

The Role of Environmental Management Accounting as a Tool to Calculate Environmental Costs and Identify their Impact on a Company's Environmental Performance

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ABSTRACT----- *The aim of this study was to investigate the impact of using Environmental Management Accounting (EMA) as an environmental management tool instead of convention costing systems (CCS) to manage environmental costs by identifying potential cost, savings, hence improving both environmental and financial performance through enhanced accounting. EMA is an important management tool for businesses to adopt whilst responding to environmental challenges. However managers are still reluctant to change from conventional costing systems to an EMA system. Conventional costing systems reflected incorrect values as environmental costs resulting in poor decision making by managers. Hence, many companies were unable to reach their sustainability targets. This ultimately impacted on company profitability. This paper is based on a case study of a paper manufacturing company in a developing country. The scope of this research focused only on the steam generation process. The results of the study show that the environmental costs indicated in the company's financial documentation were incorrect as environmental costs were previously reflected as production costs. Significant losses due to technological inefficiency and possible savings were brought to the attention of management.*

Keywords--- Environmental Management Accounting (EMA), Sustainable Targets, Profitability, Efficiency, Environmental Performance, Conventional Costing Systems (CCS)

1. INTRODUCTION

In many developing countries, the current environmental challenges caused by one's dependence on non-renewable energy, the waste created by mankind, the toxic emissions created by polluting the air one breathes and also the scarce supply of water are so complex and important that they require one's immediate attention. Strict environmental legislation, market pressures and the urgent need for sustainability, have given businesses no option but to ensure that they do all that is possible to ensure that their business operations are sustainable (Despeisse, Oales and Ball 2013).

Environmental Management Accounting (EMA) has been developed to provide past-oriented information, based on the continuous recording system which provides information required for investment appraisal and financial planning. EMA provides a combination of both financial and physical information regarding the environmental impacts and performance of a business (Christ and Burritt, 2013).

EMA has been challenged to focus on the broader concepts of CP and to provide adequate support information for CP decision making in organisations (Schaltegger et al., 2012).

Higher energy and raw material prices are causing cleaner production to grow in relevance and importance. Cleaner production (CP) focuses on improved productivity and reduced impact as the result of design over the life of products, processes and services (National cleaner production strategy, 2004; Lakhani, 2007). Most companies are using inefficient processes and technologies that are obsolete, which, therefore, consume more energy and resources than if they were using state-of-the art processes. This ultimately results in higher production costs which in turn, affects their profitability and competitiveness. A direct consequence of these inefficiencies is rapid environmental degeneration, excessive amounts of pollution and waste generation which, in turn, is hazardous to human health and affects quality of life (Schaltegger et al., 2010). As the old saying goes, ‘what you do not measure you cannot manage’. The perception of managers is that the benefits of EMA practice do not justify the high cost associated with the implementation of the system or that environmental costs are immaterial. Hence, there is a significant gap in academic knowledge concerning EMA (Ferreira et al 2010; Burritt et al., 2009; Christ and Burritt., 2013).

The researcher reviewed company production cost schedule to investigate whether or not CCS used by company reflected the company’s environmental cost accurately as compared to when EMA cost allocation procedures were followed. The environmental manager and the cost accountant were interviewed to assess the level of communication between the two departments and current environmental cost assessment activities implemented by the company. A survey questionnaire was also used to assess the awareness of managers on environmental activities and costing principles and their perception on adoption of cleaner production techniques and the adoption of an EMA system instead of a CCS.

1.1 Background of case study

The paper and pulp manufacturing process of the company, on which the case study is based, consumes large amounts of natural resources (coal) and also generates excessive waste in the form of boiler ash. It has been identified that the boiler ash contains large amounts of unburned coal. The rising costs of input resources and increasing environmental costs had a negative impact on the companies’ profitability (Cost Accountant, 2013).

The boilers used in the steam production process is obsolete and generates between 20 to 60 tons of unburned coal ash as hazardous solid waste daily (Environmental manager, 2013).

To ensure their future sustainability and competitiveness, management needed to consider adopting cleaner production (CP) techniques and technologies which would address waste issues at its source. CP was perceived by management as a costly strategy that requires innovation with no financial returns to the company in the short-term. Environmental Management Accounting (EMA) could be used as a tool to systematically trace and accurately reallocate environmental costs to the relevant processes and products to enable managers to identify opportunities for implementing CP and thus improve their environmental and economic performance. Information needed to estimate the potential for cleaner production savings was facilitated by making use of material flow analysis, a tool of EMA to allocate environmental and material flow costs (Jasch, 2009).

2. AIM AND OBJECTIVES

2.1 Aim

- To demonstrate the role and importance of EMA instead of CCS in sustainable development and to investigate the use of EMA in identifying environmental costs.

2.2 Objectives

- To identify the shortcomings of CCS and demonstrate the role and importance of EMA in sustainable development;
- Identify the benefits of adopting CP technologies as compared to end-of-pipe technology based on primary and secondary literature as well as empirical findings; and
- To assess the company’s current environmental performance by identifying environmental costs using EMA instead of conventional costing systems currently being used by the company.

Within the scope of this study, the following research questions were posed to achieve the objectives. They are listed as follows:

1. How are the major environmental costs, both physical and monetary, being captured (if at all) within the current accounting systems?
2. Are environmental costs regularly measured and monitored against technological standards to ensure that technology is functioning optimally?
3. Are environmental costs reflected as production costs and hidden under general overhead costs in financial statements?
4. What are the barriers to the adoption of an EMA system and to invest in cleaner production technologies?
5. Are there regular communication and exchange of information between the accounting department, production department, technical managers and the environmental team?
6. Are managers aware of the potential benefits of CP implementation?

