'* was attached to some factors behind EMS adoption in the following manner: to *'regulatory compliance'* by 67% of enterprises; to *'economic opportunities'* by 22% of enterprises; and to *'company's own environmental interest'* by 11% of enterprises. Figure 4.4 further indicates that the rating *'two'* was assigned the to following factors behind EMS adoption: to *'economic opportunities*' by 56% of enterprises; to *'regulatory compliance'* by 33% of

enterprises; and to *'CSR'* by 11% of enterprises. The least influential rating *(i.e. rating five)* was attached to the factors behind EMS adoption as follows: to '*CSR'* by 89% of enterprises; and to *'company's own environmental interest'* by 11% of enterprises. For a comprehensive picture of the results see Figure 4.4.

The dominance of '*regulatory compliance'* and '*economic opportunities'* in the ratings *'one'* and *'two'* respectively suggests that the enterprises were initially under pressure from regulators who penalised them for non-compliance. To circumvent the pressure from regulators and the associated compliance costs, the enterprises explored some means of survival within the regulatory confinements. In their exploration, they recognised economic opportunities that are associated with EMS adoption i.e. going beyond compliance converts regulatory compliance costs into economic benefits. The decision to go beyond compliance indicates economic opportunities spotted by the enterprises on how they can achieve their primary objective of making profit within the confines of environmental regulations. The decision of enterprises to go beyond compliance is therefore in line with what Cohen (1994) states, that enterprises will not honestly embark on environmental management projects (EMS projects) unless they have recognised some positive economic opportunities attached to such projects. In this particular case, enterprises are observed to have recognised long-term savings and cost reduction opportunities due to reduced regulatory compliance costs/penalties; reduced raw materials requirements; and overall economic opportunities as a result of efficient utilisation of raw materials.

The domination of the factor *'CSR'* in the area of rating *'five'* simply shows less interest in the promotion of social development by the majority of enterprises, as *'CSR'* is attached to rating '*one'* and '*two'* by 11% and 22% of enterprises respectively. On the one hand, this could also mean that only a very few companies are concerned about and aware of the benefits associated with social development. On the other hand, this could also mean that the majority of enterprises are aware of benefits associated with social development, but the problem could be that, investing in CSR is not a viable option, as according to Meadow et al (1972) communities in third world countries are poor and have their own needs that require immediate attention ahead of environmental management issues. Based on this argument, support of such communities to EMS compliant enterprises is minimal (i.e. not yielding much

for the enterprises), especially because 'green' products are costlier than their counterparts.

4.5.3 EMS Financing

EMS financing is one of the critical factors that determine whether or not an enterprise engages in EMS, due to high costs associated with EMS adoption. On the basis of this argument, the issue of EMS financing was looked into to establish how enterprises financed their EMS adoption exercises.

The study revealed that all enterprises under study financed their EMS adoption exercises through equity financing. In other words, the enterprises did not acquire any external financial assistance for EMS adoption.

4.5.4 Impact of EMS Financing on the Financial Performance of Enterprises

This issue was looked into to establish how EMS financing affected the economic/financial footing of the respective enterprises. In response to this matter Figure 4.5 shows that 89% of enterprises stated that EMS financing had an *'insignificant'* impact on their economic/financial performances, citing reasons like: *they had saved adequate funds for EMS adoption*.

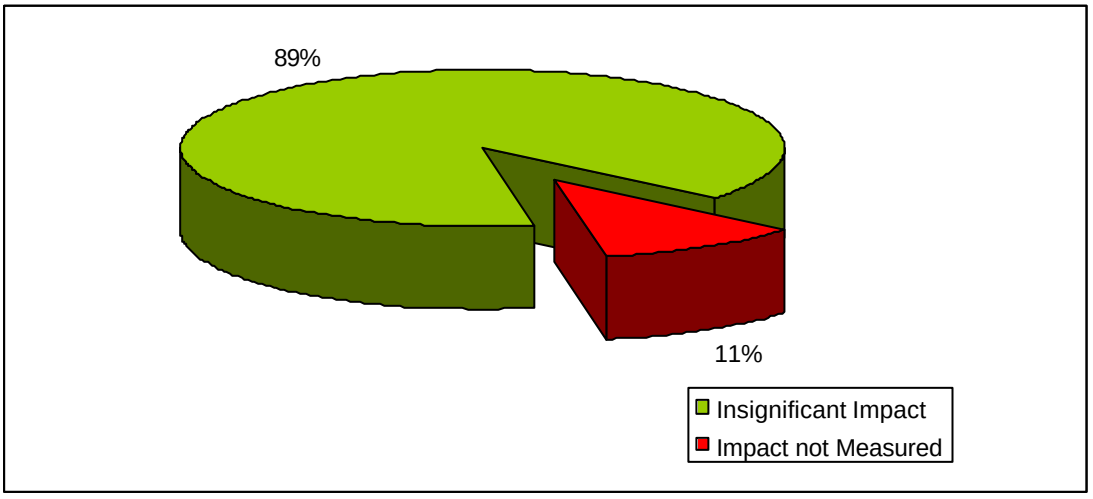


Figure 4.5: Impact of EMS Financing on Financial footing of a sample size of nine Enterprises in South Africa in June –July 2004

Referring to Figure 4.3, as it indicates that waste disposal was still the most dominant strategy adopted by enterprises in dealing with waste, and that strategies such as *'reuse, sale and recycling'* have improved at a minimal rate, it is observed that the companies have for sure experienced insignificant impact of EMS financing. This argument is based on the fact that, the domination of waste disposal as number one strategy in dealing with waste reflects poor investment in raw material optimising technology and/or strategies, which is/are actually the costlier component(s) of EMS adoption. In other words, this means that enterprises could afford to finance their EMS exercises, as such exercises were not costly given that enterprises had not invested heavily in efficient EMS technology.

However, the enterprises' act of *'saving for sometime prior to embarking on EMS undertakings'* is in line with the argument of World Bank Group (1998) that most companies pause for sometime prior to adopting EMS due to the costs associated with undertaking EMS. This act by enterprises simply indicates that much as the enterprises under study have not invested in efficient EMS technology, EMS adoption is by nature a every costly exercise, which still requires careful consideration of financial resources at the disposal of an enterprise prior to engaging in it. This means that it is highly possible that other enterprises, which cannot afford to save adequate funds or do not have adequate funds at their disposal for EMS adoption, may give up engaging in EMS projects.

Figure 4.5 further indicates that 11% of enterprises pointed out that they *did not measure* the impact of EMS financing. This response is considered to be a polite way of saying *'data is not available'*, as there is absolutely no way the impact of any funds requiring project cannot go unnoticed, be it positive or negative. In the case where such a response could be true, this would be a clear reflection of poor EMS and environmental accounting that is practised by such an enterprise.

On the whole, it is also observed that there is a possibility that enterprises may be indicating *'insignificant impact'* of EMS financing on the economic performances/footing of enterprises as a result of uninformed personnel in as far as EMS is concerned, who cannot comprehend EMS related costs.

4.5.5 Total Implementation Cost of EMS Adoption

In order to establish whether or not an investment is viable, is it quite important to establish how much an investment costs against the returns. The study therefore paid attention to the total cost of EMS implementation experienced by enterprises in the three research variable areas i.e. *water, energy and raw materials.* The costs were looked into in order to compare them with gains to establish whether the impact of EMS adoption is positive or negative on the economic performance of enterprises. In response to the matter, Figure 4.6 indicates that 67% of enterprises pointed out that '*data is not available*' (DNA) while 33% of enterprises stated that there were *'no costs'* incurred owing to EMS adoption.

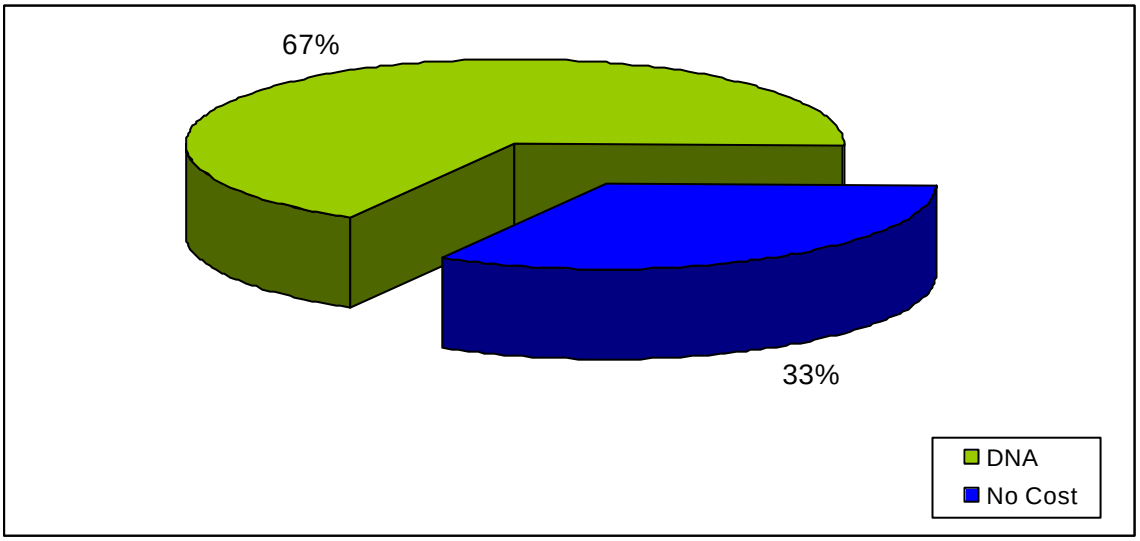


Figure 4.6: Total Cost of EMS Implementation by a sample size of nine Enterprises in South Africa in June – July 2004

On the basis of Figure 4.6, it is believed that the response '*data is not available'* from 67% of enterprises is a result of the issue that such companies cannot isolate EMS related costs from the rest of the costs that the company incurs, as their EMS and other costs of the company are completely integrated. Failure to provide data by enterprises is also observed to have been complicated further by requesting enterprises to extract costs pertaining to the research variable areas alone. Failure of accounting system of any company to isolate the required cost from the rest of the costs of the company is an indication of poor accounting and documentation systems.

As for the 33% of enterprises that indicated that they incurred *'no cost'* pertaining to EMS, they are observed to be very much uninformed with respect to EMS operations, as there is absolutely no way a company can be ISO 14001 certified without having incurred EMS costs of some sort in the research variable areas. .

Based on the unavailability of data, it has therefore been impossible to compare EMS implementation costs with gains to get a picture of EMS impact on the economic performance of the enterprises.

4.5.6 EMS Maintenance Costs per Year in the Research Variable Areas

Average annual maintenance costs were looked into to assist to figure out the total costs incurred by enterprises per year to facilitate proper comparison of the costs incurred with the gains. In response to this issue, Figure 4.7, conveys information that 89% of enterprises indicated that 'DNA' while only 11% of enterprises stated that it '*did not incur'* any EMS maintenance costs.

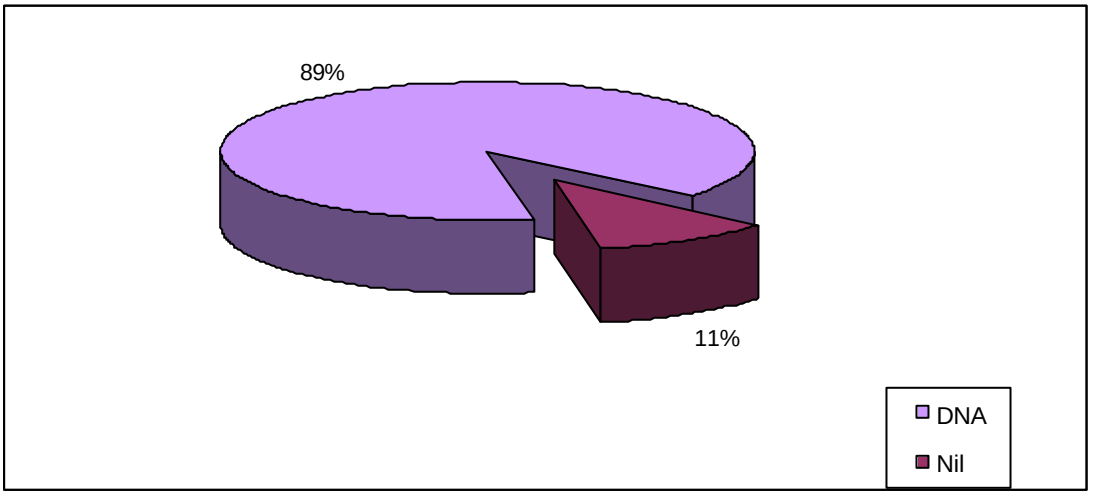


Figure 4.7: Average EMS Maintenance Costs per Year by a sample size of nine Enterprises in South Africa in June – July 2004

The fact that 89% of the enterprises cannot provide the required information is believed to be influenced by poor information documentation and environmental accounting systems, which cannot be able to retrieve maintenance costs information. Just as was the case in some sections above, where companies failed to provide the

required information, it is also believed that failure to provide information in this particular case has also been worsened by requesting information on maintenance costs for the research variable areas alone.

As for the 11% of enterprises, which pointed out that it *'did not incur'* any EMS maintenance cost, it is believed that due to an unclear distinction between environmental and other company costs, the enterprise is not aware of EMS maintenance costs it has incurred. This argument is based on the fact that there is no way an ISO 14001 certified company could have not incurred EMS maintenance costs.

In a nutshell, unavailability of data from almost all the enterprises has inhibited the comparison of costs against gains to establish whether there are any proceeds enterprises are making from EMS projects.

