Establishing a 'Green' Management Accounting Environment in the Eritrea Marble Sector

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Abstract

Purpose – The purpose of the study is to examine the environmental cost identification and usage of Eritrea marble sector and based on the findings to determine the level of effectiveness of EMA implementation for the sector.
Research approach – In the study a quantitative research approach with descriptive statistical analysis was used. A questionnaire was used for collecting primary data. Questionnaire survey was undertaken in the senior staff of the available three marble organisations. The secondary source for the study was acquired from the latest audited internal documents of the organisations.
Findings – Findings revealed that the sector had a significant impact on environment. Its practice on environmental-related activities and environmental management practices however was at infant stage. The sector was not able to properly identify and allocate its environmental costs. However, by minimising the challenges that impede EMA implementation, from overall results it was apparent that EMA establishment for the sector is feasible.
Originality/ Value – Evidences from ministry of mines and energy confirm that the study is the first in Eritrea. The study attempts to analyse the Eritrea marble sector's environmental cost identification and usage, and based on the findings to determine the level of effectiveness of EMA implementation for the sector. The paper provides important insight on EMA implementation.

Keywords: Environmental cost identification, Environmental cost usage, Environmental performance, Environmental management accounting.

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Introduction

Conventional management accounting is not helpful to organisations for their costing purpose especially when environmental costs are considered. As stated in Jasch (2009), environmental costs are either ignored or aggregated to the overhead account. To fill this gap therefore Environmental Management Accounting (EMA) emerged. EMA is the management of environment and economic performance through the development and implementation of environment-related accounting system and practice (IFAC 2005:14). Assisted by tools like activity-based costing (ABC) and material flow cost accounting (MFCA), it is becoming a helpful tool for organisations in managing their environmental costs.

The Eritrea marble sector (the focus of the study) is using a conventional management accounting system for its costing purpose. With due consideration to the drawbacks of this system and given the benefits of EMA, the article will analyse the sector's environmental cost identification and usage, and based on the findings determine how EMA can effectively be implemented for the sector. This paper also presents a problem statement, literature review, research methodology and results.

Research Problem

The problem is that environmental costs are either ignored or aggregated in general overhead in conventional management accounting (Jasch 2009). Organisations that use this approach for their cost accounting purpose, especially those that have environmental costs like the Eritrean marble sector, are lacking a clear identification and proper usage of their environmental costs. Consequently, the managers are unaware of these costs, have no detail with which to manage them and have no incentive to reduce them (UNDSD 2003). Therefore, organisations lose the opportunities they could get from managing these costs (Chang 2007).

As a result, Jasch (2009) argues that conventional management accounting practices simply do not provide information for environmental management purpose. With this approach, as many studies reveal, environmental costs are usually understated (UNDSD 2001a; Deegan 2003). Consequently, organisations have distorted information of their environmental costs which could be a means for ineffective environmental performance. Therefore, as a solution it is not unusual for organisations to seek replacement

of their conventional management accounting system with a tool that incorporates environmental costs in their cost accounting system.

Research Questions

The research questions examined in the study were:

Q1. How efficient is the marble sector in identifying its environmental costs?

Q2. How efficient is the marble sector in using its environmental costs?

Q3. What is the level of effectiveness of implementing EMA in the marble sector?

Supporting Literature

This section provides the theoretical part of the study. It presents a summary of previous literature reviews with the focus on how environmental management accounting research (guidelines) has so far contributed on the drawbacks of conventional management accounting for environmental costing purpose and for the achievements in environmental performance of organisations.

The literature reviews used in this part are selected using the variables, environmental cost identification and usage, and environmental performance keywords. The information from such literature reviews are helpful in gaining a broad understanding of the topics on EMA.

Environmental Management Accounting

The main reason why organisations implement EMA is to have proper identification and usage of their environmental costs and thereby improve their performance on environment. As far as environmental costs are concerned, the conventional management accounting approach – currently in use by some organisations – is not helpful (UNDSD 2003). With this approach environmental costs are either aggregated to general overhead or are disregarded. Consequently, managers are unaware of these costs, have no information with which to manage them and have no incentive to reduce them (UNDSD 2003). There is a general understanding that the conventional management accounting

practices do not provide adequate information for environmental management purpose (Jasch 2009).

On the other hand, Bartolomeo, Bennett, Bouma, Heydkamp, James and Wolters (2000) stated that with the progress of environmental management in organisations, it became apparent that organisations are interested in the environmental-related cost accounting. Burritt (2004) notes that this is because of the increasing evidence that shows that organisations which implemented EMA in their costing system are becoming more profitable. Jasch (2009) states that organisations, as a remedy to the limitations of conventional management accounting and to benefit from their environmental performance, need a modified management accounting that integrates environmental costs.

