Framework of Environmental Management Accounting: An Overview

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November 2012

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ABSTRACT:

This article is intended to understand environmental management accounting, its increasing importance, and new developments.

The global profile of environmental issues has risen significantly during the past two decades, precipitated in part by major incidents such as the Bhopal chemical leak (1984) and the Exxon Valdez oil spill (1989). These events received worldwide media attention and increased concerns over major issues such as global warming, depletion of non-renewable resources, and loss of natural habitats.

This study paper highlights on the utilization and benefits of using environmental management accounting for firms. In order to realize the uses and benefits of such a system, a framework is drawn to develop and implement an environmental management accounting system within an organization. The paper also compares and finds the difference between traditional financial accounting method and environmental management accounting to outline the importance of the later system in the current business environment. The research paper also discusses the methods of finding environmental costs and how the companies can accrue saving and generate revenues by separating environmental costs from general accounting. The paper attempts to find out the basic benefits companies can garner by adopting an efficient environment management accounting practice which has the primary role to lead a company in the path of progress through eco-friendly initiatives. Furthermore, the research would validate the use of system in aiding management decisions regarding designing environmental friendly products, attuning production process and managing wastes. Although, environmental management accounting is a new approach to improve the environmental performance of a company, proper implementation of the system can assure transparency for the company to report the environmental costs clearly and help them in accessing their corporate social responsibility initiatives as well. All this, in turn enhance the image of the company in the media as well as amongst its shareholders.

Key Words: Environmental Management Accounting, Environmental Costs, Physical Information, Monetary Information, Activity Based costing

1. INTRODUCTION

In today's globalized economy, companies have become too competitive and are even using unethical means to pip the other firms in the race. The greatest concern these days have been on the effect of environment that these companies are putting to earn higher revenues and increasing their bottom line. Thus, government, non-governmental organizations as well as the general public are increasingly putting pressure on the companies to become responsible towards the environment and invest substantial amount of money and effort to protect the environment.

Therefore, the issue of safeguarding the environment has gained prominence throughout the world in the past few decades, which has in turn made it important for companies to re-think their accounting structure and emphasise on accounting for environmental and other such related issues in the annual reports and management decisions. Thus, the need of the hour for companies are not just analysing financial data but also to take into account various environment-related information in the end-of-the year results.

1.2 OBJECTIVES OF THE STUDY

The central theme of this paper is to illustrate the benefits of environmental management accounting system and find out how businesses can implement this system to garner better market value and position. Some of the major benefits of the environmental management accounting include aiding companies to take responsible decisions relating to issues such as allocating costs, capital budgeting or designing processes. Experts believe that companies can use the following steps to implement the accounting system in an effective manner. The first and the foremost step are to identify the opportunities so that unnecessary costs are eliminated that does not give any value to a product or process.

Furthermore, companies need to find out the environmental costs from the account sheets which are often hidden under the overhead accounts, direct labor accounts or direct material accounts. It has been found that in most cases, environmental costs are hidden in different parts of the management accounting system. For instance, the below diagram illustrates that the environmental cost is being hidden under direct labor, direct material and overheads.

1.3 RESEARCH METHODOLOGY

This chapter analyses the methodology to be used for conducting the research on finding about the benefits and uses of environmental management accounting for firms. Furthermore, the research attempts to undertake an in-depth analysis of environmental management accounting system and the need to draw a framework to develop and implement an environmental management accounting system within an organization. It would further discuss the use of qualitative

methodology for conducting this research to understand the importance of environmental management accounting system in today's business scenario, while also providing a base for further research.

I propose to use qualitative research methodology for undertaking this thesis, as I believe that qualitative research is significant for analysing the concept of environmental management accounting and how handling of environmental issues inappropriately can damage the reputation of a business in the market. Furthermore, it is also imperative to conduct an in-depth secondary research to understand the surrounding world (Saunders et al, 2007).

2. CONCEPT OF ENVIRONMENTAL MANAGEMENT ACCOUNTING (EMA)

According to IFAC's Statement *Management Accounting Concepts,* EMA is "the management of environmental and economic performance through the development and implementation of appropriate environment-related accounting systems and practices. While this may include reporting and auditing in some companies, environmental management accounting typically involves life-cycle costing, full-cost accounting, benefits assessment, and strategic planning for environmental management."

A complementary definition is given by the United Nations Expert Working Group on EMA, which more distinctively highlights both the physical and monetary sides of EMA. This definition was developed by international consensus of the group members, representing 30+ nations. According to the UN group:
EMA is broadly defined to be the identification, collection, analysis and use of two types of information for internal decision making:

- Physical information on the use, flows and destinies of energy, water and materials (including wastes) and
- Monetary information on environment-related costs, earnings and savings.[1]

These two definitions highlight the broad types of information organizations typically consider under EMA, as well as some common EMA data analysis techniques and uses. The specific types of physical and monetary information included under this definition of EMA are discussed in more detail below and in subsequent chapters. The benefits and uses of EMA also are discussed in more detail below. In the real world, EMA ranges from simple adjustments to existing accounting systems to more integrated EMA practices that link conventional physical and monetary information systems. But, regardless of structure and format, it is clear that both MA and EMA share many common goals. And it is to be hoped that EMA approaches eventually will support the IFAC proposals in *Management Accounting Concepts* that, in leading-edge MA, "inattention to environmental or social concerns are likely to be judged ineffective," and that "resource use is judged effective if it optimizes value generation over the long run, with due regards to the externalities associated with an organization's activities."

"EMA' serves business managers in making capital investment decisions, costing determinations, process/product design decisions, performance evaluation and a host of other forward-looking business decisions."[2] Thus, EMA has an internal company-level function and focus, as opposed to being a tool used for reporting environmental costs to external stakeholders.
It is not bound by strict rules as is financial accounting and allows space for taking into consideration the special conditions and needs of the company concerned.

Accountants have a special role in EMA, or certainly should have, since they're the ones with access to the important monetary data and information systems needed for EMA activities, the ability to improve or verify the quality of such information and the skills to use that information for decision making. A number of accounting associations have, therefore, taken a leadership position in clarifying the value of EMA to their members and promoting a wider adoption of EMA and related approaches. These associations include the Association of Chartered Certified Accountants (ACCA), the Chartered Institute of Management Accountants (CIMA), the Society of Management Accountants of Canada (CMA Canada), the Australian Society of Certified Public Accountants (CPA Australia), the European Federation of Accountants (FEE), the Institute of Chartered Accountants of New Zealand (ICANZ); the Japanese Institute of CPAs (JICPA) and the Philippine Institute of Certified Public Accountants (PICPA). Many organizations have already published guidance documents on EMA.2 Guidance is also available on the related subject of environmental costing for

[1] United Nations Divisions for Sustainable Development, Environmental Management Accounting, Procedures and Principles, 2001
[2] UNDSD: Improving Government's Role in the Promotion of Environmental Managerial Accounting, United Nations, New York, 2000, p. 39

financial accounting and reporting[3] and on national accounting and reporting.[4] As well, several books on environmental accounting have been published.[5] All of these have contributed greatly to the understanding and practice of EMA.
The existing guidance documents on EMA typically have focused on:
• Guidance for different national audiences, supplemented by national case studies and pilot projects (e.g., Argentina, Australia, Austria, Canada, the Czech Republic, Germany, Japan, the Philippines, Spain, the UK, the USA);
• Specific environmental management initiatives supported by EMA (such as solid waste management vs. supply chain management vs. environmental management systems vs. external reporting);
• Different levels of emphasis on particular EMA methodologies/approaches.