4.5.7 Year of EMS Certification

The aspect of when the different enterprises obtained their respective EMS certification was regarded crucial in this study in giving a picture of the period (number of years) in which the various enterprises have been practising EMS. The year of certification was looked into to give a picture of the payback period nature of EMS projects under study, as a known length of EMS operation will be very crucial in section 4.4.7 in determining the recovery period of invested capital. Figure 4.8 presents the results, where in 1999 only 11% of enterprises got certified while from 2000 to 2003 only 22% of enterprises got certified each year. It is observed that there has been a constant pattern in EMS certification since 2000 until 2003, thus the number of enterprises getting EMS certification was neither increasing nor decreasing.

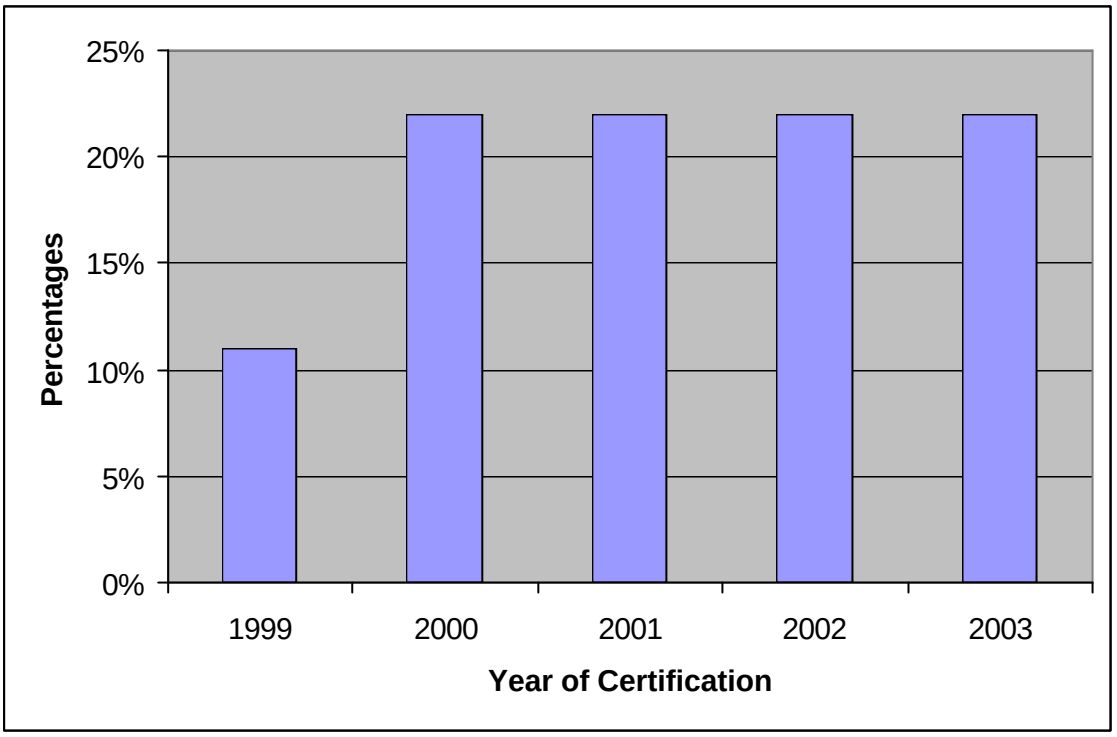


Figure 4.8: Year of EMS Certification for a sample size of nine Enterprises in South Africa in June – July 2004

4.5.8 Recovery of Funds Invested in EMS Implementation.

Investments with short payback periods are best investments, as they enable reinvestment of the recovered funds into other investments as well as to avoid loss of value resulting from inflation (Kennedy, 1998). In other words, an investment with a short payback period reaps the returns faster than an investment with a lengthy payback period, thus such investments are lucrative, and therefore investors are more interested in them than those with long payback periods. On the basis of this argument, an investigation was made to ascertain whether or not the enterprises have recovered the capital invested in the research variable areas in order to establish the impact of EMS projects payback period on the economic performance of enterprises.

In response to the matter, Figure 4.9 shows that 89% of the enterprises indicated that they have *'not recovered'* their invested capital *(where 44% of the 89% of enterprises stated that they did* ***'not quantify'*** *their proceeds; 33% of the 89% of enterprises indicated that it is* ***'too early to assess'*** *whether invested capital has been recovered or not; and 11% of the 89% of enterprises pointed out that* ***'many EMS measures***

have no returns other than a decrease in liability'). The response that proceeds *were 'not quantified'* clearly reflected poor environmental accounting and information management systems. The response *'too early to assess whether capital has been recovered or not'* as well indicated poor environmental accounting, as the company can assess its status through the cash inflows and savings it receives to notice whether it is gaining or losing. As for the response '*many EMS measures have no returns other than a decrease in liability,* simply indicated poor understanding of EMS by the company, since EMS measures yield returns in various forms including amongst others revenue, savings, improved market and improved image.

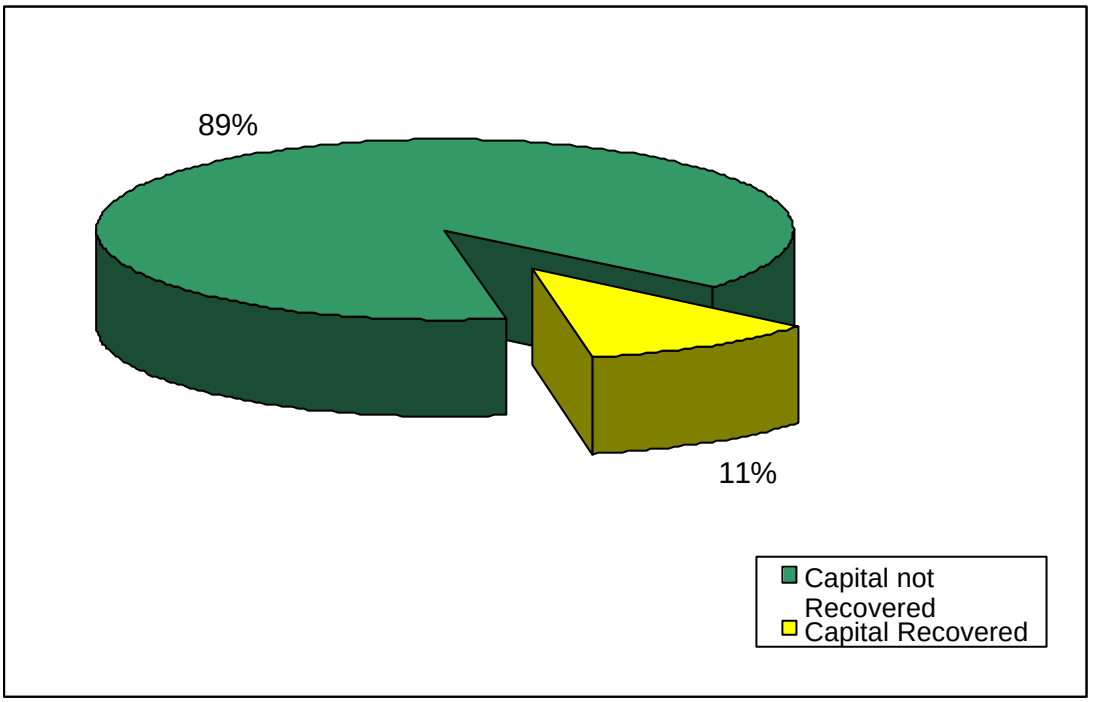


Figure 4.9: Recovery of Invested Capital by a sample size of nine Enterprises in South Africa in June– July 2004

Furthermore, Figure 4.9 presents that 11% of enterprises has '*recovered*' the invested capital. It is important to indicate at this juncture that the 11% that has recouped its invested capital is formed by the enterprise that obtained EMS certification in 1999 (see Figure 4.8). This 11% of enterprises further indicated that it recovered its capital after a period of five years. The findings here portray EMS projects payback period as a long period, as only 11% of the enterprises that acquired EMS certification in 1999 have managed to recover the invested capital, while 89% of enterprises that acquired certification since 2000 to 2003 have not yet recovered their capital. On the contrary,

it could be possible that some enterprises under study have already paid back their capital, but are not aware as a result of unavailability of data to assess their status with respect to recovery of their capital. This observation is brought in by some contradictory statements, where some enterprises indicated that they '*have not recouped'* their invested capital, and yet they also pointed out that they did *'not quantify'* their proceeds. It becomes clear therefore, that it is impossible for such enterprises to notice whether they have recovered their capital or not, if their proceeds were not quantified?

4.5.9 Documentation of Environmental Costs and Gains Information

It is important to highlight the fact that there is absolutely no operation that can be properly managed without the presence/availability of relevant data. It is therefore quite imperative that enterprises have environmental costs and gains information available to enable them to compare costs against gains to ascertain whether enterprises are gaining or losing in their EMS projects. Such information can be generated and stored in a proper information management system for fast retrieval and accessibility. Based on the importance of environmental costs and gains information, the study investigated whether or not the enterprises properly documented environmental costs and gains information.

Figure 4.10 presents the results, where on the one hand, 67% of enterprises pointed out that they did '*not properly document'* environmental costs and gains information – some citing reasons like: *'documentation is not a focus area; it is difficult to distinguish between environmental costs and other company costs; poor information documentation and storage systems;* and that *most of EMS costs are not quantifiable'*. Advancing reasons like: *'documenting environmental costs and gains information is not a focus area*' and that '*most EMS costs are not quantifiable',* is a simple indication of how ignorant some enterprises are about some key EMS issues such as information documentation. It is actually shocking to hear personnel in charge of EMS in a company providing such responses. Furthermore, the 67% of enterprises that indicated that they did *'not document environmental costs and gains information properly'* signal a problem of cash flow management.

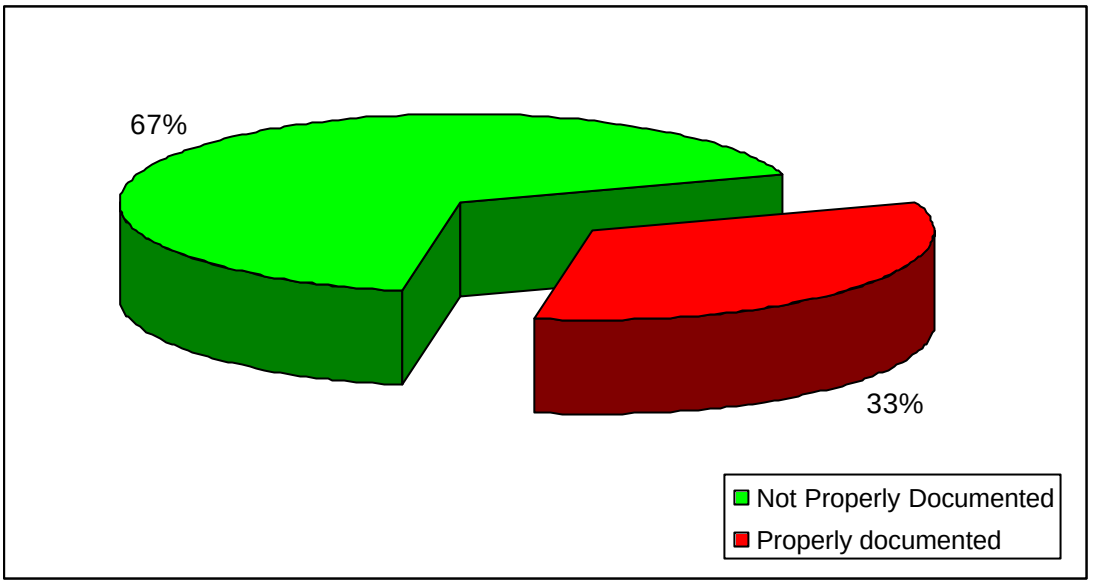


Figure 4.10: Documentation of Environmental Costs and Gains by a sample size of nine Enterprises in South Africa in June – July 2004

On the other hand, Figure 4.10 shows that 33% of enterprises stated that they did *'properly document'* environmental costs and gains information. Such a response is observed to be unconvincing, as in some areas above (i.e. in Figures 4.6 & 4.7; Table 4.3 etc) almost all enterprises could not provide the required data while in section 4.4.4 specifically, all enterprises failed to provide the required data. Had the 33% of enterprises been properly documenting costs and gains information, they would have consistently managed to provide all the required information in the above sections as well as to categorise costs and gains accordingly. This would have enabled them, for example, to notice the areas that consume more financial resources than others in order to monitor them quite closely in respect to resource usage and returns.

Due to the observed pattern of inconsistency by enterprises in providing information, it is concluded that there is lack of proper documentation and storage of environmental costs and gains information in all enterprises. This therefore means that the enterprises cannot properly manage their costs and gains related information to facilitate comparison of the cost against gains to assess whether the enterprises are gaining or losing in their EMS projects.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter is going to present a summary of major findings; draw the conclusions; and outline the recommendations and areas for further research.

5.2 Summary of Major Research Findings

The summary below will give an overall picture of the findings. This will be dealt with firstly, by looking at findings related to the variable *'water'*. Secondly, by paying attention to findings related to the variable *'energy'*. Thirdly, by focussing on findings pertaining to the variable *'raw materials', and f*inally, by dealing with the overall costs and gains related findings.

