

A case study on environmental management accounting practice at a South African manufacturing company

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ABSTRACT

Environmental concerns have been around for many years but the threat of rapid climate change has raised the profile of environmental sustainability issues. Laws and regulations will probably be revised due to an increase in environmental concerns by various stakeholders. This is likely to increase the business complexity for most companies in the manufacturing industry in South Africa. Environmental Management Accounting is Management Accounting with focus on environmental issues, such as physical information on the flow of energy, water, products and materials, as well as monetary information such as cost of waste, cost of environmental projects, and material cost of product outputs.

This study evaluates the practice of environmental management accounting in a manufacturing organisation in South Africa. A questionnaire was administered to a selected group of participants within the organisation. The organisations name has been omitted from the study due to legal concerns. The questionnaire focused on organisational characteristics, environmental management matters, physical and monetary environmental management accounting, and environmental cost allocation.

Significant insight was gained on the understanding of sustainable development, the development of world protocols and requirements for the past 53 years and environmental management system including the ISO 14000 family of standards. Significant insight was also gained on environmental management accounting, including both physical and monetary environmental management accounting, cost distribution and allocation, environmental laws and regulation in South Africa, as well as potential benefits and challenges of environmental management accounting.

The findings of this study indicate that the practice of environmental management accounting at this manufacturing organisation is positive. Also different levels of awareness exist between different functional roles in most organisations. The awareness of physical and monetary environmental management accounting principles revealed a small difference between the various functions that participated in the study. The study indicated that the organisation is good at recognising that environmentally related costs need to be allocated directly to a product. Allocating costs related to environmental aspects directly to a specific product allows for improved decision making.

Key terms: Environmental management accounting, South African manufacturing industry, environmental practices, ISO 14001, sustainable development.

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ABBREVIATIONS

CAIA	Chemical and Allied Industry Association
EA	Environmental Accounting
EMA	Environmental Management Accounting
EMS	Environmental Management Systems
GDP	Gross Domestic Product
GRI	Global Reporting Initiative
IFAC	International Federation of Accountants
ISO	International Standards Organisation
MEMA	Monetary Environmental Management Accounting
NEMA	National Environmental Management Act
PEMA	Physical Environmental Management Accounting
SD	Sustainable Development
UNSD	United Nations Department of Sustainable Development
WCED	World Commission on Environment and Development

CHAPTER 1: INTRODUCTION

1.1 Introduction to environmental management accounting

Environmental concerns have been around for many years but the threat of rapid climate change has raised the profile of environmental sustainability issues. The manufacturing industry is a major player in environmental sustainability issues due to their required inputs, such as water, energy and raw materials, and from unwanted outputs such as emissions released to the air and water sources and waste to landfill sites. Major industrial incidents such as Seveso (University of Bristol), Bhopal 1984 (Union Carbide Corporation), and the recent 2010 British Petroleum Gulf of Mexico disaster (Tripod Incident Analyses, 2010) have highlighted the impact of industries on the environment.

According to Ambe (2007), world environmental climate change conferences have highlighted stakeholders' interest in the negative impacts of industries on the environment and humans. Some of these conferences include the World Summit on Sustainable Development held in Johannesburg, in 2002, the Kyoto Protocol for Greenhouse Gas Emissions, and the United Nations Climate Change Conference held in Copenhagen (International Institute for Sustainable Development, 2016). Such incidents and conferences are catalysts in accelerating legislative requirements from governments, increased industry standards and increased customer pressure on businesses to operate in an environmentally sustainable manner. The Chemical and Allied Industry Association, also known as CAIA, is one such non-governmental organisation in South Africa that has implemented standards for its member companies. In August 1999 the United Nations set up a working group to develop procedures and principles with regards to Environmental Management Accounting. 'Environmental Management Accounting Procedures and Principles' was the document published by the United Nations in 2001 (United Nations, 2001).

Environmental concerns have been on the rise over the past two decades (United Nations, 2001). As a result of this interest of environmental issues by various stakeholders many companies are publishing triple bottom line and sustainability reports. Many of these companies are reporting according to the Sustainable Reporting Guidelines of the Global Reporting Initiative (Global Reporting, 2013). The Global Reporting Initiative (GRI) is a voluntary guideline that companies use to report on the significant economic, environmental and social impacts. The aim of the GRI is to enhance the quality of environmental reporting (Ambe, Environmental

Management Accounting in South Africa: Status, Challenges and Implementation Framework, 2007). A holistic approach to economic, social and environmental issues allows for the effective management of business opportunities and risks (South African Institute of Chartered Accountants, 2009).

According to the World Commission on Environment and Development (WCED, 1987): *“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of needs, in particular the essential needs of the world’s poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organisation on the environment’s ability to meet present and future needs.”*

Sustainable development incorporates three building blocks, namely economic, social and the environment. Environmental Management Accounting (EMA) integrates two of these, environment and economics, as they relate to an organisation's internal decision making (Savage & Jasch, 2005). Environmental Management Accounting is a system that industries can implement to assist in decision making of environmental issues and associated costs. Environmental Management Accounting is the application of conventional accounting principles to environmental issues, such as waste and emission analysis. According to Seal et al. (2012) EMA may be defined as the identification, collection and analysis of physical and monetary information. Physical information is about the use, flows, and rates of energy, water and materials, including wastes. Monetary information is about environment-related costs, earnings, and savings. Both monetary and physical environmental accounting information could be used by industry to be sustainable.

1.2 Problem statement

Laws and regulations will probably be revised due to an increase in environmental concerns by various stakeholders. This is likely to increase the business complexity for most companies in the manufacturing industry in South Africa. There are also a number of reasons why profit-oriented firms should take environmental issues seriously. Some of the most basic motives being compliance, eco-efficiency and strategy (Seal, Garrison, & Noreen, 2012). These challenges can be overcome by applying good environmental management accounting practice. According to Deegan and Rankin (2002), many opportunities for cost savings through good environmental management are lost as a result of lack of awareness and understanding of the

environmental costs being generated by organisations. Managers should therefore use both physical and monetary environmental management accounting data in their daily operations to assist in cost competitiveness. Based on the studies conducted by Ambe (2007) and Kotzee (2014) the following questions can be asked:

- What is the practice of gathering, recording and applying information for physical environmental management accounting
- What is the practice of gathering, recording and applying information for monetary environmental management accounting

1.3 Research objectives

The broad aim of this mini-dissertation is to investigate and explore how the selected organisation addresses environmental impacts and manages environmental costs. The objectives section provides an overview of what needs to be achieved by the research project.

1.3.1 Main objective

To establish and evaluate the extent to which Environmental Management Accounting is being applied at a South African manufacturing company.

1.3.2 Secondary objectives

1.3.2.1 To conduct a literature review of environmental management accounting.

1.3.2.2 To evaluate the application of physical environmental management accounting at a South African manufacturing company.

1.3.2.3 To evaluate the application of monetary environmental management accounting at a South African manufacturing company.

1.4 Research method

This research consists of two phases, a literature review and an empirical study, designed to achieve the objectives set out above:

1.4.1 Literature review

A literature review regarding the practice of environmental management accounting was conducted. The following sources were consulted:

Environmental internet sites such as:

- United Nations: Climate change and reporting
- European Environmental Council
- Chemical and Allied Industry Association
- Books on Environmental Management Accounting
- Scientific papers published mainly in Environmental and Accounting Journals

1.4.2 Empirical research

The methodology for collecting data was based on a quantitative approach. A structured questionnaire was designed to collect the data, to achieve the set objects for this study. This study was conducted on a manufacturing organisation in South Africa. The questionnaire was designed to evaluate the awareness of and the degree of implementation regarding environmental management accounting within the said organisation. The organisation's name has been omitted from this study due to legal concerns. A survey questionnaire was used to gather the required information. The questionnaires were completed using the Goggle survey platform, on which the questionnaire was designed. In order to collect data a nonprobability sample was taken from the organisation. The research targeted a sample size of 261 and observed a response rate of 41%. The raw data was captured using Microsoft Excel, edited to clean out inconsistencies and incompleteness, and coded so that the data can be analysed effectively and communicated to suit the readers. Measuring tools that were used include statistical analysis and descriptive statistics according to the Statistical Consultation Services at the North-West University.

1.5 Overview

An overview of the chapter structure in this mini-dissertation:

Chapter 1: Introduction

Presents the background and motivation for the study, problem statement, research objectives, and an outline of the research methodology followed for this study.

Chapter 2: Literature review

Chapter 2 critically reviews relevant local and international literature on sustainable development, integrated reporting, environmental management systems, environmental management accounting, monetary environmental management accounting and physical environmental management accounting from secondary sources, including journals, government publications, books and industry information.

Chapter 3: Empirical investigation and results

This chapter describes the procedure and methods followed in conducting the investigation for this research. The study design, method of data collection, development of the questionnaire and the processing of the data are discussed in this chapter. The validity and reliability of the research instrument and the sample frame are also discussed in this chapter. This chapter also presents the findings of this research.

Chapter 4: Recommendations and conclusion

Chapter 4 concludes this mini-dissertation by discussing the research objectives and general aims of the study. It also addresses what actions were taken to address the research objectives and general aim. The outcomes of these actions and recommendations are also covered in this chapter.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to review the literature on sustainable development, environmental management accounting and how it fits into the manufacturing industry in South Africa. This chapter begins with a discussion on sustainable development and reviews the developments of world protocols and requirements over the past 53 years since the publication of the book “Silent Spring” by Rachel Carson. The chapter begins with an overview of sustainable development in South Africa with particular focus on the environmental aspect. This is followed by an overview of environmental management systems and ISO 14000 family of standards. Thirdly there is a detailed discussion on environmental management accounting and its framework, including both physical and monetary environmental management accounting, cost distribution and allocation, environmental laws and regulation in South Africa, potential benefits and challenges of environmental management accounting. The last section gives an overview of the manufacturing industry in South Africa.

Many advances have marked the journey towards sustainable development since the publication of Rachel Carson’s book “Silent Spring” in 1963. Sustainable development incorporates three building blocks, namely economic, social and the environment. Environmental management accounting integrates two of these, environment and economics. The term sustainability accounting is used to refer to the process of the collection, analysis and communication of sustainability related information (Burritt, Hahn, & Schaltegger, 2002). Environmental Management Accounting is a system that can be implemented to assist in decision making on environmental issues and associated costs, which will assist with natural resource management. Environmental management accounting principles and tools should be used to generate and analyse economic information related to environmental matters, benefiting managers in their daily operations to assist in cost competitiveness.

2.2 Sustainable development

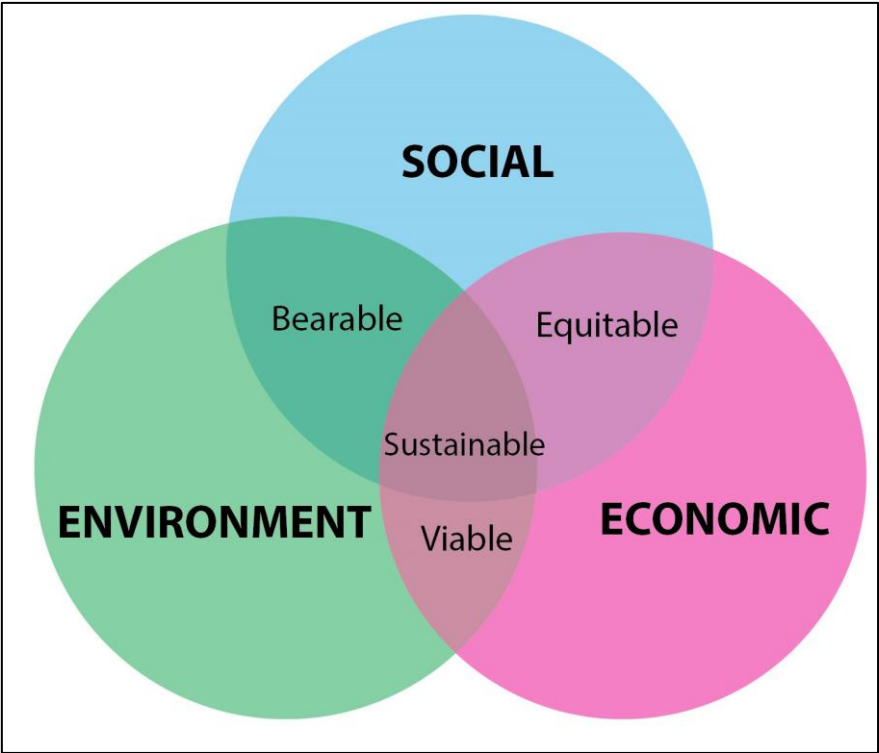
The concept of sustainability was first published in 1963 with the publication of the book “Silent Spring” by Rachel Carson, this is according to the International Institute for Sustainable Development (2014). Carson’s research proposed a link between development, human activities and damage to the environment and human health. During the same period growing

global population and its impact on the environment and social structures were raising concern (Ehrlich & Ehrlich, 1990). Since then there have been many definitions of sustainability or sustainable development but one that still remains relevant is from the report “Our Common Future”, published by the World Commission on Environment and Development.

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of needs, in particular the essential needs of the world’s poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organisation on the environment’s ability to meet present and future needs.” (WCED, 1987)

The Department of Environmental Affairs and Tourism of South Africa defined Sustainable Development as: “Sustainable development means the integration of social, economic and environmental factors into planning, implementation and decision making so as to ensure that development serves present and future generations” (DEAT, 2006). Figure 2-1 below represents the three areas of sustainable development, namely economic, social and environment. The intersecting area of all three is a space where a business can operate in a sustainable manner.

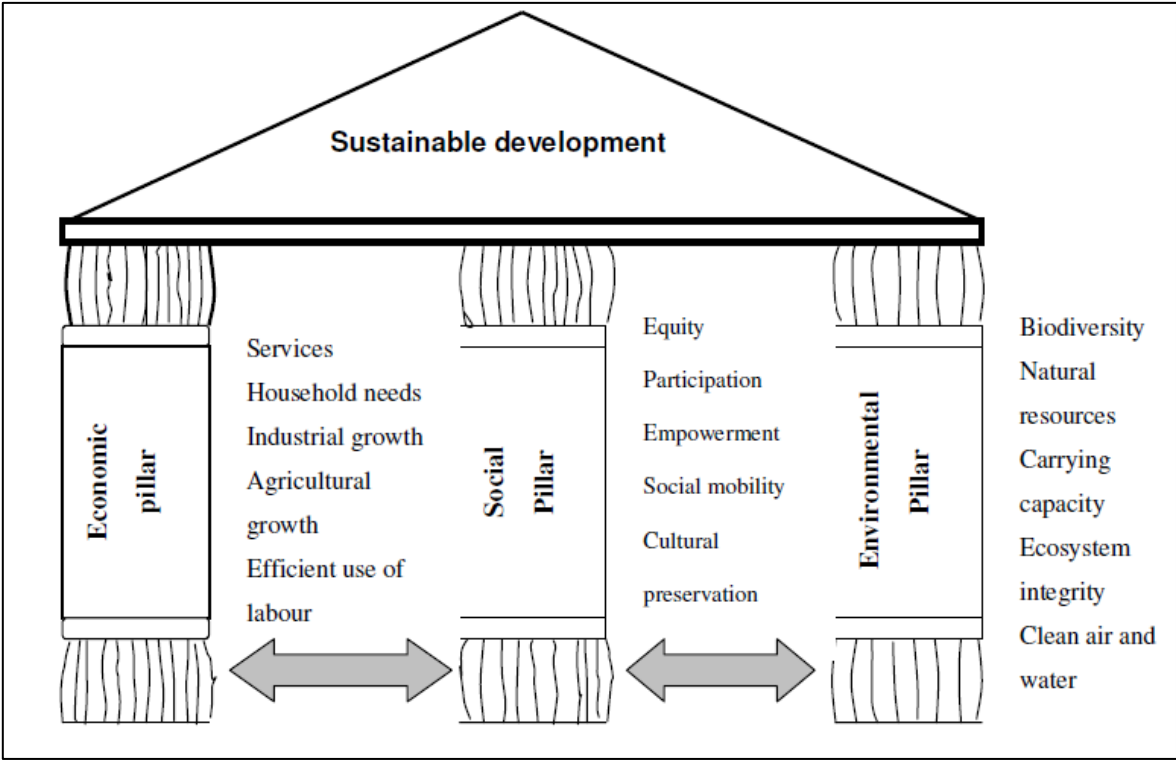
Figure 2-1: Nested model of sustainability



Source: (Department of Environmental Affairs of South Africa, 2016)

According to the World Bank (2006), meeting the needs of the future depends on how well the interconnecting relationships between economic, social and environmental objectives are managed when making decisions. Figure 2-2 below presents the Worlds Bank views of these three pillars, goals and how the interrelationships affect each other.

Figure 2-2: The three pillars and interactions of sustainable development



Source: (World Bank, 2016)

Many milestones have marked the journey towards sustainable development since the publication of Rachel Carson’s book “Silent Spring” in 1963. Below are some of these major milestones of the past 53 years:

- 1970 - First Earth Day is held in the United States as a national teach-in on the environment – 20 million people participated in peaceful demonstrations.
- 1984 - An international conference on environmental and economic issues is held. This conference concluded that the environment and economics should be mutually reinforced.
- 1987 - Our Common Future is published. Also referred to as the Brundtland Report. It is a comprehensive report that basically weaves together social, economic, cultural and environmental issues and global solutions.
- 1990 - The International Institute for Sustainable Development (IISD) is established in Canada.
- 1992 - The very first Earth Summit is held by the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro. A few agreements are

reached: Agenda 21, the Convention on Biological Diversity, the Framework Convention on Climate Change, the Rio declaration and non-binding Forest Principles.