It makes sense that different countries and organizations would adapt general EMA concepts, language and practices to suit their own goals. A certain amount of experimentation and variation is also to be expected because EMA is still a relatively young and emerging field in comparison to conventional management accounting. The great number of existing guidance documents has, however, contributed to confusion on the exact definition, benefits and applications of EMA and on available EMA approaches and tools. This has been exacerbated by the fact that EMA information is broadly useful for so many different types of management decisions and activities, as well as for external reporting. With all this in mind, the Board of Directors of the International Federation of Accountants (IFAC) decided to commission this guidance document on EMA to bring together some of the best existing information on EMA and to update it and

[3] An Introduction to Environmental Accounting as a Business Management Tool: Key Concepts and Terms (Washington: United States Environmental Protection Agency, 1995); Tools and Techniques of Environmental Accounting for Business Decisions (Hamilton, Ontario: Society of Management Accountants of Canada, 1996); Introductory Guide to Environmental Accounting: Environment and Decision-making: An Appropriate Accounting (Ottawa, Ontario: Environment Canada, 1997); US Department of Defense, National Defense Center for Environmental Excellence, Environmental Cost Analysis Methodology ECAM Handbook (Fairfax, Virginia: Concurrent Technologies Corporation, 1999); United Nations Division for Sustainable Development, Environmental Management Accounting, Procedures and Principles (New York and Geneva: United Nations Publications, 2001); VDI 3800 Determination of Costs for Industrial Environmental Protection Measures (Berlin: Association of German Engineers, 2001); T. Loew, K. Fichter, U. Müller, W. Schulz and M. Strobel, Guide to Corporate Environmental Cost Management. Translated from Leitfaden Betriebliches Umweltkostenmanagement (Berlin: Bundesumweltministerium Umweltbundesamt (German Environment Ministry), 2003); Environmental Accounting Guidelines (Tokyo: Ministry of the Environment, 2002); and Increase your profits with environmental management accounting (Oxfordshire, UK: Envirowise, 2003).

[4] Environmental Issues in Financial Reporting (London: Institute of Chartered Accountants in England and Wales Environment Steering Group, 1996); United Nations Conference on Trade and Development, Accounting and Financial Reporting for Environmental Costs and Liabilities (UNCTAD/ITE/EDS/4) (New York and Geneva: United Nations Publications, 1999); Commission Recommendation on the Recognition, Measurement and Disclosure of Environmental Issues in the Annual Accounts and Annual Reports of Companies (Brussels: European Commission, 2001); and European Parliament and Council, "Directive 2003/51/EC of the European Parliament and of the Council of 18 June 2003 on the annual and consolidated accounts of certain types of companies, banks and other financial institutions and insurance undertaking," Official Journal of the European Union, L 178/16 (July 17, 2003).
Definitions and Guidelines for Measurement and Reporting of Company Environmental Protection Expense (Luxembourg: Eurostat, 2001); European Commission, "Commission Regulation (EC) No 1670/2003 of 1 September 2003 implementing Council Regulation (EC,Euroatom) No 58/97 with regard to the definitions of characteristics for structural business statistics and amending regulation (EC) No 2700/98 concerning the definitions of characteristics for structural business statistics," Official Journal of the European Union, L 244/74 (September 9, 2003); and United Nations (Statistical Division), European Commission, International Monetary Fund, Organization for Economic Co-*Economic Accounting (2003).*

[5] M. Bennett, J. J. Bouma and T. Wolters, eds., Environmental Management Accounting: Informational and Institutional Developments. Selected papers from EMAN-Europe conferences, 1999 and 2000 (Dordrecht, Netherlands: Kluwer Academic Publishers, 2002); M. Bennett and P. James, eds., The Green Bottom Line, Environmental Accounting for Management (Sheffield, UK: Greenleaf Publishing, 1998), http://www.greenleafpublishing. com/pdfs/gblch1.pdf; M. Bennett, P. Rikhardsson and S. Schaltegger, eds., Environmental Management Accounting: Purpose and Progress. Selected papers from EMAN-Europe conference, 2002 (Dordrecht, Netherlands: Kluwer Academic Publishers, 2003); K. Fichter, T. Loew and E. Seidel, Betriebliche Umweltkostenrechung (available only in German) (Berlin: Springer Verlag, 1997); K. Fichter, T. Loew, C. Redmann and M. Strobel, Flusskostenmanagement, Kostensenkung und Öko-Effizienz durch eine Materialflußorientierung in der Kostenrechnung (available only in German) (Wiesbaden, Germany: Hessisches Ministerium für Wirtschaft, Verkehr, und Landesentwicklung, 1999); R. Gray and J. Bebbington, Accounting for the Environment, 2nd ed. (London: Sage Publications, 2001); R. Gray, J. Bebbington and D. Walters, Accounting for the Environment. 1st ed. (London: Paul Chapman Publishing, 1993); K. Fichter, T. Loew, C. Redmann and M. Strobel, Flusskostenmanagement, Kostensenkung und Öko-Effizienz durch eine Materialflußorientierung in der Kostenrechnung (available only in German) (Wiesbaden, Germany: Hessisches Ministerium für Wirtschaft, Verkehr, und Landesentwicklung, 1999); S. Schaltegger and R. Burritt, Contemporary Environmental Accounting: Issues, Concepts and Practice **(**Sheffield, UK: Greenleaf Publishing, 2000).

add to it as necessary. The goal is to help reduce some of the international confusion on this important topic and to give some practical introductory guidance to individuals and organizations that wish to explore EMA further.

Why Care about Environmental Issues?

Why should organizations (or accountants) care about environmental issues? First, many internal and external stakeholders are showing increasing interest in the environmental performance of organizations, particularly private sector companies.[6] An example of internal stakeholders might be employees affected by pollution in the work environment. External stakeholders include communities affected by local pollution, environmental activist groups, government regulators, shareholders, investors, customers, suppliers and others. The types and intensities of environmental pressures can vary widely from country to country and among different business sectors. It is safe to say, however, that environmental pressure is forcing many organizations to look for new, creative and cost-efficient ways to manage and minimize environmental impacts. Prominent examples of environmental pressure relevant at the international level include:

• supply chain pressures, such as large companies requiring their suppliers to comply with the Environmental Management System (EMS) standard of the International
Standardization Organization;[7]
• Disclosure pressures from various stakeholders for companies to publicly report their environmental performance in annual financial accounts and reports [8] or in voluntary corporate environmental performance reports, for example, via the guidelines of the Global
Reporting Initiative;[9] financing pressures via the worldwide growth of socially responsible investment (SRI) funds, investment rating systems such as the Dow Jones Sustainability Index and investment policy disclosure requirements;[10]
• regulatory control pressures, for example, the RoHS Directive, a European Union (EU) regulation that restricts the use of certain hazardous substances in electrical and electronic equipment sold in the EU;[11]
• environmental tax pressures, for example, various government-imposed environment related taxes such as carbon taxes, energy use taxes, landfill fees and other emissions fees;
• Cap and trade pressures, such as the emissions cap and trading aspects of the Kyoto Protocol.