5.2.1 Findings on the Variable '*Water*'

Under this variable, it was discovered that strategies adopted by enterprises to reduce water consumption are not efficient, as the strategy of '*awareness campaigns*' is the least adopted strategy, yet it is actually a strategy that is supposed to be adopted by all enterprises to sharpen other strategies that are already in operation. Thus, the strategies adopted in this regard are not optimising the potential value of water to the fullest. However, based on the fact that at least something is done with respect to water consumption reduction, strategies that are adopted/practised by enterprises are discovered to have reduced water consumption level per year to some small extent. Although Table 4.1 shows that 44% of enterprises stated that they have experienced a rise in water consumption level per year during EMS period as opposed to pre-EMS period, it was discovered that with respect to water consumption per unit of production all enterprises have actually experienced a reduction in water consumption. This means that, EMS adoption has in actual fact reduced total water consumption per year. This is based on the observation that increased total water consumption level per year experienced by 44% of the enterprises in the EMS era is a result of growth of enterprises in terms of size and production capacity.

Table 4.1 further shows that the total water consumption status of 33% of the enterprises in the EMS era as against the Pre-EMS era per year is *'unknown'*. This is due to failure of such enterprises to provide the required data. The total water consumption of such companies per year is however, observed to have dropped, as all enterprises (including the aforementioned 33%) in section 4.2.4 stated that their water consumption per unit of production has dropped. It is on the basis of this information that EMS adoption is to some small extent observed to have reduced total water consumption per year. This issue of *'to some small extent'* is based on the ineffectiveness of the water reduction strategies adopted and the under utilisation of others such as *'awareness campaigns'* (see Figure 4.1)

5.2.2 Findings on the Variable '*Energy*'

In this case as well, it was discovered that the most crucial strategies (*i.e. energy surveys* and *awareness campaigns*) were under-utilised, as they were adopted by only 44% and 11% of enterprises respectively. These strategies are observed to be under-utilised, as they are supposed to be adopted by all enterprises to reinforce other strategies that enterprises have employed. This shortfall is observed to have weakened the effectiveness of energy reduction consumption strategies employed. However, the number one strategy *i.e. energy consumption balance monitoring system* – is adopted by 67% of the enterprises, and is together with other strategies believed to have reduced total energy consumption to some little extent (see Figure 4.2).

On the issue of total energy consumption level per year, it was discovered that on the whole, total energy consumption level of all enterprises per year has declined despite the fact that 33% of enterprises in Table 4.2 stated that their total energy consumption per year has *'increased'* during EMS as opposed to the pre-EMS adoption era. The fact that there is a general decline in total energy consumption per year was proved by, establishing (through information given by enterprises) that energy consumption per unit of production in all enterprises has actually decreased owing to EMS adoption. This means that *'increased'* total energy consumption per year experienced by 33% of enterprises was due to growth in size and production capacity the enterprises were experiencing.

According to Table 4.2, total energy consumption status of 44% of the enterprises in the EMS era as against the pre-EMS era per year is *'unknown'* due to failure of enterprises to provide the required data. It has however been observed that their total annual energy consumption has dropped, as all enterprises (including the aforementioned 44% of enterprises) stated that their energy consumption per unit of production has declined. On the basis of these facts, it is observed that EMS adoption has to some small extent actually reduced total energy consumption of enterprises per year. This issue of *'a reduction to some small extent'* is based on the ineffectiveness of energy reduction strategies adopted and under utilisation of others such as *'awareness campaigns and energy surveys.'*

5.2.3 Findings on the Variable 'Raw Materials'

Under the variable raw materials, it was established that all enterprises have adopted/practised only *'reuse and sale'* of waste material strategies in both the pre-EMS and EMS eras to promote efficient utilisation of raw materials, with the exception of only one (11% of) enterprise that also adopted the strategy of waste *'recycling'* in both eras. Although according to Figure 4.3 *'waste disposal'* is still generally the most dominant strategy in dealing with waste in the EMS era, there is however an overall drop in waste disposal rate. The second most dominant strategy in dealing with waste is observed to be *'sale'* of waste materials, as there seems to be a relatively better growth in waste material sale in EMS era as opposed to the pre-EMS era. The strategy of *'sale'* of waste is then followed by '*reuse*' of waste material, as there is a slight growth in the use of such strategy in the EMS era as opposed to the pre-EMS era. The last and least adopted is the strategy of *'waste recycling'*, as it is adopted by only 11% of enterprises in both the EMS and pre-EMS eras (see Figure 4.3). However, the low percentage of *'waste recycling'* is observed to be a result of the fact that, 'recycling' is practised by enterprises whose nature of business is solely to recycle. Unfortunately, such enterprises did not fall within the sample enterprises.

This pattern of waste utilisation was a reflection of inefficient utilisation of raw materials, as in general terms waste disposal still dominated waste utilisation strategies in the EMS era. However, this is observed to be a result of poor designs for environment (i.e. designing of products that will be recyclable, reusable, repairable

and saleable in their post life stage) and high costs associated with technology that promotes optimisation of raw materials.

In the case of annual expenditure on raw materials, all enterprises failed to provide such information. However, given that there is a general drop in *'waste disposal'* rate and a rise in the *'sale and reuse'* of waste materials the EMS era as against the pre-EMS era as per Figure 4.3, it is believed that such enterprises are gaining some revenue and savings, which would otherwise be lost. Thus, there is some positive contribution of EMS on the economic/financial performance of enterprises, though it cannot be quantified due to failure of enterprises to provide the required information.

5.2.4 Findings on the Overall Costs and Gains of EMS Adoption

Under this aspect, it was established that the number one factor behind EMS adoption by enterprises was *'regulatory compliance'*, followed by the factor *'economic* opportunities' while the least influential factor, which has been to assigned rating *'five'* is CSR (see Figure 4.4 for a comprehensive picture). It was further discovered that all enterprises financed their EMS adoption through their own equity. This has been attributed to poor investment in efficient EMS technology by enterprises. Thus, their EMS implementation costs were quite low, therefore they could afford to finance their own EMSs without external financial assistance. This poor investment in efficient EMS technology then gave rise to the inefficient nature of EMS adopted by enterprises.

On the issue of '*the impact of EMS financing on the economic footing of enterprises'*, 89% of enterprises stated that they experienced *'insignificant impact'* while 11% pointed out that it experienced 'no costs' at all. Such responses have been attributed to poor understanding of EMS and the associated costs.

On the aspect of *'total EMS implementation costs*', 67% of enterprises could not provide the required information, stating that it is *'not available'* while 33% of enterprises stated that they experienced 'no costs' at all. Furthermore, on the issue of EMS maintenance costs in the research variable areas, 89% of enterprises failed to provide such data while 11% stated that it experienced *'no EMS maintenance costs'*.

Responses in this paragraph are attributed to poor management of data and lack of understanding in as far as EMS costs are concerned.

With respect to the issue of recovery of invested capital, it was established that only 11% of enterprises, which obtained EMS certification in 1999 managed to recoup its invested capital while 89% of enterprises, which obtained EMS certification from 2000 to 2003 stated that they have not recouped their invested capital. On the contrary, it could be possible that some enterprises under study have already paid back their capital, but are not aware as a result of unavailability of data to assess their status with respect to recovery of their capital.

In the case of environmental costs and gains information documentation, 67% of enterprises stated that they *'did not properly document'* environmental costs and gains information while 33% pointed out that their environmental costs and gains information was *'properly documented'*. The response of the 33% of enterprises, that their information is properly documented was observed to be rather unconvincing given that almost all enterprises failed to provide the required data consistently in some sections above. As for the response from the 67% of enterprises, such response is observed to be a reflection of poor data management, and therefore comparison of costs against gains could not be possible.

On the whole, a general observation has been that almost all the enterprises have a great problem in providing data, which signalled poor documentation of data.

5.3 Conclusions

This paper looked into the impact of EMS on the economic/financial performance of enterprises in South Africa with specific reference to the three research variables, namely *water*, *energy* and *raw materials*. On the basis of the findings, the first objective – '***to establish how EMS impacts on the inputs of business enterprises, with specific reference to optimization of the three research variables, namely water, energy and raw materials***', has been met. It has been achieved since the strategies adopted by the majority of enterprises to optimise *'water, energy and raw materials'* were established to be of low standard, thus, their impact on optimisation

of the research variables has been established to be low, given that enterprises reaped only little cost reductions; little savings and little revenue from their EMS projects.

As for the second and third objectives, namely - ***'to evaluate the impact of EMS on business enterprises' cost reduction, and to establish the impact of EMS on the proceeds of business enterprises'*** respectively, have not been met due to failure of enterprises to provide the required data. However, qualitatively there is evidence of little savings; little cost reduction; and little revenue accruing to enterprises, as it was discovered that consumption of the research variables per unit of production has decreased in the EMS era as opposed to the pre-EMS period. The savings; cost reduction and revenue reaped by enterprises are referred to as *'little'* on the basis of the inefficiency of EMS adopted by enterprises.

With respect to objective four, though the findings of the study indicate a long payback period of approximately *'five'* years and an *'insignificant impact'* of EMS financing on the financial performance of enterprises, it is strongly believed that there is a possibility that some enterprises have already paid back their capital in less than five years, but due to lack of data they cannot assess their status to this effect. On the issue of *'insignificant impact'* of EMS financing on the financial footing of enterprises, it is believed that the financial footing of the 89% of enterprises was insignificantly affected by EMS financing, since EMS programmes adopted by enterprises is of low standard, and as a result not costly. The issue of 'low standard' is based on the dominance of waste disposal in the EMS era over other waste utilization strategies (i.e. reuse and sale of waste materials) in the same era. Based on this argument, it is believed that EMS financing was certainly not a blow on the financial footing of such enterprises.

However, this does not overrule the possibility that a significant impact of EMS financing could be overshadowed by lack of data and perhaps covered up by lucrative returns from other areas outside the research variable areas. In such cases, enterprises may not even notice the significance of EMS financing.

Based on the findings, the hypothesis that – ***'implementation of EMS impacts positively on economic/financial performances of the business enterprises',*** has

neither tested positively nor negatively due to failure by enterprises to provide data on revenue, savings and costs associated with EMS programmes in the research variable areas. This has impeded the comparison of cash inflow (revenue and savings) against the costs to establish the nature of EMS impact.

On the whole, given that the findings of the study reflect inefficient EMSs adopted by enterprises (as reflected in sections 4.2.2; 4.3.2; and 4.4.3), it is concluded that EMS in South Africa is still at its infancy, and therefore there is a lot of work that needs to be done to improve the situation. On the basis of the findings, it is further concluded that enterprises are operating in an opportunistic state (as reflected in section 4.5.2), where their decision to go beyond compliance is associated with the economic opportunities, which enterprises explored within the confinements of environmental regulations. However, enterprises were observed not to be reaping much of the so '*pronounced'* lucrative economic benefits of EMS, as enterprises have not employed adequate/proper strategies and tactics to achieve such benefits. In other words, based on Figure 2.9 (The Sustainable Development Journey), business enterprises hoped to reap economic benefits associated with the stage of '*business and sustainable development'*, yet their *strategies; tactics*; and *limited (financial and other) resources* invested in their EMS projects were not only inadequate, but also weak (inefficient) to enable them to reach the stage of *'business and sustainable development'* in order to reap lucrative economic benefits of EMS.

Failure of the majority of enterprises to provide data due to unavailability of such data has as well been observed to be a reflection of poor EMS practices in South Africa. This is based on the fact that enterprises, which are engaged in proper/effective EMS programmes have to practice proper documentation of activities and proper management of information to enable them to manage their operations properly. It is therefore concluded that the enterprises are in possession of poor environmental accounting systems and database. In support of this argument KPMG (2000) states that very few organisations practice proper financial accounting and reporting systems that enable them to precisely quantify their environmental costs and liabilities. Furthermore, it is very crucial to note that although there is evidence of little savings and little revenue in the research variable areas, it has been difficult to compare EMS gains against the costs, since enterprises failed to provide the required data.

The last objective – ***'to explore ways of promoting adoption of EMS by business enterprises - given its effect on the economic performances of business enterprises*** – is taken care of by the recommendations and areas for further research outlined below.

5.4 Recommendations

Based on the research findings, some loopholes have been identified, and therefore the following recommendations are proposed to meet such loopholes:

- The findings of the study have revealed failure by enterprises to provide the required data due to unavailability of such data. Based on this revelation, business enterprises are recommended to have in place a comprehensive database and information management system pertaining to their operations. Such a system should be run by trained EMS information technology personnel to facilitate smooth management of activities of business enterprises (i.e. the system will enable clear categorisation of costs as well as to facilitate comparison of costs against gains)

- The majority of business enterprises are observed to have applied strategies to cut down on the research variables consumption without research to identify areas of high consumption of such resources, appropriate strategies, and the magnitude of strategies required. It is on the basis of this shortfall that business enterprises are recommended to always conduct some form of research ahead of any action, in order to develop a rather more appropriate and more responsive programme of strategies to the identified problem areas at the required scale.

- There are several incidences in the research where it was observed that responses from business enterprises portrayed poor understanding of EMS principles, essentials and practices. In the interest of proper and efficient EMS, business enterprises are recommended to man EMS activities with personnel trained in EMS.

- Government is recommended to play a leading role in promoting environmental awareness amongst business enterprises, highlighting for example, the advantages of long-term economic benefits of EMS over (against) a long payback period of EMS projects. This calls for change of attitude in making investment decisions, where long-term investment decisions should take precedence over short-term investment decision-making in the interest of sustainable development. Government is further encouraged to promote commitment of the nation to environmental management through incorporation of environmental and risk management courses in the curriculum as core programmes, given that environmental management issues cut across the activities of all professions.