The questions listed above informed the research and guided the data collection.

3. LITERATURE REVIEW

3.1 Sustainable Development

Sustainability became a topical issue almost two decades ago. Fore and Mbohwa (2010) point out that increased environmental problems, because of increased production and consumption, had contributed to the concept of sustainable development (SD). As sustainability developed, the question was where and how would companies derive information needed to support the operational issues of various processes to ensure that the necessary data was available when required (Bennett, Schaltegger and Zvezdov, 2013).

This had placed companies under pressure to adopt sustainability due to industry pressure and competition; stricter environmental regulation; pressure from stakeholders to monitor activities and outputs more closely; and increasing shortages of natural resources and higher energy costs. Since sustainability focuses more on non-financial information, there is a demand for companies to adopt new information systems or adapt their existing accounting system. The international community committed itself to sustainable development at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. SD is ultimately about development that meets the needs of the present generation without compromising the ability of future generations to meet their needs.

Sustainability accounting and production has encouraged companies to review their processes and products to take into account and respond to changing cost structures and risks (Bennett, Schaltegger, and Zvezdov, 2013). Gil, Andres and Salinas (2007) argue that management commitment and awareness of environmental responsibility significantly influence corporate strategy. Many of the goals stated in environmental policies have not been achieved due to lack of commitment to move past pollution control and waste disposal strategies.

Most companies are just content to satisfy the minimum requirements of an ISO 14001 audit without changing or improving their production processes or technologies.

To remain sustainable and to achieve eco-efficiency in their production processes, there is an urgent need for companies to adopt cleaner production techniques and technologies as part of the strategy towards sustainable development.

As part of the requirement of ISO14001, it is critical that companies look at ways to achieve sustainable competitive advantage by improving their production process by implementing the use of clean technologies that reduce their raw material input, thereby resulting in lower amounts of waste or at times no waste at all (Radonjic and Tominc, 2007).

The question then raised is that if there are both environmental and economic benefits to cleaner technologies, why are companies reluctant to adopt such technologies as part of their business processes/operations?

Investing in environmental technology is costly with no real payback. Hence, most financial managers are reluctant to take the risk of high investment costs with no viable financial return. Accountants and financial managers need to be made aware of the costs associated with unsustainable production processes, that is, 'environmental costs'.

3.2 Development and Theoretical Framework of EMA

Environmental management accounting is an approach to management accounting with particular emphases on cost associated to environmental issues and wasted raw materials. Its objective is to influence both environmental and financial performance of an organization. Benette, Schaltegger and Zvezdov (2013) developed a working definition for EMA as 'a tool for transforming physical and financial measures of environmental data into information for decision making to judge environmental performance.' Qian, Burritt and Monroe (2011) added that EMA is used to identify, collect and analyse both physical and monetary information for internal decision making.

Physical information comprises of data on use and flows of energy, water, and materials including waste, whereas monetary information is based on environment-related costs, savings and earnings, and environmental costs that are generally hidden under overheads. As per International Federation of Accountant (IFAC), EMA is defined as the development and implementation of environment-related systems and practices to manage environmental and economic performance (Schaltegger et al, 2010). Li (2004) suggests that, in a contemporary world, EMA should be used in the strategic development process to create a balancing interaction between economic, social and technological factors to ensure a sustainable environment.

EMA has the ability to accurately identify estimate allocate and reduce expenditure and also manage the use and flow of energy and materials thereby supporting cost-effective programs to improve environmental balance. EMA is therefore useful for applying preventative environmental activities such as cleaner production (CP)(Schaltegger et al., 2010).

There was an apparent lack of awareness and understanding of the significance of the environmental costs and their impact on the overall performance of the organization. What had been brought to the forefront was the potential savings to South African companies by implementing good environmental management by using EMA to accurately trace and identify environmental costs (Ambe, 2007). It can, therefore, be concluded that Environmental Accounting can be used to demonstrate the potential for environmental investment to yield financial benefits to an organization.

Initially, the environmental management paradigm was to implement measures to control pollution and treat wastes after they have been created (Environmental strategies, 2013) therefore current management accounting systems were inadequate to provide the information on monetary and physical environmental impacts.

Qian, Burritt and Monroe (2011) emphasise the incompleteness of conventional management accounting approaches by using terms such as 'true', 'total', 'comprehensive', and 'life cycle'.

Decisions based on conventional accounting practices only took into consideration the operational costs of waste management as compared to EMA, which generated both financial and non-financial information that was used by managers to support internal environmental management processes.

They pointed out that companies do not consider alternatives such as resource recovery and material recycling as disposal to landfill is considered as the most feasible and competitively attractive option because of the low operation costs of landfill disposal. This is caused by incorrect calculation of actual environment cost by current management accounting systems.

As a rule in environmental management, 80 percent of environmental costs are caused by 20 percent of production activities undertaken by an organisation. Under traditional accounting, these costs are blocked under overhead accounts and thus shared by all product lines, thus, leading to incorrect estimation of product prices and reduced profitability of the organisation (Bennett, Rikhardsson, and Schaltegger, 2003). According to Jasch (2008), during decision making, the cost of wasted materials, capital and labour needed to be added to assess the value of total corporate environmental costs.

Table 1 shows the internal calculation of environmental costs by a company.