2.3 – Uses and Benefits of EMA

The specific uses and benefits of EMA are numerous, but can be organized into three broad categories, as illustrated below. The emphasis on Eco-efficiency and Strategic Position in two of the categories parallel the overall evolution of management accounting to include not only information provision and management planning and control, but also a focus on effective resource use and value creation. The strategic focus of EMA can, however, vary widely among different organizations.

It should be noted that there are no strict dividing lines among these three categories. For example, a manufacturing firm that reduces water use and, thus, wastewater generation via eco-efficiency projects might also reduce the load to, and costs of, an in-house wastewater treatment plant installed primarily for compliance purposes. The remainder of this section briefly discusses some prominent uses of EMA-type data that can have compliance, eco-efficiency and strategic benefits for organizations. One area that has received much attention from EMA researchers and practitioners is the use

[6] Information for Better Markets, Sustainability: the Role of Accountants (London: Institute of Chartered Accountants of England and Wales, 2004).

[7] Environmental Management – Environmental Management Systems – Specification (Geneva: International Standardization Organization, 1996)

[8] Environment Steering Group, Environmental Issues in Financial Reporting (London: Institute of Chartered Accountants in England and Wales, 1996); United Nations Conference on Trade and Development, Accounting and Financial Reporting for Environmental Costs and Liabilities, 1999; European "Commission Recommendation of 30 May 2001 on the recognition, measurement and disclosure of environmental issues in the annual accounts and annual reports of companies"; "Directive 2003/51/EC of the European Parliament and of the Council of 18 June 2003 on the annual and consolidated accounts of certain types of companies, banks and other financial institutions and insurance undertaking"

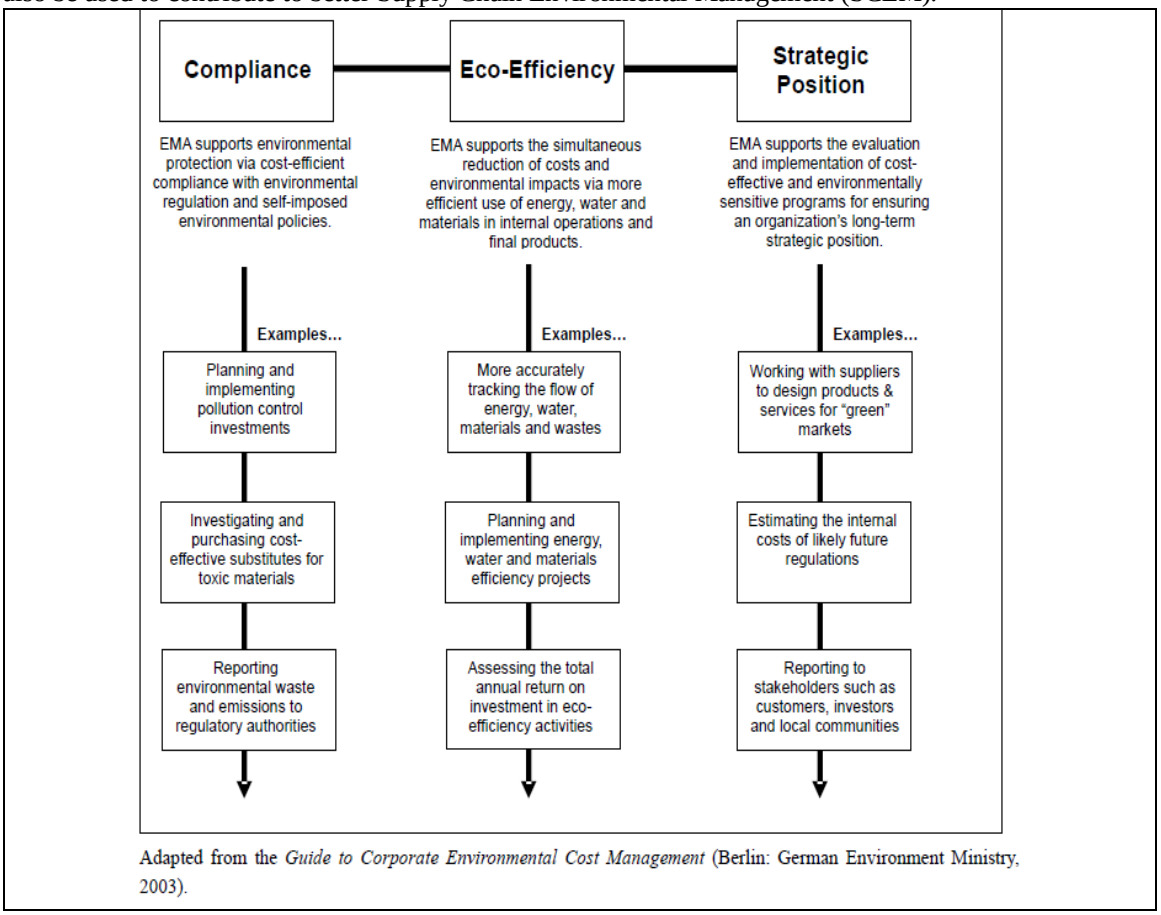
[9] Global Reporting Initiative, Sustainability Reporting Guidelines on Economic, Environmental and Social Performance (Amsterdam, 2002).

[10] Information for Better Markets, Sustainability: the Role of Accountants.

[11] D. Lea, Briefing Paper on the RoHS Directive (Herndon, Virginia: Celestica, Inc., 2004).

of EMA approaches for Investment Appraisal.[12] Investment Appraisal is a core management accounting technique that informs both routine and strategic organizational decisions. Under investment appraisal, organizations need to consider all potentially relevant and significant costs, including environment-related costs that may influence the return on investment. This includes somewhat uncertain costs that may best be handled by scenario analysis. This paper provides examples of the use of EMA perspectives for appraising investment projects related to eco-efficiency improvements in a manufacturing process, new product development and reduction of long-term environmental liability.

EMA approaches and information can be used not only to help assess particular investment projects, but also to help assess the environmental and related cost implications of particular types of materials and products. The assessment of a particular product line is often referred to as Life-cycle Assessment (LCA) or Life-cycle Costing (LCC). Such initiatives may take place within a single organization or via aggregation of information from several organizations along the product chain. Aggregation of EMA-type (and other) information from an organization's suppliers and customers can also be used to contribute to better Supply Chain Environmental Management (SCEM).



Adapted from the *Guide to Corporate Environmental Cost Management* (Berlin: German Environment Ministry, 2003).

Figure 1 – Uses and Benefits of EMA
Adapted from the Guide to Corporate Environmental Cost Management (Berlin: German Environment Ministry, 2003).