According to Burritt and Christ (2013), environmental management accounting provides a solution to the limitations of conventional management accounting system regarding environmental issues. By providing data on the physical and financial elements of environmental performance, environmental management accounting will provide the information that can be used by managers to assess opportunities for economic and environmental improvement (Gale 2006).

EMA Definition

EMA is a subset of environmental accounting that considers environmental costs as main parameters for environmental performance (Deegan 2003). Thus to better understand EMA, defining the environmental costs and also environmental accounting is helpful.

Defining Environmental Costs – IMA (1996) argues that to properly account and manage environmental costs, organisations require correct information on their products, which is done by classifying the environmental costs rather than by defining the environmental costs. As described by IFAC (2005), there is no precise definition for environmental costs and the definition of environmental costs usually attributes to the intended use of the information by the organisation. US EPA (1995:8 - 11) include conventional company, potentially hidden, contingent and image and relationship.

Defining Environmental Accounting – The term environmental accounting is open to interpretation (IMA 1996:2). However, there is consensus among

different researchers that it should contain both the physical and monetary environmental information (UNDSD 2001a; and IFAC 2005). IMA (1996:2), argues that environmental accounting is the identification, measurement and allocation of environmental costs, the integration of these environmental costs into business decisions, and the subsequent communication of the information to a company's stakeholders.

Defining EMA – EMA has no single, universally accepted definition (IFAC 2005:7). It is the management of environmental and economic performance through the development and implementation of appropriate environment-related accounting system and practices (IFAC 2005:19).

Benefits of EMA

EMA is becoming a helpful tool for environmental cost accounting purpose. As a result, organisations are introducing it to improve their environmental performance. As per UNDSD (2003) EMA helps business organisations to more accurately identify, estimate and manage costs, particularly costs of wasted raw materials and management of waste streams; to better identify and estimate the financial and other business benefits of environmental management activities; and to measure and report environmental and financial performance, thus improving company image with customers, investors, financial institutions, employees, communities, environmental organisations, and government.

Sayedeh, Saudah and Parvaneh (2011) identify that the costs (including environmental costs) through EMA has *three* main effects on firms which may lead to high firm performance. First, total annual costs provide a frightening picture of costs for firms, because, EMA also discovers the extent of costs of inefficiency. Second, it provides decision makers to consider better cost information in manufacturing processes and operational decisions, including designing new processes and products and benefits and cost of new technologies. Thirdly, EMA through its tools leads to efficient usage of resources by helping to reduce resource waste and costs and improving firm performance.

Successful implementation of EMA therefore has many benefits; the main ones as stated by Jasch (2006) are compliance, eco-efficiency and strategic position. In general, enhancing efficiency in the use of energy, water and other raw materials bring not only environmental improvements (reduced resource use and reduced waste and emissions), but also potentially significant

monetary savings as the costs of materials purchase and waste treatment decrease accordingly (IFAC 2005:11).

Challenges to Implement EMA

EMA implementation is not however without problems. First, 'MA lacks a standard definition of environmental costs' (UNDSD 2001a:7). Second, various studies reveal that organisations find its implementation costly. Thirdly, as stated by Bartolomeo *et al.* (2000), it requires collaboration among different functions of an organisation mainly among accounting and environmental functions. Furthermore, Bartolomeo *et al.* (2000) argue that communication between accounting and environmental functions in an organisation is not encouraging. Often environmental practitioners have a good knowledge on environmental activities but have limited understanding of accounting records.

Besides to these, components of conventional management accounting systems – in use by many organisations – make it difficult for EMA to be established in an organisation (UNDSD 2001a) They are not helpful for proper identification and allocation of environment-related data. As stated in UNDSD (2003), environment-related costs are not assigned to the products which created those costs. They are usually aggregated in overhead accounts (Jasch 2009). Consequently, material use, flow and cost often is not tracked adequately (IFAC 2005:27).

Usage of Environmental Costs

Organisations to improve their environmental performance need information on their environmental costs. This information shall comprise the physical and monetary environmental information. The identification and allocation of environmental costs however is not simple. Yet there is no standard definition and identification for environmental costs (UNDSD 2001a). Therefore, as argued by Deegan (2003) and Jasch Ayres and Bernaudat (2010) the focus should not be on what to include in the environmental costs rather in ensuring the appropriateness of allocating the major environmental costs and whether major environmental costs are considered so as to make informed decisions.

Assisted by techniques like activity-based accounting (ABC) and material flow cost accounting (MFCA), 'EMA attempts to make all relevant,

significant costs visible to that they can be considered when making business decisions' (Jasch 2003:670).