- It has been observed that failure of business enterprises to engage efficient EMS is due to limited financial resources at their disposal. On the basis of this observation, the government of South Africa is recommended to provide an enabling environment, not only by formulating policies that support EMS compliant enterprises (i.e. policies on subsidising EMS adoption costs and/or introducing tax holidays/reduction for EMS compliant enterprises etc), but by also ensuring implementation of such policies.

- Failure by enterprises to utilise a full potential value of waste material is observed to be a result of short-sighted planning in the design of products. It is recommended that government and all stakeholders promote EMS tools such as design for the environment to ensure that the designed products will be reusable, recyclable, saleable, and repairable. This planning is recommended to also encompass cost effective systems of recovery of recyclable, reusable materials etc.

5.5 Areas for Further Research

The study has come up with important findings with respect to the impact of EMS on the economic/financial performance of business enterprises. However, there is no

single study that can get to the bottom of all issues pertaining to EMS, and hence the following areas for further research are proposed:

- An investigation into EMS documentation and information management systems employed by business enterprises in South Africa.
- An evaluation of environmental accounting systems that business enterprises are practising in South Africa.
- A study into cost effective recyclable material recovery systems in South Africa.
- A study into the promotion of cost effective and efficient EMS in South Africa.
- A comprehensive study on the impact of EMS on the economic performance of business enterprises, which is not only confined to certain variables, but comprehensively covers all EMS related variables such as amongst others human resource costs and corporate social responsibility.

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APPENDICES

Appendix A: Questionnaire Responses

UNIVERSITY OF WITWATERSRAND

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT
SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

QUESTIONNAIRE FOR DATA COLLECTION FOR A STUDY ON

THE EVALUATION OF THE IMPACT OF ENVIRONMENTAL MAMAGEMENT SYSTEMS ON THE ECONOMIC PERFORMANCE OF THE BUSINESS ENTERPRISES.

BY

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The questionnaire is divided into four sections that are meant to evaluate the impact of EMSs on the economic performance of business enterprises with respect to the three research variables, namely water, energy and raw materials..

SECTION ONE.
This section looks into the impact of the variable *'Water'* **on the economic performance of business enterprises.**

1.1 What strategies has the business enterprise adopted to reduce water consumption?
_____ USING WATER CONSERVATIVELY. THIS IS MEASURED BY THE MONTHLY REVIEW OF OUR WATER
BILL._____
_____
_____

1.2 What is/was the business enterprise's average water consumption per year? i.e.

- Water consumption per year during the EMS period____1095 UNITS_____
- Water consumption per year prior to EMS adoption____972 UNITS_____

1.3 What is the average water consumption rate per unit of production in the EMS period as opposed to the Pre EMS era?

- Higher during the EMS period and Lower in the Pre-EMS period **[ ]**
- Higher in the Pre-EMS period and Lower in the EMS Period **[X]**
- Still the same (i.e. Has not changed) **[ ]**

SECTION TWO

This section pays attention to the impact of the variable *'Energy'* **on the economic performance of business enterprises**

2.1 What strategies has the business enterprise adopted to cut down on energy consumption? __AS PER WATER
ABOVE._____
_____
_____
_____

2.2 What is/was the business enterprise's average energy consumption rate per year? i.e.

- Energy consumption per year during the EMS period __32256 UNITS _
- Energy consumption per year in the Pre-EMS period ___28992 UNITS___

2.3 What is the business enterprise's average energy consumption rate per unit of production during the EMS period as opposed to the Pre-EMS era?

- Higher during EMS period and Lower in the Pre-EMS era **[ ]**
- Higher in the Pre-EMS era & Lower in the EMS period **[X]**
- Still the same (i.e. has not changed). **[ ]**

SECTION THREE

This section focuses on the impact of the variable *'Raw Materials'* **on the economic performance of business enterprises**

3.1 What strategies has the business enterprise adopted to promote efficient utilisation of raw materials? ____REUSE & SALE_____
_____

3.2 Please indicate in percentage form the manner in which the business enterprise makes/made use of waste material that it generates/generated with regard to the following categories/uses**: reuse, recycling, selling** and **disposing of**. (If for example, usage of the company's waste is/was spread across more than one usage/category it should reflect as follows: : *20% Reuse, 30% recycle, 50% sell etc)*

Pre EMS Period			
Reuse	Recycle	Sell	Dispose of
20%		10%	70%
During EMS Period			
Reuse	Recycle	Sell	Dispose of
20%		20%	60%

3.3 What is/was the average annual raw material expenditure? i.e.:

- Raw materials annual expenditure before EMS adoption__NO RECORDS_____
- Raw materials annual expenditure in the EMS era___NO RECORDS_____

3.4 What is/was the average amount of savings and revenue the business enterprise reaps/reaped annually due **to reusing, recycling** and **selling of** waste? i.e. **N/A**

- Pre EMS Period_____NO RECORDS_____

- During EMS Period_____NO RECORDS_____

SECTION FOUR

This section looks into the overall costs and gains from EMS adoption.

4.1 What was the company's reason(s) behind the adoption of certified EMS? [*If only one reason, simply use [X] to indicate your answer in the box provided, but if more than one reasons please use numerical values (e.g. 1, 2, 3 etc) in the boxes provided to indicate their order importance i.e. where 1 represents the most important reason & 5 represents the least important reason]*

- Economic opportunities **[2]**
- Regulatory compliance **[1]**
- Corporate Social Responsibility **[5]**
- Company's own environmental interest **[4]**
- Customer/supplier pressure **[3]**

4.2 How did the business enterprise finance its EMS adoption exercise?

- Equity Financing [ ]
- Financial Institutions [ ]
- Other (specify)__SELF_____

4.3 What was the impact of EMS financing on the business enterprise's economic/financial performance? ___NOT MEASURED - UNKNOWN_____
_____
_____

4.4 What was the total EMS implementation cost pertaining to the three research variable areas (i.e. water, energy, raw materials)? _____ NO COST INVOLVED_____

4.5 What is the average EMS maintenance cost per year in the three research variable areas? _____NIL_____

4.6 In what year did the enterprise acquire certified EMS?_____2002_____

4.7 Has the business enterprise recovered capital invested in the three EMS research variable areas *(i.e. based on the revenue and savings the company reaps in the*

research variable areas alone) ?

- YES [ ] *(Proceed to question 4.7.1)*
- NO [X] *(Proceed to question 4.7.2)*

4.7.1 If yes, after how many years (how long)? _____

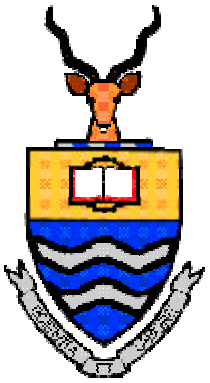
4.7.2 If no, why?_____ NOT EASILY QUANTIFIABLE._____
_____
_____
_____

4.8 Does the business enterprise document environmental costs and gains information?

- YES [ ] (Proceed to question 4.8.1)
- NO [X] (Proceed to question 4.8.2)

4.8.1 If yes, how does the company benefit out of such information? _____
_____
_____
_____

4.8.2 If no, why? _____CAN'T DISTINGUISH ENVIRONMENTAL COSTS FROM OTHER COMPANY COSTS EASILY_____
_____
_____
_____



UNIVERSITY OF WITWATERSRAND

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT
SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

QUESTIONNAIRE FOR DATA COLLECTION FOR A STUDY ON

THE EVALUATION OF THE IMPACT OF ENVIRONMENTAL MAMAGEMENT SYSTEMS ON THE ECONOMIC PERFORMANCE OF THE BUSINESS ENTERPRISES.

BY

Motseki Khuto

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The questionnaire is divided into four sections that are meant to evaluate the impact of EMSs on the economic performance of business enterprises with respect to the three research variables, namely water, energy and raw materials..

SECTION ONE.
This section looks into the impact of the variable *'Water'* **on the economic performance of business enterprises.**

1.4 What strategies has the business enterprise adopted to reduce water consumption?
_____targets for water use_____

1.5 What is/was the business enterprise's average water consumption per year? i.e.

- Water consumption per year during the EMS period__Not known_____
- Water consumption per year prior to EMS adoption___Not known_

1.6 What is the average water consumption rate per unit of production in the EMS period as opposed to the Pre EMS era?

- Higher during the EMS period and Lower in the Pre-EMS period **[ ]**
- Higher in the Pre-EMS period and Lower in the EMS Period **[x]**
- Still the same (i.e. Has not changed) **[ ]**

SECTION TWO

This section pays attention to the impact of the variable *'Energy'* **on the economic performance of business enterprises**

2.1 What strategies has the business enterprise adopted to cut down on energy consumption? _____Energy efficiency targets_____
_____

2.2 What is/was the business enterprise's average energy consumption rate per year? i.e.

- Energy consumption per year during the EMS period __Not known_____
- Energy consumption per year in the Pre-EMS period ___Not known_____

2.3 What is the business enterprise's average energy consumption rate per unit of production during the EMS period as opposed to the Pre-EMS era?

- Higher during EMS period and Lower in the Pre-EMS era **[ ]**
- Higher in the Pre-EMS era & Lower in the EMS period **[x]**
- Still the same (i.e. has not changed). **[ ]**

SECTION THREE

This section focuses on the impact of the variable *'Raw Materials'* **on the economic performance of business enterprises**

3.1 What strategies has the business enterprise adopted to promote efficient utilisation of raw materials? _____We reuse and sell waste materials _____
_____

3.2 Please indicate in percentage form the manner in which the business enterprise makes/made use of waste material that it generates/generated with regard to the following categories/uses**: reuse, recycling, selling** and **disposing of**. (If for example, usage of the company's waste is/was spread across more than one usage/category it should reflect as follows: : *20% Reuse, 30% recycle, 50% sell etc)*

Pre EMS Period			
Reuse	Recycle	Sell	Dispose of
20%		20%	60%
During EMS Period			
Reuse	Recycle	Sell	Dispose of
20%		40%	40%

3.3 What is/was the average annual raw material expenditure? i.e.:

- Raw materials annual expenditure before EMS adoption__Not known_____
- Raw materials annual expenditure in the EMS era ____Not known_____

3.4 What is/was the average amount of savings and revenue the business enterprise reaps/reaped annually due **to reusing, recycling** and **selling of** waste? i.e.

- Pre EMS Period _____Not known_____
- During EMS Period_ _____Not known_____

SECTION FOUR

This section looks into the overall costs and gains from EMS adoption.

4.1 What was the company's reason(s) behind the adoption of certified EMS? [*If only one reason, simply use [X] to indicate your answer in the box provided, but if more than one reasons please use numerical values (e.g. 1, 2, 3 etc) in the boxes provided to indicate their order importance i.e. where 1 represents the most important reason & 5 represents the least important reason]*

- ♦ Economic opportunities **[2]**
- ♦ Regulatory compliance **[1]**
- ♦ Corporate Social Responsibility **[5]**
- ♦ Company's own environmental interest **[3]**

- Customer/supplier pressure **[4]**

4.2 How did the business enterprise finance its EMS adoption exercise?

- Equity Financing **[x]**
- Financial Institutions **[ ]**
- Other (specify)_____

4.3 What was the impact of EMS financing on the business enterprise's economic/financial performance? ____Not significant as we saved for some time before embarking on EMS exercise_____
_____

4.4 What was the total EMS implementation cost pertaining to the three research variable areas (i.e. water, energy, raw materials)? __Data is not available
_____

4.5 What is the average EMS maintenance cost per year in the three research variable areas? ___Data is not available_____

4.6 In what year did the enterprise acquire certified EMS?____2001_____

4.7 Has the business enterprise recovered capital invested in the three EMS research variable areas *(i.e. based on the revenue and savings the company reaps in the research variable areas alone)* ?

- YES [ ] *(Proceed to question 4.7.1)*
- NO [x] *(Proceed to question 4.7.2)*

4.7.1 If yes, after how many years (how long)? _____

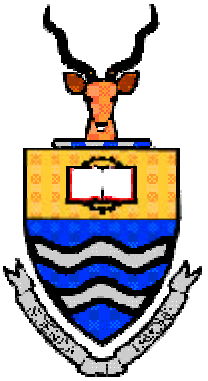
4.7.2 If no, why? ____Because savings are nor properly quantified _____
_____

4.8 Does the business enterprise document environmental costs and gains information properly?

- YES [ ] (Proceed to question 4.8.1)
- NO [x] (Proceed to question 4.8.2)

4.8.1 If yes, how does the company benefit out of such information? _____
_____

4.8.2 If no, why? __Most of the costs and gains are not quantifiable
_____
_____



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BY

Motseki Khuto

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Company: Nissan SA

The questionnaire is divided into four sections that are meant to evaluate the impact of EMSs on the economic performance of business enterprises with respect to the three research variables, namely water, energy and raw materials..

SECTION ONE.
This section looks into the impact of the variable *'Water'* **on the economic performance of business enterprises.**

1.7 What strategies has the business enterprise adopted to reduce water consumption?
_Nissan S.A has a strategy to continuously reduce water usage year on year therefore it has employed the following strategies: recycling and reuse; and water usage monitoring system.
_____
_____
_____

1.8 What is/was the business enterprise's average water consumption per year? i.e.

- Water consumption per year during the EMS period_2000 – 265 315 kiloliter
- Water consumption per year prior to EMS adoption_ 1999 – 334 811 kiloliter

1.9 What is the average water consumption rate per unit of production in the EMS period as opposed to the Pre EMS era?

- Higher during the EMS period and Lower in the Pre-EMS period **[ ]**
- Higher in the Pre-EMS period and Lower in the EMS Period **[x]**
- Still the same (i.e. Has not changed) **[ ]**

SECTION TWO

This section pays attention to the impact of the variable *'Energy'* **on the economic performance of business enterprises**

2.1 What strategies has the business enterprise adopted to cut down on energy consumption? __ Nissan S.A has a strategy to continuously reduce energy usage year on year. It has therefore employed energy consumption monitoring system to identify irregularities_____
_____

2.2 What is/was the business enterprise's average energy consumption rate per year? i.e.

- Energy consumption per year during the EMS period __2000 – 28 168 550 kWh

- Energy consumption per year in the Pre-EMS period __1999 – 36 991 080 kWh

2.3 What is the business enterprise's average energy consumption rate per unit of production during the EMS period as opposed to the Pre-EMS era?