[12] D.E. Savage and A. L. White, "New Applications of Total Cost Assessment: An Exploration of the P2- Production Interface," Pollution Prevention Review (Winter 1994/1995); A. L. White, A. Dierks and D. E. Savage, Environmental Accounting Principles for the Sustainable Enterprise, roceedings of the 1995 International Environmental Conference of the Technical Association of the Pulp and Paper Industry (Atlanta, 1995); A. L. White and D. E. Savage, "Budgeting for Environmental Projects: A Survey," Management Accounting (October 1995); M. Kennedy, Total Cost Assessment for Environmental Engineers and Managers (New York: John Wiley & Sons, Inc., 1998); C. Jasch and H. Schnitzer, Umweltrechnungswesen – Wir, zeigen, wie sich Umweltschutz rechnet, Beispielsammlung zur Umweltkostenrechnung und Investitionsrechnung (Vienna: Bundesministerium für Verkehr, Innovation und Technik and Bundesministerium für Land- und Forstwirtschaft, Umwelt, und Wasser, 2002), available in a pdf file in English at www.ioew.at.

Decision making at many different levels can be supported by the continuing development and use of Environmental Performance Indicators (EPIs). EPIs can be created from purely physical information collected under EMA (for example, the total amount of wastewater treated each year) or purely monetary information collected under EMA (for example, the total cost of wastewater treatment each year). Physical EPIs and monetary EPIs can also be combined into cross-cutting EPIs that link the two types of information (such as the wastewater treatment costs per unit customer service each year).

Although management accounting traditionally supports internal decision making as its primary goal, many practitioners also view EMA as a support tool for external reporting to the many stakeholders interested in organization-level environmental performance. For example, many businesses report EMA-type physical information in voluntary corporate environmental performance reports, and some report related monetary information as well.

APPROACHES OF ENVIRONMENTAL MANAGEMENT ACCOUNTING FRAMEWORK:
This section outlines the two mainstream environmental management accounting frameworks:

- EMA limited to internal environmental accounting based on monetary measures
- EMA as a general term for internal environmental accounting

EMA as Monetary Internal Environmental Accounting:

The first approach considering EMA as monetary internal environmental accounting (see e.g. Schaltegger et al. 1996, Schaltegger & Burritt 2000) is derived from a general framework of environmental accounting **(figure :2)**

Accounting-Systems (&Measurement)	Environmentally Differentiated Conventional Accounting (MU)						Ecological accounting (PU)		
Stakeholders (example)	Management Accounting		Financial Accounting		Other Accounting Systems		Internal Ecological Accounting	External Ecological Accounting	Other Ecological Accounting
Management									
Shareholders									
Tax Agency									
Creditors									
Ecological Rating Agencies									
Environmental protection agency									
etc	…	…	…	…	…	…	…	…	…

ENVIRONMENTAL MANAGEMENT ACCOUNTING FRAMEWORK:
EMA is the generation and analysis of both financial and non-financial information in order to support internal environmental management processes. It is complementary to the conventional financial management accounting approach, with the aim to develop appropriate mechanisms that assist in the identification and allocation of environment-related costs (Bennett and James (1998a), Frost and Wilmhurst (2000)). The major areas for the application for EMA are:

- product pricing
- budgeting
- investment appraisal
- calculating costs and
- Savings of environmental projects, or setting quantified performance targets.

EMA is as wide-ranging in its scope, techniques and focus as normal management accounting. Burritt et al (2001) stated: 'there is still no precision in the terminology associated with EMA'. They viewed EMA as being an application of conventional accounting that is concerned with the environmentally-induced impacts of companies, measured in monetary units, and company-related impacts on environmental systems, expressed in physical units. EMA can be viewed as a part of the environmental accounting framework and is defined as 'using monetary and physical information for internal management use'. Burritt et al developed a multi-dimensional framework of EMA (Figure 3). Their framework considers the distinctions between five dimensions:

- internal versus external
- physical versus monetary classifications
- past and future timeframes
- short and long terms and
- ad hoc versus routine information gathering in the proposed framework for the application of EMA.

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

Figure 3: Proposed framework of EMA according to Burritt et al (2001)

Within this framework the different techniques of EMA - such as environmental lifecycle costing or environmental cost accounting - can be placed and assigned. The management of a company can choose appropriate tools on the basis of their information needs. Similarly, in a series of publications (1997, 1998a, 1998b), Bennett and James describe the diverse range and scope of environmental management accounting. They provide a set of useful models, one of which is

'The Environment-Related Management Accounting Pyramid', to help evaluate environmental management accounting practices as well as to help in the design and implementation of new systems.

According to Bennett and James (1998a, EMA is concerned with gathering data related to the environment (lowest levels), which are converted through techniques and processes (middle level) into information which is useful for managers (top). Key data is both non-financial and financial in nature. Management accounting techniques such as performance measurement, operational budgeting, costing or pricing are used for the transformation.

The structure of the integrated framework of EMA introduced in this article can also be used for the wider context of environmental accounting. Analogous to the distinction between for MEMA and PEMA environmental accounting in general can be divided into two main categories Monetary Environmental Accounting (MEA) and Physical Environmental Accounting (PEA) (see figure 4). EMA then is clearly defined as a subject of environmental accounting being concerned with the provision of environment related information to management i.e. serving the information needs of internal company stakeholders.

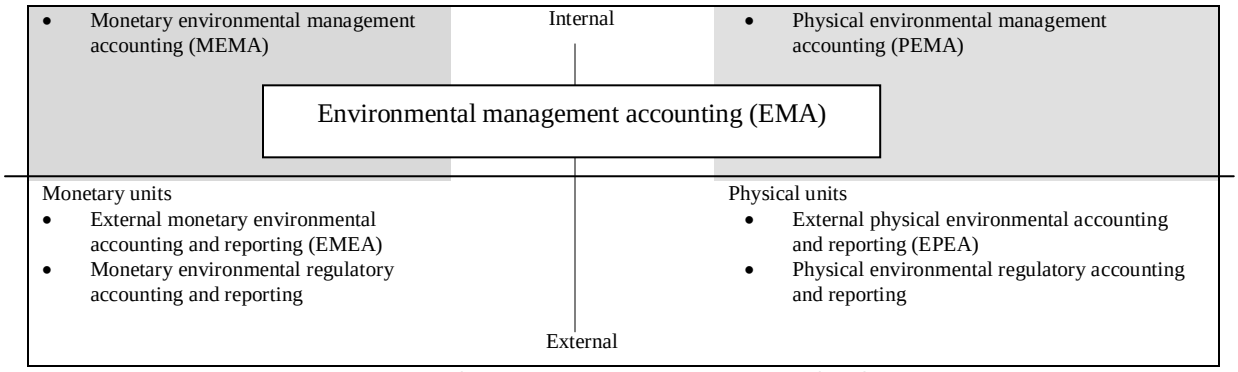


Figure 4: comprehensive Framework of Environmental Accounting (modified from Bartolomeo et al. 2000, 33)

Techniques of Environmental Management Accounting

The main difficulty associated with environmental costs is their identification and allocation. According to UNDSD (2003), conventional accounting systems tend to attribute many of the environmental costs to general overhead accounts with the result that they are 'hidden' from management. Thus, management is often unaware of the extent of environmental costs and cannot identify opportunities for cost savings. EMA attempts to make all relevant, significant costs visible so that they can be considered when making business decisions (Jasch, 2003). UNDSD (2003) identified management accounting techniques which are useful for the identification and allocation of environmental costs as: input/output analysis, flow cost accounting, activity-based costing (ABC), and lifecycle costing.