ABC is a technique that 'represents a method of managerial cost accounting that allocates all internal costs to the cost centres and cost drivers on the basis of the activities that caused the costs' (UNDSD 2003). Unlike to traditional management accounting, ABC assumes that activities as a cause for costs. That is, 'activities consume resources, and cost objects in turn consume activities; when this applied to environmental costs, ABC distinguishes between environmental-related costs and environmental-driven costs' (Mowen, Hansen & Heitger 2014:259).

As to Material Flow Cost Accounting, MFCA traces all inputs materials in the production process and categorises them as either 'positive products' or 'negative product' where the identification and monitoring of material flows inside the company become an important instrument in order to identify the improving potential in the domain of pollution prevention and cleaner production (Jasch 2009).

Physical Accounting Side of EMA

'EMA places a particular emphasis on physical information because (1) the use of energy, water and materials, as well as the generation of waste and emissions, are directly related to many of the environmental impacts of organisational operations; and (2) materials purchase costs are a major cost driver in many organisations' (IFAC 2005:7).

'Under the physical accounting side of EMA, an organisation should try to track all physical inputs and outputs and ensure that no significant amounts of energy, water or other materials are unaccounted for. The accounting for all energy, water, materials and wastes flowing into and out of an organisation is called a materials balance' (IFAC 2005:30).

Jasch *et al.* (2010) suggested that the starting point for EMA is the assessment of a material flow balance, the input-output balance in quantity and monetary terms. IFAC (2005) argues that the inputs and outputs must balance because all physical inputs are eventually become outputs. 'In the first year of material flow analysis, it is sufficient to trace and account for about 70% of all materials (mainly raw materials and packaging, and if possible auxiliary materials also) in the material flow balance' (Jasch 2006:1208). As a result, the manufacturers around the globe try to generate as little as possible, mainly

through reaction choice, process design and recycling (Clements, Dunn, Firth, Hubbard, Lazonby & Waddington 2013).

Product outputs comprise: (i) Products – comprise main products and associated packaging; and (ii) By-products – comprise minor products created along with the main product including associated packaging.

Any output that is not a product output is by definition a non-product considered as waste and/or emissions (IFAC 2005:25). These comprise: Solid waste – is solid in nature and relatively not hazardous; Hazardous waste – can be in the form of solid, liquid, or mixed and depending on its context can be classified as toxic, carcinogenic, flammable or infectious.; Waste water – relates to any waste stream which comprise water as the main component and contains contaminants of some kind; and Air emissions – are contaminated air streams with excessive level of pollutants including by-products from energy combustion. Also heat, radiant and noise (IFAC 2005:36).

Environmental Cost Categories

Environmental costs are categorised as 'materials cost of product outputs, waste and emission control costs, prevention and other environmental management costs, research and development costs and less tangible costs' (IFAC 2005:38). UNDSD (2001b:36) on its side categorised environmental costs as waste and emission treatment, prevention and other environmental management, material purchase value of non-product output, and processing costs of non-product output. Environment-related earnings, savings and less tangible benefits are included.

As per UNDSD (2001b:59) the environmental related cost categories include: Waste and emission treatment (Depreciation for related equipment; Maintenance, operating materials and services; Related personnel; Fees, taxes, charges; Fines and penalties; Insurance for environmental liabilities; and Provisions for clean-up costs, re-mediation). Prevention and environmental management (External services for external management; Personnel for general environmental management activities; Research and development; Extra expenditure for cleaner technologies; and Other environmental management costs). Material purchase value of non-product output (Raw materials; Packaging; Auxiliary materials; Operating materials; Energy; Water). Processing cost of non-product output. Environmental earnings (Subsidies, awards; Other earnings).

EMA Implementation

Jasch *et al*. (2010) argue that the integration of environmental costs into the decision making for organisations entail a corporate team from various functions including environmental managers and management accountants. The actors here should be management accountants. They stated that the implementation of EMA starts by putting the right team members together. Because experience shows that the environmental manager barely has access to the actual cost accounting documents of the company and only is aware of a tiny fraction of aggregate environmental costs. On the other hand, the financial accountant/controller does have most of the information but is unable to separate the environmental part without further guidance (Jasch *et al*. 2010:99).

Subsequently, managers sometimes lack the ability to properly combine the physical information with the monetary information when making decisions. Consequently, the managers are forced to make decisions based on incomplete environmental-related data. Thus, as described by IFAC (2005) the decisions made by having inaccurate and inadequate information on the environment-related data attributes to the low quality of the decision and may negatively affect the environmental performance of an organisation.