- 1997 - United Nations General assembly review of Earth Summit. This session acts as a sober reminder that little progress has been made in implementing Agenda 21 and the discussions ends without any significant new comments.
- 1999 - The first global sustainability index gets launched. The purpose is to track leading corporate sustainability practices worldwide. The Dow Jones Sustainability Group Indexes provides a bridge between those companies implementing sustainable principles and investors looking for trustworthy information to guide investment decisions.
- 2002 - Second World Summit on sustainable development is held in Johannesburg. In the climate of frustration at the lack of government progress, the summit promotes partnerships as a non-negotiated approach to sustainability.
- 2005 - The Kyoto Protocol is signed. Developed countries are legally bound into goals to reduce greenhouse gas emissions and to establish the Clean Development Mechanism for developing countries.
- 2009 - The Copenhagen climate negotiations are held. The specific outcomes are unclear and the process might be in trouble but the Copenhagen Accord itself may be in terms of engaging developing countries.
- 2012 - Third Earth Summit is held in Rio de Janeiro. During the Rio+20 Summit the international community decides to establish a high-level Political Forum on Sustainable Development to subsequently replace the commission on Sustainable Development.
- 2013 - The high-level Political Forum on Sustainable Development held its first meeting on 24 September 2013.
- 2014 - 52nd Session of the UN Commission for Social Development held on 11-21 February.
- 2015 - Third International Conference on Financing for Development held in Addis Ababa, Ethiopia on 13-16 July.
- 2015 - Global Network Conference on Resource Efficient and Cleaner Production held in Davos, Switzerland on 12-16 October.
- 2016 - 49th Session of the Commission on Population and Development held in New York City, USA on 11-15 April.
- 2016 - G20 Energy Sustainability Working Group Meeting #2 held in Shenzhen, China on 12-14 April.

Source: (International Institute for Sustainable Development, 2016)

After considering this overview of sustainable development let's review sustainable development in a South African context.

2.3 South Africa and sustainable development

South Africa has numerous and unique challenges related to economic, social and environmental pillars of sustainable development. According to Cock and Koch (1991), "South Africa with its mix of First World environmental problems, such as acid rain, and Third World environmental problems, such as soil erosion, is a microcosm of the environmental challenges facing the planet". An economy's growth is measured by the change in the volume of its output or in the real incomes of its residents (World Bank, 2016). South Africa's average Gross Domestic Product (GDP) from 1998 to 2015 was 2,9%. The current economic drive in South Africa is to increase employment and reduce poverty levels through the Accelerated and Shared Growth Initiative – South Africa (Ambe, 2007). An analysis of South Africa's key social indicators reveal a positive trend for access to primary schooling, reduction of gender inequalities to basic education, decrease in maternal mortality rate, increase in number of households with access to clean drinking water and sanitation, and a reduction in the number of people living in informal settlements. Challenges exist with poverty, hunger reduction, unacceptably high levels of child mortality, causes of death due to HIV and tuberculosis. The focus of this research is on the environmental pillar of sustainable development which is discussed in the next section.

Figure 2-3: South African people living directly off the land

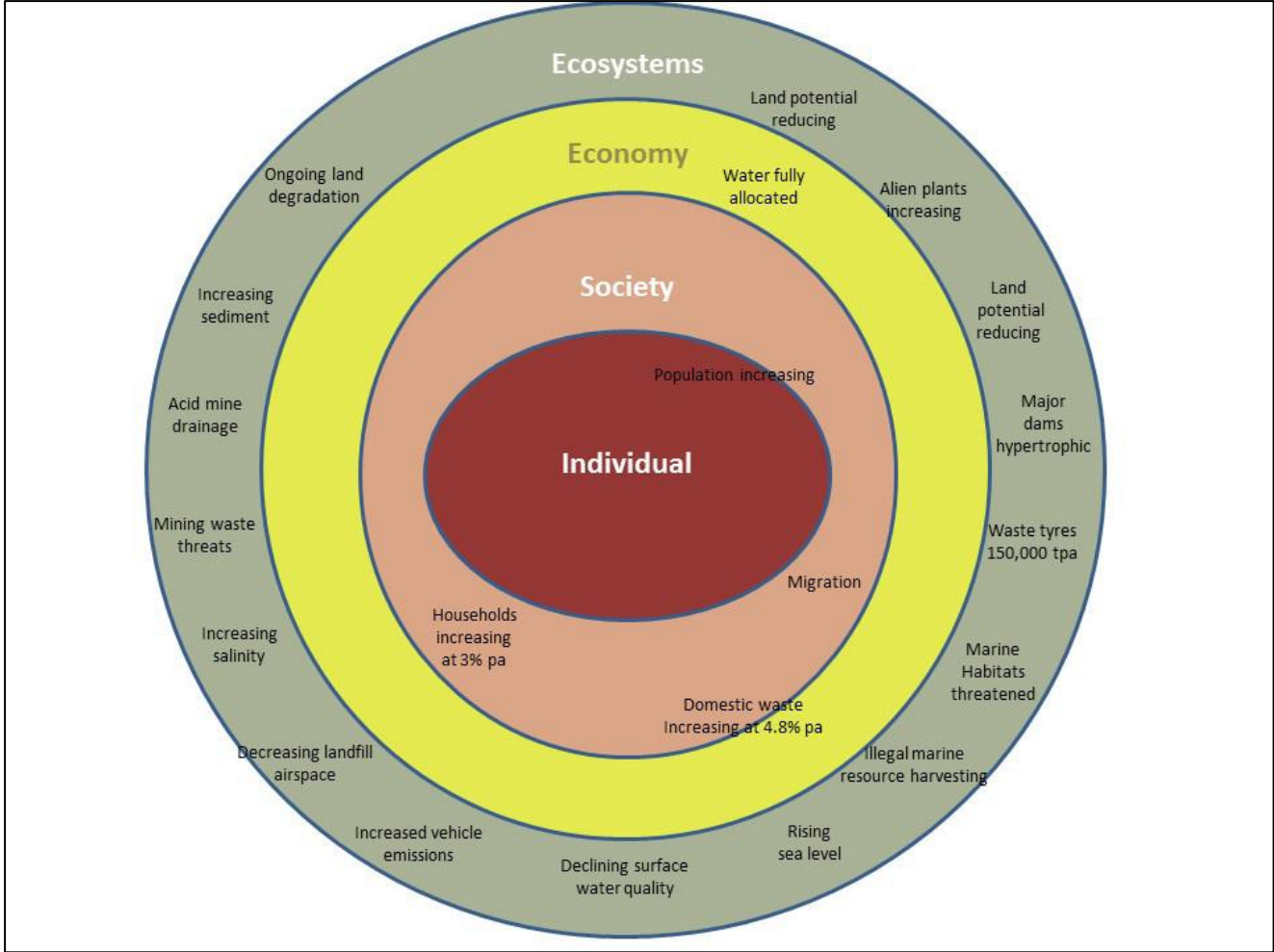


Source: (Department of Environmental Affairs of South Africa, 2016)

2.3.1 Environmental pillar of sustainable development in South Africa

Economic growth and poverty eradication strategies cannot be separated from sustainable natural resource exploitation. Natural resources provide the basic elements that human beings require for food, shelter and water. It is usually the poor that pay the price for ecosystem derogation as they usually depend more on the land for good soil to plant food, rivers for direct drinking water and fish from rich water sources (International Institute for Sustainable Development, 2016). A review of South Africa's natural resources and ecosystems reveal that these systems are under pressure. According to the South African Department of Environmental Affairs (2016), some of the issues affecting the ecosystem are human population increase, land potential reducing, major dams hypertrophic, on-going land degradation, acid mine drainage, increasing sedimentation, increasing vehicle emissions, declining surface water quality, rising sea level and marine habitats being threatened. Figure 2-4 below indicates the major environmental areas of concern in South Africa.

Figure 2-4: The major areas of concern in respect of the current state of the environment in South Africa



Source: (Department of Environmental Affairs of South Africa, 2016)

This section discussed Sustainable Development in South Africa with particular focus on the environmental pillar. The next section reviews environmental management systems that provide an organisation with a framework to support environmental management.

2.4 Environmental management systems and ISO 14000

An environmental management system (EMS) provides an organisation with a framework to recognise and assess how its business activities affect the environment in which it operates. A

strategy is then developed that will ensure the company takes appropriate measures to manage its environmental impacts and achieve legal compliance, while driving to reduce material inputs and increasing productivity.

Some aspects of an environmental management system include:

- An environmental policy
- Identifying environmental impacts
- Developing environmental objectives and targets
- Implementing indicators of performance and processes to manage them
- Continued monitoring, auditing and reviewing

According to Marrinova and Altham (2000), organisations that have implemented an environmental management system are more likely to embrace new environmental technologies. They are also more aware of the environmental impacts of their activities than those organisations that did not implement an environmental management system. Globalisation and increased pressure on companies to operate in an environmental friendly manner lead to a need for international EMS standards. This resulted in the development of the ISO 14000 family of standards which aims at achieving standardisation in the field of environmental management and thereby guides the implementation and maintenance of an EMS (Ambe, 2007).

The International Organisation for Standardization (ISO) has a family of standards, namely ISO 14000, related to environmental management that are globally recognised. The International Organisation for Standardization was established in 1947 with delegates from 25 countries. ISO is an independent, non-governmental international organization with a membership of 163 national standards bodies and 3 368 technical bodies. Through its members, it brings together experts to share knowledge and develop voluntary, consensus-based, market relevant international standards that support innovation and provide solutions to global challenges.

The ISO 14000 family of standards are listed in Table 2-1 below according to the Plan-Do-Check-Act model.

Table 2-1: The ISO 14000 family standards related to environmental management

Plan	Do	Check	Act
Environmental management system implementation	Conduct life cycle assessment and manage environmental aspects	Conduct audits and evaluate environmental performance	Communicate and use environmental declarations and claims
ISO 14050:2009 Environmental management – Vocabulary	ISO 14040:2006 Environmental management – Life cycle assessment – Principles and framework	ISO 14015:2001 Environmental management – Environmental assessment of sites and organizations (EASO)	ISO 14020:2000 Environmental labels and declarations – General principles
ISO 14001:2004 Environmental management systems – Requirements with guidance for use	ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines	ISO 14031:1999 Environmental management – Environmental performance evaluation – Guidelines	ISO 14021:1999 Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling)
ISO 14004:2004 Environmental management systems – General guidelines on principles, systems and support techniques	ISO/TR 14047:2003 Environmental management – Life cycle impact assessment – Examples of application of ISO 14042	ISO 19011:2002 Guidelines for quality and/or environmental management systems auditing	ISO 14024:1999 Environmental labels and declarations – Type I environmental labelling – Principles and procedures

Plan	Do	Check	Act
<p>ISO/DIS 14005 Environmental management systems – Guidelines for the phased implementation of an environmental management system, including the use of environmental performance evaluation</p>	<p>ISO/TS 14048:2002 Environmental management – Life cycle assessment – Data documentation format</p>		<p>ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and procedures</p>
			<p>ISO/AWI 14033 Environmental management – Quantitative environmental information – Guidelines and examples</p>
<p>Address environmental aspects in products and product standards</p>		<p>Evaluate greenhouse gas performance</p>	
<p>ISO Guide 64:2008 Guide for addressing environmental issues in product standards</p>	<p>ISO/TR 14049:2000 Environmental management – Life cycle assessment – Examples of application of ISO 14041 to goal and scope definition and inventory analysis.</p>	<p>ISO 14064-3:2006 Greenhouse gases – Part 3 : Specification with guidance for the validation and verification of greenhouse gas assertions</p>	<p>ISO 14063:2006 Environmental management – Environmental communication – Guidelines and examples</p>

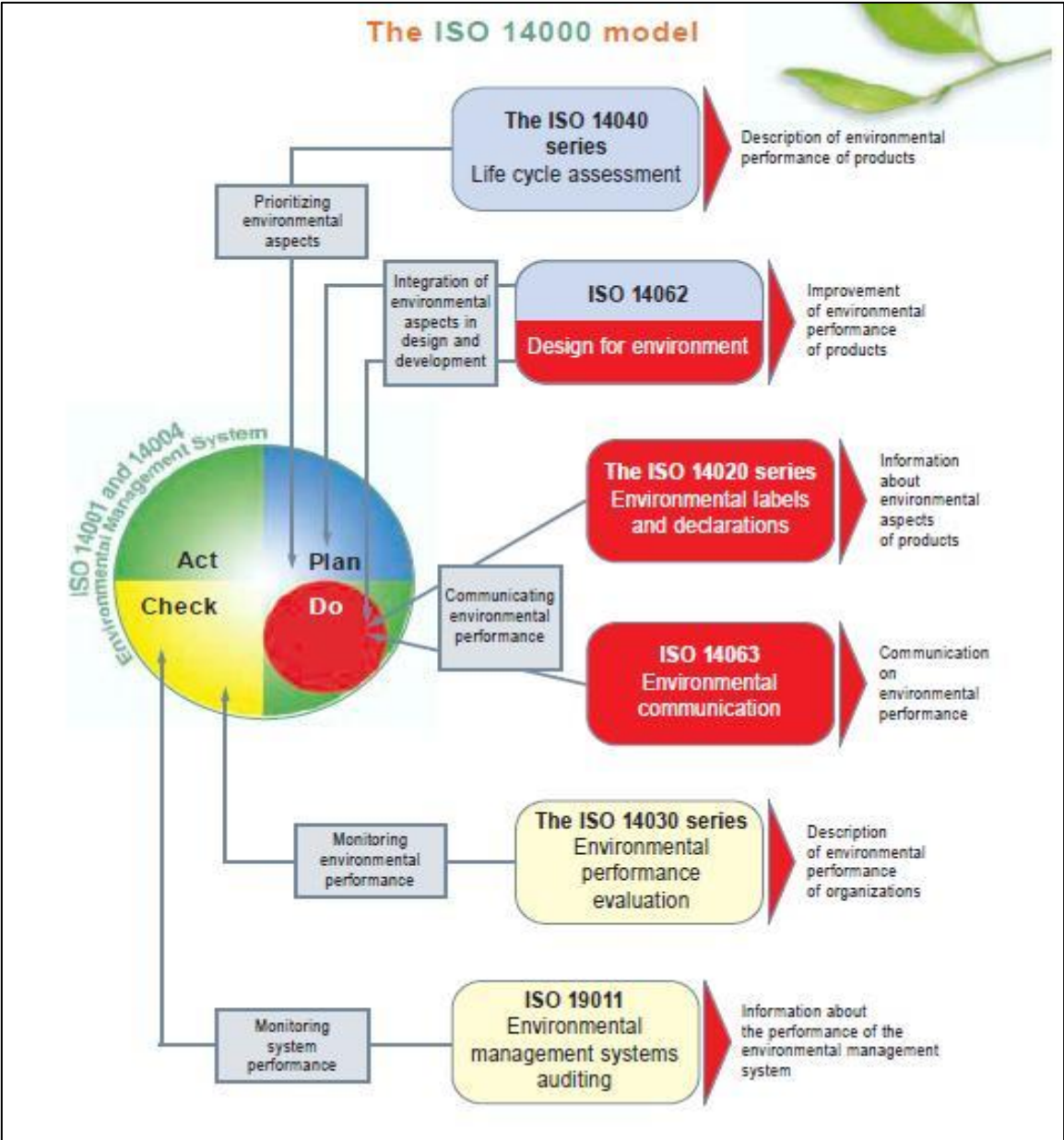
Plan	Do	Check	Act
ISO/CD 14006 Environmental management systems – Guidelines on ecodesign	ISO/CD 14051 Environmental management – Material flow cost accounting – General principles and framework	ISO 14065:2007 Greenhouse gases – Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition	
	ISO/WD 14045 Eco-efficiency assessment – Principles and requirements		
	Manage greenhouse gases		
ISO/TR 14062:2002 Environmental management – Integrating environmental aspects into product design and development	ISO 14064-1:2006 Greenhouse gases – Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals	ISO/CD 14066 Greenhouse gases – Competency requirements for greenhouse gas validators and verifiers document	
	ISO 14064-2:2006 Greenhouse gases – Part 2 : Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements		

Plan	Do	Check	Act
	ISO/WD 14067-1 Carbon footprint of products – Part 1: Quantification		
	ISO/WD 14067-2 Carbon footprint of products – Part 2: Communication		
	ISO/AWI 14069 GHG – Quantification and reporting of GHG emissions for organizations (Carbon footprint of organization) – Guidance for the application of ISO 14064-1		

Source: (International Organization for Standardization, 2009)

The relationship between the ISO 14000 family of standards and an Environmental Management System is demonstrated in Figure 2-6 below.

Figure 2-5: The International Organisation for Standardization 14000 Model



Source: (ISO, 2016)

2.5 Environmental management accounting

Financial accounting is based on historic information and the emphasis is on verifiability and precision. In financial accounting the focus is on the whole organisation and it must follow prescribed formats, such as those set by the International Accounting Standards Board. Cost or Management accounting provides information for managers of an organisation who direct and control its operations. Cost accounting has a future focus and is relevant for planning and control. In financial accounting the information needs to be precise while with cost accounting it needs to be timely. Cost accounting focuses on segments of the organisation and does not need to follow a prescribed format (Seal, Garrison, & Noreen, 2012).