- **Input/output analysis**

  The input/output analysis is a technique that can provide useful environmental information, sometimes referred to as mass balance (Envirowise, 2003). This technique records material flows with the idea that 'what comes in must go out - or be stored' (Jasch, 2003).

  As shown in Figure-5, the purchased input is regarded as 100% and is balanced against the outputs - which are the produced, sold and stored goods and the residual (regarded as waste). Materials are measured in physical units and include energy and water. At the end of the process, the material flows can be expressed in monetary units. Process flow charts can help to trace inputs and outputs, in particular waste. They demonstrate the details of the processes so that the relevant information can be allocated to main activities.

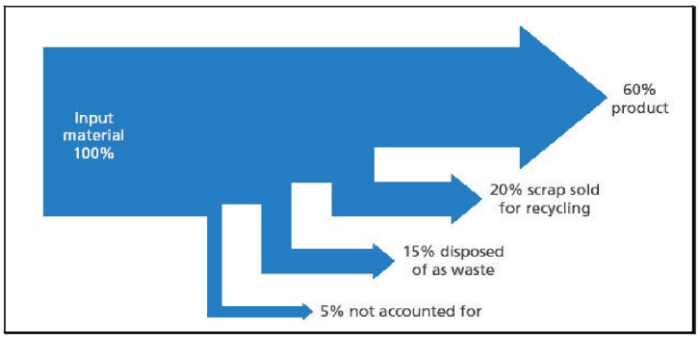


Figure 5: Input/output Analysis according To Envirowise (2003)

Process flow charts bring together technical information and cost accounting information (UNDSD, 2003). Flow cost accounting is a tool of a new management accounting approach - flow management. It aims to '...organise production end-to-end in terms of flows of materials and information -all structured in an efficient, objective-oriented manner' (UNDSD, 2003). It is more than a simple assessment of environmental costs, because it is focused on assessment of total costs of production.

Flow management involves not only material flows, but also the organisational structure. Classic material flows are recorded as well as material losses incurred at various stages of production. Flow cost accounting makes material flows transparent by using various data, which are quantities (physical data), costs (monetary data) and values (quantities x costs). The material flows are divided into three categories, material, system, and delivery and disposal, as shown in Figure -6. The material values and costs apply to the materials which are involved in the various processes. The system values and costs are the in-house handling costs, which are '...incurred inside the company for the purpose of maintaining and supporting material throughput, e.g. personnel costs or depreciation,' (UNDSD, 2003). The delivery and disposal values and costs refer to the costs of flows leaving the company, for example transport costs or cost of disposing waste. EMA can benefit from flow cost accounting because it aims to reduce the quantities of materials, which leads to increased ecological efficiency (UNDSD, 2003).

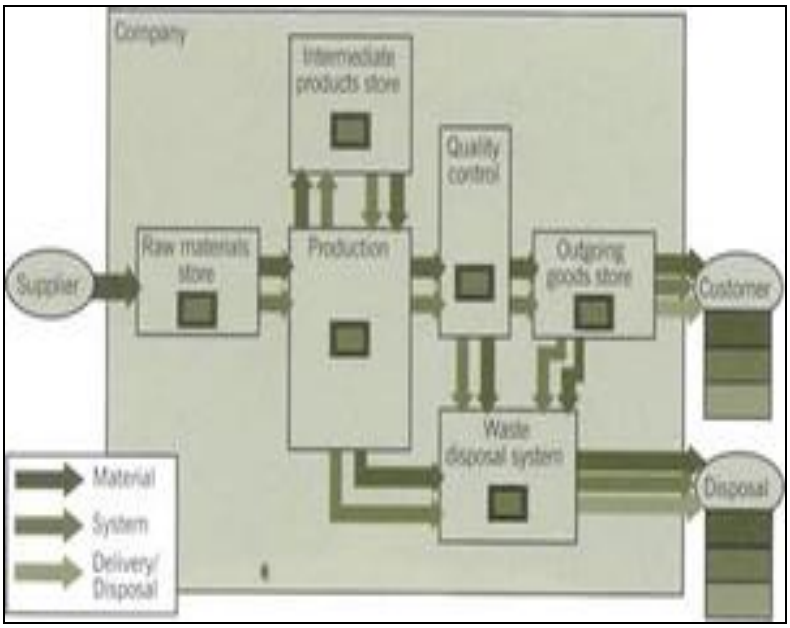


Figure -6: The basic idea of flow cost accounting according to UNDSD (2003)

- **Process flow charts**

The next step after environmental cost assessment and material flow balances on a corporate level is to allocate the data from the system boundary of the company fence to internal processes. Process flow charts, which trace the inputs and

outputs of material flows (solid, liquid and volatile) on a technical process level, give insights into company-specific processes and allow the determination of losses, leakages and waste streams at the originating source. This requires a detailed examination of individual steps in production - again in the form of an input output analysis, but sometimes linked to technical Sankey diagrams. The process flow charts combine technical information with cost-accounting data. They are not done on a yearly basis but for a specified production unit, machinery or cost centre. In total, they should aggregate to the yearly amount. This level of material flow analysis will be in the responsibility of technicians, but the data gathered should be cross-checked to ensure consistency with the cost-accounting system. Usually a harmonization of technical data with data from financial bookkeeping is not undertaken due to lack of interdepartmental communication. Experience has shown that such a consistency check provides great optimization potentials, and has thus become a major tool in environmental accounting. Therefore it is desirable for the technical and financial bookkeeping to be conducted in a compatible way.

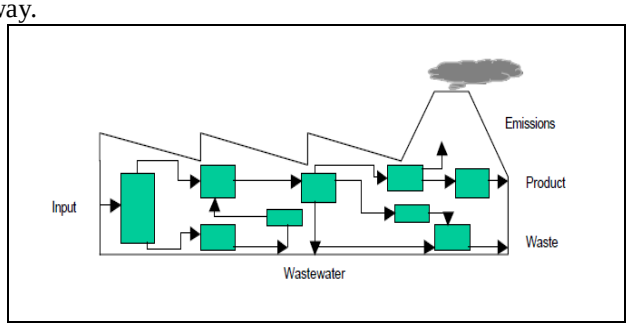


Figure-7. Process Flow Charts: Opening of the Black Box

- **Environmental Activity-Based Accounting**

  Activity-based costing (ABC) '...represents a method of managerial cost accounting that allocates all internal costs to the cost centers and cost drivers on the basis of the activities that caused the costs,' (UNDSD, 2003). ABC applied to environmental costs distinguishes between environment-related costs and environment-driven costs. The former are attributed to joint environmental cost centers, for example incinerators or sewage plants. The latter are hidden in the general overheads and do not relate directly to a joint environmental cost centre, e.g. increased depreciation or higher cost of staff. Nevertheless they vary with the amount of throughput.

  Schaltegger and Muller (1998) stated 'the choice of an adequate allocation key is crucial for obtaining correct information'. The four main allocation keys are:

  - volume of emissions or waste
  - toxicity of emission and waste treated
  - environmental impact added (volume x input per unit of volume) volume of the emissions treated and
  - the relative costs of treating different kinds of emissions.