In implementing EMA, from an accountant's point of view the most likely starting point for EMA is the list of accounts. From an environmental manager's point of view, the desired starting point may be an EMA analysis of a particular waste stream of environmental interest (IFAC 2005:45). So combining competencies on monetary accounting and environmental management and gaining support from both side is vital for the success of

Gray, Bebbington and Walters (2001) argue that although the guidelines about the physical and monetary information are important, most importantly however is the guidelines on how to account them, where energy usage, and management and control of waste are the main ones. Gray *et al*. (2001) believe that proper accounting for energy costs and wastes contributes to improving the environmental performance of organisations, and provided the following steps in accounting for energy costs and wastes.

Steps for accounting wastes: Use different cost heading for waste management costs; Develop a non-financial accounting waste tracking system; Relate the costs to the waste tracking and identification system; Charge back the cost to the process creating the waste based on advice from appropriate technical staff; Use techniques like ABC and Build in waste management into the performance appraisal system.

Research Design and Methodology

The research method was based on a descriptive survey using a questionnaire with a consideration to the variables, and the research questions and the problem statement. The data was presented using descriptive and correlation statistics. The study focused on the environmental performance of Eritrea marble sector. For this purpose, the sectors' environmental cost identification and usage were assessed from the internal documents of the organisations. Accordingly, the level of effectiveness of EMA implementation for the sector was communicated with the management of the organisations.

The population for the study was the three marble organisations in Eritrea. The researchers used the Ministry of Mining and Energy records to identify the marble organisations. The data from the Ministry showed that, out of the three marble organisations, one was a government owned organisation and the rest were small family owned organisations. The sample size taken for the study was the entire population.

Questionnaires and internal documents of the MARGRAN organisation were used as main data collection instrument for the study. The second source, which the researcher sused were the latest three years (2012 - 2014) audited documents of the MARGRAN organisation (secondary data). From the three sampled organisations, MARGRAN was the only organisation that generates such audited documents. In the study the researchers delivered and collected back the questionnaire in person. To test the reliability and validity of an instrument, the researchers pilot tested the questions, which help them to determine whether the individuals in the sample are capable of completing the questionnaire survey and if they can understand the questions. The consistency of answers from the respondents indicated the reliability of the questionnaire.

Research Results

Most of the data for the study was found from MARGRAN organisation (www.margran.er). MARGRAN is a government owned organisation that comprises about 200 employees. The other two marble organisations, Belainesh Weldemariam and Thehaye Tekle are family owned having not more than 20 employees each. Results were obtained from the visits to the organisations. MARGRAN is a marble organisation established in 1993 by reactivating an Italian marble processing plant, which at that time had a way

back history of 45 years. Since then the organisation is engaged in quarrying and processing different types of marble (www.margran.er).

At present the main operating and productive sites of the organisation are the Goranda quarry located in Gogne 310 km away from the city (Asmara), a modern processing plant at Ghindae 45 km away from the city and a small-scale processing factory in Asmara (www.margran.er).

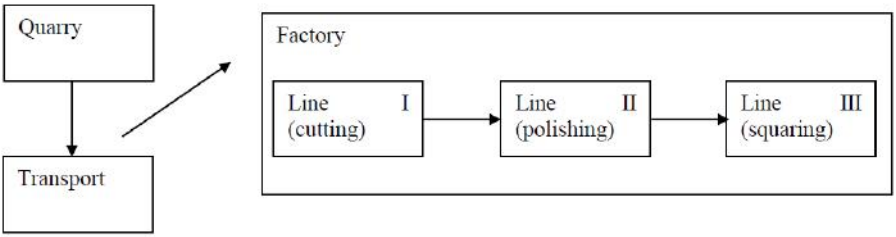

Figure 1: Cost Centres of MARGRAN

Nearly 67% were in the age range of 41-50 years, 26.70% were in the age range of 51-60 years and the remaining 6.70% were in the age range above 60 years. All the respondents were aged enough to suggest that they can act in a responsible manner. Out of the 30 respondents the 60% were male. Every respondent served their current organisation for more than 10 years. This shows that the respondents had experience in their respective fields and acquired sufficient knowledge of their business activities in environment.

The results show that 50% of the respondents were from the accounting department, 30% from environment, 10% from production and 10% other (general managers). The study focused on accounting procedures in relation to environmental costs. As a result, most of the data was acquired from the accountants and some from environment practitioners. General Managers and production supervisors were also involved in the study.

Background of Respondents

Table 1 below shows the number of questionnaires distributed to the three marble organisations and the percentage of the returned ones. The respondents' participation in the survey was good. Table 1 shows that all of the distributed

questionnaires were returned. This may show the interest of the participants on establishing green management accounting environments (EMA) for their organisations and to take part in the study.