- Higher during EMS period and Lower in the Pre-EMS era **[ ]**
- Higher in the Pre-EMS era & Lower in the EMS period **[x]**
- Still the same (i.e. has not changed). **[ ]**

SECTION THREE

This section focuses on the impact of the variable *'Raw Materials'* **on the economic performance of business enterprises**

3.1 What strategies has the business enterprise adopted to promote efficient utilisation of raw materials? ____Reuse and sale of waste material.

_____

3.2 Please indicate in percentage form the manner in which the business enterprise makes/made use of waste material that it generates/generated with regard to the following categories/uses**: reuse, recycling, selling** and **disposing of**. (If for example, usage of the company's waste is/was spread across more than one usage/category it should reflect as follows: : *20% Reuse, 30% recycle, 50% sell etc)*
Do not have this data

Pre EMS Period			
Reuse	Recycle	Sell	Dispose of
10%		20%	70%
During EMS Period			
Reuse	Recycle	Sell	Dispose of
20%		40%	40%

3.3 What is/was the average annual raw material expenditure? i.e.:

- Raw materials annual expenditure before EMS adoption_ **Do not have data on hand**
- Raw materials annual expenditure in the EMS era_ **Do not have data on hand**

3.4 What is/was the average amount of savings and revenue the business enterprise reaps/reaped annually due **to reusing, recycling** and **selling of** waste? i.e.

- Pre EMS Period____ **Do not have data on hand**
- During EMS Period____ **Do not have data on hand**

SECTION FOUR

This section looks into the overall costs and gains from EMS adoption.

4.1 What was the company's reason(s) behind the adoption of certified EMS? [*If only one reason, simply use [X] to indicate your answer in the box provided, but if more than one reasons please use numerical values (e.g. 1, 2, 3 etc) in the boxes provided to indicate their order importance i.e. where 1 represents the most important reason & 5 represents the least important reason]*

- Economic opportunities **[3]**
- Regulatory compliance **[2]**
- Corporate Social Responsibility **[5]**
- Company's own environmental interest **[1]**
- Customer/supplier pressure **[4]**

4.2 How did the business enterprise finance its EMS adoption exercise?

- Equity Financing [ ]
- Financial Institutions [ ]
- Other (specify)___Own Budget_____

4.3 What was the impact of EMS financing on the business enterprise's economic/financial performance? **Insignificant**_____
_____
_____

4.4 What was the total EMS implementation cost pertaining to the three research variable areas (i.e. water, energy, raw materials)? __No special implementation cost_____

4.5 What is/was the average maintenance cost per year in the three research variable areas? i.e.

- In the Pre-EMS period _____ Do not have data on hand _____
- During EMS period____ Do not have data on hand _____

4.6 In what year did the enterprise acquire allowed EMS?___2000_____

4.7 Has the business enterprise recovered capital invested in the three EMS research variable areas *(i.e. based on the revenue and savings the company reaps in the research variable areas alone)* ?

- YES [ ] *(Proceed to question 4.7.1)*
- NO [x] *(Proceed to question 4.7.2)*

4.7.1 If yes, after how many years (how long)? _____

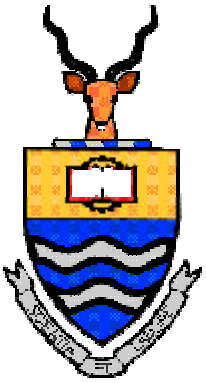
4.7.2 If no, why?_____Not quantified_____
_____

4.8 Does the business enterprise document environmental costs and gains information?

- YES [ ] (Proceed to question 4.8.1)
- NO [x] (Proceed to question 4.8.2)

4.8.1 If yes, how does the company benefit out of such information? _____
_____
_____
_____

4.8.2 If no, why? ___Not a focus area
_____
_____
_____
_____



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BY

Motseki Khuto

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Company : BMW

The questionnaire is divided into four sections that are meant to evaluate the impact of EMSs on the economic performance of business enterprises with respect to the three research variables, namely water, energy and raw materials..

SECTION ONE.
This section looks into the impact of the variable *'Water'* **on the economic performance of business enterprises.**

1.10 What strategies has the business enterprise adopted to reduce water consumption?
__implemented water reuse and recycling system. Water use balance monitoring system _____ _____

1.11 What is/was the business enterprise's average water consumption per year? i.e.

- Water consumption per year during the EMS period__503 400 cubic meters__
- Water consumption per year prior to EMS adoption_____180 066 cubic meters_

1.12 What is the average water consumption rate per unit of production in the EMS period as opposed to the Pre EMS era?

- Higher during the EMS period and Lower in the Pre-EMS period **[ ]**
- Higher in the Pre-EMS period and Lower in the EMS Period **[x]**
- Still the same (i.e. Has not changed) **[ ]**

SECTION TWO

This section pays attention to the impact of the variable *'Energy'* **on the economic performance of business enterprises**

2.1 What strategies has the business enterprise adopted to cut down on energy consumption? ___Energy surveys to determine biggest consumers and implement appropriate strategies . Energy use balance monitoring system_____
_____

2.2 What is/was the business enterprise's average energy consumption rate per year? i.e.

- Energy consumption per year during the EMS period __77 171 Kwh_____
- Energy consumption per year in the Pre-EMS period __56 580 Kwh_____

2.3 What is the business enterprise's average energy consumption rate per unit of production during the EMS period as opposed to the Pre-EMS era?

- Higher during EMS period and Lower in the Pre-EMS era **[ ]**
- Higher in the Pre-EMS era & Lower in the EMS period **[x]**
- Still the same (i.e. has not changed). **[ ]**

SECTION THREE

This section focuses on the impact of the variable *'Raw Materials'* **on the economic performance of business enterprises**

3.1 What strategies has the business enterprise adopted to promote efficient utilisation of raw materials? ___we reuse and sell waste materials_____
_____

3.2 Please indicate in percentage form the manner in which the business enterprise makes/made use of waste material that it generates/generated with regard to the following categories/uses**: reuse, recycling, selling** and **disposing of**. (If for example, usage of the company's waste is/was spread across more than one usage/category it should reflect as follows: : *20% Reuse, 30% recycle, 50% sell etc)*

Pre EMS Period			
Reuse	Recycle	Sell	Dispose of
20%		40%	40%
During EMS Period			
Reuse	Recycle	Sell	Dispose of
30%		50%	20%

3.3 What is/was the average annual raw material expenditure? i.e.:

- Raw materials annual expenditure before EMS adoption_ Data not available_____
- Raw materials annual expenditure in the EMS era ___Data not available_____

3.4 What is/was the average amount of savings and revenue the business enterprise reaps/reaped annually due **to reusing, recycling** and **selling of** waste? i.e.

- Pre EMS Period_ _____Data not Available_____
- During EMS Period _____R 3, 306, 181_____

SECTION FOUR

This section looks into the overall costs and gains from EMS adoption.

4.1 What was the company's reason(s) behind the adoption of certified EMS? [*If only one reason, simply use [X] to indicate your answer in the box provided, but if more than one reasons please use numerical values (e.g. 1, 2, 3 etc) in the boxes provided to indicate their order importance i.e. where 1 represents the most important reason & 5 represents the least important reason]*

- Economic opportunities **[2]**
- Regulatory compliance **[1]**
- Corporate Social Responsibility **[5]**
- Company's own environmental interest **[3]**
- Customer/supplier pressure **[4]**

4.2 How did the business enterprise finance its EMS adoption exercise?

- Equity Financing [x]
- Financial Institutions [ ]
- Other (specify)_____

4.3 What was the impact of EMS financing on the business enterprise's economic/financial performance? __almost not felt , as funds were from our profits_____
_____

4.4 What was the total EMS implementation cost pertaining to the three research variable areas (i.e. water, energy, raw materials)? ____Data not available
_____

4.5 What is the average EMS maintenance cost per year in the three research variable areas? _Records not available_____.

4.6 In what year did the enterprise acquire certified EMS?__1999_____

4.7 Has the business enterprise recovered capital invested in the three EMS research variable areas *(i.e. based on the revenue and savings the company reaps in the research variable areas alone)* ?

- YES [x] *(Proceed to question 4.7.1)*
- NO [ ] *(Proceed to question 4.7.2)*

4.7.1 If yes, after how many years (how long)? ___5 years_____

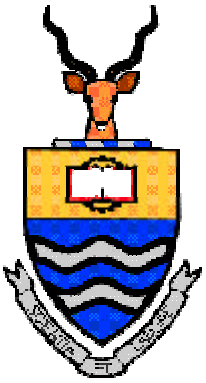
4.7.2 If no, why?_____
_____
_____
_____

4.8 Does the business enterprise document environmental costs and gains information?

- YES [x] (Proceed to question 4.8.1)
- NO [ ] (Proceed to question 4.8.2)

4.8.1 If yes, how does the company benefit out of such information? _____
_____to determine the magnitude of savings_____
_____
_____

4.8.2 If no, why? _____
_____
_____
_____



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Company: Metalloys

The questionnaire is divided into four sections that are meant to evaluate the impact of EMSs on the economic performance of business enterprises with respect to the three research variables, namely water, energy and raw materials..

SECTION ONE.
This section looks into the impact of the variable *'Water'* **on the economic performance of business enterprises.**

1.13 What strategies has the business enterprise adopted to reduce water consumption?
_____Closed circuit water recycling & reuse system, water consumption budget allocation to each department to regulate its consumption, and water balance program monitoring how much water is used and if there are any irregularities
_____
_____

1.14 What is/was the business enterprise's average water consumption per year? i.e.

- Water consumption per year during the EMS period___900 000 kl ____
- Water consumption per year prior to EMS adoption___150 000 kl_____

1.15 What is the average water consumption rate per unit of production in the EMS period as opposed to the Pre EMS era?

- Higher during the EMS period and Lower in the Pre-EMS period **[ ]**
- Higher in the Pre-EMS period and Lower in the EMS Period **[x]**
- Still the same (i.e. Has not changed) **[ ]**

SECTION TWO

This section pays attention to the impact of the variable *'Energy'* **on the economic performance of business enterprises**

2.1 What strategies has the business enterprise adopted to cut down on energy consumption? We have a plant built for conversion of gas into electricity, hence discounted off the national grid for the energy that we produce here. Awareness campaigns on wise use of energy. Energy balance program monitoring energy use and identifying irregularities. Energy efficiency targets
_____
_____

2.2 What is/was the business enterprise's average energy consumption rate per year? i.e.

- Energy consumption per year during the EMS period __180 000 MWH____

- Energy consumption per year in the Pre-EMS period __Do not have figures___

2.3 What is the business enterprise's average energy consumption rate per unit of production during the EMS period as opposed to the Pre-EMS era?

- Higher during EMS period and Lower in the Pre-EMS era **[ ]**
- Higher in the Pre-EMS era & Lower in the EMS period **[x]**
- Still the same (i.e. has not changed). **[ ]**

SECTION THREE

This section focuses on the impact of the variable *'Raw Materials'* **on the economic performance of business enterprises**

3.1 What strategies has the business enterprise adopted to promote efficient utilisation of raw materials? _Reuse, recycle and sell some waste materials_____

_____

3.2 Please indicate in percentage form the manner in which the business enterprise makes/made use of waste material that it generates/generated with regard to the following categories/uses**: reuse, recycling, selling** and **disposing of**. (If for example, usage of the company's waste is/was spread across more than one usage/category it should reflect as follows: : *20% Reuse, 30% recycle, 50% sell etc)*

Pre EMS Period			
Reuse	Recycle	Sell	Dispose of
20%	10%	10%	60%
During EMS Period			
Reuse	Recycle	Sell	Dispose of
40%	20%	20%	20%

3.3 What is/was the average annual raw material expenditure? i.e.:

- Raw materials annual expenditure before EMS adoption _Figures not available_
- Raw materials annual expenditure in the EMS era_ Don't have figures_____

3.4 What is/was the average amount of savings and revenue the business enterprise reaps/reaped annually due **to reusing, recycling** and **selling of** waste? i.e.

- Pre EMS Period ____Don't have figures_____
- During EMS Period____ Millions of Rands due to palletising plant designed to recover sludge & prepare it for resmelting in the furnance _____

SECTION FOUR

This section looks into the overall costs and gains from EMS adoption.

4.1 What was the company's reason(s) behind the adoption of certified EMS? [*If only one reason, simply use [X] to indicate your answer in the box provided, but if more than one reasons please use numerical values (e.g. 1, 2, 3 etc) in the boxes provided to indicate their order importance i.e. where 1 represents the most important reason & 5 represents the least important reason]*

- Economic opportunities **[3]**
- Regulatory compliance **[1]**
- Corporate Social Responsibility **[2]**
- Company's own environmental interest **[5]**
- Customer/supplier pressure **[4]**

4.2 How did the business enterprise finance its EMS adoption exercise?

- Equity Financing [x]
- Financial Institutions [ ]
- Other (specify)_____

4.3 What was the impact of EMS financing on the business enterprise's economic/financial performance? __Insignificant since it was a cost taken care of by our profits.