This section discusses activity-based costing of pollution prevention. The focus of this approach deals with correct allocation of costs to products, by reducing the amount of costs hidden in overhead cost categories. Applying this approach can improve economic Performance as a consequence of improved environmental protection.[13] Moreover, ignoring this approach could distort product pricing and investment decisions. The example in figure -8 shows that costs of "joint" environmental cost centers, such as Incinerators, waste water treatment plants, etc., should be differentiated from other overhead costs. The manufacturer has three production steps that all produce waste. The entire waste is treated in a shared incinerator on the production site. The costs of incinerating the waste from current production are $800; the remaining overhead costs for general administration, salaries of top management, etc. are $9,000.

Internal environmental costs are often treated as overhead costs and divided equally between all cost drivers. A common example is that the costs of treating toxic waste of a product are included in the general overhead costs, and the overhead is allocated in equal parts to all products. However, "dirty" products cause more emissions and require more clean-up facilities than "clean" products. Equal allocation of those costs therefore subsidizes environmentally more harmful

[13] Schaltegger et al., The description of ABC in the following is taken from S. Schaltegger and K. Müller, (1997).

products. The clean products, on the other hand, are "penalized" by this allocation rule as they bear costs that they did not cause.

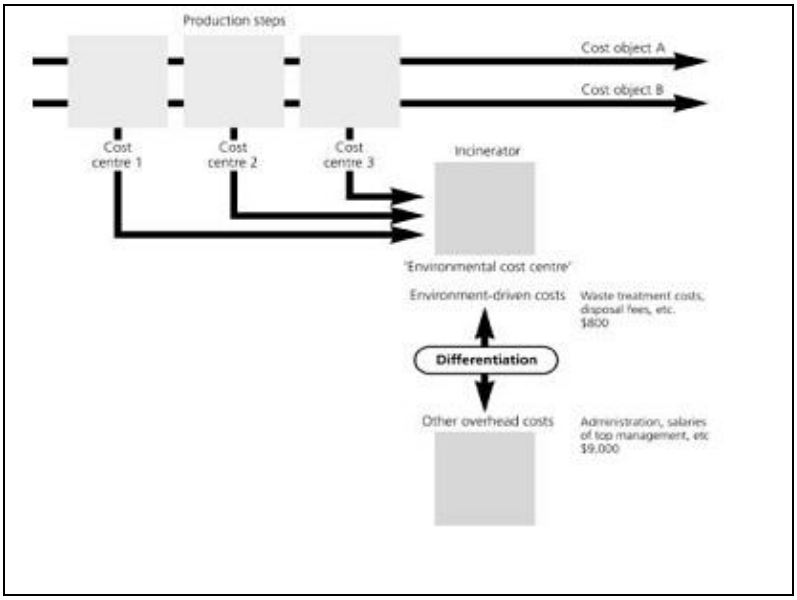


Figure – 8Tracking and tracing of environmental related costs
Source: Schaltegger, Müller, 1997.

Many companies simply include all environmental protection costs in their general overhead costs, together with the top management salaries, advertising costs and all other costs that were not traced back to individual production processes. At a time when environmental compliance costs were marginal and profits high, this might have been reasonable. But with increased environmental awareness, strong competition and the need to improve production efficiency, especially with regard to material efficiency, the cost of tracking and tracing material flows throughout the company are by far outweighed by the improvement potentials identified and realized. A simple example in figure-9 illustrates how equal allocation can lead to suboptimal management decisions. Two processes are compared: process A is clean" and does not cause any environment-driven costs for the company, while process B causes $50 of extra costs because it is environmentally harmful. If these costs are assigned to general overhead and allocated equally, both processes appear to create a profit of $75. (If $50 is allocated to overhead, $25 will implicitly be allocated to each process. This leads to a profit of $75 [$200- $100-$25]). In reality, however, process A has created a profit of $100, while process B has only contributed $50 to the company's profit.

	'Clean' process A	'Dirty' process B
Revenues	$200	$200
Production costs	$100	$100
Environmental costs	$0	$50
True profit	$100	$50
If environmental costs are overhead	$25	$25
Then the book profit is	$75	$75
Which is incorrect by	–25%	+33%

Figure-9 Example of correct and incorrect cost allocation
Source: Schaltegger, Müller, 1997.

Suboptimal management decisions materially influence the pricing of products. The cross subsidized dirty products are sold too cheaply whereas the environmentally less harmful products are sold too expensively. In consequence, market share is lost in more sustainable fields of activity and at the same time the company's item is enhanced in fields with higher risk and poor business future. Whenever possible, environment-driven costs should be allocated directly to the activity that causes the costs and to the respective cost centers and cost drivers. Consequently, the costs of treating, for example, the toxic waste arising from a product should directly and exclusively be allocated to that product.

Many terms are used to describe this correct allocation procedure, such as environmentally enlightened cost accounting, full cost accounting or activity-based costing (ABC). ABC, activity-based costing, "is a product costing system, ... that allocates costs typically allocated to overhead in proportion to the activities associated with a product or product family". ABC represents a method of managerial cost accounting that allocates all internal costs to the cost centers and cost drivers on the basis of the activities that caused the costs. The activity based costs of each product are calculated by adding the appropriate share of joint fixed and the joint variable costs to the direct costs of production. The strength of ABC is that it enhances the understanding of the business processes associated with each product. It reveals where value is added and where value is destroyed.

The example in figure-10 illustrates the method of ABC. It shows two steps of allocation: first, from joint environmental cost centers to the responsible cost centers (i.e., production processes); and, second, from the production cost centers to the respective cost drivers (i.e., products A and B). Today, it is substantially misleading to include all environment-related costs in general Overhead costs; nevertheless, some remain as overhead, such as those costs clearly related to general overhead activities (e.g., new insulation of the office building). Also, costs of past production that are clearly related to strategic management decisions for the whole company might qualify as general overhead costs (e.g., liability costs for products that have been phased out). At present, even in some advanced management accounting systems, only the visible (direct) costs of environmental cost centers are directly allocated to production cost centers and cost drivers. However, additional costs can be environment-driven even though they do not directly relate to a joint environmental cost centre (e.g., an incinerator). Yet some indirect costs could be saved if less waste were created. Waste occupies manufacturing capacities, requires labour, and increases administration, and so on. If no waste were produced, the equipment would not depreciate as quickly, and less salary would have to be paid.