Table 1: Questionnaire distributed and returned rate

Organisation	Questionnaires distributed	Questionnaires returned	Percentage (%)
MARGRAN PLC	18	18	100
Belainesh Weldemariam	6	6	100
Tsehaye Tekle	6	6	100
Total	**30**	**30**	**100**

Results of the Research Questions

Here, the theme was to evaluate the significance of the sector's impact on environment and based on the results to deduce whether EMA is helpful for the sector. As stated by De Palma and Csutora (2001), EMA is beneficial to any organisation. It can however be said that, the more an organisation has impact on environment, the more it benefits from EMA. This is because EMA assist organisations in minimising their environmental costs (Jasch 2009).

The respondents perceived their business activities affect the environment the most through resource inputs that is, through raw and auxiliary material usage (Mean = 4.80), water (Mean = 4.30), energy (Mean = 4.27) and use of non-renewable resources (Mean = 3.77). The consumption of such resources is pertinent in every single business activity (IFAC 2005). On the other hand, the smell pollution (Mean = 1.83), hazardous waste (Mean = 2.00), use of toxic inputs (Mean 2.13) and noise pollution (mean = 2.13) were perceived as the least significant impacts. This is not because control measures were in place, but due to the sector's nature of operation in generating waste and emissions. All the rest were perceived to have an average impact (Mean 2.30 – 2.67).

In general, the sector had significant impact on environment through its input resources and limited impact through waste and emissions. The

highest observed mean was on raw and auxiliary material usage (Mean = 4.80) and the least observed one was on smell pollution (Mean = 1.83). The overall findings from the respondents show that on average the Eritrea marble sector had a moderate impact on environment (Mean = 2.6677).

When the environmental impact of the sector was further analysed with due consideration to the profession of the respondents, findings show that the production supervisors had rated environmental impact of the sector lower (Mean = 1.0700). The reason might be due to the level of exposure and knowledge regarding the topic, as the topic is more associated with the accounting and environmental departments. The accounts are the ones that have good knowledge on the topic and scored a mean of 3.0067. The general managers have scored similar mean with the accountants (Mean = 3.1111). This indicates that there is some interaction between the accounting department and the general manager. The response of the environmental practitioners was different from that of the accountants. The environmental practitioners, unlike the accountants, believed the sector to have a moderate impact (Mean = 2.0345). The reason for this could be the environmentalists focus more on waste and emissions.

Q1. How efficient is the sector in identifying its environmental costs?
Q2. How efficient is the sector in using its environmental costs?

The sector had done environmental-related activities to a very limited extent (Mean = 1.6926). The result was observed on its interest or initiatives to environmental-related management activities (Mean = 2.2). This indicates that the sector had an interest to manage its environmental activities. It's score however does not have any significant effect (only 14%) when the overall score of the items is considered. The results further showed that most of the items had mean values between 1.47 and 1.87. This, on its side, indicates that the sector had a limited practice of environmental-related activities. The least score was observed in KPIs usage with mean value of 1.47. This suggests that the sector had no targets set on environmental-related activities that contribute to improved performance if applied properly.

The following weaknesses in the sector's current management accounting system in relation to environmental-related activities were observed. That is, environmental costs were not systematically identified and traced back to production processes. Contingent liabilities were not properly

estimated. No formal accounting procedure were followed, but manuals were observed. It had also been found that environmental managers have insufficient information about the magnitude of environmental costs. Furthermore, KPIs and product life-cycle cost assessment were not available. Finally, even in the initiatives to environmental-related cost management the sector is interested only to a limited extent, suggesting that it is a required activity within marble organisations.

When the findings were further analysed considering the profession of the respondents there exist little difference between accountants (Mean = 1.9556), general managers (Mean = 1.8889) and production supervisors (Mean = 1.7407). All suggested that the sector had a limited practice in environmental-related activities. Environmental practitioners were the only respondents that believe the sector had no such activities (Mean = 1.1728). This in turn confirms that the accountants often do not interact with other functions. The environmental manager has limited access to the actual cost accounting documents of the company and only is aware of a tiny fraction of aggregate environmental costs (Jasch *et al*. 2010). Nevertheless, all the respondents believe that the sector does not identify and allocate its environmental costs.

From the overall results the non-existence of EMA in the sector was apparent. From the documents of the sector, similar to the argument of Jasch (2009) it was also found that environmental costs were accumulated in overheads (manufacturing expense) and these costs were not allocated in a proper way of their actual use. The sector was using conventional management accounting for its costing purpose. Consequently, 'managers have no incentive to reduce environmental costs, and executives are often unaware of the extent of environmental costs' (UNDSD 2001b:1). Thus, organisations lose the opportunities for reducing their environmental costs (Chang 2007).