Table 1: Environmental costs of a company

	Environmental Protection Costs (Emission Treatment and Pollution Prevention)
+	Costs of wasted material
+	Costs of wasted capital and labour
=	Total corporate environmental costs

Source: Jasch (2009)

Table 1 indicates that, when calculating environmental costs, the purchase value of wasted material and the production costs of waste and emissions must be considered.

Ambe (2007) clarified the following shortcomings of conventional management accounting practices in environmental cost consideration during internal decision making:

- Many environmental costs were ‘hidden’ in overhead accounts;
- The allocation of environmental costs from the overhead accounts were thereafter incorrectly allocated to processes and products;
- Some environmental costs were incorrectly considered ‘fixed’ instead of ‘variable’;
- Volume and cost of wasted raw materials were incorrectly calculated;
- Relevant and significant environmental costs were excluded completely from accounting records resulting in environmental costs being understated; and
- EMA information is not considered during investment appraisal.

In response to the abovementioned shortcomings of conventional management accounting system and increased environmental challenges, EMA was suggested as a valuable business tool for implementation by organisations to create a better link between environmental and economic performance (Ambe 2007:6). This made it possible for businesses to achieve the triple bottom-line without compromising the environment.

Godschalk (2008) concluded that, ultimately, the internally-orientated benefits of adopting EMA are as follows: assist organisations in achieving competitive advantage, greater cost-efficiency, and improved image and customer relations. Olson and Jonall (2008) stress the importance of having a more structured accounting system in increasing cost efficiency and improving environmental performance. Incorrect cost allocation leads to incorrect decision making.

Therefore, tracing cost to the actual cause of it, either a process or product rather than reflecting it under overhead accounts, is extremely important, especially in strategic decision making.

Table 2: Environmental Cost Categories

1	2	3	4	5
WASTE AND EMISSION TREATMENT	PREVENTION AND ENVIRONMENTAL MANAGEMENT	MATERIAL PURCHASE VALUE OF NON-PRODUCT OUTPUT	PROCESSING COST OF NON-PRODUCT OUTPUT	ENVIRONMENTAL REVENUES

Source: (Introducing Environmental Management Accounting at Enterprise Level, 2001)

Table 2 was developed by the United Nations Department of Sustainable Development (UNSD) in 2001 and provides a framework and guidelines on environmental cost categorisation. Hence, this information could be useful to companies that want to implement EMA as part of their continuous improvement policy.

The benefits of using Environmental Management Accounting (EMA) in practice as an environmental and sustainability tool to collect, evaluate and interpret the information needed to estimate the potential for cleaner production saving with particular emphasis on non-product output costs and to make decisions to choose the right CP options had been established in several business cases. However, the level of implementation of EMA in practice remained low because of the significant gap in academic knowledge concerning EMA and its role in identifying inefficiencies in a production process and benchmarking environmental costs to yield superior environmental and economic performance (Ferreira et al., 2010; Burritt et al., 2009; Christ and Burritt, 2013; Schaltegger et al., 2010; Thant and Charmondusit, 2010; Chiu and Leung, 2002; V'an, 2012).

The United Nations Environmental Programme (UNEP) had embarked on several activities to educate and encourage companies of the benefits of using EMA. Following these international developments, South African companies have considered environmental issues in their decision-making processes regarding products and processes. There is an apparent lack of awareness and understanding of the significance of the environmental costs and their impact on the overall performance of the organization. What had been brought to the fore front was the potential savings to South African companies by implementing good environmental management by using EMA to accurately trace and identify environmental costs (Ambe, 2007). It can, therefore, be concluded that Environmental Accounting could be used to demonstrate the potential for environmental investment to yield financial benefits to an organization.

Recent developments in EMA emphasize the greater need for accounting information when making decisions regarding environmental projects (Qian and Burritt, 2008). Hence, communication between the accounting department and the environmental management department is crucial if an organisation wishes to succeed in EMA implementation.

In addition, there is also the need to assess whether or not costs have been allocated and handled correctly and in accordance with environmental policies and guidelines. Therefore, in order to gain maximum benefits of EMA, an integrated system that provides comprehensive information would be needed.

Every company would have a different goal and vision according to its needs and available resources for environmental-related activities. Hence, EMA should be customized to suit the needs and requirements of individual organisations. It is, therefore, suggested that the current management accounting system of a company be adapted to include environmental cost information.

According to Jasch (2008), any waste generated is a sign of inefficient production based on the underlying assumption that all purchased materials must leave the company either as a product or waste and emission. It should be noted that management of environmental-related costs is important even before reporting them. Hence, environmental and financial performance is managed and improved by adopting an EMA system (Schaltegger et al., 2010).

Although environmental accounting forms an important part of industrial decision making in first-world countries, there is, however, a lack of commitment to the environment in South Africa (De Beer and Friend, 2006). Environmental Assessment (EA) is an integral component of environmental regulatory systems in developing countries like South Africa.

Following great developments internationally, South Africa began to place emphasis on environmental impact during decision making on processes and products, more especially in the context of energy and raw material consumption and the resulting waste of production processes. Despite commitment from government and many organisations, the level of EMA application still remains low. Ambe (2007) concluded that EMA implementation in developing countries was still at its infancy stage. Conventional cost accounting systems are still used by the majority of the organisations in developing countries such as South Africa since managers do not actually see benefits of detailed environmental costing. Company managers believe that developing new systems are expensive and traditional systems are perceived as adequate for reporting purposes.

3.3 Challenges of EMA Implementation

Ferenhofet al. (2014) mentioned some challenges to adopting EMA that they discovered during research: implementation of EMA has a lack of organisation incentives at the start as some companies perceive disclosure of accounting information as risky.