Environmental Management Accounting (EMA) is Management Accounting with focus on environmental issues, such as physical information on the flow of energy, water, products and materials, as well as monetary information such as cost of waste, cost of environmental projects, and material cost of product outputs. According to Seal et al. (2012) environmental management accounting may be defined as the identification, collection and analysis of physical and monetary information. Both monetary and physical environmental accounting information should be used by industry to be sustainable. According to Ambe (2007), Environmental Management Accounting is closely related to process costing and activity-based costing, as well as to environmental performance and management systems.

Environmental management accounting generates useful information that can be used for external reporting and internal decision making. A common problem with environmental management accounting is the non-standardisation of environmental costs. What should be included and what should be excluded as environmental costs depends on the interest of the person answering the question. In addition, these costs are not allocated to a specific product but simply allocated to an overhead account (United Nations, 2001). According to the United Nations Division for Sustainable Development (2001), Environmental Management Accounting incorporates monetary and physical data of four areas namely, corporate, product, business application and national application. Figure 2-6 below visually demonstrates Environmental Management Accounting according to the United Nations and also provides examples of tools that can be used to collect data.

Figure 2-6: Environmental Management Accounting according to United Nations Division for Sustainable Development

Accounting in Monetary Units		Accounting in Physical Units	
Conventional Accounting	Environmental Management Accounting		Other Assessment Tools
	MEMA Monetary EMA	PEMA Physical EMA	
DATA ON THE CORPORATE LEVEL			
Conventional bookkeeping	Transition of environmental part from bookkeeping and cost accounting	Material flow balances on the corporate level for mass, energy and water flows	Production planning systems, stock accounting systems
DATA ON THE PROCESS/COST CENTRE AND PRODUCT/COST CARRIER LEVELS			
Cost accounting	Activity based material flow cost accounting	Material flow balances on the process and product levels	Other environmental assessments, measures and evaluation tools
BUSINESS APPLICATION			
Internal use for statistics, indicators, calculating savings, budgeting and investment appraisal	Internal use for statistics, indicators, calculating savings, budgeting and investment appraisal of environmental costs	Internal use for environmental management systems and performance evaluation, benchmarking	Other internal use for cleaner production projects and ecodesign
External financial reporting	External disclosure of environmental expenditures, investments and liabilities	External reporting (EMA-statement, corporate environmental report, sustainability report)	Other external reporting to statistical agencies, local governments, etc.
NATIONAL APPLICATION			
National income accounting by statistical agency	National accounting on investments and annual environmental costs of industry, externalities costing	National resource accounting (material flow balances for countries, regions and sectors)	

Source: (United Nations, 2001, p. 10)

In 2002 Burritt, Hahn and Schaltegger developed a framework for environmental management accounting. The framework linked business actions and environmental management accounting tools. Figure 2-7 below provides a structure for managers to understand and assess the variety of environmental management accounting tools that they have developed over time in order to encourage the adoption of environmental management accounting.

Figure 2-7: A framework for environmental management accounting

		Environmental Management Accounting (EMA)			
		Monetary Environmental Management Accounting (MEMA)		Physical Environmental Management Accounting (PEMA)	
		Short Term Focus	Long Term Focus	Short Term Focus	Long Term Focus
Past Oriented	Routinely generated information	Environmental cost accounting (e.g. variable costing, absorption costing, and activity based costing)	Environmentally included capital expenditure and revenues	Material and energy flow accounting (short term impacts on the environment - product, site, division and company levels)	Environmental (or natural) capital impact accounting
	Ad hoc information	Ex post assessment of relevant environmental costing decisions	Environmental life cycle (and target) costing Post investment assessment of individual projects	Ex post assessment of short term environmental impacts (e.g. of a site or product)	Life cycle inventories Post investment assessment of physical environmental investment appraisal
Future Oriented	Routinely generated information	Monetary environmental operational budgeting (flows) Monetary environmental capital budgeting (stocks)	Environmental long term financial planning	Physical environmental budgeting (flows and stocks) (e.g. material and energy flow activity based budgeting)	Long term physical environmental planning
	Ad hoc information	Relevant environmental costing (e.g. special orders, product mix with capacity constraint)	Monetary environmental project investment appraisal Environmental life cycle budgeting and target pricing	Relevant environmental impacts (e.g. given short run constraints on activities)	Physical environmental investment appraisal Life cycle analysis of specific project

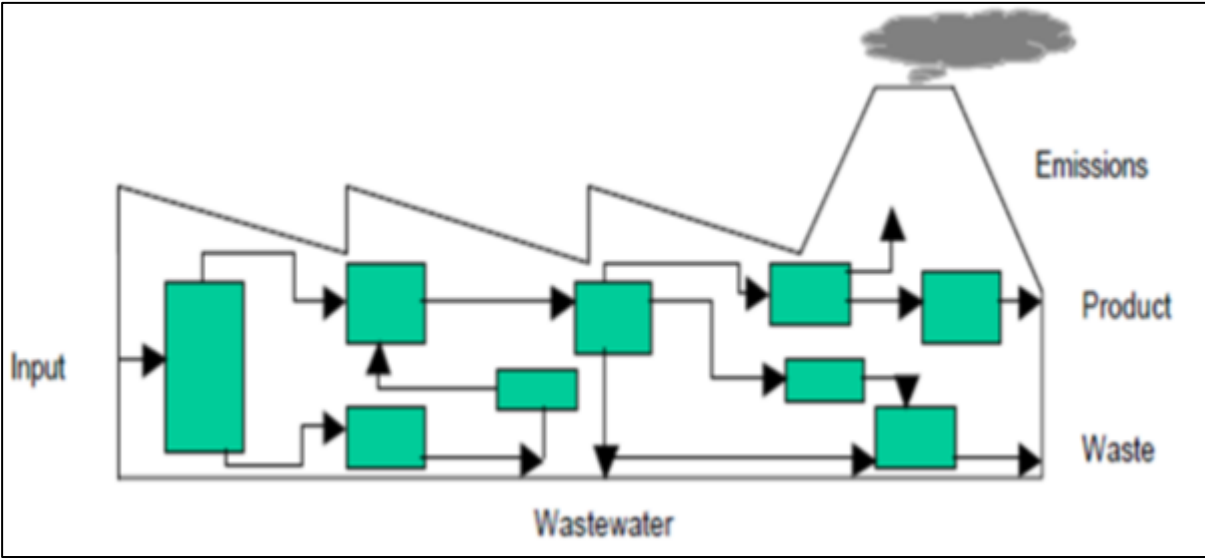
Source: (Burritt, Hahn, & Schaltegger, 2002)

The framework integrates methodically two important modules of environmental management accounting, namely physical and monetary environmental management accounting.

2.5.1 Physical environmental management accounting

Physical environmental management accounting (PEMA) is the measurement and recording of actual unit inputs of materials, energy and water, and the outputs of waste, products and emissions, generated during the manufacturing of valuable products. This information should be used for internal decision making. The boundaries for these inflows and outflows can be set on any level, from unit facility to organisation wide to nationwide (see Figure 2-8).

Figure 2-8: Boundary limits set on a facility of a manufacturing organisation



Sources: (United Nations, 2001)

Table 2-2 below gives a list of some common inputs, system boundaries and outputs involved in physical accounting system.

Table 2-2: Inputs, system boundaries and outputs for material flow balances

Input	System boundaries	Output
Raw and auxiliary materials - input materials that become part of an organisation's final product or by-product	Nations	Product - any tangible products created by the organisation.
Packaging materials - input materials intended for use in shipping the organisation's final products.	Regions	By-products - minor products incidentally produced during the manufacture of the primary product.
Merchandise - items that are then directly sold again as products with little or no additional processing.	Corporations	Air emissions - air streams that are contaminated with problematic levels of pollutants.
Operating materials - input materials that are purchased and used by the organisation, but which do not become part of any tangible product delivered to a customer.	Processes	Waste water - streams whose primary component is water, but which also contain contaminants of some kind.
Energy: - includes all energy used by an organisation, of all types, e.g. electricity, gas, coal, fuel oil, district heating and cooling, biomass, solar, wind, and water.	Products	Hazardous waste - hazardous waste material in solid form, liquid form or mixed form.

Input	System boundaries	Output
Water - includes all water used by an organisation, from all sources.		Solid waste - relatively non-hazardous waste in solid form, such as waste paper, plastic containers, food waste, non-hazardous solid scrap products.

Sources: (United Nations, 2001)

This section discussed an overview of physical information on environmental management accounting while the next section gives an overview of monetary information on environmental management accounting.

2.5.2 Monetary environmental management accounting

Monetary environmental management accounting (MEMA) is a subsystem of environmental management accounting that deals with the financial impacts of environmental performance (Savage & Jasch, 2005). Monetary environmental information provides management with the ability to perform a better evaluation of financial aspects of products. According to Ambe (2007), organisations define costs related to environmental issues differently depending on the required use of the information, the organisations economic and environmental targets, to name a few. Prior to 2000 the most widely used sets of definitions and process for allocating environmental costs were from the United States Environmental Protection Agency and the Japan Ministry of the Environment. Currently the most recognised sets of definitions and processes for allocating environmental costs is the United Nations procedure and principle document on Environmental Management Accounting (United Nations, 2001). Most Governments and Non-governmental organisations have used this United Nations procedure and principle document as a base for their own process. Environmental cost categories are a part of monetary environmental management accounting. Savage and Jasch (2005), gives some examples of environmental related cost categories:

- **Materials Costs of Product Outputs**

Includes the purchase costs of natural resources such as water and other materials that are converted into products and packaging

- **Materials Costs of Non-Product Outputs**

Includes the purchase (and sometimes processing) costs of energy, water and other materials that become Non-Product Output (Waste and Emissions)

- **Waste and Emission Control Costs**

Includes costs for: handling, treatment and disposal of waste and emissions; remediation and compensation costs related to environmental damage; and any control related regulatory compliance costs.

- **Prevention and Other Environmental Management Costs**

Includes the costs of preventative environmental management activities such as cleaner production projects. Also includes costs for other environmental management activities such as environmental planning and systems, environmental measurement, environmental communication and any other relevant activities.

- **Research and development cost**

Includes the costs for Research and Development projects related to environmental issues.

- **Less Tangible Costs**

Includes both internal and external costs related to less tangible issues. Examples include liability, future regulations, productivity, company image, stakeholder relations and externalities.

Monetary environmental information and physical accounting data can be combined and used as environmental performance indicators known as eco-efficient indicators that can be used to reduce cost and increase profits in an organisation.

2.5.3 Cost distribution and allocation

In some countries the Government Environmental Departments require that environmental related costs be reported by environmental domain. Environmental domain is a method of listing environmental issues under common themes, such as air/climate, wastewater, waste, soil/groundwater, noise/vibration, biodiversity/landscape and radiation. The distribution of costs related to the environment by environmental domain can illustrate results and trends that can be used for internal management purposes. Table 2-3 below is the United Nations summary of environmental expenditure/costs and revenue/earnings by environmental domain.

Table 2-3: Environmental expenditure/costs and revenue/earnings

Environmental media	Air / Climate	Wastewater	Waste	Soil /Groundwater	Noise /Vibration	Biodiversity / Landscape	Radiation	Other	Total
Environmental cost/expenditure categories									
1. Waste and emission treatment									
1.1. Depreciation for related equipment									
1.2. Maintenance and operating materials and services									
1.3. Related personnel									
1.4. Fees, taxes, charges									
1.5. Fines and penalties									
1.6. Insurance for environmental liabilities									
1.7. Provisions for clean-up costs, remediation									
2. Prevention and environmental management									
2.1. External services for environmental management									
2.2. Personnel for general environmental management activities									
2.3. Research and development									
2.4. Extra expenditure for cleaner technologies									
2.5. Other environmental management costs									
3. Material purchase value of nonproduction output									
3.1. Raw materials									
3.2. Packaging									
3.3. Auxiliary materials									
3.4. Operating materials									
3.5. Energy									
3.6. Water									
4. Processing costs of non-product output									
Σ Environmental expenditure									
5. Environmental revenues									
5.1. Subsidies, awards									
5.2. Other earnings									
Σ Environmental revenues									

Source: (United Nations, 2001)

According to Savage & Jasch (2005), environmental-related cost information is often hidden in overhead accounts. They further discuss several examples where potentially important environmental related costs are being accidentally hidden in the accounting records. Allocating these hidden costs to overheads is most probably also not the solution as it can skew process and pricing costs. Managers who would benefit from this hidden data cannot find it easily.

2.5.4 Environmental Law and Regulations

Environmental governance has been the subject of numerous studies and the concept is now firmly established in local and international law (Feris, 2010). Section 24 of the Constitution of the Republic of South Africa, 1996 states:

Everyone has the right-

- (a) to an environment that is not harmful to their health or well-being; and
- (b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that-
 - i. prevent pollution and ecological degradation;
 - ii. promote conservation; and
 - iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

This clearly states that everyone has the right to an environment that is not harmful to their health or well-being and that the environment needs to be protected for the benefit of present and future generation through reasonable legislative measures. The National Environmental Management Act 107 of 1998 (NEMA) gives effect to section 24 of the Constitution. Other South African environmental legislative include:

- Environmental Conservation Act (No.73 of 1989)
- National Water Act (No.36 of 1998)
- Atmospheric Pollution Prevention Act (No.45 of 1965) (APPA)
- National Environmental Management: Air Quality Act (No.39

In 2008 the South African Cabinet approved the National Framework for Sustainable Development and in 2011 approved the National Strategy for Sustainable Development and Action Plan. According to Kotzee (2014), five important strategic objectives were identified during this process:

- (1) Enhancing systems for integrated planning and implementation;
- (2) Sustaining our ecosystem and using natural resources efficiently;
- (3) Growing towards a green economy;
- (4) Building sustainable communities; and
- (5) Responding effectively to climate change.

South Africa has adopted first-world principles in its environmental law and introduced regulations to promote environmental management. According to Diemont et al. (Environmental Law, 2012) while environmental management in South Africa is highly regulated the enforcement of environmental prohibitions have been largely inconsistent.

2.5.5 Benefits of Environmental Management Accounting

Environmental Management Accounting (EMA) assists organisations to monitor and manage its physical and associated monetary resources more effectively. It also allows the organisation to identify opportunities for cost savings, efficiency improvements and better decision making based on reliable and accurate information thereby giving the organisation strategic advantages. According to Ambe (2007), some of the benefits of EMA include:

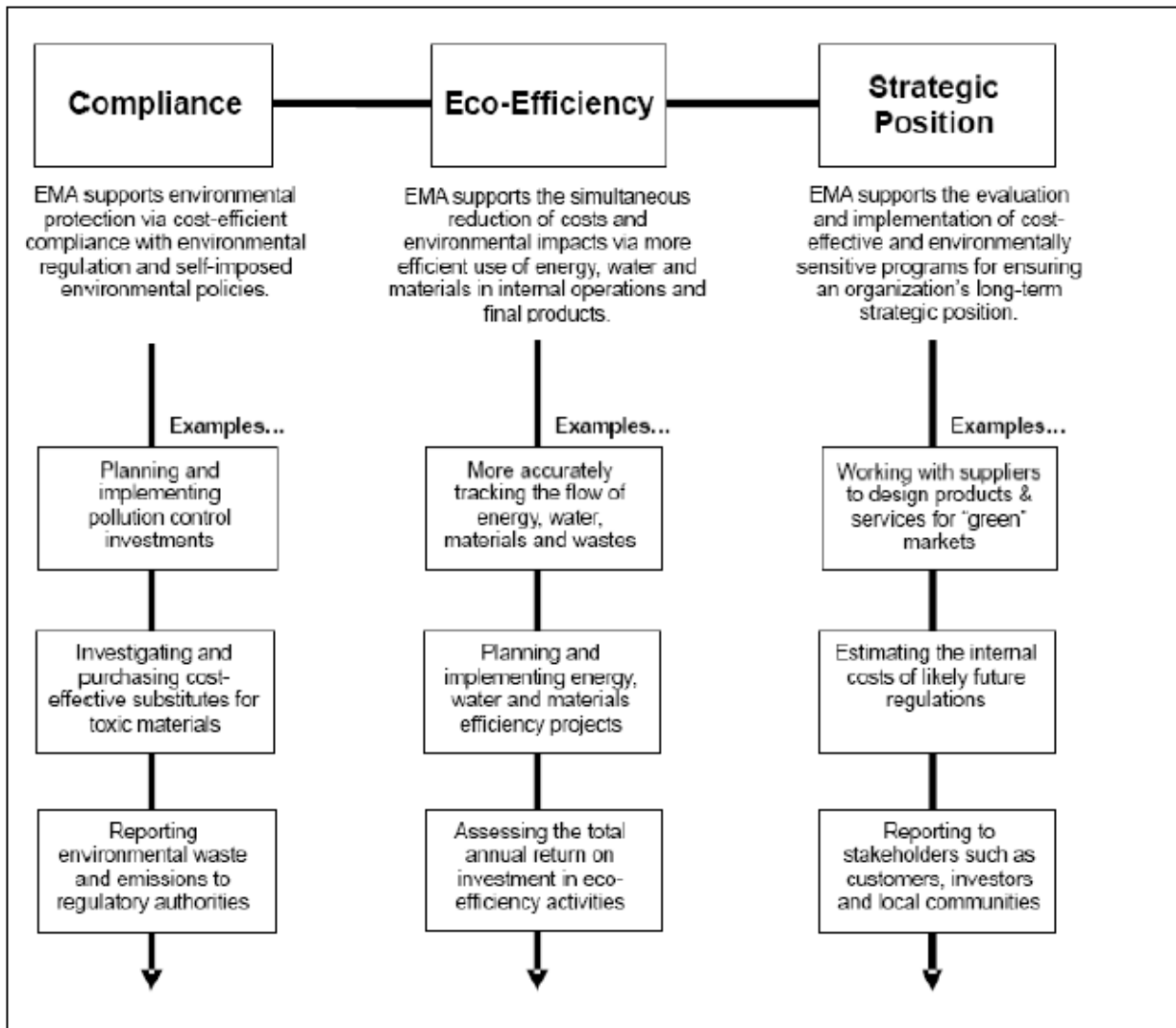
- More complete and precise information to support the establishment of cost-effective programmes to improve environmental performance.
- The capability to monitor and manage the consumption and flow of energy and materials more accurately.
- More complete and precise information for the measuring and reporting of environmental performance, thus improving the company image with stakeholders.
- The capabilities to identify, estimate, allocate and manage/reduce environmental types of costs more accurately.