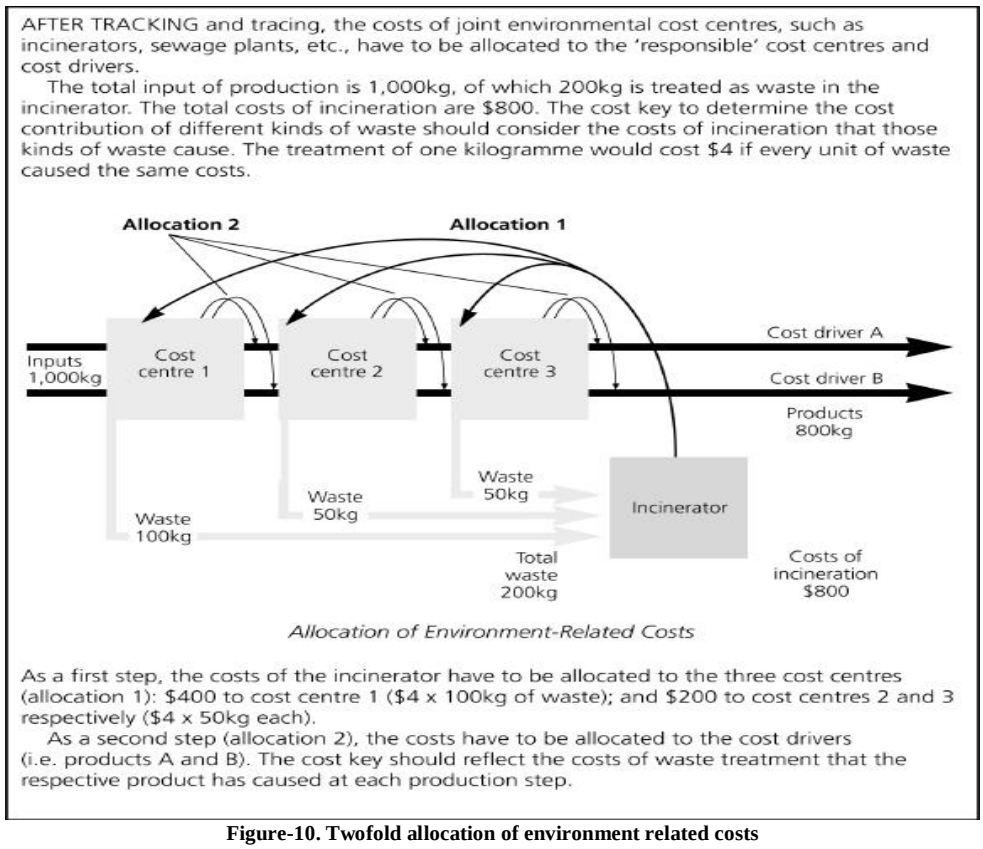


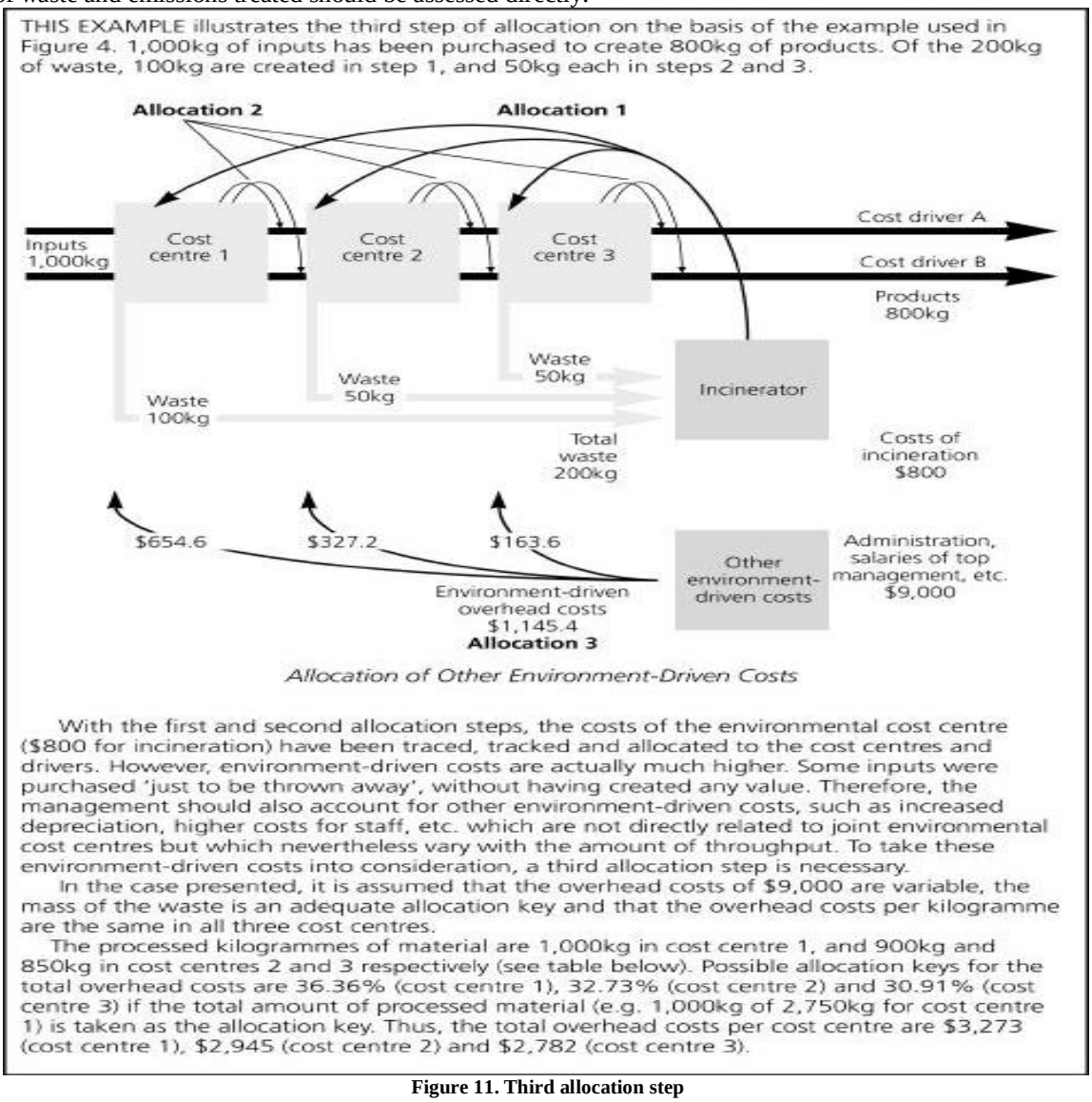
Figure-10. Twofold allocation of environment related costs
Source: Schaltegger, Müller, 1997.

For instance, in the example in figure 32, 200 kg of the 1,000 kg of inputs were purchased only to be emitted without creating any value. Thus, the related waste has caused a 20 per cent higher purchasing cost, higher costs of depreciation and administration, etc. Therefore, a third allocation step is necessary. As shown in figure 11, this third allocation step can motivate management to realize huge efficiency gains by improving the environmental record at the same time! The choice of an accurate allocation key is crucial for obtaining correct information for cost accounting. It is important that

the chosen allocation key is closely linked with actual, environment-related costs. In practice, the following four allocation keys are considered for environmental issues:

- Volume of emissions or waste treated;
- Toxicity of emissions or waste treated;
- Environmental impact added (volume is different to impact per unit of volume) of the emissions;
- Relative costs of treating different kinds of waste or emissions.