Accountants are usually unaware of information improvements that could be obtained by using EMA methodology when they design an accounting system, making it difficult for effective collection and evaluation of environment-related information. De Beer and Friend (2006) added that deficiencies in institutional capacities, untrained staff, shortages of resources as well as inadequate base-line data and environmental monitoring have been identified as some of the shortcomings in current regulatory systems in middle-income countries. Furthermore, research showed that there were poor communication links between accounting and other departments in an organization. As a result, information used by management for decision making may be inaccurate.

Inconsistencies in the type of information system used by the accounting and technical departments also make it difficult to track and trace certain environmental costs accurately (Schaltegger et al., 2010). Li (2004) claimed that problems related to EMA were the poor specification of environmental accounting information, allocation of environmental costs, legislation issues, and lack of environmental accounting standards. Hence, stricter regulatory compliance is necessary for companies to implement EMA systems and procedures because, if this is optional, many organisations would not likely want to make the change even though they may be aware of the potential benefits of the systems. They view such changes as 'not worth their while'.

Some barriers that EMA helps to overcome, as mentioned by Jonall (2008), are management commitment by making managers aware of actual environmental costs, information inconsistency, becoming more efficient and focused, thus resulting in improved environmental and economic performance, and promoting better quality of products through reducing the amount of defective products. In conventional cost accounting, both environmental and non-environmental costs are included under overhead accounts and hidden from management, resulting in incorrect decision making.

EMA, as described by Olson and Jonall (2008), is a combined approach representing the transition of data from financial accounting, cost accounting, and material flow cost accounting.

Material flow balances, in physical units within a defined system, forms the core part of Environmental Information System.

3.4 Empirical Evidence of EMA

A large number of pilot testing projects have been conducted on EMA demonstrating its positive contribution towards companies achieving both environmental and economic targets (Qian et al., 2011; Khalid, Lord and Dixon, 2012; and Bennette, Schaltegger and Zvezdov, 2013). A brief summary of the findings from other pilot case studies that are considered relevant, are mentioned below.

A pilot testing project of Environmental Management Accounting on 10 case studies conducted by Jasch and Schnitzer (2002) showed that there is clearly lack of communication between the environmental manager and cost accountant in companies. The environmental manager has limited access to actual cost accounting documents and although the cost controller has most of the information, they lack the ability to separate the environmental part without proper guidance. Environmental Management Accounting is a combined approach to bridge this communication gap and provide for the transition of data from cost accounting and financial accounting to reduce the environmental impact by increasing material efficiency. Jonall (2008) mentions in his review of corporate results that, when EMA methodology was applied at a Canadian Mackenzie Paper Division paper mill, environmental costs were found to be more than twice as high as those reported in the company's year-end report. This finding concludes that many important environmental costs are hidden in other accounts and supports the view that environmental costs are higher than generally perceived by management. EMA implementation remains a 'niche' in South Africa as organisations are reluctant to adopt new systems unless they are compelled to do so as a regulatory or legislative requirement.

3.5 Non-Product Output

The most significant share of total environmental costs is usually non-product output costs. An EMA system can provide information needed that could be used for directing decisions towards the adoption of cleaner production measures implementing new technologies to reduce these costs (Domil, Peres, and Peres, 2010).

Hyrsova (2011) believes that an EMA system provided users with valuable information regarding the material purchase value of non-product output and makes it possible to track and trace where non-product outputs are created. Management can use this information to propose measures to increase the efficiency of material use that will reduce environmental impacts and concurrently improve the economic performance of the organisation.

Thus, evidence has identified material purchase value of non-product output as the category of EMA that has the potential of the largest cost savings, as stated by Jonall (2008).

3.6 Role of Environmental Management Accounting (EMA) in Cleaner Production Implementation

A number of research studies have been done on the application of cleaner production techniques and technologies in various manufacturing industries in both developed and developing economies and have reported environmental, social and economic benefits for companies that had adopted the CP approach.

There is sufficient empirical evidence that revealed that the CP approach does actually have a positive impact on both the environmental and economic performance of an organisation. Experts have agreed that organisations do not know how much they can save by adopting cleaner production and EMA tools because they do not realise how much they actually spend to produce waste and to manage it (Scavone, 2006). Hence, measurement and accounting for waste and emissions are necessary for cleaner production and EMA projects. CP sets a challenge for research in EMA to provide frameworks that needs to be couched in terms of their theoretical foundations that focus on drivers of change as well as incentives and barriers to change in the technological, organization and accounting innovations' context and their development (Schaltegger et al, 2010).

Pandey and Brent (2008) concluded that development of cleaner technologies is slower in developing countries such as South Africa, due to greater emphasis being placed on economic growth rather than environmental protection. Technological and organisational innovations are crucial in order to change a company's profile into becoming environmentally, economically and socially sustainable.

4. RESEARCH METHODOLOGY

The study was based on a case study following a multi-method approach, that is, method triangulation. The researcher implemented both qualitative and quantitative data analysis methods during the study.

Since managers are the only respondents who could provide the required data for this study, the researcher elected to conduct a census study. Qualitative methodology comprised of interviews, and observation, and quantitative methodology involved the use of questionnaires and quantified input and output material flows using mass flow balance. It was suggested by Yin (2009) that the triangulation approach to data collection enhances accuracy as it involves a combination of three approaches, use of questionnaires, interviews and systematic observation. The triangulation method increased the confidence in the research data and established validity.

4.1 Data Analysis

The statistical package for social sciences, SPSS 22 – was used for descriptive and inferential statistics data analysis. Inferential techniques used in the study included the use of correlations and chi square test values; which were interpreted using the p-values.