- The more industry can justify environmental programmes on the basis of financial self-interest, the lower the financial, political, and other burdens of environmental protection on government.
- Implementation of EMA by industry should strengthen the effectiveness of existing government policies/regulations by revealing to companies the true environmental costs and benefits resulting from those policies/regulations.
- Government can use industry's EMA data to estimate and report on financial and environmental performance matrices for government stakeholders, such as regulated industries or the industry partners in voluntary programmes.
- Industry's EMA data can be used to inform government programme/policy design.
- Government can use industry's EMA data to develop matrices for reporting the financial and environmental benefits of voluntary partnership programmes with industry, innovative approaches to environmental protection, and other government programmes and policies.
- Industry's EMA data can be used for accounting purposes at regional or national level.
- Government's EMA data can be used for environmental and other decisions in government operations, e.g. purchasing, capital budgeting, and federal/provincial facility environmental management systems.
- Government's EMA data can be used to estimate and report financial and environmental performance matrices for government operations.
- To enable the more efficient and cost-effective use of natural resources, including energy and water.
- To enable the cost-effective reduction of pollutant emissions.
- To reduce the external societal costs related to industry pollution, such as the costs of environmental monitoring, control and remediation, as well as public health costs.
- To provide improved information for improved public policy decision making.
- To provide industrial environmental performance information that can be used in the broader context of the evaluation of environmental performance and conditions in economies and geographic regions.

Figure 2-9 below gives some uses and benefits of Environmental Management Accounting according to the German Environmental Ministry. They give examples of some of the benefits related to compliance, eco-efficiency and strategic position. Some benefits of EMA listed by the German Environmental Ministry include:

- Supports environmental protection via cost-efficient compliance with environmental regulation and self-imposed environmental policies.
- Supports the simultaneous reduction of costs and environmental impacts via more efficient use of energy, water and materials in internal operations and final products.
- Supports the evaluation and implementation of cost-effective and environmentally sensitive programmes for ensuring an organisation is long-term strategically positioned.

Figure 2-9: Uses and benefits of environmental management accounting



Source: (German Environmental Ministry, 2003)

2.5.6 Challenges to Environmental management accounting

Many limitations of conventional management accounting systems and practices can make it difficult to effectively collect and evaluate environmental related data. These limitations can

easily lead to inaccurate decision making by management, based on missing, inaccurate and/or misinterpreted information (Ambe, 2007). As a result, these can have negative financial consequences on the company and environmental performance will reflect poorly.

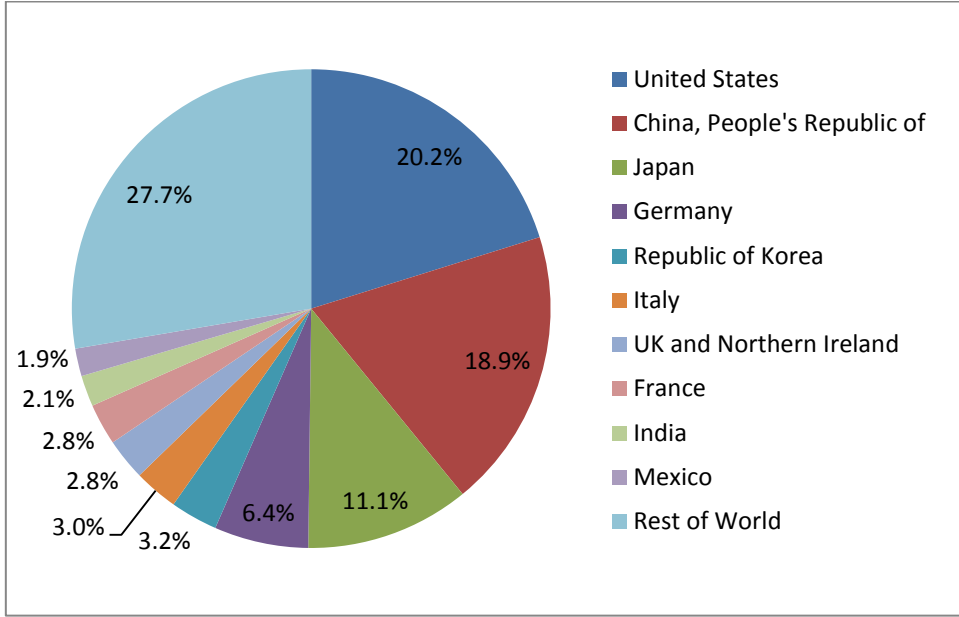
Savage and Jasch (2005) have documented some environmental management accounting challenges that may be experienced in an organisation:

- Communication between accounting and other departments are often not well developed. Frequently accounting personnel are withholding accounting information that can be useful for environmental and technical personnel.
- Environmental costs are not correctly allocated from overhead accounts back to processes, products and process lines
- The communication between accounting and other departments is poor
- Environment related cost information is not found in the accounting record
- Investment decisions are made on information that is incomplete
- Volumes are inaccurate for wasted raw materials and costs will then also be inaccurate.

2.6 Manufacturing industry in South Africa

According to Friedman (2006), the service sector tends to be wealth consuming while manufacturing is a wealth creating sector in the economy. The top 10 countries in the world manufacture 72.3% of the world's manufacturing goods (Small Enterprise Development Agency, 2012). Figure 2-10 below indicates the split of the world's manufacturing with focus on the top 10 manufacturing countries.

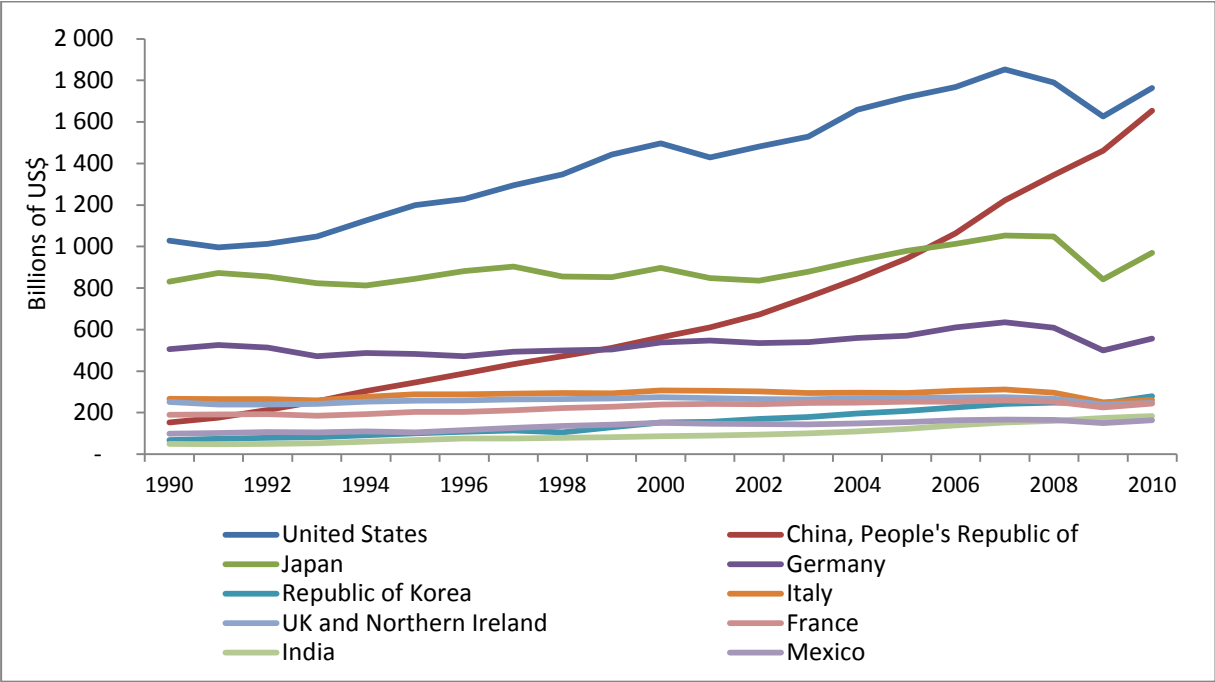
Figure 2-10: Share of Worlds manufacturing for the top 10 manufacturing economies in 2010 (Small Enterprise Development Agency, 2012)



Source: United Nations

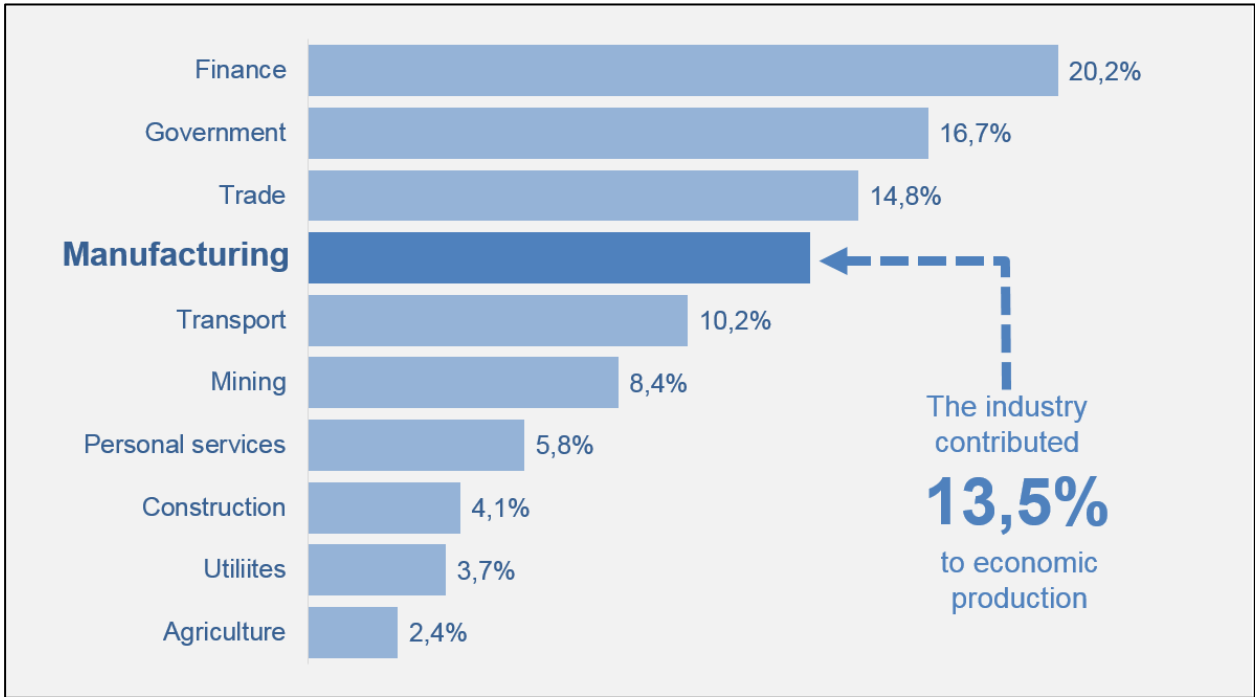
Figure 2-11 shows manufacturing output trend between 1990 and 2010 for the top ten manufacturing countries. South African manufacturing output has increased in dollar terms from \$30 billion in 1990 to \$44 billion in 2010. South African share of world manufacturing output has decreased from 0.61% in 1990 to 0.5% in 2010 which highlights the need for domestic policy to improve the domestic economy and manufacturing output (Small Enterprise Development Agency, 2012).

Figure 2-11: Trend in manufacturing output in the top 10 manufacturing countries (1990 - 2010) (Small Enterprise Development Agency, 2012)



Source: United Nations

Figure 2-12: South Africa’s economic activity contribution for 2014 (Statistics South Africa, 2014)



Source: Statistics South Africa

South Africa is considered to be the most industrialized country on the African continent (SouthAfrica.info, 2016). Since the end of apartheid and the lifting of international sanctions, economic growth has been strong and major reforms have been implemented. South Africa has a well-developed, established and diversified manufacturing base that has shown its resilience and potential to compete in the global economy. South Africa’s manufacturing sector presents an opportunity to significantly accelerate the country's growth and development plans. The South African manufacturing sector contributed 13,5% to the country’s economic production in 2014 (Figure 2-12 above). South Africa’s manufacturing sector is dominated by the following industries (SouthAfrica.info, 2016):

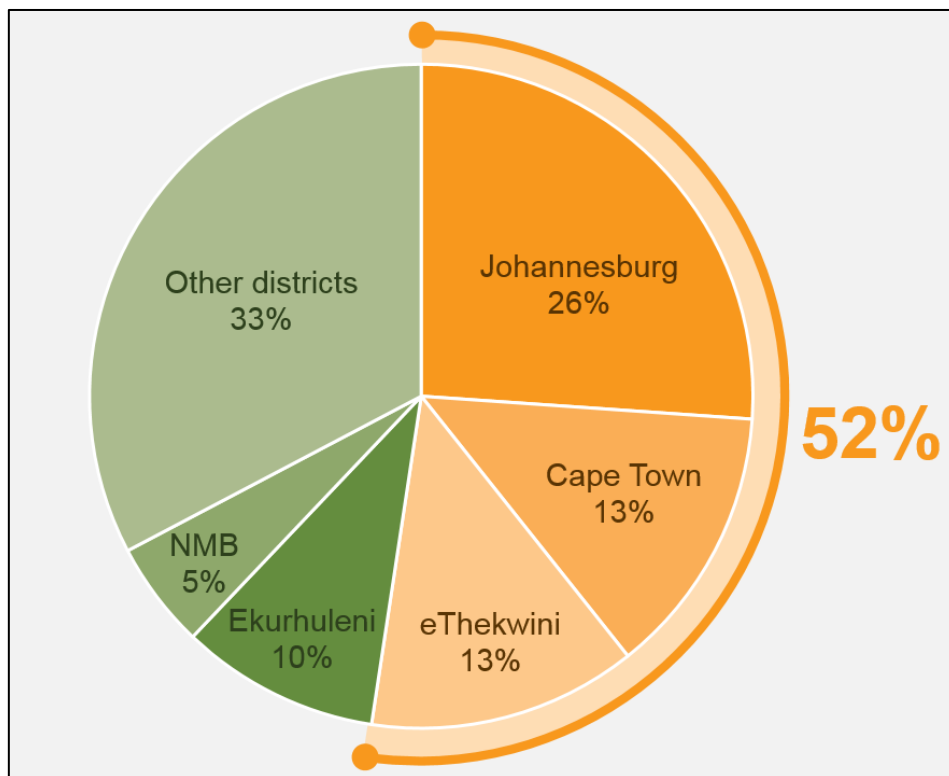
- Automotive - The automotive industry is one of South Africa's most important sectors, with many of the major multinationals using South Africa to source components and assemble vehicles for both the local and international markets. Vehicle manufacturers such as BMW, Ford, Volkswagen, Daimler-Chrysler and Toyota have production plants in the country.
- Chemicals - The South African upstream chemical sector is concentrated and well developed while the downstream sector is diverse but remains underdeveloped. The synthetic coal and natural gas-based liquid fuels and petrochemicals industry is

prominent with South Africa being recognised as a world leader in coal-based synthesis and gas-to-liquids (GTL) technologies. The primary and secondary sectors are dominated by Sasol, AECI and Dow Sentrachem.

- ICT and electronics - The South African information technology industry growth outstrips the world average. The country's communications technology and electronics sector comprises more than 3 000 companies and was ranked 22nd in 2001 in terms of total worldwide IT spend.
- Metals - South Africa's large, well-developed metals industry, with vast natural resources and a supportive infrastructure. It comprises basic iron ore and steel, basic non-ferrous metals and metal products.

Over half of the SA's manufacturing workforce is located in three metros, namely eThekweni, Cape Town and Johannesburg (Figure 2-13 below). On a provincial level 44% manufacturing employees live in Gauteng, 19% in Kwazulu Natal and 19% in the Western Cape.

Figure 2-13: South Africa's percentage of employees by district



Source: Statistics South Africa

2.7 Chapter summary

Organisations need to take social and environmental factors into account when making business decisions to ensure profitability and long-term sustainability. Environmental management accounting generates useful information that can be used for external reporting and internal decision making. Environmental management accounting focuses on identification, collection, analysis and reporting of physical information, such as material and energy flow, as well as monetary information including environmental costs, raw material cost and other related cost.

The literature review has demonstrated the progress thus far towards sustainable development and environmental management accounting principles and policies. This chapter also provided a detail discussion on environmental management accounting, including both physical and monetary environmental management accounting, cost distribution and allocation, environmental laws and regulation in South Africa, potential benefits and challenges of environmental management accounting. This study focused on a manufacturing company in South Africa therefore an overview of the manufacturing industry in South Africa was also discussed.