The results revealed that in all the items except two, environmental management practices had never been done in the sector or if so to a very limited extent (Mean ranging between 1.13 and 1.50). The items; influence of customers, regulatory and local community on the sector's environmental performance, and cost-benefit analysis for environmental issues were ranked relatively highest (Mean = 2.1111 and 2.07 respectively). The highest mean was on influence of customers, regulatory and local community to environmental performance (Mean = 2.1111) and the least was on regular environmental audit (Mean = 1.03). Overall the sector's experience on

environmental management practices was low (Mean = 1.3778), which indicates that the necessary environmental practices were not in place.

From the overall findings it was apparent that the sector does not have an environmental policy, does not conduct regular environmental audit and training, and does not incorporate environmental information on its annual reports. In integrating environmental-related information in management accounting system, and on setting environmental goals and targets, the sector had very limited experience. The mean score was observed on items; influence of customers, regulatory and local community on the sector's environmental performance and cost-benefit analysis for environmental issues, which suggests that an environmental management practice, is a requirement for the sector. Respondents have rated compliance with regulation as relatively the biggest driver for the organisation's environmental management practices. Furthermore, although it is not on regular bases, the respondents suggested that the sector had limited practice on cost-benefit analysis when environmental issues are raised.

When this was further analysed in relation to the profession of the respondents, all the accountants (Mean = 1.3667), general managers (Mean = 1.3000) and environmental practitioners (Mean = 1.2481) believe that the sector had a limited practice on environmental management. The similarity of the results may be from the sufficient knowledge or information they have on the environmental practice. The only difference observed on the responses of production supervisors (Mean = 1.9000). The production supervisors believe that the sector had a limited practice on environmental management, which may be attributed to limited knowledge of the supervisors on the topic and interest for such practices.

As stated by Wagner and Schaltegger (2004), environmental performance indicates organisations achievement in their impact on environment and is usually measured using reductions in input (usage of natural resources) and output (negative environmental impact) variables. Overall the respondents suggested that EMA adoption improves environmental performance (Mean = 2.9152). When the components of the environmental performance were taken separately, the score for reduction in usage of natural resources was high (Mean = 3.6444). While the score for the reduction of negative impact was average (Mean = 2.6417). This indicates that the sector will improve its environmental performance, especially reduction in usage of natural resources if EMA is implemented. This was also in line with the

respondents' perception on environmental impact of the sector, which is their business environment affect the environment the most through resource inputs. On the other hand, the moderate score in the reduction of negative impact was attributed to the sector's nature of operation in generating waste and emission.

The respondents suggested that the adoption of EMA will have a contribution on the environmental performance of the sector. The sector will be able to reduce its usage of natural resources, that is in usage of water (Mean = 3.80), in usage of energy (Mean = 3.63) and in usage of non-renewable resources (3.50). With regard to the reduction in negative environmental impact the most was from reduction of hazardous waste, solid waste, wastewater, and noise (Mean = 3.60, 3.43, 2.97 and 2.90 respectively). Average score was observed in reduction of landscape damage (Mean = 2.77) and air emission (Mean = 2.33). Low and not at all was observed on reduction of smell emission (Mean = 1.97) and use of toxic inputs (Mean = 1.13).

When this was further analysed considering profession of the respondents, all believe that EMA adoption has significant contribution on environmental performance of the sector. The highest mean was observed on the response of production supervisors (Mean = 3.3030), next general managers (Mean = 2.9391) and then accountants and environmental practitioners (Mean = 2.8970 and 2.8081 respectively). When the components of the environmental performance were taken separately, regarding the reduction in usage of natural resources a highest score is observed from accountants, production supervisors and general managers (Mean = 4.1556, 4.1111 and 4.1111).

That is, 70% of the respondents believe that by adopting EMA the sector could reduce natural resource usage and could improve its environmental performance to a large extent. Only environmental practitioners believe that EMA adoption had a moderate impact on environmental performance of the sector (Mean = 2.4815). This could be in line with the environmental practitioners' opinion that the sector generates only a minimal amount of waste and emission. Regarding the reduction on negative environmental impact, the highest score was observed from production supervisors and environmental practitioners (Mean = 3.0000 and 2.9306 respectively). The scores of general managers and accountants were 2.500 and 2.425 respectively. Overall it seems that there was no much difference in their opinion. All believe that the sector could improve its environmental performance through the moderate reduction in its negative environmental impact.

Table 2: Correlations between EMA adoption and environmental performance

		EMA adoption practices	Environmental performance
EMA adoption practices	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	30	
Environmental performance	Pearson Correlation	.171	1
	Sig. (2-tailed)	.365	
	N	30	30

The analysis shows that although not significance the relationship between EMA adoption and environmental performance of the sector is a positive. This may not guarantee significant correlation, but it can be concluded that the improvement in environmental performance to some extent attributes to the adoption of EMA. The next section discusses on the level of effectiveness of EMA implementation in the sector.