Reliability of primary data was also established by using questionnaires to collect data on the company's current level of environmental performance and economic impact. The Cronbach's Alpha Coefficient was used to measure the reliability of the questionnaires in this study. The overall reliability score of each section exceeded the recommended value of 0.70. Hence, it would seem that the case study is reliable (Quinlan, 2011). Reliability of the case study was established by using multiple sources of evidence.

Some of these secondary data used in the study was found in the company's internal documents. Environmental management costs were assessed from annual reports complemented with information extracted from the firm's environmental manager and a member of the Financial Accounting and Cost Accounting Department (Management accountant, 2013).

5. ANALYSIS OF RESULTS AND DISCUSSION

5.1 Summary of Empirical Findings

The study yielded the following results:

The researcher, during the interview, discovered that the environmental costs are perceived to be insignificant and only accounted for annually, using a traditional accounting system. Therefore, investment in CPT to improve environmental performance and reducing environmental cost was not viewed as a necessary measure by the organisation.

It was also evident that the company only considers their waste disposal and water treatment costs as environmental costs. Their material losses are not evaluated and added to NPO costs. All raw materials used were allocated to product cost, irrespective of whether they actually formed part of the final product. Therefore, no decisions were made towards improving production processes and moving towards CPT. The cost of investing in CP technology was not justified, due to the inaccurate assessment of environmental costs resulting in it being underestimated. Environmental costs were also reflected under the general overhead account and were not being traced back to the product or process.

5.2 Coal Input and Steam Production Output of Boilers

Data from the input/output schedule (Appendix 1) of the steam production process for the period under review (October 2012 to September 2013) was used to test the efficiency of the boiler technology against technological standards. According to technological standards of the company's current boiler technology, the standards input/output ratio of coal and steam generated is 1:7.

However, the input/output schedule (appendix 1) indicates the actual amount of coal used for the 12-month period. This ratio was compared to technological standards of 1:7 to identify technological inefficiencies of the steam generation process.

Figure 3 illustrates comparative results relating to output and input ratios.

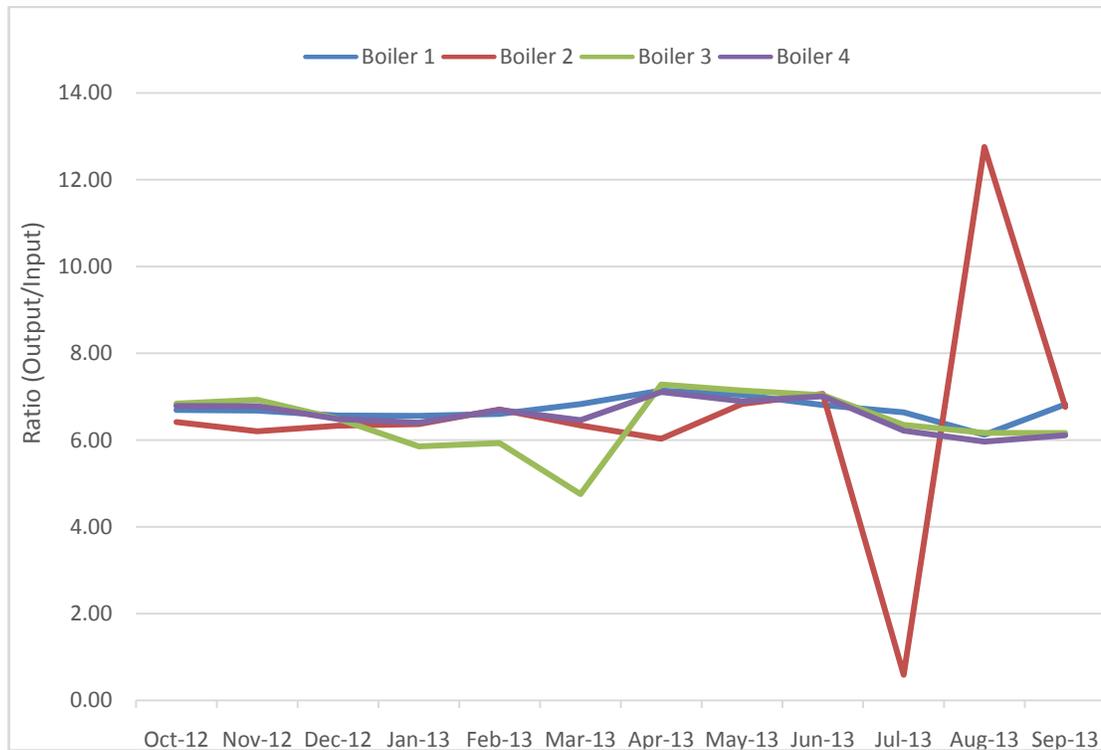


Figure 3: Output to Input Ratio

The mean ratio values per boiler (table 3) were then determined and compared to the standards (converted to a ratio as well).

Only boiler 2 was not significantly different. The other 3 boilers are different. The three means are significantly less than the standard of 7. This implies that the company's current technology is not operating according to design specification. This is, therefore a sign of an inefficient production process.

The NPO costs at this level could be reduced by better housekeeping, for example, better monitoring of raw material consumption, avoiding scraps and wastes and reducing energy and water consumption. This information needed to be generated on a monthly basis for companies to react faster.

In comparison to Test Standard 1:7 (technological standards as identified by technical flow chart) the following one-sample statistics were found.

Table 3 Breakdown and calculation of losses incurred in steam generation process for period under review, October 2012 to September 2013.