The literature review is followed by an empirical study. In the empirical study the research design and the development of the questionnaire is discussed. Data collected from the questionnaire is analysed statistically to evaluate the awareness of environmental management accounting in the South African manufacturing company.

CHAPTER 3: EMPIRICAL INVESTIGATION AND RESULTS

3.1 Introduction

This chapter outlines the methodology that was used to conduct the research study and discusses the results obtained. The research study was conducted on a manufacturing organisation in South Africa. The company's name has been omitted from the study due to legal concerns. The objective of this study was to evaluate the extent to which environmental management accounting is applied at the selected organisation. A questionnaire was used to assess this objective. The questionnaire had five themes namely, organisational characteristics, environmental management, physical environmental management accounting, monetary environmental management accounting and environmental cost allocation. The chapter begins with an explanation of the empirical investigation and data analysis methods followed. This is followed by a detail discussion on the results obtained for the five themes investigated to evaluate the extent to which environmental management accounting is applied. The last section gives an overview of the chapter.

3.2 Empirical investigation

This study was conducted on a manufacturing organisation in South Africa. The organisations name has been omitted from this study due to legal concerns. A questionnaire was used to gather the required information. An email explaining the reason for the study and containing a link to the questionnaire was distributed to all personnel within the organisation. The questionnaires were completed using the Goggle survey platform, on which the survey questionnaire was designed.

The questionnaire was designed to evaluate the awareness and degree of implementation regarding environmental management accounting at the said organisation. The questionnaire was divided into five sections, specifically organisational characteristics, environmental management matters, physical and monetary information on environmental management accounting, and environmental cost allocation.

Section 1 focused on the organisational characteristics of the manufacturing organisations. It included the geographical area, the departmental or functional area, level within the

organisation and age demographic of the respondents. The organisation is divided into three geographical areas, one based in KwaZulu-Natal and two in Gauteng. Departmental or functional areas are divided into operational, financial, safety, health and environmental (SHE), supply chain, technical, and other. A respondent's level within the organisation is categorised as executive management, senior management, middle management, first line management, senior specialist/foremen or specialist/staff.

Section 2 evaluates the extent to which environmental management practices are applied in the organisation. The objective of this section is to establish and evaluate the existence of an environmental policy, ISO 14001 system, compliance to regulation and industry standards, Sustainable Development requirements and the Responsible Care initiative. Drivers for an environmental management system in any organisation include compliance with national regulation, certification of international standard and good practices, and corporate citizenship.

Section 3 evaluates the organisations ability to generate and record data for physical environmental management accounting. Physical environmental management accounting information includes raw, packaging and operating materials used in the process; water and energy consumed in the process; products, by-products, solid and hazardous wastes, waste water and air emissions generated as a result of the production process. Evaluation of this information can give an assessment of the organisations ability to use it in daily operations and of the level of disclosure in their annual reporting. A 5-point Likert-type-scale was used to determine the level at which the organisation generates and records physical environmental management accounting information.

Section 4 of the questionnaire addresses monetary environmental management accounting information. Monetary environmental management accounting information includes the cost of material inputs, the material costs of non-product outputs, waste and emission costs, preventative and other environmental management costs, research and development costs, environmental operating expenditure, and environmental capital expenditure. A 5-point Likert-type-scale was used to determine the level at which the organisation generates and record monetary environmental management accounting information.

Section 5 of the questionnaire addresses the allocation of environmental costs.

A 5-point Likert-type-scale, ranging from (1) to (5), where (1) is extremely low, (2) is low, (3) is medium, (4) is high and (5) extremely high, was used to assess the level of disclosures of general environmental matters and of physical and monetary environmental management accounting information.

3.3 Data analysis

A quantitative research approach was followed in evaluating the data. The data was collected using the Goggle survey platform. The research targeted a sample size of 261 and observed a response rate of 41%. The data was then analysed using statistical analysis methods with the guidance of the Statistical Consultation Services of North-West University. Statistical analyses conducted include frequency analysis, crosstab analysis, chi-square test and symmetric measure analysis.

A frequency distribution tallies the values of a numerical variable into a set of numerically ordered classes. Each class groups a mutually exclusive range of values, called a class interval. The class midpoints are the values that are halfway between the lower and upper boundaries of each class. A relative frequency distribution presents the relative frequency, or proportion, of the total for each group that each class represents. A percentage distribution presents the percentage of the total for each group that each class represents (Levine, Stephan, & Szabat, 2013). A crosstab analysis indicates the relationship between two or more survey questions. It provides a side-by-side comparison indicating how different groups of respondents answered the survey questions. The chi-square test for independence, also called Pearson's chi-square test or the chi-square test of association, is used to discover if there is a relationship between two categorical variables (Laerd Statistics, 2016). Symmetric measure analysis: Phi and Cramer's V are both tests of the strength of association.

3.3.1 Organisational characteristics

3.3.1.1 Objective

The objective of section 1 was to understand the differences that may exist in the organisation related to the perceptions and practices of environmental management accounting. An

employee's perceptions and practices could be influenced by geographical location, department or functional area, level within the organisation and age of the employee. The organisation is divided into three geographical areas, one based in KwaZulu-Natal and two in Gauteng. Departmental or functional areas are divided into operational, financial, SHE, supply chain, technical, and other. A respondent's level within the organisation is categorised as executive management, senior management, middle management, first line management, senior specialist/foremen or specialist/staff.

Operations personnel are responsible for managing and controlling the production unit. They are the people that ensure the production unit is being operated efficiently and that all waste streams are controlled and accounted for at various levels in the production process. Financial practitioners are mainly concerned with the flow of money. They are employees that should apply conventional financial mechanisms to environmental management data that is usually recorded by operations or technical personnel. Environmental management is a known concept to most SHE personnel because they are the employees that usually collect and record environmentally related information to ensure compliance to the environmental management system. Supply chain, technical and other personnel may have an idea of the concept of environmental management accounting. Their daily jobs should involve some flow of information that is recorded and used in environmental management accounting by the operations, financial and SHE personnel.

Personnel at different levels within the organisation are exposed to different levels of environmental management information. The employees on the lower levels, namely work force and first line management, may not be aware of the concept of environmental management accounting but they record information and control processes that are central to environmental management. Employees on the specialist and middle management levels should have the most knowledge of environmental management as they are the employees that use physical and monetary environmental information and convert it into usable graphs and reports for higher management. Senior and executive management use these graphs and reports in their short, medium and long term planning.

Environmental requirements have changed in recent history therefore employee's perception of environmental management may be affected by their age. One would expect employees that are between 20 and 40 years to be more knowledgeable due to recent developments to

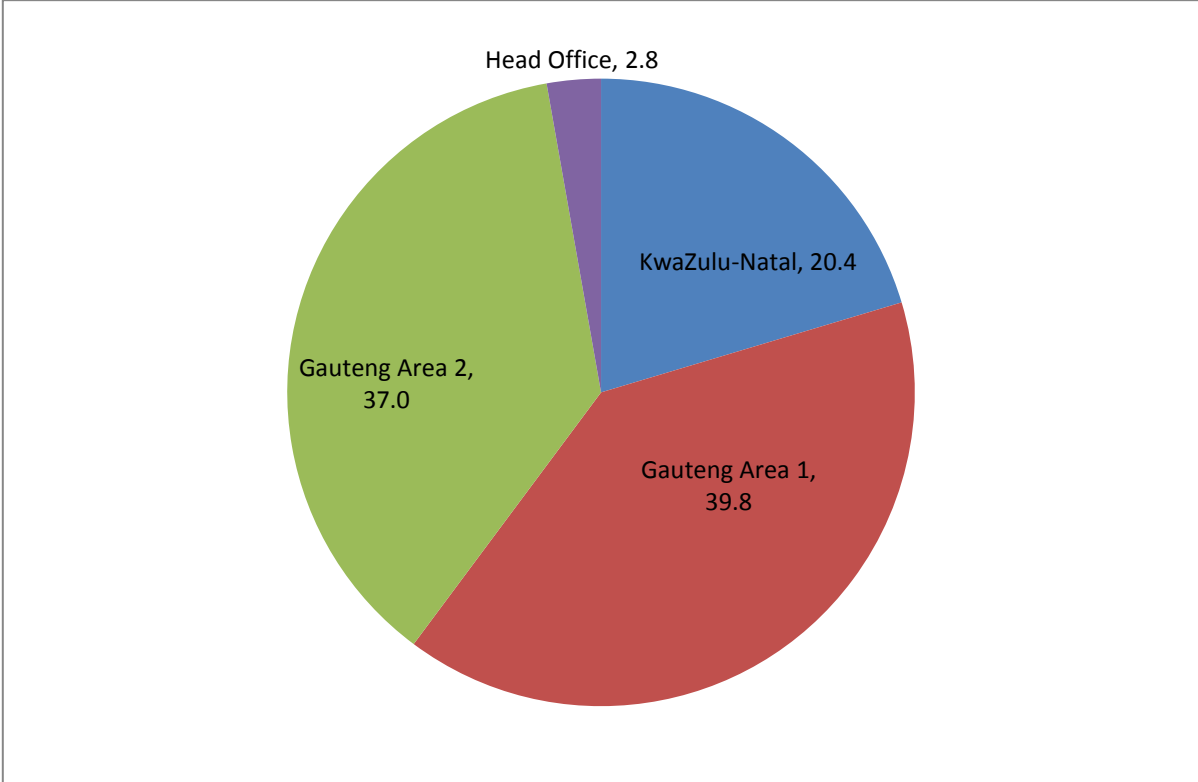
environmental management requirements, while their colleagues that are 40 years and older to have lesser knowledge regarding recent environmental management developments. The exception to this would be in an organisation where environmental management changes are well communicated within the organisation or where the person works in an environmental management area.

3.3.1.2 Results

3.3.1.2.1 Geographical location

The largest percentage of the respondents were from Gauteng area 1 with 39,8%. Figure 3-1 presents the distribution of the respondents across the manufacturing organisation with Gauteng area 2 representing the second largest value with 37%, Kwa-Zulu Natal 20,4% and head office 2,8% of the respondents. These values are representative of the distribution of employees across the organisation.

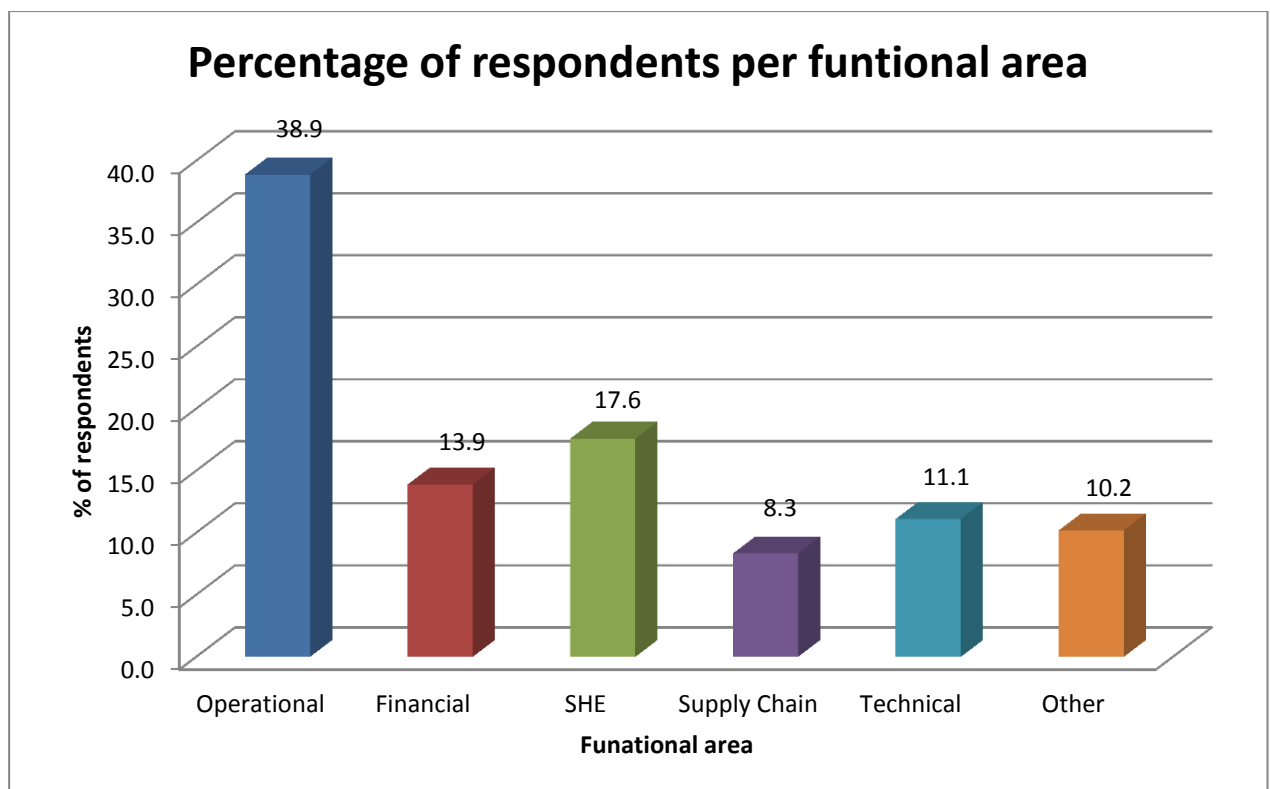
Figure 3-1: Percentage of respondents for each geographical area within the organisation.



3.3.1.2.2 Department or functional area demographic

Figure 3-2 indicates the percentage distribution of respondents within the manufacturing organisation. The largest percentage of respondents was from operations with 38,9%. Similarly, with many manufacturing organisations, operations represent the largest number of employees. 13,9% of the respondents were from financial departments, 17,6% where from safety, health and environmental departments, and supply chain, technical and other areas represent 29,6% of the respondents.

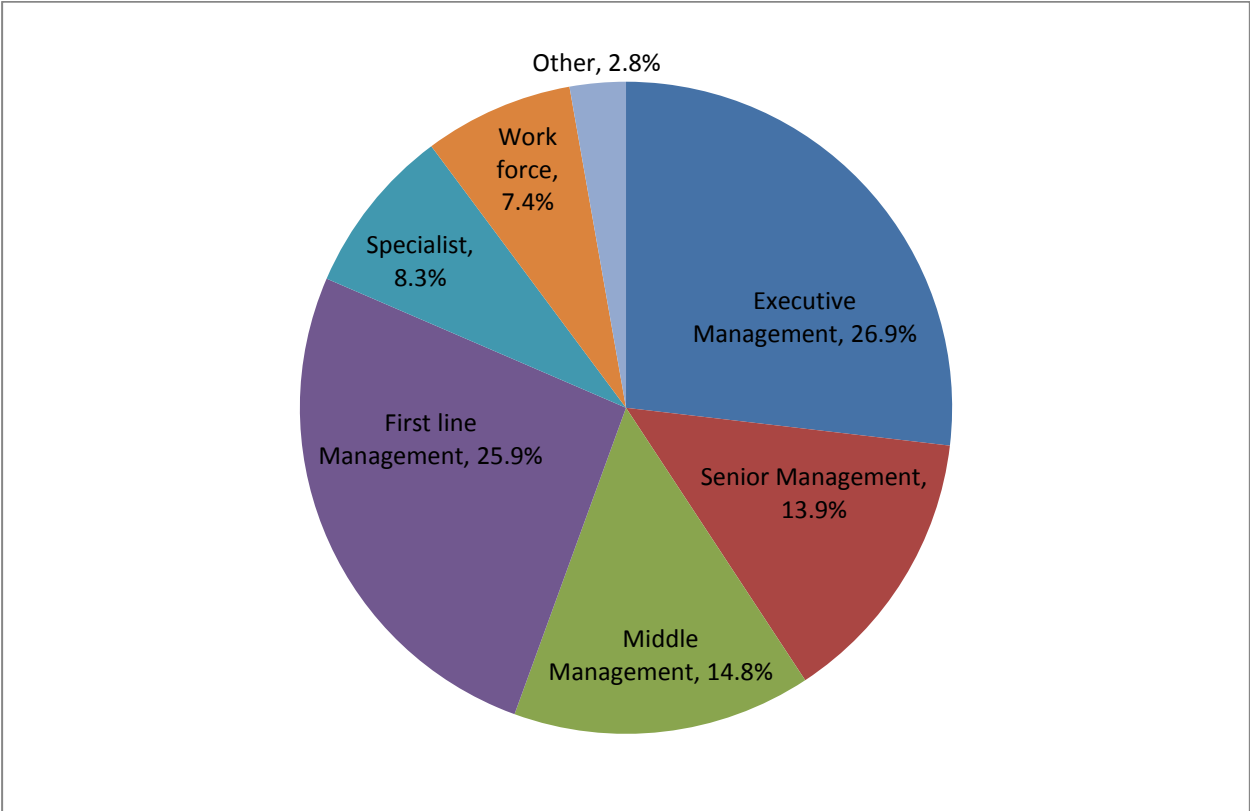
Figure 3-2: Percentage of respondents for each functional area within the organisation.



3.3.1.2.3 Seniority within the organisation

Figure 3-3 indicates that the work force (7,4%) and first line management (25,9%) represented 33,3% of the respondents. Middle management (14,8%) and specialist (8,3%) represented 23,5% while senior management (13,9%) and executive management (26,9) represented 40,8% of the respondents.