One possibility is to allocate the environment-driven costs based on the volume of waste caused by each cost driver (e.g., volume treated by hour, waste/kg of output, and missions /working hour of equipment). This is a rather arbitrary key in cases where the capital costs (interest and depreciation of construction costs [capital assets]) as well as the variable costs are not related to the total volume treated. Due to higher safety and technological requirements, the construction costs and the variable costs often increase substantially with a higher degree of toxicity of the waste treated. In many cases, these additional costs are due only to a small percentage of the waste. Thus, the costs of a treatment or prevention facility are often not clearly related to the overall volume treated, but rather to the relative cleaning performance required. Another possibility is to allocate costs according to the potential environmental impact added of the treated emissions. The environmental impact is calculated by multiplying the volume of waste by the toxicity of the emissions. However, this allocation key, too, is often inappropriate, as the costs of treatment do not always relate to the environmental impact added. Thus the choice of allocation key must be adapted to the specific situation, and the costs caused by the different kinds of waste and emissions treated should be assessed directly.



Allocation of Other Environment-Driven Costs

With the first and second allocation steps, the costs of the environmental cost centre ($800 for incineration) have been traced, tracked and allocated to the cost centres and drivers. However, environment-driven costs are actually much higher. Some inputs were purchased 'just to be thrown away', without having created any value. Therefore, the management should also account for other environment-driven costs, such as increased depreciation, higher costs for staff, etc. which are not directly related to joint environmental cost centres but which nevertheless vary with the amount of throughput. To take these environment-driven costs into consideration, a third allocation step is necessary.

In the case presented, it is assumed that the overhead costs of $9,000 are variable, the mass of the waste is an adequate allocation key and that the overhead costs per kilogramme are the same in all three cost centres.

The processed kilogrammes of material are 1,000kg in cost centre 1, and 900kg and 850kg in cost centres 2 and 3 respectively (see table below). Possible allocation keys for the total overhead costs are 36.36% (cost centre 1), 32.73% (cost centre 2) and 30.91% (cost centre 3) if the total amount of processed material (e.g. 1,000kg of 2,750kg for cost centre 1) is taken as the allocation key. Thus, the total overhead costs per cost centre are $3,273 (cost centre 1), $2,945 (cost centre 2) and $2,782 (cost centre 3).

Figure 11. Third allocation step
Source: **Schaltegger, Müller, 1997.**

- **LIFE CYCLE COSTING**

Environmental Management as part of Total Quality Management

The pursuit of environmental quality management via the development of an Environmental Management System (EMS) can only be achieved if 'environmental audit' is a concomitant feature of such a system. In this respect the organisation becomes self-regulating and the undertaking of environmental audits on a regular basis provides the platform for organisations to adopt a self-critical and analytical posture as part of their routine organisational management processes. Organisations should be striving to achieve an integrated environmental strategy underpinned by the same type of culture that is required for the successful operation of a programme of total quality management (TQM).

It is arguable that the two are inextricably linked insofar as good environmental management is increasingly recognised as an essential component of TQM. In common with TQM, the focus is upon 'continuous improvement' and the pursuit of excellence. Such organisations pursue objectives that may include zero complaints, zero spills, zero pollution, zero waste and zero accidents. Information systems need to be able to support such environmental objectives via the provision of feedback - on the success or otherwise - of the organisational efforts in achieving such objectives. This approach to environmental quality management requires the development of environmental performance measures and indicators that will enable a comprehensive review of environmental performance to be undertaken. Many - if not all - total quality management accounting techniques can be modified and effectively adopted to help manage environmental issues.

CONCLUSION

It can be said that most companies do not know about the extent of their environmental costs and tend to underestimate them. This leads to distorted calculations of improvement options. For example, Amoco Yorktown Refinery estimated their environmental costs at 3% of non-crude operational costs. Actually they comprised 22% of non-crude operating costs as the case study of Ditz et al (1998) revealed. However, the study also discovered a large proportion of environmental costs were caused by other processes that had not been identified by Amoco.

EMA can solve these problems. The above-mentioned accounting techniques are useful for EMA to identify and allocate environmental costs. In addition, there are alternative techniques to estimate environmental costs such as the 'environmental cost decision tree' as described by Rimer (2000). The most significant problem of EMA lies in the absence of a clear definition of environmental costs. This means it is likely that organisations are not monitoring and reporting such costs. The increase in environmental costs is likely to continue, which will result in the increased information needs of managers and provide the stimulus for the agreement of a clear definition. If a generally applicable meaning of environmental costs is established, the use of EMA will probably increase with positive effects for both organisations and the environment in which they operate. In the future it will not only be large companies which can afford to implement EMA but also small and medium-sized enterprises which have fewer available financial resources.

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UNDSD - United Nations Division for Sustainable Development, Environmental Management Accounting Procedures and Principles (EMARIC Environmental Management Accounting Research and Information Center, 2003), Environmental Management Accounting Procedures and Principles(PDF)

The International Website on EMA

This website includes a section on EMA news and events, a searchable electronic library of EMA Documents, and descriptive links to the organizations and websites listed below.

http://www.EMAwebsite.org
Asia-Pacific Centre for Environmental Accountability http://www.accg.mq.edu.au/apcea/
Association of Chartered Certified Accountants (ACCA): Social & Environmental accounting
http://www.accaglobal.com/publications/environment/
Canadian Institute of Chartered Accountants (CICA): Environmental Accounting Resources
http://www.cica.ca/index.cfm
The Centre for Social and Environmental Accounting Research (CSEAR)
http://www.st-andrews.ac.uk/management/csear/index.html
The Chartered Institute of Management Accountants (CIMA) http://www.cimaglobal.com
EMA Network (EMAN) Asia Pacific http://www.eman-ap.net/
EMA Network (EMAN) Europe http://www.eman-eu.net/
Environmental Management Accounting for South-East Asia http://www.environmental-accounting.org
Environment Agency (England and Wales): Environmental Accounting
http://www.environment-agency.gov.uk/environmentalaccounting
Environmental Management Accounting Research and Information Center (EMARIC)
http://www.emawebsite.org/about_emaric.htm
The European Federation of Accountants (FEE): Sustainability Working Party
http://www.fee.be/issues/other.htm#Sustainability
German Technical Cooperation Association (GTZ): Environment-oriented Cost Management (EoCM)
http://www.gtz.de/p3u/english/EoCM.htm
Institute of Chartered Accountants in England and Wales (ICAEW) http://www.icaew.co.uk/sustainability
Institute of Chartered Accountants of New Zealand (ICANZ): Sustainability Special Interest Group (SSIG)
http://www.icanz.co.nz/StaticContent/Regions/SIG.cfm?SIGNAME=AKSWG&SIGID=0
ENVIRONMENTAL MANAGEMENT ACCOUNTING 87
Institute for Environmental Economics and Management (IOEW) Vienna
http://www.ioew.at/ioew/index-en.html click on "projects" then "environmental accounting
Institute for Management & the Environment (IMU): Eco-Effizienz Project - Materials Flow Accounting
http://www.imu-augsburg.de/engl/index.php?seite=material_intelligence/mi_problemstellung.html
http://www.eco-effizienz.de/index_noflash.htm
Japan Ministry of the Environment (MOE): Environmental Accounting Guidelines
http://www.env.go.jp/en/ssee/eag02.pdf
Northeast Waste Management Official's Organization (NEWMOA): Environmental Management Accounting Topic Hub
http://www.newmoa.org/prevention/topichub/toc.cfm?hub=105&subsec=7&nav=7
United Nations Division of Sustainable Development (DSD/UNDESA): EMA Initiative
http://www.un.org/esa/sustdev/estema1.htm