Barriers to EMA Implementation

Q3. *What is the level of effectiveness of implementing EMA in the sector*?
Effective implementation of EMA has many benefits, where the main ones are compliance, eco-efficiency and strategic position (Jasch 2006). Implementation of EMA however depends on how effectively could the barriers to its implementation be minimised. Literature provides lack of standard environmental cost definition (UNDSD 2001a), financial constraints (Chang 2007), weak relation among functions (Jasch *et al*. 2010) and the current management accounting system (UNDSD 2003) as barriers for EMA implementation.

Environmental Costs – In literature this is considered as one of the influencing factors for EMA implementation. However, Jasch *et al*. (2010) argue that the concentration should be on the idea that major costs are not disregarded. From the findings it was apparent that, the respondents were aware of the main environmental costs of the sector. From the internal

document of the sector, in *quarry* the identified environmental costs were site consumable fuel, consumable quarry, water expense, amortisation expense, spare parts, and depreciation of the building, machineries and equipment in the site. In the *factory* consumable diamond and blades, electricity, transportation, repair and maintenance, spare parts, and depreciation building, machinery and equipment.

As depicted previously, the environmental costs of the sector can be categorised according to the framework proposed by IFAC (2005) and UNDSD (2001). Therefore, since effective implementation of EMA depends on appropriate categorisation of the environmental costs rather than on their definition, it can be concluded that this is not a barrier for EMA implementation.

Financial constraints – Financial constraints are also considered as barriers for EMA implementation. These concerns about the cost of capturing more data and additional human resources required to process the data (Chang 2007). There are additional costs the organisations to incur for obtaining the information on environment-related costs. However, as most of the information is available within the sector and the environmental practitioners are there to interpret the data, there was not much cost to incur in this matter.

However, since most of these team members are internals, no significant additional expense on human resource is also required. Furthermore, literature shows that EMA could start with a modification on the costing system, on process/product or functions (Jasch *et al*. 2010). According to IFAC (2005), EMA can be applied at organisational levels; by material, process or equipment line, product or product line, site or facility, division and at the entire organisational level. Therefore, financial constraints were not barriers for the sector.

Communication between Functions – The barrier is usually the unavailability of communication procedures among the functional areas; especially between accounts and environmental functions. The difference observed in responses of the accountants and the environmental practitioners is attributed to such problems. This indicates that there was no information between the accounting and environment functions.

Jasch *et al*. (2010) argued that there exists a lack of communication between the environmental practitioners and accountant in organisations. The

environmental manager barely has access to the actual cost accounting documents of the company and only is aware of a tiny fraction of aggregate environmental costs. On the other hand, the management accountant does have most of the information but is unable to separate the environmental part without further guidance.

In the case of the sector, when opinion on the environmental-related activities are considered, findings revealed that environmental practitioners' response (Mean = 1.1728) was different from that of the accountants (Mean = 1.9556). This attributes to the insufficient information environmental practitioners have on the management accounting practices. There should be formal communication between the accounting and environment functions in the same way the accountants do with the general managers. From this it was apparent that, the awareness of the general managers was better than the environmental practitioners, which may be due to the regular reports they receive from the accounting department. Hence it can be concluded that the communication barrier did not seem to be significant enough to impede EMA implementation.

Current Management Accounting System – Even though the sector has activities that impact the environment, findings revealed that environmental-related activities were exercised to limited extent and environmental management practices were in the lower end of the scale. Therefore, the effectiveness of the sector's current system from an environmental point of view is questionable. Environmental costs are classified as overhead (manufacturing) expenses only.

Moreover, the current system does not help functions in reconciling their view on environmental-related activities. For example, environmental practitioners view environmental impact from different angle than that of the accountants. Results showed that the environmental practitioners give more weight to waste and emissions. Overall the barriers for EMA implementation were not significant enough to prevent its implementation. Thus, from this and from the proposed framework (topic of the following section) it can be concluded that EMA could effectively be implemented for the sector.

Proposed Framework for EMA Implementation

De Palma and Csutora (2001) argue that EMA is a beneficiary for any organi-

Sation. Jasch *et al*. (2010) advice that the splitting up the corporate flows into cost centres, or even down to specific production equipment, allows for an investigation of technical improvement options. Special attention should be drawn to the quantitative recording of materials on a consistent basis.