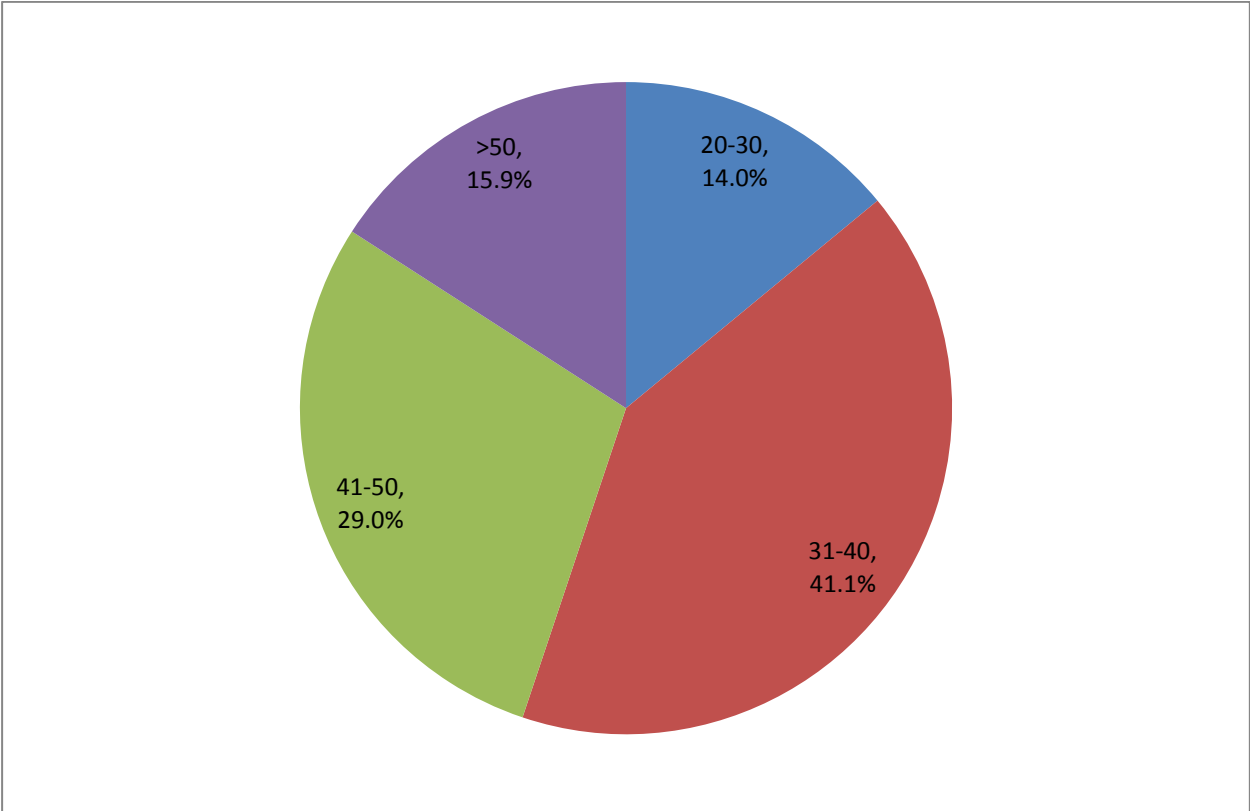
Figure 3-3: Percentage of respondents based on seniority within the organisation.



3.3.1.2.4 Age demographic of the respondents

Figure 3-4 indicates that 41,1% of the respondents were between the ages 31 and 40 while 29% of the respondents were between the ages of 41 and 50. Respondents below 20 years (0%), between 20 and 30 (14%), and above 50 years (15,9%) made up the remaining 29,9% of the respondents.

Figure 3-4: Percentage of respondents based on age group within the organisation.



3.3.1.3 Discussion

The distribution of the number of respondents is representative of the organisation. The 26,9% indicated for executive management is high for an organisation of this size. The organisation recently went through an organisational restructuring with new position titles and roles therefore some of the respondents could have been confused about the position category and position title.

3.3.2 Environmental management matters

3.3.2.1 Objective

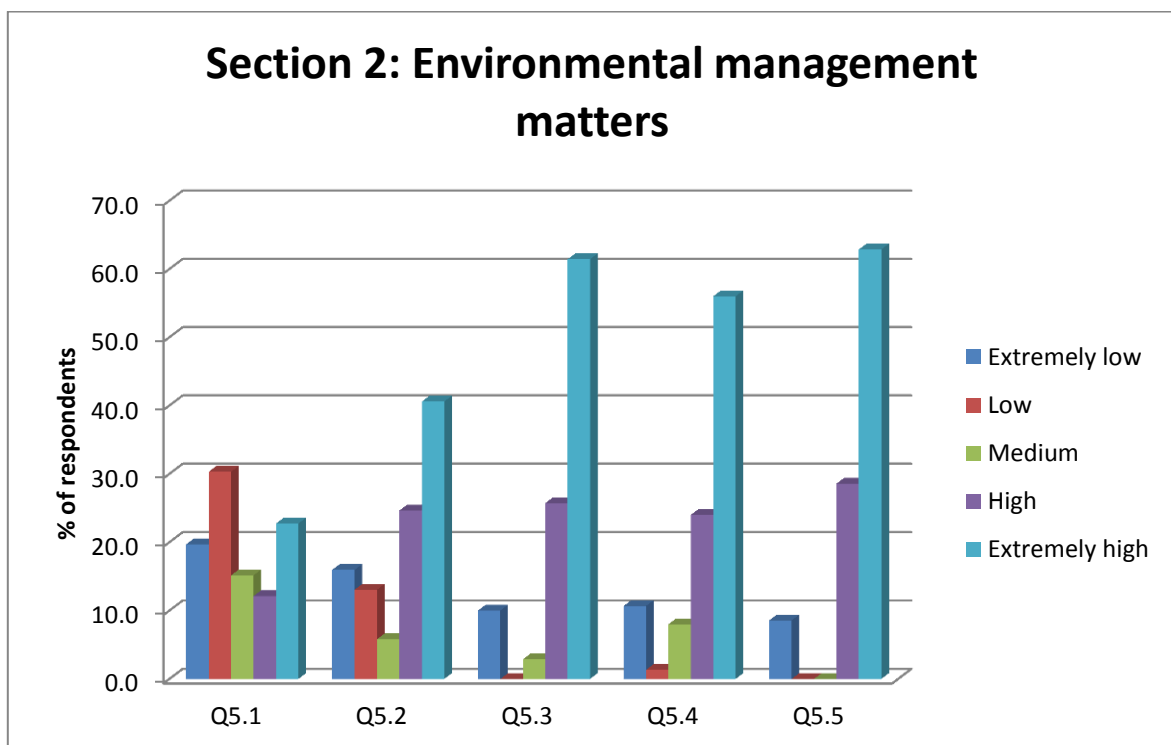
Organisational growth depends on its ability to set goals and establish strategies that provide a framework for being profitable and sustainable in the long-term. These include environmental aspects related to compliance to regulation and legislation. This section is focused on environmental management matters and the level of actuality in the organisation:

- Q5.1 - Establishing and communicating the environmental policy in your area
- Q5.2 - Maintaining ISO 14001 certification
- Q5.3 - Compliance with regulation or standards (waste emission certificates, air monitoring, etc.)
- Q5.4 - Reporting of environmental data for Sustainable Development Reports.
- Q5.5 - Reporting of environmental data for Responsible Care Initiative (Quantitative Indicators of Performance (QIP) data to CAIA).

3.3.2.2 Results

Figure 3-5 below indicates that most respondents selected “Extremely high” for Q5.2: Maintaining ISO 14001 certification (40,6%), Q5.3 Compliance with regulation or standards (waste emission certificates, air monitoring, etc.) (61,4%), Q5.4 Reporting of environmental data for Sustainable Development Reports (56,0%) and Q5.5 Reporting of environmental data for Responsible Care Initiative (62,9%). Only 22,7% respondents selected “Extremely high” for Q5.1: Establishing and communicating the Environmental policy in your area.

Figure 3-5: Environmental management matters



3.3.2.3 Discussion

The majority of the employees are aware that the organisation maintains its ISO 14001 certification, complies with regulation and standards and reports environmental information for the Sustainable Development and Responsible Care initiatives. For Q5.1 30,3% of the respondents answered “Low”. A possible reason for this could be that organisations are good at creating an environmental policy but not good at communicating it throughout the organisation.

3.3.3 Physical environmental management accounting

3.3.3.1 Objective

The objective of this section was to evaluate the respondent’s awareness regarding the level at which their organisation generates and records physical environmental information. Information for physical environmental management accounting includes raw, packaging and operating materials, water, energy, products, by-products, solid and hazardous wastes, water and air emissions. This section focused on physical environmental management matters and the level of actuality in the organisation:

- Q6.1 - Raw materials (these are input materials that become part of the final product or by-product)
- Q6.2 - Packaging materials (used to store and transport the final products)
- Q6.3 - Operating materials (these are materials purchased and used by the operating hub, but do not become part of any tangible product delivered to a customer)
- Q6.4 - Water (all water used by your operating hub)
- Q6.5 - Energy (all energy used by your operating hub)
- Q6.6 - Products (any tangible products produced by your operating hub)
- Q6.7 - By-products (produced during the manufacture of the primary product)
- Q6.8 - Solid waste (such as waste paper, plastic containers, domestic waste)
- Q6.9 - Hazardous waste (solid form, liquid form or mixed form)
- Q6.10 - Waste water
- Q6.11 - Air emissions

3.3.3.2 Results

Figure 3-6 below indicates that most respondents selected “Extremely high” when compared to the other options. 53,3% of the respondents said that the organisation is “Extremely high” in generating and recording raw materials used, similar 39,7% for packaging materials, 48,5% for operating materials, 50% for water, and 49,2% for energy.

Figure 3-6: Physical information of environmental management accounting

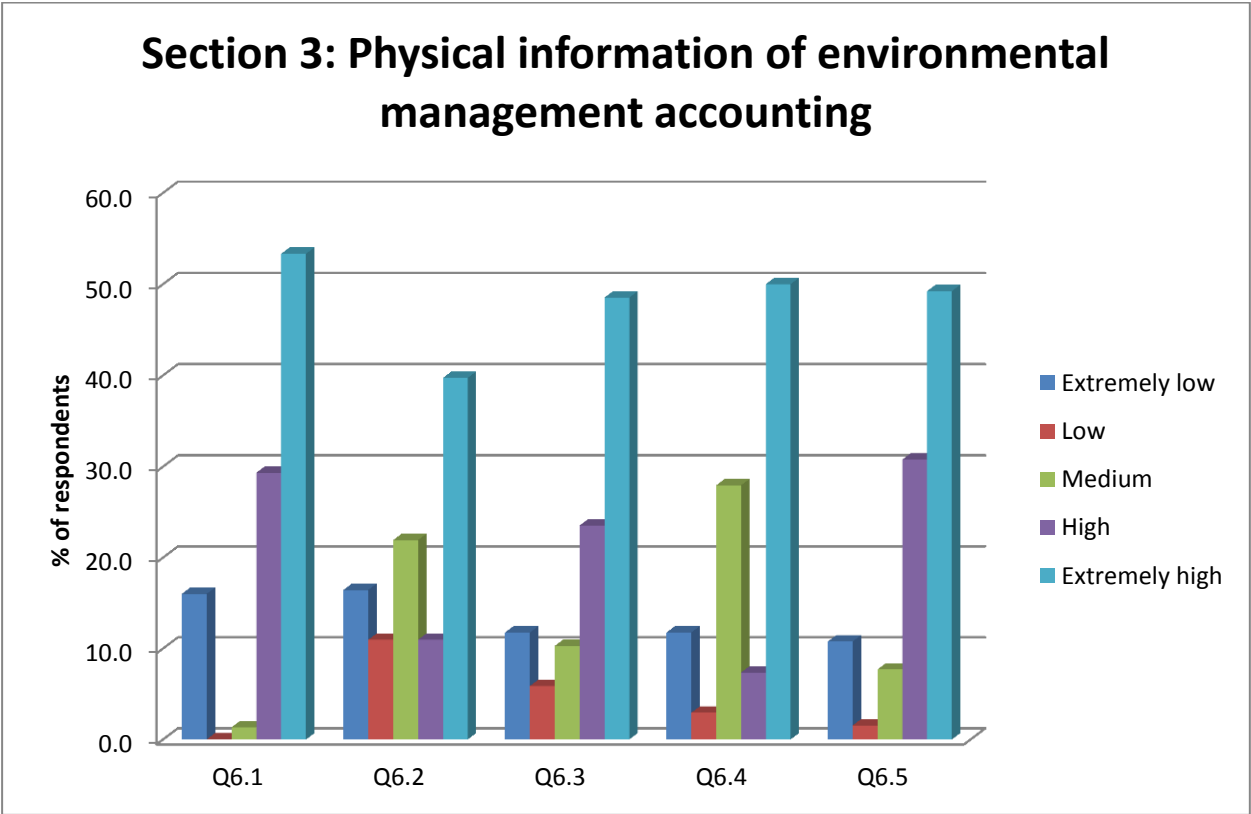
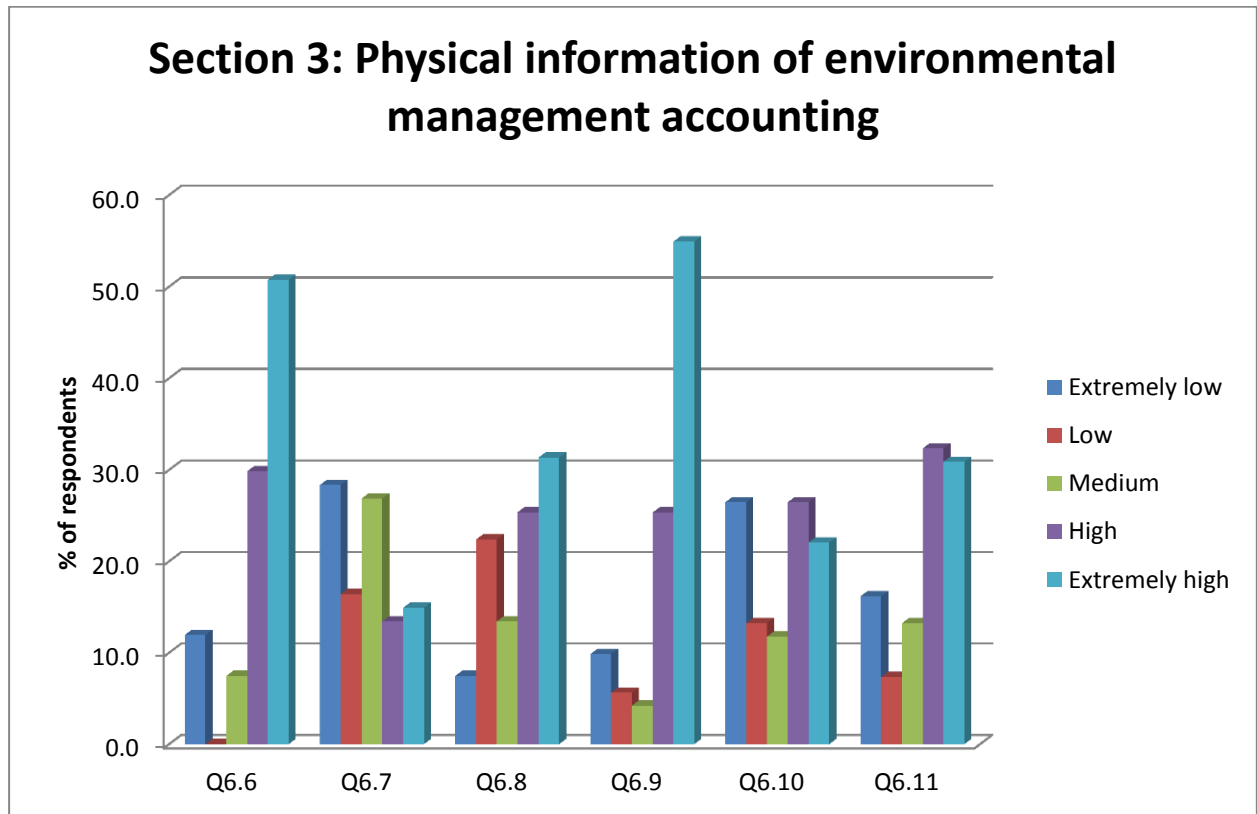


Figure 3-7 below indicates that 80,6% of the respondents selected “Extremely high” or “High” for the organisations ability to generate and record product data, while only 11,9% selected “Extremely low”. For by-product data we see that only 28,3% of the respondents selected “Extremely high” or “High”. This indicates that the organisation is good at recording product data but is poor when it comes to by-products.

We also see that 56,7% of the respondents selected “Extremely high” or “High” for the organisations ability to generate and record solid waste, 80,3% for hazardous waste, 48,6% for waste water and 63,3% for air emissions. Hazardous waste has a negative effect on the

environment and the health of humans and animals therefore there is greater focus on the control of this material.

Figure 3-7: Physical information of environmental management accounting



3.3.3.3 Discussion

Raw and packaging materials are input materials that become part of an organisation's final product or by-product. Operating materials are input materials that are purchased and used by the organisation, but which do not become part of the final tangible product. Water and energy refers to the quantity that is used by the organisation to produce the product. Solid waste refers to relatively non-hazardous waste, such as waste paper, plastic containers, food waste and non-hazardous solid scrap products. Hazardous waste is hazardous materials generated from the production process that may be present in solid, liquid or mixed form. Waste water is a stream where the primary component is water, but which also contains some kind of contaminants. Air emissions are air streams that are contaminated with challenging levels of pollutants. The results indicate that the organisation is good at recording and analysing physical

information related to raw, packing and operating materials, water, energy, products, solid and hazardous wastes, waste water and air emissions, but is poor when it comes to by-products.