_____

4.4 What was the total EMS implementation cost pertaining to the three research variable areas (i.e. water, energy, raw materials)? _Records not available_____

4.5 What is the average EMS maintenance cost per year in the three research variable areas? _____No Records_____

4.6 In what year did the enterprise acquire certified EMS?_____2001_____

4.7 Has the business enterprise recovered capital invested in the three EMS research variable areas *(i.e. based on the revenue and savings the company reaps in the research variable areas alone)* ?

- YES [ ] *(Proceed to question 4.7.1)*
- NO [x] *(Proceed to question 4.7.2)*

4.7.1 If yes, after how many years (how long)? _____

4.7.2 If no, why?_____not properly quantified_____

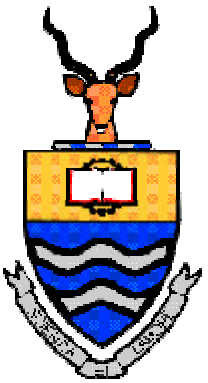
_____
_____

4.8 Does the business enterprise document environmental costs and gains information properly?

- YES [x] (Proceed to question 4.8.1)
- NO [ ] (Proceed to question 4.8.2)

4.8.1 If yes, how does the company benefit out of such information? _____
_____to update us on whether or not our pollution prevention projects are paying off
_____

4.8.2 If no, why? _____
_____
_____
_____



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Company: Gold Fields

The questionnaire is divided into four sections that are meant to evaluate the impact of EMSs on the economic performance of business enterprises with respect to the three research variables, namely water, energy and raw materials..

SECTION ONE.
This section looks into the impact of the variable *'Water'* **on the economic performance of business enterprises.**

1.16 What strategies has the business enterprise adopted to reduce water consumption?
_Water consumption targets. Water balance procedures to have been devised to report on performance against targets _____
_____

1.17 What is/was the business enterprise's average water consumption per year? i.e.

- Water consumption per year during the EMS period __Data not available___
- Water consumption per year prior to EMS adoption_ Data not Available_____

1.18 What is the average water consumption rate per unit of production in the EMS period as opposed to the Pre EMS era?

- Higher during the EMS period and Lower in the Pre-EMS period **[ ]**
- Higher in the Pre-EMS period and Lower in the EMS Period **[x]**
- Still the same (i.e. Has not changed) **[ ]**

SECTION TWO

This section pays attention to the impact of the variable *'Energy'* **on the economic performance of business enterprises**

2.1 What strategies has the business enterprise adopted to cut down on energy consumption? _____As in 1.1 above_____
_____

2.2 What is/was the business enterprise's average energy consumption rate per year? i.e.

- Energy consumption per year during the EMS period _ data is not available ___
- Energy consumption per year in the Pre-EMS period ___data is not available _

2.3 What is the business enterprise's average energy consumption rate per unit of production during the EMS period as opposed to the Pre-EMS era?

- Higher during EMS period and Lower in the Pre-EMS era **[ ]**
- Higher in the Pre-EMS era & Lower in the EMS period **[x]**
- Still the same (i.e. has not changed). **[ ]**

SECTION THREE

This section focuses on the impact of the variable *'Raw Materials'* **on the economic performance of business enterprises**

3.1 What strategies has the business enterprise adopted to promote efficient utilisation of raw materials? _____sell and reuse waste _____
_____
_____

3.2 Please indicate in percentage form the manner in which the business enterprise makes/made use of waste material that it generates/generated with regard to the following categories/uses**: reuse, recycling, selling** and **disposing of**. (If for example, usage of the company's waste is/was spread across more than one usage/category it should reflect as follows: : *20% Reuse, 30% recycle, 50% sell etc)*

Pre EMS Period			
Reuse	Recycle	Sell	Dispose of
10%		20%	70%
During EMS Period			
Reuse	Recycle	Sell	Dispose of
30%		30%	40%

3.3 What is/was the average annual raw material expenditure? i.e.:

- Raw materials annual expenditure before EMS adoption _Data is not available
- Raw materials annual expenditure in the EMS era _data is not available____

3.4 What is/was the average amount of savings and revenue the business enterprise reaps/reaped annually due **to reusing, recycling** and **selling of** waste? i.e.

- Pre EMS Period___ No data_____
- During EMS Period_ ____No data_____

SECTION FOUR

This section looks into the overall costs and gains from EMS adoption.

4.1 What was the company's reason(s) behind the adoption of certified EMS? [*If only one reason, simply use [X] to indicate your answer in the box provided, but if more than one reasons please use numerical values (e.g. 1, 2, 3 etc) in the boxes provided to indicate their order importance i.e. where 1 represents the most important reason & 5 represents the least important reason]*

- Economic opportunities **[1]**
- Regulatory compliance **[2]**
- Corporate Social Responsibility **[5]**
- Company's own environmental interest **[4]**
- Customer/supplier pressure **[3]**

4.2 How did the business enterprise finance its EMS adoption exercise?

- Equity Financing **[x]**
- Financial Institutions **[ ]**
- Other (specify)_____

4.3 What was the impact of EMS financing on the business enterprise's economic/financial performance? ___Insignificant, as we saved adequate funds for such exercise._____
_____

4.4 What was the total EMS implementation cost pertaining to the three research variable areas (i.e. water, energy, raw materials)? __No records_____

4.5 What is the average EMS maintenance cost per year in the three research variable areas? __No records_____

4.6 In what year did the enterprise acquire certified EMS?___2002_____

4.7 Has the business enterprise recovered capital invested in the three EMS research variable areas *(i.e. based on the revenue and savings the company reaps in the research variable areas alone)* ?

- YES [ ] *(Proceed to question 4.7.1)*
- NO [x] *(Proceed to question 4.7.2)*

4.7.1 If yes, after how many years (how long)? _____

4.7.2 If no, why? _____Too soon to tell_____
_____ _____
_____

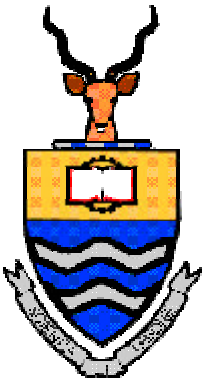
4.8 Does the business enterprise document environmental costs and gains

information?

- YES [ ] (Proceed to question 4.8.1)
- NO [x] (Proceed to question 4.8.2)

4.8.1 If yes, how does the company benefit out of such information? _____
_____
_____
_____

4.8.2 If no, why? _____Difficult to keep records since some environmental costs are hidden _____
_____



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QUESTIONNAIRE FOR DATA COLLECTION FOR A STUDY ON

THE EVALUATION OF THE IMPACT OF ENVIRONMENTAL MAMAGEMENT SYSTEMS ON THE ECONOMIC PERFORMANCE OF THE BUSINESS ENTERPRISES.

BY

Motseki Khuto

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The questionnaire is divided into four sections that are meant to evaluate the impact of EMSs on the economic performance of business enterprises with respect to the three research variables, namely water, energy and raw materials..

SECTION ONE.
This section looks into the impact of the variable *'Water'* **on the economic performance of business enterprises.**

1.19 What strategies has the business enterprise adopted to reduce water consumption?
__We reuse and recycle water_____

1.20 What is/was the business enterprise's average water consumption per year? i.e.

- Water consumption per year during the EMS period____2,7 million kl___
- Water consumption per year prior to EMS adoption_ 2,.1 million kl_____

1.21 What is the average water consumption rate per unit of production in the EMS period as opposed to the Pre EMS era?

- Higher during the EMS period and Lower in the Pre-EMS period **[ ]**
- Higher in the Pre-EMS period and Lower in the EMS Period **[x]**
- Still the same (i.e. Has not changed) **[ ]**

SECTION TWO

This section pays attention to the impact of the variable *'Energy'* **on the economic performance of business enterprises**

2.1 What strategies has the business enterprise adopted to cut down on energy consumption? __Awareness campaigns . Energy consumption monitoring system to ensure optimisation - _____
_____

2.2 What is/was the business enterprise's average energy consumption rate per year? i.e.

- Energy consumption per year during the EMS period _28 million GJ_____
- Energy consumption per year in the Pre-EMS period ___24 million GJ___

2.3 What is the business enterprise's average energy consumption rate per unit of production during the EMS period as opposed to the Pre-EMS era?

- Higher during EMS period and Lower in the Pre-EMS era **[ ]**
- Higher in the Pre-EMS era & Lower in the EMS period **[x]**
- Still the same (i.e. has not changed). **[ ]**

SECTION THREE

This section focuses on the impact of the variable *'Raw Materials'* **on the economic performance of business enterprises**

3.1 What strategies has the business enterprise adopted to promote efficient utilisation of raw materials? _____Sale and reuse of waste material_____

3.2 Please indicate in percentage form the manner in which the business enterprise makes/made use of waste material that it generates/generated with regard to the following categories/uses**: reuse, recycling, selling** and **disposing of**. (If for example, usage of the company's waste is/was spread across more than one usage/category it should reflect as follows: : *20% Reuse, 30% recycle, 50% sell etc)*

Pre EMS Period			
Reuse	Recycle	Sell	Dispose of
10%		30%	60%
During EMS Period			
Reuse	Recycle	Sell	Dispose of
20%		60%	20%

3.3 What is/was the average annual raw material expenditure? i.e.:

- Raw materials annual expenditure before EMS adoption __Data not available in hand_____
- Raw materials annual expenditure in the EMS era _ Data not available in hand _

3.4 What is/was the average amount of savings and revenue the business enterprise reaps/reaped annually due **to reusing, recycling** and **selling of** waste? i.e.

- Pre EMS Period_____Don't have data_____
- During EMS Period____ R90, 000, 000_____

SECTION FOUR
This section looks into the overall costs and gains from EMS adoption.

4.1 What was the company's reason(s) behind the adoption of certified EMS? [*If only*

one reason, simply use [X] to indicate your answer in the box provided, but if more than one reasons please use numerical values (e.g. 1, 2, 3 etc) in the boxes provided to indicate their order importance i.e. where 1 represents the most important reason & 5 represents the least important reason]

- Economic opportunities **[2]**
- Regulatory compliance **[1]**
- Corporate Social Responsibility **[5]**
- Company's own environmental interest **[3]**
- Customer/supplier pressure **[4]**

4.2 How did the business enterprise finance its EMS adoption exercise?

- Equity Financing **[x]**
- Financial Institutions **[ ]**
- Other (specify)_____

4.3 What was the impact of EMS financing on the business enterprise's economic/financial performance? ____Insignificant because we financed it with our own profits_____

4.4 What was the total EMS implementation cost pertaining to the three research variable areas (i.e. water, energy, raw materials)? _____Did not incur any costs _____

4.5 What is the average EMS maintenance cost per year in the three research variable areas? _____Do n't have data _____

4.6 In what year did the enterprise acquire certified EMS?___2000_____

4.7 Has the business enterprise recovered capital invested in the three EMS research variable areas *(i.e. based on the revenue and savings the company reaps in the research variable areas alone)* ?

- YES [ ] *(Proceed to question 4.7.1)*
- NO [x] *(Proceed to question 4.7.2)*

4.7.1 If yes, after how many years (how long)? _____

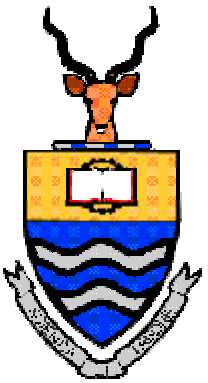
4.7.2 If no, why? _____Many environmental measures implemented have no returns other than a decrease in liability _____ ___ _____

4.8 Does the business enterprise document environmental costs and gains information?

- YES [x] (Proceed to question 4.8.1)
- NO [ ] (Proceed to question 4.8.2)

4.8.1 If yes, how does the company benefit out of such information? _____
_____To recognise whether we a re losing or gaining _____

4.8.2 If no, why? _____
_____
_____
_____



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The questionnaire is divided into four sections that are meant to evaluate the impact of EMSs on the economic performance of business enterprises with respect to the three research variables, namely water, energy and raw materials..

SECTION ONE.
This section looks into the impact of the variable *'Water'* **on the economic performance of business enterprises.**

1.22 What strategies has the business enterprise adopted to reduce water consumption?
_____we have adopted awareness campaigns as our strategy _____
_____

1.23 What is/was the business enterprise's average water consumption per year? i.e.

- Water consumption per year during the EMS period_ No records_____
- Water consumption per year prior to EMS adoption __No records_____

1.24 What is the average water consumption rate per unit of production in the EMS period as opposed to the Pre EMS era?

- Higher during the EMS period and Lower in the Pre-EMS period **[ ]**
- Higher in the Pre-EMS period and Lower in the EMS Period **[x]**
- Still the same (i.e. Has not changed) **[ ]**

SECTION TWO

This section pays attention to the impact of the variable *'Energy'* **on the economic performance of business enterprises**

2.1 What strategies has the business enterprise adopted to cut down on energy consumption? _____Awareness campaigns on wise energy use_____
_____

2.2 What is/was the business enterprise's average energy consumption rate per year? i.e.

- Energy consumption per year during the EMS period _No records_____
- Energy consumption per year in the Pre-EMS period ____No records_____

2.3 What is the business enterprise's average energy consumptio n rate per unit of production during the EMS period as opposed to the Pre-EMS era?