In implementing EMA, Kumpulainen and Pohjola (2008) advice that the organisation's process is described in detail, the organisation's environmental impact be accounted and the organisation calculate its environmental costs and propose improvement areas in the process. Furthermore, Gray *et al*. (2001) advice organisations to emphasise on how not what to account for the physical and monetary information, with the focus on energy usage, and management and control of waste as environmental improvement parameters could also be of help to EMA implementation.

Conclusion and Recommendations

With regard to the research question *three*- the level of effectiveness of EMA implementation depends on the significance of the barriers for its implementation and the sector's ability to eliminate or minimise them. Literature provides lack of standard environmental cost definition, financial constraints, weak relation among functions and the current management accounting system as significant barriers for EMA implementation (UNDSD 2001a; Chang 2007; Jasch *et al*. 2010; and UNDSD 2003). These however had no considerable effect in the sector. Findings revealed that these barriers were not significant enough to impede EMA implementation for the sector.

When EMA implementation is considered, literature provides steps on how EMA could effectively be implemented in organisations (Gray *et al*. 2001; Jasch *et al*. 2010; and Kumpulainen & Pohjola 2008). Thus by following these steps and by adopting the proposed framework of 'United Nations' expert working group on EMA' (see Appendix II), EMA can effectively be implemented in the sector. Therefore, establishing EMA for the sector is feasible.

Recommendations

The overall results of the study show that the sector had a moderate environmental impact, very limited environment-related activities and its management practice was at the lower end of the scale. From this it was

apparent that EMA is of high necessity for the sector. Therefore, considering the role of EMA in managing environmental costs, it is recommended that the sector should implement EMA. According to UNDSD (2001a) EMA attempts to integrate management accounting principles with environmental practice.

Implementing EMA for the sector being the main one, recommendations on items that are required for effective implementation of EMA are presented as follows.

There seems although small a difference in the awareness between different functions and it is recommended that environmental practitioners get the same exposure in environmental-related activities and environmental management practices. For constructing effective link between physical and monetary information systems there should be a formal information communication between environmental practitioners and management accountants (Jasch *et al*. 2010).This will cause improved levels of awareness on accounting procedures for environmental costs among the function which may improve performance of the sector on its environmental activities. Furthermore, since the corporate team usually comprises staffs from various functions especially accountants and environmental practitioners, there need to expose the members of the team to components of EMA practices. As stated by Setthasakko (2010), the environmental practitioners and management accountants should work in collaboration so as to identify significant environmental issues of their organisation and propose solution. By creating such environment, significant improvement in generating, reporting and decision making will be observed.

There also seems a difference in view of environmental practitioners from that of the accountants with regard to the sector's environmental impact. This attributed to the lack of awareness of the environmental practitioners on the impact of raw material inputs (input resources) on environment. Consequently, 'managers have no incentive to reduce environmental costs, and executives are often unaware of the extent of environmental costs' (UNDSD 2001b:1). Thus guidance of accountants on this topic is required to increase the level of awareness of the environmental practitioners on the overall environmental impact of the sector not only on waste and emission. It is the integrated effort and knowledge of the accountants and environmental practitioners among others that contribute to the improved environmental performance.

Regarding the existing accounting system, the following changes are

recommended. Overhead (manufacturing expense) accounts should be reviewed and environmental costs should be identified. IFAC (2005) and UNDSD (2001a) provided procedures for identifying environmental costs of organisations (see Appendix II). That is, as per Jasch (2009) 'the sector should separately identify and capture environmental costs from unit inputs, production processes and non-product outputs from overheads, then allocates them to a single production activity where these costs are consumed based on cost allocation and cost centre of ABC approach'. If applied properly, this will contribute to the reduction of wasted materials and improved process efficiency.

In general, the Eritrea marble sector should consider the following items identified in the data and the theory, so as to effectively implement EMA:

i. Gain support from top management
ii. Identify and categorise potential environmental costs
iii. Determine the composition of EMA team
iv. Review existing accounting systems
v. Identify areas of major opportunities for waste reduction
vi. Identify environmental revenue
vii. Consider the barriers for EMA implementation and
viii. Follow EMA implementation framework

The study was aimed at determining the level of effectiveness of EMA implementation for the Eritrean marble sector. Significant insight from previous literature review assisted in the formulation of the research questions and further investigation of findings. As a method of data collection questionnaire survey was undertaken on the senior staff of the available three marble organisations. Internal documents of the MARGAN organisation were also used.

Findings revealed that the sector had a significant impact in environment. Its practice on environmental-related activities and environmental management practices however was at infant stage. The sector was not able to properly identify and allocate its environmental costs. In other words the sector was using the conventional management account for its costing purpose. Consequently, the sector was unaware of the true value of its environmental costs. That is, the sector was losing opportunities for identifying and allocating the major environmental costs (UNDSD 2003).

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