3.3.4 Monetary environmental management accounting

3.3.4.1 Objective

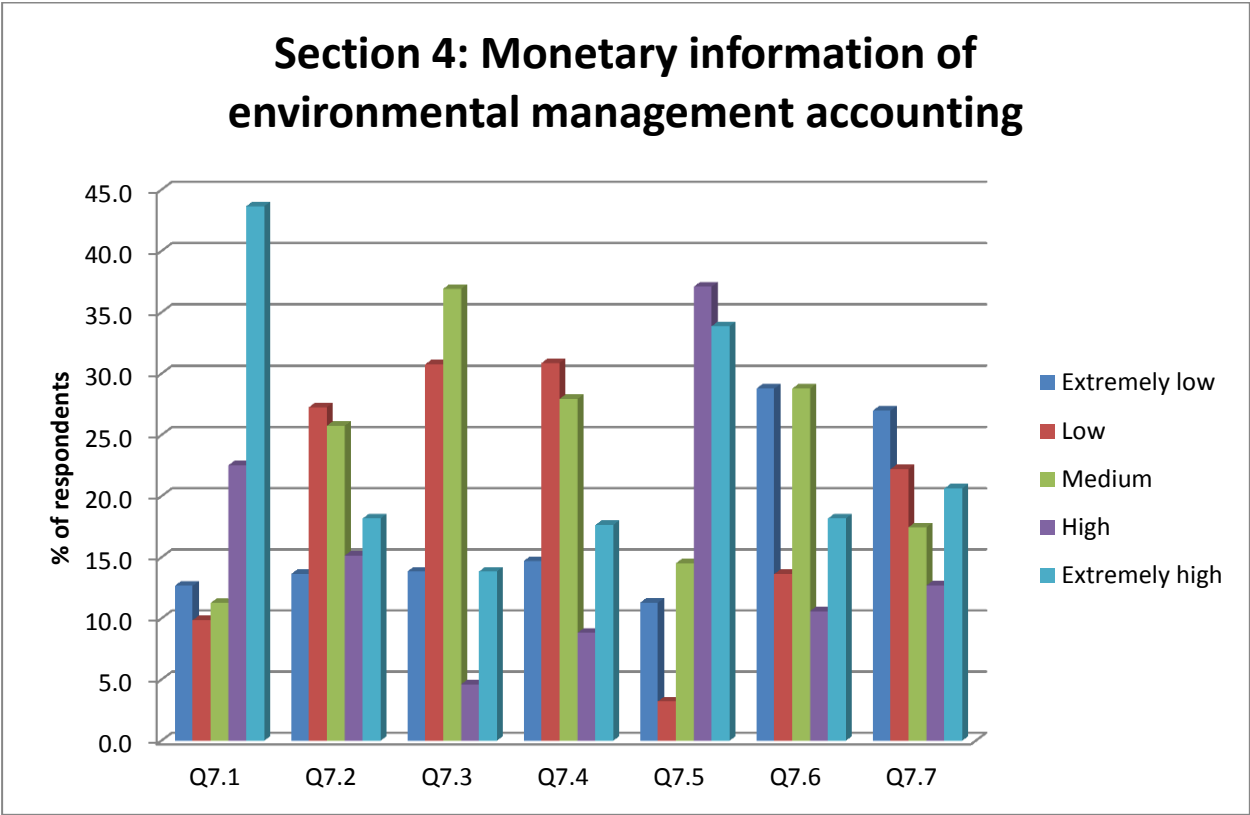
The main objective of this section was to evaluate the respondent's awareness regarding the level at which their organisation generates and records monetary environmental information. Monetary information for environmental management accounting refers to information such as:

- Q7.1 - Cost of material inputs (the purchasing cost of natural resources, such as energy, water and other materials that are converted into products and by-products)
- Q7.2 - Cost of material of non-product outputs (these are materials purchased and used by the organisation, but which do not become part of any tangible product delivered to a customer)
- Q7.3 - Waste and emission costs (including the handling, treatment and disposal costs of waste and emissions; remediation and compensation costs related to environmental damage; and any control-related regulatory compliance costs)
- Q7.4 - Prevention and other environmental management costs
- Q7.5 - Research and development costs (the cost of research and development projects related to environmental issues)
- Q7.6 - Environmental operating expenditure independent of any other operating expenditure
- Q7.7 - Environmental capital expenditure tracked independent of capital expenditure

3.3.4.2 Results

Figure 3-8 below indicates that 43,7% of the respondents selected "Extremely high" for the organisations ability to generate and record costs of material inputs, while only 12,7% selected "Extremely low". For costs of material of non-product outputs we see that only 18,2% of the respondents selected "Extremely high". We also see that 13,8% of the respondents selected "Extremely high" for the organisations ability to generate and record costs associated with waste and emission, 17,6% for prevention and other environmental management costs, 33,9% for research and development costs, 18,2% for environmental operating expenditure and 20,6% for environmental capital expenditure.

Figure 3-8: Monetary information of environmental management accounting



3.3.4.3 Discussion

The results indicate that the organisation is good at recording cost of material input and Research and development costs but is poor at recording cost of material of non-product outputs, waste and emission costs, prevention and other environmental management costs, environmental operating expenditure independent of any other operating expenditure, and environmental capital expenditure tracked independent of capital expenditure.

3.3.5 Allocation of environmental costs

3.3.5.1 Objective

Allocating costs related to environmental aspects directly to a product allows for improved decision making. This allows management to make decisions related to the costing of a product,

environmental improvements, and also stopping the production of a particular product easier. If these costs are all allocated to an overhead account then these decisions could be made with incorrect or incomplete information. This may lead to money been spent on environmental improvement projects in the wrong area of the production process, it may lead to loss of market share has competitors may cost their products lower, and it could even lead to closure of a product line that is profitable while keeping products that are not profitable in production.

3.3.5.2 Results

Figure 3-9 below indicates that 54,7% of the respondents feel that the organisation is very good at allocating environmental costs directly to a specific product, while only 5,7% think they are outstanding and 30,2% feel they are good. This is good for the organisation has it indicates that 94,3% of the respondents replied that they are good or better while only 5,7% respondent poor.

Figure 3-9: Allocation of environmental cost directly to a specific product

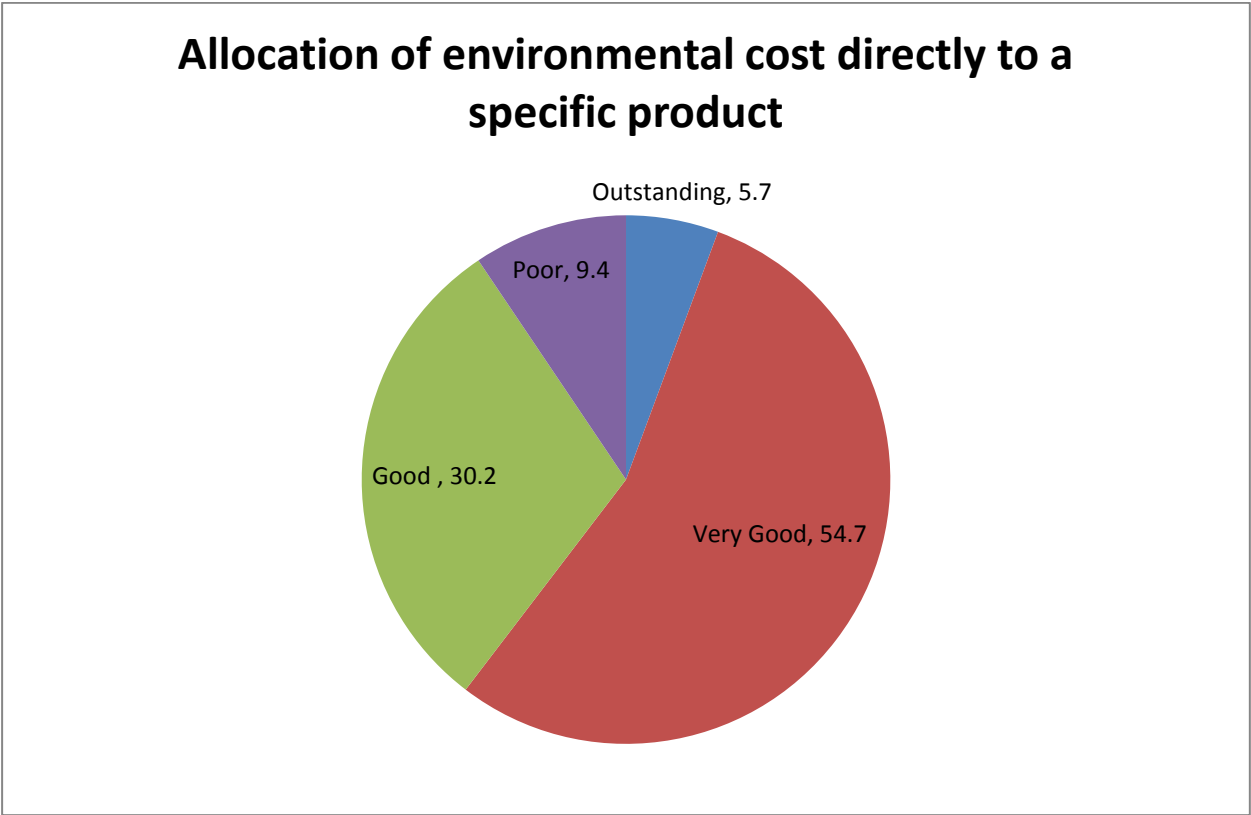
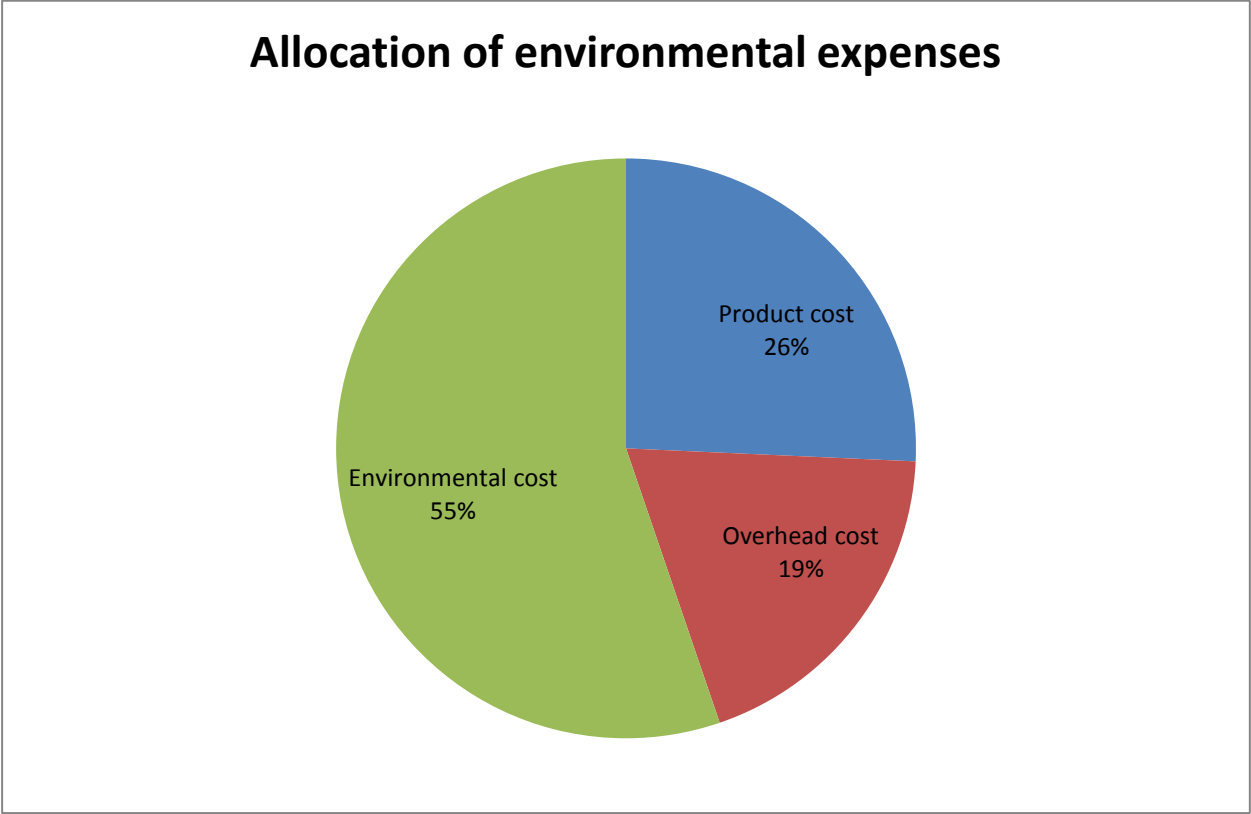


Figure 3-10 below indicates that 55% of the respondents believe that the organisation allocates environmental expenses as environmental costs, while only 25,7% believe these costs are allocated to product costs. Only 19% of the respondents believe that the organisation allocates environmental expenses as overhead costs. It was observed that the organisation is in the process of calculating environmental costs for direct allocation to specific products. Their plan was based on starting with the main products based on volume then moving onto the other products.

Figure 3-10: Allocation of environmental cost directly to a specific product



3.3.5.3 Discussion

Allocating costs related to environmental aspects directly to the specific product produced allows for improved decision making. The results indicate that the organisation is good at recognising that environmentally related costs need to be allocated to a product. It was observed that the organisation is in the process of calculating environmental related costs for direct allocation to specific products. Their plan was based on starting with the main products

based on volume then moving onto the other products. The results also indicate that the organisation allocates most of their environmental expenses as environmental or product costs which is positive.

3.4 Conclusion

This chapter outlined the methodology that was used to conduct the empirical investigation and data analysis methods followed. This was then followed by a detail discussion on the results obtained for the five facets investigated to evaluate the extent to which environmental management accounting is applied at the organisation. The next chapter gives a conclusion and provides some recommendations.

CHAPTER 4: CONCLUSIONS AND RECOMENDATIONS

4.1 Introduction

The purpose of this chapter is to draw conclusions for the primary and secondary objectives that were established at the beginning of the study. The chapter provides conclusions and recommendations on the empirical study. Conclusions are presented based on the outcome of the study. Recommendations are also presented on the importance of environmental management accounting and the level of awareness of it has within the manufacturing organisation.

Significant insight was gained in the understanding of sustainable development and the development of world protocols and requirements for the past 53 years. Previous chapters discussed sustainable development in South Africa with particular focus on the environmental aspect and gave an overview of environmental management system including the ISO 14000 family of standards. Significant insight was also gained on environmental management accounting, including physical and monetary environmental management accounting, cost distribution and allocation, environmental laws and regulation in South Africa and its potential benefits and challenges.

Environmental Management Accounting may still be regarded as an unknown concept to many but its principles are practiced by many organisations. The empirical study has shown that the majority of respondents are aware that environmental management matters and their related costs are important to the organisation. Good environmental practices are being applied and the organisation is aware of the necessity to comply with legislation. Environmentally related information is generated and reported to drive the need for continuous improvement through the implementation of an environmental management system such as ISO 14001 as well as disclosed in the integrated sustainability report.

The awareness of physical and monetary environmental management accounting principles was also studied and revealed a small difference between the various functions that participated in the study. Allocating costs related to environmental aspects directly to a specific product allows for improved decision making. In general the data indicated that the organisation is good at recognising that environmentally related costs need to be allocated to a product.

4.2 Conclusion

4.2.1 Organisational characteristics

Employees' perceptions and practices could be influenced by geographical location, department or functional area, level within the organisation and age. The distribution of the number of respondents was representative of the organisation. The awareness of physical and monetary environmental management accounting principles was also studied and revealed a small difference between the various demographic groups that participated in the study.

4.2.2 Environmental management matters

The majority of the employees are aware that the organisation maintains its ISO 14001 certification, complies with regulation and standards, reports environmental information for the Sustainable Development and Responsible Care initiatives. It was observed that there was a low awareness regarding environmental policy. A possible reason for this could be that the organisation is good at creating an environmental policy but not good at communicating it throughout the organisation.

4.2.3 Physical environmental management accounting

The organisation is good at recording and analysing physical information related to raw, packing and operating materials, water, energy, products, solid and hazardous wastes, waste water and air emissions, but is poor when it comes to by-products. There are two possible reasons for the lack of recording and analysing of by-product information. Firstly, it could be that the value chain is extremely integrated, so a by-product from one line can be reworked in another line for a different product. Secondly, by-products could be sold as scrap material to third parties, so all that is available in storage is in fact sold.

4.2.4 Monetary environmental management accounting

The organisation is good at recording costs of material input and research and development costs but is poor at recording cost of material of non-product outputs, waste and emission costs, preventative and other environmental management costs, environmental operating expenditure

independent of any other operating expenditure, and environmental capital expenditure tracked independent of capital expenditure. A possible reason for this is that monetary information related to the above cost factors are not shared beyond management and financial personnel within the daily operations.

4.2.5 Environmental cost allocation

The organisation is good at recognising that environmentally related costs need to be allocated to a product. It was observed that the organisation is in the process of calculating environmental related costs directly to a specific product. Their plan was based on starting with the main products based on volume then moving onto the other products. The result also indicate that the organisation allocates most of their environmental expenses as environmental or product costs which is positive.