- Higher during EMS period and Lower in the Pre-EMS era **[ ]**
- Higher in the Pre-EMS era & Lower in the EMS period **[x]**
- Still the same (i.e. has not changed). **[ ]**

SECTION THREE

This section focuses on the impact of the variable *'Raw Materials'* **on the economic performance of business enterprises**

3.1 What strategies has the business enterprise adopted to promote efficient utilisation of raw materials? ____We reuse and sell some waste material_____

3.2 Please indicate in percentage form the manner in which the business enterprise makes/made use of waste material that it generates/generated with regard to the following categories/uses**: reuse, recycling, selling** and **disposing of**. (If for example, usage of the company's waste is/was spread across more than one usage/category it should reflect as follows: : *20% Reuse, 30% recycle, 50% sell etc)*

Pre EMS Period			
Reuse	Recycle	Sell	Dispose of
10%		10%	80%
During EMS Period			
Reuse	Recycle	Sell	Dispose of
10%		20%	70%

3.3 What is/was the average annual raw material expenditure? i.e.:

- Raw materials annual expenditure before EMS adoption __No data_____
- Raw materials annual expenditure in the EMS era_ __No data_____

3.4 What is/was the average amount of savings and revenue the business enterprise reaps/reaped annually due **to reusing, recycling** and **selling of** waste? i.e.

- Pre EMS Period ____No data_____
- During EMS Period ___No data_____

SECTION FOUR

This section looks into the overall costs and gains from EMS adoption.

4.1 What was the company's reason(s) behind the adoption of certified EMS? [*If only one reason, simply use [X] to indicate your answer in the box provided, but if more than one reasons please use numerical values (e.g. 1, 2, 3 etc) in the boxes provided to indicate their order importance i.e. where 1 represents the most important reason & 5 represents the least important reason]*

- Economic opportunities **[2]**
- Regulatory compliance **[1]**
- Corporate Social Responsibility **[5]**
- Company's own environmental interest **[4]**
- Customer/supplier pressure **[3]**

4.2 How did the business enterprise finance its EMS adoption exercise?

- Equity Financing **[x]**
- Financial Institutions **[ ]**
- Other (specify)_____

4.3 What was the impact of EMS financing on the business enterprise's economic/financial performance? _____Impact was quite minimal given we funded the project with own profits _____

4.4 What was the total EMS implementation cost pertaining to the three research variable areas (i.e. water, energy, raw materials)? __No records _____

4.5 What is the average EMS maintenance cost per year in the three research variable areas? ____No data_____

4.6 In what year did the enterprise acquire certified EMS?____2003_____

4.7 Has the business enterprise recovered capital invested in the three EMS research variable areas *(i.e. based on the revenue and savings the company reaps in the research variable areas alone)* ?

- YES [ ] *(Proceed to question 4.7.1)*
- NO [x] *(Proceed to question 4.7.2)*

4.7.1 If yes, after how many years (how long)? _____

4.7.2 If no, why?_ ____Too soon to assess_____

_____

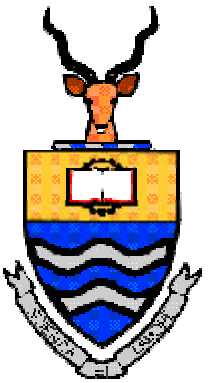
4.8 Does the business enterprise document environmental costs and gains information properly?

- YES [ ] (Proceed to question 4.8.1)

- NO [x] (Proceed to question 4.8.2)

4.8.1 If yes, how does the company benefit out of such information? _____
_____
_____

4.8.2 If no, why? _____we can't distinguish environmental costs from the rest of company costs _____
_____
_____
_____



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Company: Sondors

The questionnaire is divided into four sections that are meant to evaluate the impact of EMSs on the economic performance of business enterprises with respect to the three research variables, namely water, energy and raw materials..

SECTION ONE.
This section looks into the impact of the variable *'Water'* **on the economic performance of business enterprises.**

1.25 What strategies has the business enterprise adopted to reduce water consumption?
___We practice awareness campaigns on optimisation of water, and we conduct regular maintenance of leakages in piping system _____

1.26 What is/was the business enterprise's average water consumption per year? i.e.

- Water consumption per year during the EMS period__700 units_____
- Water consumption per year prior to EMS adoption__1023 units_____

1.27 What is the average water consumption rate per unit of production in the EMS period as opposed to the Pre EMS era?

- Higher during the EMS period and Lower in the Pre-EMS period **[ ]**
- Higher in the Pre-EMS period and Lower in the EMS Period **[x]**
- Still the same (i.e. Has not changed) **[ ]**

SECTION TWO

This section pays attention to the impact of the variable *'Energy'* **on the economic performance of business enterprises**

2.1 What strategies has the business enterprise adopted to cut down on energy consumption? _____Good practice and training (awareness campaigns)_____
_____

2.2 What is/was the business enterprise's average energy consumption rate per year? i.e.

- Energy consumption per year during the EMS period __2228 units_____
- Energy consumption per year in the Pre-EMS period __2458 units___

2.3 What is the business enterprise's average energy consumption rate per unit of production during the EMS period as opposed to the Pre-EMS era?

- Higher during EMS period and Lower in the Pre-EMS era **[ ]**
- Higher in the Pre-EMS era & Lower in the EMS period **[x]**
- Still the same (i.e. has not changed). **[ ]**

SECTION THREE

This section focuses on the impact of the variable *'Raw Materials'* **on the economic performance of business enterprises**

3.1 What strategies has the business enterprise adopted to promote efficient utilisation of raw materials? _____sell and reuse_____

3.2 Please indicate in percentage form the manner in which the business enterprise makes/made use of waste material that it generates/generated with regard to the following categories/uses**: reuse, recycling, selling** and **disposing of**. (If for example, usage of the company's waste is/was spread across more than one usage/category it should reflect as follows: : *20% Reuse, 30% recycle, 50% sell etc)*

Pre EMS Period			
Reuse	Recycle	Sell	Dispose of
10%		10%	80%
During EMS Period			
Reuse	Recycle	Sell	Dispose of
10%		20%	70%

3.3 What is/was the average annual raw material expenditure? i.e.:

- Raw materials annual expenditure before EMS adoption__ _Not known___
- Raw materials annual expenditure in the EMS era_ ___ Not known_____

3.4 What is/was the average amount of savings and revenue the business enterprise reaps/reaped annually due **to reusing, recycling** and **selling of** waste? i.e.

- Pre EMS Period _____Not known_____
- During EMS Period _____Not known_____

SECTION FOUR

This section looks into the overall costs and gains from EMS adoption.

4.1 What was the company's reason(s) behind the adoption of certified EMS? [*If only one reason, simply use [X] to indicate your answer in the box provided, but if more than one reasons please use numerical values (e.g. 1, 2, 3 etc) in the boxes provided to indicate their order importance i.e. where 1 represents the most important reason & 5 represents the least important reason]*

- Economic opportunities **[1]**
- Regulatory compliance **[2]**
- Corporate Social Responsibility **[5]**
- Company's own environmental interest **[4]**
- Customer/supplier pressure **[3]**

4.2 How did the business enterprise finance its EMS adoption exercise?

- Equity Financing **[x]**
- Financial Institutions **[ ]**
- Other (specify)_____

4.3 What was the impact of EMS financing on the business enterprise's economic/financial performance? ___very minor impact because we had saved a lot money for sometime to finance our EMS _____
_____
_____

4.4 What was the total EMS implementation cost pertaining to the three research variable areas (i.e. water, energy, raw materials)? ___No records_____

4.5 What is the average EMS maintenance cost per year in the three research variable areas? ___No records, therefore not known_____

4.6 In what year did the enterprise acquire certified EMS?__2003_____

4.7 Has the business enterprise recovered capital invested in the three EMS research variable areas *(i.e. based on the revenue and savings the company reaps in the research variable areas alone)* ?

- YES [ ] *(Proceed to question 4.7.1)*
- NO [x] *(Proceed to question 4.7.2)*

4.7.1 If yes, after how many years (how long)? _____

4.7.2 If no, why? _____too early to assess_____
_____

4.8 Does the business enterprise document environmental costs and gains information properly?

- YES [ ] (Proceed to question 4.8.1)
- NO [x] (Proceed to question 4.8.2)

4.8.1 If yes, how does the company benefit out of such information? _____
_____
_____
_____

4.8.2 If no, why? ___poor documentation & information storage system___
_____

Appendix B

How to Evaluate Costs and Savings of Alternatives

Evaluating the cost of the baseline and alternatives requires several steps as described below. A description of these steps is followed by an example.

Step 1: Map baseline and alternatives. Module 1 describes how to develop a map of your company's processes, products, and services. This map is important to understanding the activities occurring in your facility that cost you money. To also understand the potential costs and savings of alternatives, it is important to develop process maps for alternatives **if the alternative will vary your current processes.** For example, Figure F.1 shows a metal finisher's baseline cleaning process using a solvent, which is collected and shipped off-site for proper disposal. One alternative examined by the metal finisher was installing a distillation system that could recover 95% of the spent solvent. Figure F.2 shows the process map with the distillation system – spent solvent is collected, recycled on-site, and re-used in the cleaning process. The map helps you visualize the differences between the baseline and alternative, and can help guide you in collecting cost data.

> **Note:** Remember to include potentially hidden and less tangible costs.

Step 2: Collect annual operating costs for baseline and alternatives. Using the process maps from Step 1 you can now begin collecting annual operating costs for both your baseline and alternatives. Use Worksheet 4-5a to help you collect cost information. Table F.2 lists examples of some of these costs that may be relevant to your baseline and alternatives. Costs that are the same for the baseline and the alternative can be omitted from the analysis. In the solvent cleaning example, labor time and energy required for cleaning remains the same for both the baseline process and the solvent recycling alternative. Therefore, these costs can be excluded from the analysis.

Be as thorough as possible when considering costs, but don't worry about how you classify costs. For example, you may wish to consider personal protective equipment as a regulatory compliance cost, especially if its use is required by regulations. Alternatively, you may wish to classify all protective equipment as "materials."

Figure F.1 Current Cleaning Process

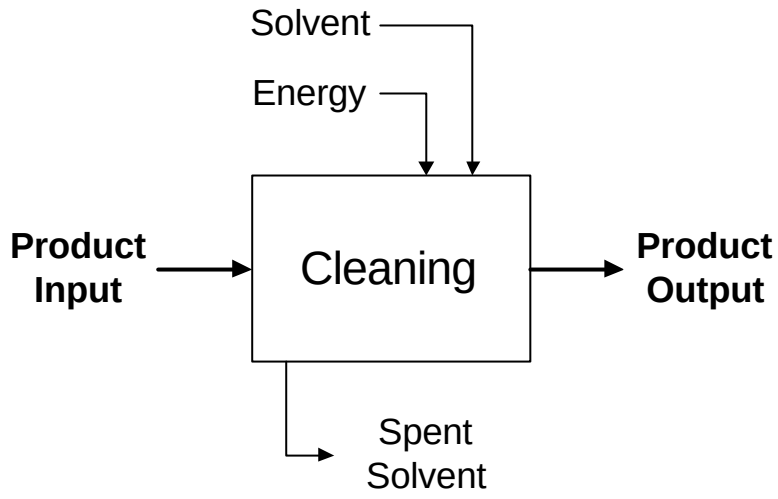
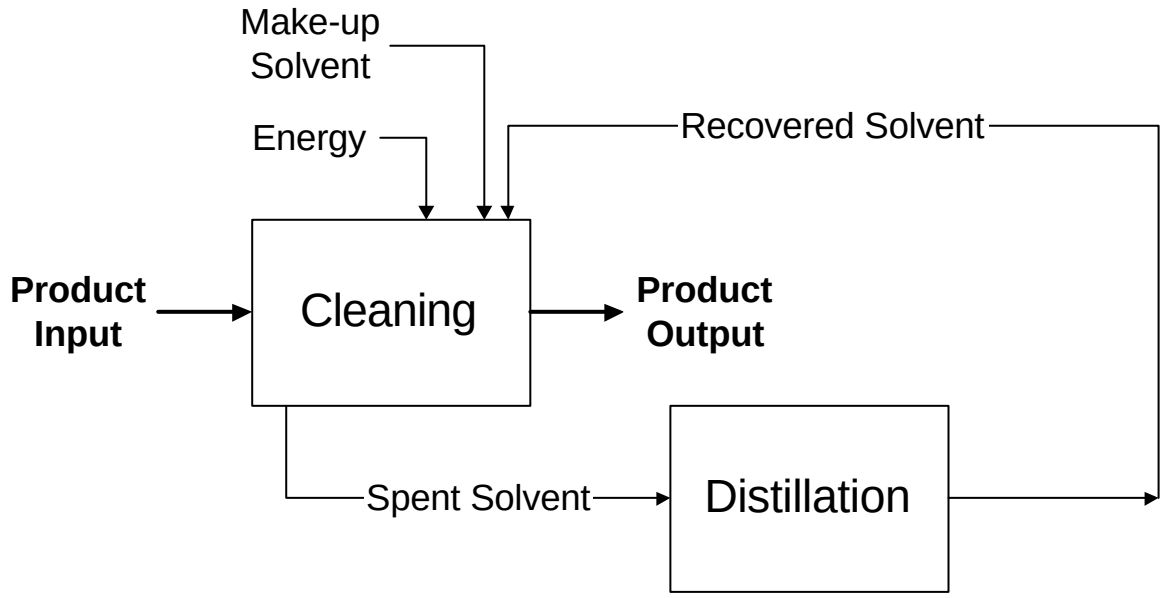


Figure F.2 Alternative Cleaning Process



Note: Remember that changes in one process may affect costs in other processes. You should include these costs as well.