Table 3: One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Boiler 1	12	6.7062	.25947	.07490
Boiler 2	12	6.5326	2.61052	.75359
Boiler 3	12	6.4092	.71007	.20498
Boiler 4	12	6.5773	.36191	.10447

Table 4 shows the variance in coal usage by comparing the actual usage to allowed usage.

Table 4: Year-to-date variance in tons and Rand's

	Allowed usage in tons	Actual usage in tons	Variance in tons	Allowed usage in Rands	Actual usage in Rands	Variance in Rands
Coal	74,065	76,022	-1956,696	R69,106,650	R70,923,659	-R1,817,009.25

Source: (Company's financial data reports, 2013)

Table 4 shows that the actual usage of coal was higher than allowed usage of coal for the amount of steam generated, resulting in a negative variance of R1 817 009.25.

Note:

Gross production of steam for the period under review was 517 938.000 tons per year.

Data presented in table 4 indicated that there was a minor difference between the accounting records and boiler plant records for steam generated of (517 938 – 514 848) 3 090 tons and also coal usage of (78 190 – 76 022) 2 168 tons. The difference was negligible, and was, therefore, considered insignificant.

It should be noted that a negative variance in coal usage for the year ended September 2013, resulting in a loss of R1 817 009.25 according to accounting records, could be attributed to the inefficiency of their current technology used in the steam-production process. The excess usage of coal impacts negatively on the environment and decreases the economic performance of the company in terms of more costs for raw material used in the steam production process.

5.3 Current Accounting Practices for Managing Environmental Cost of the Company

The standard accounting information system was used for both financial and management accounting. Only monetary information was provided for environmental costs.

For the steam generation process, no environmental costs were included. Production costs for the process included raw material (coal), electricity, water and fixed cost (Appendix 2). All coal purchased was included as part of production costs. Raw material lost during production was not calculated and measured in monetary and physical terms. The non-product output is an environmental cost to the company as this loss represents waste which is a sign of inefficiency in production.

Depreciation of environmental equipment should be recognised as part of environmental costs and not fixed overhead costs. Labour cost of handling and disposal of waste including the salary of the environmental manager should be allocated to environmental cost. However, this is not being done by the company. Environmental costs were allocated to overhead accounts and key managers were not held liable for these costs. This tends to discourage managers from actively managing environmental costs. There was limited environmental accountability.

Based on the above information regarding accounting practices for managing environmental cost, it can be concluded that, due to the inadequacies of the company's current accounting systems, environmental costs reported by the company were significantly underestimated. The environmental costs included in financial statements were not a true and accurate reflection of the actual environmental costs.

There was poor communication between the management accountant and the environmental manager. Management accountants tend to be constrained to thinking within the existing chart of accounts, and pay less attention to environmental costs (Chang, 2007). Due to this break in communication, opportunities for reducing environmental costs remain unidentified. In order to build a link between physical and monetary information systems and improve environmental and economic performance, it is essential that there be regular interaction and information sharing between the environmental and accounting departments. In terms of the management of major environmental costs:

- A monthly management report is produced by the Finance department in order to review current operations and assess performance against the budget. Hence, major environmental costs are allocated as per budget;
- A detailed breakdown of the costs are not provided and, therefore, due to incomplete information, management of environmental costs are not prioritized; and
- The problem stems from the fact that there was no prior focus on environmental cost management. The fact that senior managers feel that the environmental costs are insignificant means that they do not know the extent of environmental costs.

The limitations mentioned above are not specific to this case study, but could be common to many other organisations, as discussed in the literature review. These limitations do, however, impact negatively on the company's environmental and economic performance.

5. 4 Questionnaire Findings

5.4.1 The Sample

In total, 40 questionnaires were despatched and 37 were returned which gave a 92.5% response rate.

5.4.2 Reliability Statistics

The two most important aspects of precision are reliability and validity. Reliability is computed by taking several measurements on the same subjects. A reliability coefficient of 0.70 or higher is considered as “acceptable” (Willemse, 2009).

Table 5 reflects the Cronbach’s alpha score for all the items that constituted the questionnaire.

Table 5: Cronbach scores

		Number of Items	Cronbach's Alpha
Q1	Corporate environmental strategy of the organisation	4 of 4	.878
Q2	Environmental related activities	12 of 12	.978
Q3	Reasons for the promotion of clean production by industries	-	-
Q4	Cause of pollution/waste generation	-	-
Q5	Perspectives of environmental management accounting	5 of 5	.922
Q6	Environmental audit assessments	5 of 5	.884
Q7	Barriers to adoption of cleaner technologies	10 of 10	.837
	Overall	36 of 36	.962

The overall reliability score of each section exceeded the recommended value of 0.70. This indicates a high (overall) degree of acceptable, consistent scoring for the research.

All of the themes (sub-sections) have values that exceed the acceptable standard.

Questions 3 and 4 are scalar in nature. Cronbach’s alpha was not determined.

5.5 Correlations

Bivariate correlation was also performed on the ordinal data. The results indicate the following patterns:

The correlation value for Business factors between “Integrated environmental issues are incorporated into the company’s strategic planning process” and “Environmental objectives are linked with the company’s corporate goals” is 0.721. This is a directly related proportionality. Respondents agree that the more integrated environmental issues are incorporated into the company’s strategic planning processes, the more likely the environmental objectives are linked with the company’s corporate goals, and vice versa.

Respondents also agreed that the allocation of environmental-related costs to production processes and classification of environmental-related costs results in improvements to environment-related cost management (correlation of 0.880 and 0.978, respectively).