4.3 Recommendations

There is a high level of understanding and awareness regarding physical and monetary environmental management accounting. There seems to be a small difference in the awareness between different functions. It is recommended that environmentally related processes, specifically the generation and recording of monetary environmental management accounting information be shared with functions other than just the financial department. This will improve levels of environmental cost awareness within the organisation and may lead to opportunities to improve environmental performance.

Environmental management accounting integrates best managerial accounting principles with environmental thinking and practice. There is a good level of understanding and awareness of environmental management accounting principles within this South African manufacturing organisation. The awareness regarding environmental strategies and tools is good and drives the environmental management systems to ensure compliance with regulation. The organisation should improve its employee awareness of their environmental policy.

The organisation is good at recording and analysing physical and monetary accounting management information related to the process. Improvements can be made to by-product

related information analysis which could lead to improved production efficiency of the main products or maximising profit from the by-product. It is also recommended that the monetary information related to production and environmental cost factors be shared beyond management and financial personnel. The information systems should be integrated and display real-time information to the relevant people to facilitate them making informed decisions.

The organisation is making good progress in calculating environmentally related costs to be directly allocated to specific products. This should be fast tracked, which could lead to improved management of environmental projects and related costs. Also if the environmental costs of producing a specific product is lower than a competitor this may lead to an increase in customers who appreciate the lower demand on natural resources, leading to an increase in profits.

Environmental management remains a challenge and should be embedded as a core value of the organisation. Manufacturing organisations in South Africa need to understand the environmental footprint of their business, analyse the impact and sustainably manage it for future generations.

BIBLIOGRAPHY

- (2016, 10 12). Retrieved 10 12, 2016, from World Bank: <http://www.worldbank.org/>
- AccountingEDU.org. (2014). *AccountingEDU.org*. Retrieved December 15, 2014, from <http://www.accountingedu.org/enviromental-accounting.html>:
<http://www.accountingedu.org/enviromental-accounting.html>
- Ambe, C. M. (2006). *Environmental Management Accounting Network Africa (EMAN-Africa)*. Retrieved January 3, 2015, from Auditing SA:
http://saiga.co.za/index_htm_files/13%20Environmental%20management%20accounting%20-%20cosmas%20ambe.pdf
- Ambe, C. M. (2007). *Environmental Management Accounting in South Africa: Status, Challenges and Implementation Framework*. Pretoria: Tshwane University of Technology.
- Ambe, C. M. (2008). *The Practice of Environmental Management Accounting in South Africa*. Retrieved January 4, 2015, from [http://emu.tkk.fi/eman2007/parallel/cosmas ambe.pdf](http://emu.tkk.fi/eman2007/parallel/cosmas%20ambe.pdf)
- Anderson, R., Bates, T., Bizjak, J., & Lemmon, M. (n.d.). Corporate governance and firm diversification. *Financial Management, Vol. 29, Issue 1*, 5-22.
- Association of Chartered Certified Accountants. (2014). *Enviromental Accounting Management*. Retrieved December 15, 2014, from Association of Chartered Certified Accountants:
<http://www.accaglobal.com/gb/en/student/acca-qual-student-journey/gual-resource/acca-qualification/p5/technical-articles/environmenta-management.html>
- Burritt, R., Hahn, T., & Schaltegger, S. (2002). An Integrative Framework of Environment Accounting. *Environmental Management Accounting: Informational Institutional Developments*, 21-35.
- Bushman, R., Chen, Q., Engel, E., & Smith, A. (2004). Financial accounting information, organizational compleity and corporate governance systems. *Journal of Accounting and Economics, Vol. 37*, 167-201.
- Carson, R. (1963). *Silent Spring*. London: Hamish.
- Cock, J. a. (1991). *Going green: People, Politics and the Environment in South Africa*. Cape Town: Oxford University Press.

- Conradie, W., Fourie, C., & Nieuwenhuizen, C. (2002). *Basic Financial Management for Entrepreneurs*. Lansdowne: Juta & Co.
- Cronje, C., & Gouws, D. (2008). Corporate annual reports: accounting practices in transition. *Southern African Business Review*, Vol. 12, No 2, 108-133.
- DEAT. (2006). *Draft Strategic Framework for Sustainable Development in South Africa*. Pretoria: South African Government.
- Deegan, C., & Rankin, M. (1997). The Materiality of environmental information to users of annual reports. *Accounting, Auditing and Accountability Journal*, Vol. 10, No. 4, 562-583.
- Deloitte. (2011). Retrieved March 21, 2013, from Integrated reporting – navigating your way in a truly integrated report: www.deloitte.com/assets/Dcom.../integrated_reporting_2.pdf
- Denis, D., Denis, D., & Yost, K. (2002). Global diversification, industrial diversification and firm value. *The Journal of Finance*, Vol. 57, Issue 57, 1951-1977.
- Department of Environmental Affairs of South Africa. (2016). *The 2nd South Africa Environment Outlook*. Pretoria.
- Diemont, M., Rapson, G., & Gilmour, K. (2012). Retrieved June 21, 2015, from Environmental Law: <http://www.investinginsouthafrica.co.za/downloads/en/CHAPTER%2021%20-%20ENVIRONMENTAL%20LAW.pdf>
- Dikgwatlhe, P. (2013). *Assessing the awareness of environmental management accounting in the mining industry*. Potchefstroom: North-West University.
- Ehrlich, P. R., & Ehrlich, A. H. (1990). *The Population Explosion*. London: Hutchinson.
- EMAN-Africa. (2009). *Environmental Management Accounting Network*. Retrieved March 19, 2015, from <http://eman-africa.com/>
- Ernst & Young. (2012). *Ernst & Young*. Retrieved April 14, 2013, from Excellence in Integrated Reporting Awards 2012: [http://www.ey.com/Publication/vwLUAssets/Excellence_in_Integrated_Reporting_Awards_2012/\\$FILE/120830%20Excellence.indd.pdf](http://www.ey.com/Publication/vwLUAssets/Excellence_in_Integrated_Reporting_Awards_2012/$FILE/120830%20Excellence.indd.pdf)
- Farouk, S., Cherian, J., & Jacob, J. (2012). Green Accounting and Management for Sustainable Manufacturing in Developing Countries. *International Journal of Business and Management*, 36-43.

- Feris, L. (2010). The role of good environmental governance in the sustainable development of South Africa. *Potchefstroom Electronic Law Journal*, 73.
- Friedman, D. (2006). No Light at the End of the Tunnel. *Los Angeles Times*.
- German Environmental Ministry. (2003). *Guidance to corporate environmental cost management*. Berlin.
- Global Reporting. (2013). *Sustainable Reporting Guidelines, Global Reporting Initiatives (GRI) 4th Generation Guidelines*. Retrieved February 1, 2015, from <http://www.globalreporting.org>
- Goddard, W., & Melville, S. (2005). *Research Methodology: An Introduction*. Lansdowne: Juta & Co.
- Godelink, R. (2012). *Reason integrated reporting will be a game changer*. Retrieved March 21, 2013, from <http://www.triplepoint.com/2012/03/5-reason-tintehrated-reporting-be-game-changer.aspx>
- Hoozee, S. (2013). *Exploring the interface between environmental reporting and management accounting*. Lille: IESEG School of Management.
- International Institute for Sustainable Development. (2014). *Operational Sustainability*. Retrieved September 12, 2014, from International Institute for Sustainable Development: <http://www.iisd.org/about/sdreporting>
- International Institute for Sustainable Development. (2016). Retrieved July 12, 2016, from International Institute for Sustainable Development: <http://sdg.iisd.org/events/calendar/>
- International Organization for Standardization. (2009). *ISO*. Retrieved 2016, from ISO: http://www.iso.org/iso/theiso14000family_2009.pdf
- ISO. (2016). *ISO*. Retrieved from <http://www.iso.org/iso/home.html>
- Jasch, C. (2003). The use of Environmental Management Accounting (EMA) for indentifying environmental costs. *Journal of Cleaner Production*, 667–676.
- Kotzee, E. (2014). *Evaluating the awareness of EMA in the South African chemical industry*. Potchefstroom: North-West University.
- KPMG. (2015). Retrieved 2015, from KPMG: <https://home.kpmg.com/za/en/home/misc/search.html?q%3D2012>

- Kruger, F., Mitchell, B., & Welman, C. (2012). *Research Methodology, 3rd ed.* Cape Town: Oxford University Press.
- Kumar, R. (2005). *Research methodology. 2nd ed.* London: SAGE Publications Ltd.
- Laerd Statistics. (2016). Retrieved 10 20, 2016, from Laerd Statistics:
<https://statistics.laerd.com/spss-tutorials/chi-square-test-for-association-using-spss-statistics.php>
- Levine, D., Stephan, D., & Szabat, K. (2013). *Business Driven Technology. Statistics for Managers: Using Microsoft Excel.* New York: Pearson.
- Marinova, D., & Altham, W. (2000). ISO 14001 and the adoption of new technologies. *Evidence from Western Australian companies' in ISO 14001. Case studies and practical experiences*, 251-260.
- Möhr-Swart, M. (2008). *An environmental management accounting model.* Tshwane: Tshwane University of Technology.
- Namakonzi, R., & Inanga, E. (2014). *Environmental management accounting and environmental management in manufacturing industries in Uganda.* Kampala: Maastricht School of Management.
- Oracle. (2011). *Tracking Emissions Using Oracle Environmental Accounting and Reporting.* Retrieved January 3, 2015, from
<http://www.oracle.com/us/products/applications/green/oracle-environmental-accounting-433571.pdf>
- PricewaterhouseCoopers. (2010). *Corporate governance series.* Retrieved March 21, 2013, from Corporate governance series:
<http://www.kpmg.com/global/en/issuesandinsights/articlespublications/pages/road-to-integrated-reporting.aspx>
- Prinsloo, T. (2010). *Does it pay to be green? An empirical study of the South African mining industry.* Potchefstroom: North-West University.
- Savage, D., & Jasch, C. (2005). *International Guidance Document on Environmental Management Accounting.* New York: International Federation of Accountants.
- Seal, W., Garrison, R., & Noreen, E. (2012). *Management Accounting.* Berkshire: McGraw-Hill Education.

- Small Enterprise Development Agency. (2012). *Research on the Performance of the Manufacturing Sector*. Um Jwali Market Research.
- South African Institute of Chartered Accountants. (2009). *Summary of report on Governance for South Africa*.
- SouthAfrica.info. (2016). Retrieved November 2016, from SouthAfrica.info:
http://www.southafrica.info/business/economy/sectors/manufacturing.htm#.WDQDAXn_rIU
- Statistics South Africa. (2011). *Living Conditions of Households in SA*. Pretoria.
- Statistics South Africa. (2014). *Manufacturing and construction industries*. Pretoria: Statistics South Africa.
- Statistics South Africa. (2016). *Manufacturing industry: Financial, 2014*. Pretoria: Statistics South Africa.
- Statistics South Africa. (2016, April 18). *Statistics South Africa*. Retrieved 2016, from The Social Profile of Youth, 2009–2014: <http://www.statssa.gov.za/?p=6395>
- Statistics South Africa. (2016). *Statistics South Africa*. Retrieved 2016, from Work & Labour Force: http://www.statssa.gov.za/?page_id=737&id=1
- Tilley, C. (2010). *Corporate reporting needs new approach*. Retrieved February 23, 2013, from Financial Management: <http://www.fm-magazine.com>
- Tripod Incident Analyses. (2010). *BP Gulf of Mexico disaster*. Retrieved December 15, 2014, from Tripod Incident Analyses: <http://tripodincidentanalyse.com/1486>
- Union Carbide Corporation. (n.d.). *Bhopal Gas Tragedy Information*. Retrieved December 15, 2014, from <http://www.bhopal.com/>
- United Nations. (2001). *Environmental Management Accounting Procedures and Principles*. Retrieved December 15, 2015, from <https://sustainabledevelopment.un.org/resourcelibrary>
- United Nations. (2002). *Environmental Management Accounting: Policies and Linkages*. New York. Retrieved from <https://sustainabledevelopment.un.org/resourcelibrary>

United Nations. (2003, March). Measurement for improved Environmental & Economic Performance: Environmental Management Accounting for Government. New York. Retrieved from <https://sustainabledevelopment.un.org/resourcelibrary>

United Nations Division for Sustainable Development. (2003). Clean and Competitive: Environmental Management Accounting for Business. New York. Retrieved from <https://sustainabledevelopment.un.org/resourcelibrary>

University of Bristol. (n.d.). *The Seveso incident*. Retrieved December 15, 2014, from <http://www.chm.bris.ac.uk/motm/245t/245th/seveso.htm>

WCED. (1987). *Our Common Future*. Oxford: Oxford University Press.

ANNEXURES

Annexure 1: Survey Questionnaire

Title: A case study on environmental management accounting practice at a South African manufacturing company.

Introduction

Environmental Management Accounting is a system that industries can implement to assist in decision making of environmental issues and associated costs. Environmental Management Accounting (EMA) is the application of conventional accounting principles to environmental issues, such as waste and emissions analysis. EMA may also be defined as the identification, collection and analysis of physical and monetary information. Both monetary and physical environmental accounting information could be used by industry to be sustainable and more profitable.

Section 1: Organisational characteristics

1. In which operational area are you based?

KZN Operations	Pipelines	Ekandustria	Other
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2. Please indicate your department or function.

Operational	Financial	SHE	Supply Chain	Technical	Other
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3. What is your role category?

Leadership	Specialisation	Optimisation	Execution	Process Optimisation	Process Implementation	Other
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4. What is your current age?

<20	20-30	31-40	41-50	>50
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Section 2: Environmental management matters

5. How will you rate your area regarding the following environmental issues – where (1) is “extremely low” and (5) “extremely high”?

5.1	Establishing and communicating the Environmental policy in your area	1	2	3	4	5
5.2	Maintaining ISO 14001 certification	1	2	3	4	5
5.3	Compliance with regulation or standards (waste emission certificates, air monitoring, etc.)	1	2	3	4	5
5.4	Reporting of environmental data for Sustainable Development Reports.	1	2	3	4	5
5.5	Reporting of environmental data for Responsible Care Initiative (Quantitative Indicators of Performance (QIP) data to CAIA).	1	2	3	4	5

Section 3: Physical information of environmental management accounting

Physical information is about the use, flows (kg/hr, etc.), and rates of energy (kJ/hr, etc.), water (kilo liters) and materials (kg, tons, etc.), including wastes.

6. At what level does your area generate and record physical environmental information with regard to the following – where (1) is “extremely low” and (5) “extremely high”?

6.1	Raw materials (these are input materials that become part of the final product or by-product)	1	2	3	4	5
6.2	Packaging materials (used to store and transport the final products)	1	2	3	4	5
6.3	Operating materials (these are materials purchased and used by the operating hub, but do not become part of any tangible product delivered to a customer)	1	2	3	4	5
6.4	Water (all water used by your operating hub)	1	2	3	4	5

6.5	Energy (all energy used by your operating hub)	1	2	3	4	5
6.6	Products (any tangible products produced by your operating hub)	1	2	3	4	5
6.7	By-products (produced during the manufacture of the primary product)	1	2	3	4	5
6.8	Solid waste (such as waste paper, plastic containers, domestic waste)	1	2	3	4	5
6.9	Hazardous waste (solid form, liquid form or mixed form)	1	2	3	4	5
6.10	Waste water	1	2	3	4	5
6.11	Air emissions	1	2	3	4	5

Section 4: Monetary information of environmental management accounting

Monetary information is about environment-related costs, earnings, and savings of related physical information.

7. At what level does your area generate and record monetary environmental information with regard to the following – where (1) is “extremely low” and (5) “extremely high”?

7.1	Cost of material inputs (the purchasing cost of natural resources, such as energy, water and other materials that are converted into products and by-products)	1	2	3	4	5
7.2	Cost of material of non-product outputs (these are materials purchased and used by the organisation, but which do not become part of any tangible product delivered to a customer)	1	2	3	4	5
7.3	Waste and emission costs (including the handling, treatment and disposal costs of waste and emissions; remediation and compensation costs related to environmental damage; and any control-related regulatory compliance costs)	1	2	3	4	5
7.4	Prevention and other environmental management costs	1	2	3	4	5

7.5	Research and development costs (the cost of research and development projects related to environmental issues)	1	2	3	4	5
7.6	Environmental operating expenditure independent of any other operating expenditure	1	2	3	4	5
7.7	Environmental capital expenditure tracked independent of capital expenditure	1	2	3	4	5

Section 5: Environmental Cost Allocation

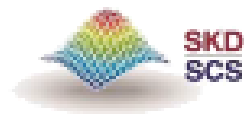
8. How well does your area allocate environmental costs directly to a specific product? (E.g. R 100 waste water to the production of 1000 litres of 95 octane petrol)

Outstanding	Very Good	Good	Poor
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9. Are environmental expenses mostly allocated to:

Product cost	Overhead cost	Environmental cost
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Annexure 2: Statistical Consultation Services of the North-West University



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18 September 2015

Dear

Clinton Govender

We hereby confirm that the Statistical Consultation Services of the North-West University analysed the data involved in the study of the above-mentioned student and assisted with the interpretation of the results. However, any opinion, findings or recommendations contained in this document are those of the author, and the Statistical Consultation Services of the NWU (Potchefstroom Campus) do not accept responsibility for the statistical correctness of the data reported.

Kind regards

Mr SC Liebenberg (MSc Statistics)
Statistical Consultation Services