Environmental projects may save you money not only by reducing your costs, but also by generating revenues. For example, an alternative may increase your product throughput because the activity takes less time to complete, or product quality may be improved enabling you to sell more of your product. The alternative may also let you recover materials previously disposed of, and generate revenues through sales of the reclaimed material (such as recovering metal scrap which can be sold to scrap dealers). These annual revenue effects should be considered using Worksheet 4-5b to assist you. Quantify these revenue effects if possible, and add them to the total operating costs in Worksheet 4-5d. If these potential revenues are difficult to quantify, you can consider them qualitatively in your evaluation by making a note in the last column of Worksheet 4-5d.

By convention, costs (or outflows) are usually denoted by a negative (-) sign while an inflow (or revenue) is denoted by a plus (+) sign. Make sure to keep these signs correct when adding revenues to costs. For example, if the annual operating cost of your alternative is -$20,000, but the alternative will generate an additional $10,000 in revenues, your total annual operating cost would be -$10,000.

Table F.2 Annual Operating Costs

Materials (Purchase, delivery, storage)	Regulatory compliance (Labor, materials)
Raw materials	Labeling
Solvents	Manifesting
Catalysts	Recordkeeping
Personal protective equipment	Permitting
Maintenance supplies	Reporting
Direct labor (Wages, benefits)	Protective equipment
Operating	Insurance
Supervision	Commercial general liability
Inspection	Workers' compensation
Utilities	Health insurance
Electricity	Pollution liability
Steam	Future liability
Water	Fines/penalties
Fuel	Legal costs
Waste management (Labor, materials)	Business shutdown
On-site handling	Personal injury
Treatment	Property/natural resource damage
Storage	Remediation
Hauling	
Disposal	

Step 3: Collect initial investment costs for each alternative. If any of your alternatives will require an investment in new equipment, you will need to consider these costs. These not only include capital costs, but also other one-time costs accompanying your investment, such as installation costs or new equipment training. Use Worksheet 4-5c to help you collect these costs. Table F.3 lists examples of these costs that may be relevant to your alternatives.

Step 4: Calculate net present value for the baseline and alternatives. The next step enables you to compare the baseline and alternatives to determine which options appear to be most financially attractive. Because a change in your processes or activities may affect your costs and savings over many years, the analysis should look at long term costs and savings. For example, if you are considering installing new equipment that will last for 10 years, your analysis should include the costs and savings that will accrue to you over the 10 year period. This is especially important for environmental projects which often times reap benefits over the long term.

Table F.3 Initial Investment Costs

Purchased equipment (Purchase, tax, delivery)	Construction/installation
Process equipment	Consultant/contractor fees
Storage and materials handling equipment	In-house
Safety/protective equipment	Equipment rental
Monitoring/control equipment	Vendor fees
Laboratory/analytical equipment	Start-up/training (Labor, materials)
Waste handling/treatment equipment	Consultant/contractor fees
Initial spare parts	In-house
Utility systems/connection	Safety/environmental training
Electricity	Trials/manufacturing variances
Water	Vendor fees
Steam	Permitting
Fuel	Consultant/contractor fees
HVAC	In-house
Plant air	Permit fees
Inert gas	Vendor fees
Sewerage	Other
Refrigeration	Buildings
Plumbing	Land
Planning/engineering (Labor, materials)	Contingency
Consultant/contractor fees	Working capital (cash, inventory)
In-house planning/engineering	
Procurement	
Vendor fees	
Site preparation (Labor, materials)	
Consultant/contractor fees	
In-house	
Demolition & clearing	
Equipment rental	
Equipment/rubbish disposal	
Disposal	
Grading/landscaping	
Vendor fees	

A critical component of assessing a project where costs and savings may occur over several years is incorporating the notion that the value of money changes over time – commonly called the "time value of money." Most businesses prefer to have money sooner rather than later. If you have money today, you have the opportunity to use it now to grow your business, for example. Put another way, there is a cost if you receive the money tomorrow instead of today. For example if you receive $1,000 today and put it in the bank receiving 10% interest, at the end of the first year you would have $1,100. This is clearly preferable to receiving $1,000 a year from now. Thus, because $1 today is not equal to $1 tomorrow, you need to adjust the value of future dollars to reflect their diminished value to you today.

The mechanism for making this adjustment is called a discount rate. A discount rate is a percentage that is applied to future costs or revenues to determine its present value. Typically, for business decisions, the discount rate chosen represents the business's cost of capital plus some level of desired return on an investment plus an additional margin to account for uncertainty. Your accountant will be able to assist you in selecting an appropriate discount rate for your analysis.

To calculate the present value (PV) of a cost or savings in the future, use the following equation:

$$PV = \frac{FV_t}{(1+r)^t}$$

where FV = the future value of a cash flow (i.e., a cost or cash outflow, or a revenue or cash inflow) received in year t, and

r = the discount rate.

For example, the present value of a $1,000 revenue you expect to receive over the next four years would be:

$$PV = \frac{\$1000}{(1+0.10)^1} + \frac{\$1000}{(1+0.10)^2} + \frac{\$1000}{(1+0.10)^3} + \frac{\$1000}{(1+0.10)^4} \quad \text{or:}$$

Year	Future Value	Present Value
1	$1000	$ 909
2	$1000	$ 826
3	$1000	$ 751
4	$1000	$ 683
Total		**$3169**

The net present value (NPV) can then be calculated as follows:

$$NPV = \sum PV - I$$

where ΣPV is the sum of the present values of the cash inflow or outflows and
I = the initial investment cost.

In our above example, if the initial investment cost is $1000, then the NPV equals $2169 ($3169 - $1000). If your alternative won't require an initial investment – for example, you are substituting a toxic chemical with a less hazardous chemical, but there are no changes in your equipment, then NPV is equal to the sum of the present values ($3169 in the above example).

Note: In financial analyses, a cost (or outflow) is usually denoted by a negative (-) sign while an inflow (or revenue) is denoted by a plus (+) sign.

NPV can be calculated using a financial calculator, spreadsheet software like Excel, or using project profitability analysis software such as P2/FINANCE (see the resources list at the end of this Appendix).

Step 5: Assess the costs and savings. The last step is to evaluate your baseline and alternatives from a cost and savings perspective. The difference between the alternative and baseline is entered in Worksheet 4-6. A positive number indicates that the alternative saves money, while a negative number indicates that the alternative is more expensive than the baseline. The alternative with the greatest NPV is the most profitable one.

Note: Remember that your accountant can assist you in these calculations.

Example: Baseline vs. Alternative Cleaning Processes

As described above, as part of its EMS, a metal finisher examined methods for reducing solvent use in cleaning. Recovering solvent via a distillation system was one alternative identified. The cost and savings analysis of the baseline versus alternative follows.

Step 1: Map baseline and alternatives. These processes are mapped in Figures F.1 and F.2.

Step 2: Collect annual operating costs for baseline and alternatives. The current annual costs for the baseline are shown in Table F.4. These costs are readily available from purchase orders. Because labor and electricity costs for the cleaning operation remains the same for the baseline and alternative, these costs are omitted from our analysis.

Table F.4 Annual Operating Costs -- Baseline

Annual Operating Costs	$/year
MATERIALS	
Solvent	11,631
WASTE MANAGEMENT	

Solvent disposal	19,041

Annual operating costs for the alternative are shown in Table F.5. Material costs include make-up solvent (because 95% of the solvent is recovered from distillation, make-up solvent must be added) as well as oil and filters for the distillation system. Electricity costs are for operating the distillation system only (electricity use for cleaning is the same for both the baseline and alternative). These costs are available from the equipment vendor.

Table F.5 Annual Operating Costs – Cleaning with Solvent Recovery

Annual Operating Costs	$/year
MATERIALS	
Chemicals	6692
Oil	375
Filters	2284
WASTE MANAGEMENT	
Disposal	439
UTILITIES	
Electricity	241

These operating costs are entered into Worksheet 4-5a. Note that there are no potential annual revenue effects for the alternative project so Worksheet 4-5b is not included.

Step 3: Collect initial investment costs for each alternatives. The initial investment costs for the distillation system, provided by the equipment vendor, appear in Table F.6. These costs are then entered in Worksheet 4-5c.

Table F.6 Initial Investment Costs for the Distillation System

Investment Costs	Cost in $
PURCHASED EQUIPMENT	
Distillation system	26,200
START-UP/TRAINING	
Start-up & Training	750

Worksheet 4-5a – Annual Operating Costs per year

Alternative	Materials	Direct labor	Utilities	Waste management	Regulatory compliance	Insurance	Future liability	Total Operating Cost
A (Baseline)	11,631		0	19,041				30,672
B	9,351		241	439				10,031

Worksheet 4-5c – Initial Investment Costs

Alternative	Purchased equipment	Utility systems/ connection	Planning/ engineering	Site preparation	Construction/ Installation	Start-up/ training	Permitting	Other	Total Inv. Costs
A (Baseline)	--	--	–	--	--	--	--	--	--
B	26,200					750			26,950

Worksheet 4-5d – Cost Comparison of Alternatives

Alternative	Total Operating Costs (Present Value)	Total Investment Costs (Present Value)	NPV	Annual Revenue Effects (qualitative
A (Baseline)	-233,293	N/A	-233,293	
B	-76,296	-26,950	-103,246	

Worksheet 4-6 – Evaluation of Alternatives

Alternative	Environmental Effects	Performance	Regulatory Considerations	NPV (Alternative – Baseline)	Overall Evaluation
A (Baseline)				--	
B				$130,047	

Step 4: Calculate net present value for the baseline and alternatives. Next, the net present value for the baseline and alternative is calculated using the company's discount rate of 10%. Because the lifetime of the distillation system is 15 years, operating costs are assessed over 15 years. These costs are entered in Worksheet 4-5d. Remember that cash outflows (such as investments or operating costs) are entered using a negative (-) sign while inflows (revenues) are denoted by a plus (+) sign.

Step 5: Assess the costs and savings. Worksheet 4-5d shows that the NPV for the baseline is -$233,293 while the NPV of the alternative is -$103, 246. The difference between the alternative and baseline (alternative minus baseline) is entered in Worksheet 4-6. A positive number indicates that the alternative saves money, while a negative number indicates that the alternative is more expensive than the baseline. Worksheet 4-6 shows that the distillation system will save the metal finisher $130, 047 over 15 years.

Getting Started – Where to Find Cost Data

You now have the tools to evaluate the cost and savings of your alternatives. However, you may not be sure where to find the data necessary for conducting this analysis. To assist you, Table F.7 lists costs and sources for these data in your business. Note that when collecting similar cost data for your alternatives, suppliers and vendors are frequently a good information source.

Future assessments can benefit from improving your business' current cost tracking system. While at first glance this may seem intimidating, you can begin to incorporate these costs into your accounting framework one step at a time. Begin by tracking a few costs on a routine basis, selecting the most significant costs first. You may want to begin by examining the costs associated with environmental issues to gain a better awareness of how they affect your business' bottom line. Use this awareness to focus your efforts on specific cost areas that appear to have the most importance to your business. As your level of knowledge increases, you can expand your cost tracking system to include other cost data. Eventually you will have a system that meets your needs and provides you with extensive crucial business information.

Table F.7 Where to Find Costs

Cost Category	Data Elements	Where Found	Who to Ask
Process Chemicals	Usage Rates Unit Costs	Production Records Purchase Orders	Foreman Billing Dept.
Ancillary Chemicals	Usage Rates Unit Costs	Prod. Specifications Purchase Orders	Product Engineers Billing Dept.
Storage Space	Total Square Footage Cost/Sq. Ft.	Actual Measurement Rental Contract	Maintenance or Engineering Billing Dept.
Waste Treatment	Flow Rates Total Chemical Costs	WWT Log Sheets Purchase Orders	WWT Operator Purchasing Dept.
Testing	Number of Tests/Year Cost per Test	Environmental Files Invoices	Environmental Manager Accounts Payable
Disposal	Type and Quantity Disposed Unit Costs of Each	Manifests Invoices	Environmental Manager Accounts Payable
Training	Number of People Number of Trainings Length of Training Hourly Labor Rates	Training Records Wage Rate Sheet	Environmental Manager or Contractor Personnel Dept.
Personal Protective Equipment	Type and Quantity Used Cost per Item	Stock Room or Inventory	Environmental Manager Purchasing Dept.
Insurance	Type and Coverage Premium	Capital Budgets Invoices	CFO, Accountant Accounts Payable
Production	Machine Down Time Machine Rates Labor Rates	Prod. Records Operating Budget Personnel Records	Production Manager Finance Dept. Personnel Dept.
Taxes/Fees	Sewer Use Tax Chemical Use Tax Water Use Tax Volume of Weight of Each Taxed Item	Water Bills Environmental Records Water Bills Water, Chemical Usage Records	Accounts Payable Environmental Manager Local POTW Production Manager, Purchasing
Environmental Compliance	Hours of Labor for All Compliance Tasks	Estimates, Salaries, or Environmental Management Records	Environmental Manager
Maintenance Labor	Hours of Labor Tasks Performed	Maintenance Log	Maintenance Dept. Shop Foreman
Maintenance Materials	Amount of Materials Costs of Materials	Maintenance Log Purchase Orders	Maintenance Dept. Purchasing Dept.
Water Usage	Annual Usage Rate Cost/Gal. or Cu. Ft.	Flow Meters or Logs Town Water Bills	Production Manager Accounts Payable
Electricity Usage	Annual Usage Rate Cost/kWh	Equipment Specs. Utility Bills	Production Manager Accounts Payable
Steam Usage	Cost of Production Fraction of Total Used by Process	Fuel Bills, Boiler Maintenance Logs, Count of Processes Using Steam	Accounts Payable Maintenance Dept. Plant Walk-Through
Source: Appendix C of *Total Cost Assessment for Environmental Engineers and Managers* (John Wiley & Sons, 1998).			