Further analysis showed that assessments of environmental impact issues during capital investment decisions demonstrate greater commitment and awareness of environmental issues by the business managers (positive correlation of 0.748). Input and raw material waste seems to be positively related to poor manufacturing.

Respondents agreed that improper use of technologies, are directly related to insufficient operator training and commitment (positive correlation of 0.964). In addition, findings reveal that old technologies used in production indicate management’s resistance to change (positive correlation 0.701).

Negative values, as identified in the correlation results, imply an inverse relationship. That is, the variables have an opposite effect on each other. Analysis on negative coefficients for certain variables was interpreted as follows:

The coefficient between “The fear for business sustainability in the future and its uncertainties” and “Classification of environment-related costs” is -0.664.

This finding indicates that the greater the environmental business costs, the less sustainable businesses may become, and vice versa.

Interestingly, a negative correlation exists between inclusion of environmental information in the present management accounting information system and input and raw material waste. This means that input and raw material waste decreases when environmental issues are incorporated into the company’s management accounting system (- 0.656). This trend indicates an inverse relation between environmental management activities practised and input and raw material waste generated. Hence, by incorporating environmental management activities into daily business operations, input and raw material waste generated can be reduced and manufacturing can be improved.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The aim of this research was to identify the environmental costs of the production process using CCS and compare the difference in the value of these costs when EMA method was implemented, and also to highlight scope for potential savings and improved environmental performance (Appendix 2). During initial analysis, the focus was on what the company identified as environmental costs and also what other costs are environmental but concealed in other accounts.

A comprehensive review of the literature clearly highlighted the role of EMA in sustainable development.

EMA was used to identify the environmental costs of the steam generation process and compared to environmental costs reflected in company records using a conventional costing system.

The findings were as follows:

- An average of 20% of the boiler ash generated during steam production process was made up of unburned coal. Hence, this process was inefficient and resulted in a financial loss to the company and impacted negatively on the environment. The 20% loss of coal becomes waste and needed to be evaluated.
- In the case study, the boilers used for the generation of steam is more than 40 years old, and were, therefore, considered obsolete, which could lead to inefficient steam production incurring high environmental costs and poor economic performance. CP is not being adopted by the company, although this strategy could improve both the organisation's environmental and economic performance. As a coal-fired boiler gets older, the coal used to replace the original fuel is usually poorer in quality: lower in heating value and higher in ash than the original design fuel (Sheldon, 2001).

6.1.1 Environmental and economic impact

Frequent disruptions resulting in losses due to downtime could be attributed to insufficient maintenance and poor housekeeping measures. Furthermore, the company incurs high maintenance costs for boilers.

The only cost incurred according to financial records, are the fixed and variable costs according to the production cost schedule (Appendix 2). Furthermore, NPO cost was not calculated for the unburned coal found in the boiler ash. This generally forms a large proportion of environmental costs and should have been allocated to the steam production process. Instead, the entire purchase value of the coal is indicated as production costs (as per production cost schedule). The company used a conventional cost accounting system which was inadequate to calculate 'actual environmental' cost. Hence, environmental costs were significantly underestimated. All other environmental costs were hidden under overhead accounts. Similar shortcomings of conventional management accounting practices in environmental cost consideration during internal decision making were reported by Ambe (2007).

6.1.2 The sub-objective of the study was to assess the company's current environmental performance.

In order to assess the company's current environmental performance, various procedures and policies were investigated. The empirical results were as follows:

According to the results of the survey questionnaire, the company's current environmental performance could be rated as average, considering that paper and pulp production is resource intensive and generates a lot of waste. Environmental data is collected by the company. Environmental data collection is poorly coordinated within the company.

The company does not have an environmental management accounting component. Therefore, financial criteria were not taken into account when identifying environmental issues. Environmental costs were accumulated in overheads and these costs were being allocated in a manner that did not necessarily reflect their actual use and waste costs were understated as NPO costs were not considered. Hence, opportunities for improved financial performance had been overlooked because of inaccurate measurement of environmental costs. Furthermore, the organisation is unaware of the true value of internal environmental costs of their operational activities. The general knowledge in the company about different environmental costs and the identification and allocation of environmental costs is limited although the general environmental awareness is good.

6.1.3 The following weaknesses in the company's current system in calculating environmental costs were identified:

Costs of waste disposal were not consistently gathered and evaluated and the cost of handling of waste within the organisation was seldom taken into account.

It had also been found that environmental and technical managers have insufficient information about the magnitude of operational costs. Only accountants were exposed to this kind of information. Furthermore, comprehensive cost statements for environmental costs were not available.

Therefore, it can be deduced that the environmental costs reflected in the company records are incorrect as most of the costs that should be included in the cost calculation are omitted. The reason for this is strongly attributed to the conventional accounting system being used by the company.

Lack of resources had been reported as most challenging in implementing environmental management systems. Difficulty in motivating staff has also been identified as a major challenge. Sinclair-Desgagne (2004) suggests that all business units need to be involved in environmental goal-setting and implementation in order to successfully achieve environmental objectives.

6.1.4 Communication between accounting department and environmental department

The environmental manager is the only individual involved in handling environmental issues and, at times, environmental issues are outsourced to an environmental specialist. Poor inter-departmental communication is evident. There was also no link between systems for collecting financial and non-financial data.

The limitations mentioned above are not specific to this case study, but rather could be common to many other organisations as discussed in the literature review. These limitations did however impact negatively on the company's environmental and economic performance.

6.2 Recommendations

6.2.1 Recommendation 1

To adopt an EMA system rather than a conventional accounting system

It is highly recommended that the company introduce an EMA system instead of using the conventional accounting system. The EMA system will highlight the actual environmental costs under various cost categories. Currently the company's environmental costs is greatly minimized as these cost are not accurately traced to specific products and processes and most of them are hidden under general overheads and some reflected as part of production costs. The reason for this is mainly due to the inability of the conventional cost accounting system to identify and allocate these costs under the specific categories.

An improvement of the current accounting system by adopting an EMA has been suggested as this will bring about environmental benefits and ensure environmental reporting according to legislative requirements by focusing on both physical and monetary environmental cost information. Reduction of material and energy loss values is necessary to improve environmental and economic performance. Increased transparency of environmental costs and greater accuracy in calculating these costs are needed.

A general recommendation for the improvement of the data collection of environmental costs and material flow costs is also suggested. Written procedures must be developed for distribution of costs to the correct cost categories.

6.2.2 Recommendation 2

Key managers should be held liable for the environmental costs of each department. This will make them accountable and encourage managers to actively manage these environmental costs.

6.2.3 Recommendation 3

To adopt cleaner production techniques or technologies

Short-term measures

In order to improve environmental and economic performance, the organisation needs to adopt a CP strategy. Therefore, it is advisable that, in the shorter-term, the company must ensure that their current technology is operating efficiently and according to technological standards. In the short-term, waste cannot be totally eliminated and, according to technological specifications, the loss of coal is estimated to be approximately 10%, which is R7 092 366.00 (refer to appendix 2). By proper housekeeping and regular maintenance of their current boilers, the company would be able to save R7 092 366 (as expected loss of coal is 10%). Excess carbon present in the waste, indicates poor operational practices. The company would also reduce the cost of disposal of ash to landfill and, since disposal of carbon to landfill is prohibited, this would ease off the environmental burden to the company.

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APPENDICES

Appendix 1

Input/Output Schedule of Raw Material Used and Steam Generated

Date	Boiler 1		Boiler 2		Boiler 3		Boiler 4	
	Coal (tons)	Steam (tons)						
Oct-12	1888	12630	1732	11106	1712	11706	1707	11584
Nov-12	1900	12684	1882	11673	1277	8845	1778	12066
Dec-12	1691	11095	2085	13195	1191	7727	1608	10431
Jan-13	1929	12648	2130	13559	1454	8506	1476	9446
Feb-13	1298	8565	1822	12214	705	4181	1395	9341
Mar-13	1968	13434	1466	9294	427	2031	105	679
Apr-13	1061	7574	1965	11853	1898	13815	998	7092
May-13	2364	16640	248	1694	2152	15359	1855	12790
Jun-13	2191	14916	1740	12291	1415	9956	954	6691
Jul-13	2361	15669	2518	1485	1979	12561	872	5426
Aug-13	2275	13924	2438	31091	1743	10741	1789	10675
Sep-13	1648	11240	2274	15383	1258	7747	1570	9595
Total	22573	151019	22299	144837	17210	113176	16108	105816

Source: Company records (2013)

Appendix 2

Table 6 illustrates the total cost of steam generation process from October 2012 to September 2013

Table 6: Breakdown of total cost in rand and percentages

TOTAL BREAKDOWN COST	ANNUAL COST IN RANDS	PERCENTAGE OF TOTAL COST (%)
TOTAL VARIABLE COST	86 059 302.11	91.36
ELECTRICITY	15 035 643.00	15.962
WATER	100 000.00	0.106
MATERIAL PURCHASE	70 923 659.11	75.294
FIXED COST	8 136 805.98	8.64
TOTAL COST	94 196 108.09	100.00

Source: Self Generated (Company's financial data reports, 2013)

Table 6 shows that the variable portion of the total production cost of steam is 91.36%, whereas the fixed cost portion is only 8.64% of total production costs.

Table 7 shows the loss value in Rands of excess coal used due to boiler operating below technological standards.

Table 7: Calculation of boiler efficiency

Actual steam x 0.143	517938 tons x 0.143 = 74 065 tons
Actual coal usage – budgeted coal usage	76 022 tons – 74 065 tons = 1957 tons excess
Loss in Rand value	1957 tons x R933 per ton = R1 825 881

Source: Self Generated

The calculation of disposal cost of ash is as follows:

Transport and labour = estimated to be approximately R 2 000 per 10 ton load of ash to dispose off at landfill 5 km away from mill (General manager DCLM 2014). Approximately 1 960 tons of boiler ash disposed off by the plant monthly.

Total transportation cost @ R2 000 per 10 ton load = R392 000 per month and R4 704 000 per annum. Standard waste generated during this process is approximately half this amount (Edgar 2014).

Therefore, an estimated amount of R2 352 000 per annum represents additional disposal cost incurred by the company due to technological and production inefficiencies.

Pay loader hired for approximately 2 hrs per day to load the ash from hopper onto truck is approximately R3 500 per day (Environmental manager 2014).

Table 8 also represents the estimated saving opportunity for the company based on operating according to technological standards.

Table 8: Total estimated environmental cost based on EMA approach

Non-product output value due to inefficient production process at 10 percent excess material lost (expected loss during process is 10 percent)	R 7 092 366.00
Loss due to input/output standards below technological standards of 1:7	R 1 825 000.00
Disposal cost	R 2 352 000.00
Cost incurred in hiring of pay loader estimated (2hrs a day @R500 per hour)	R240 000.00
ESTIMATED TOTAL ENVIRONMENTAL COST	R 11 509366.00 per annum

Source: Self generated