PART II

THE METHODOLOGY

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A. Background

Much work has been done over the past three years in the field of EMA. The methodology used within the EMA TEST project uses the experience from this work.[10] This includes the use of environmental cost allocation. The project appraisal portion relied on the total cost accounting concept published by EPA and used in the UNIDO COMFAR and the P2 Finance (developed by the Tellus Institute[11]) software tools. Cost categories were defined following the existing workbook published by United Nations Division for Sustainable Development (UNDSD).[12]

Within the TEST Project framework, a significant contribution to the practical use of EMA was made in the following areas:

- Linking CPA and EMA: introducing different controlling methods for non-product output costs. EMA was divided into three main categories to reflect the different levels of controllability of costs for both short and long term conditions. This will lead to a better understanding of the amount a company can save, by just improving the operation of its existing technology, or by making major technology change over to environmentally sound technologies;
- Developing outlines for scoping EMA: defining the steps of implementation and developing an information system for EMA;
- Identifying both the barriers to EMA, and ways to overcome them, when it is introduced under different circumstances.

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[10] Stefan Shaltegger and Roger Buritt: Contemporary Environmental Accounting, Issues, Concepts and Practice, 2000.

[11] www.tellus.org.

[12] UNDSD: Environmental Management Accounting: Procedures and Principles, United Nations, New York, 2001.

B. Implementing the EMA

In the following section, the steps of the EMA implementation process used in the TEST project are described.

1. Scoping EMA

Once management is committed to introducing an EMA, the first step is to define the scope of the EMA, which means to identify the area of the company where the project should focus its implementation and the depth of the analysis. Usually the processes and/or the products, which are causing the most significant environmental aspects and impacts, are selected as the initial focus of an EMA project.

Setting the goal of the project will lead to defining the depth of the analysis within the selected focus area. An EMA project will start with calculating environmental costs, and depending on the goal which has been initially set, will move to the next step of allocating those costs to cost centres[13] and to products.

For some industrial processes, where the same technological process produces several products, the environmental costs of one specific product are linked to the costs of other products. Therefore, in several cases one product may not be able to be evaluated without also evaluating others. In this way the selection of the focus area and the depth of the analysis are inter-related and decisions should take into account the type of industrial production processes that are in place as well as the kind of products that are manufactured.

Generally, not all possible environmental cost items will be measured. The main criteria for selection of which to measure is the magnitude of the environmental cost item compared to the total production costs. The trade-off between the efforts for data collection and the benefit of having more accurate information will influence the selection of the environmental costs items chosen. The selection of the project's priority environmental cost items is made during the initial step of scoping an EMA project.

[13] Costs centres are the smallest units of activities of responsibilities for which accounts are accumulated. A cost centre can be a process, a department, a programme, etc.

It is the joint responsibility of the environmental manager and the accounting department to decide which costs are relevant and considered for the EMA project. An EMA expert can assist in this decision-making process. Although an initial estimation of environmental costs is needed to properly scope an EMA, the actual environmental costs will only be known at the end of the EMA project, when the values have been correctly calculated. The situation is complicated by the fact most companies underestimate their environmental costs.

This problem can be overcome by setting a very conservative limit on the magnitude of environmental costs that will be dealt with and by applying a systematic approach to the analysis. For example, the company might initially decide to deal with environmental costs initially estimated to be less than 1 per cent of product costs. If the EMA calculation of environmental costs reveals that this preliminary estimation is correct, the company can continue to assign these costs into overhead. On the contrary, it might turn out that some costs, originally estimated to be under this limit, are actually higher than initially estimated. For example, it may be determined that 1 per cent of production costs was too low as criteria and the level could be increased to 3 per cent or more before it needs to be addressed. The limits must be set in a conservative manner to reduce the risk of bad estimations, but can be revised as appropriate.

By the end of the scoping exercise, there will usually have been a definition of a preliminary set of environmental costs that are considered relevant or of concern. They will be controlled on a periodic basis, but may change at the end of the project when the final parameters are chosen, based on their real value and impact on production costs. The EMA is an iterative process and can be applied incrementally to processes and products. Therefore, additional environmental costs items, not selected in the initial scope of the EMA, can still be considered within the frame of the project. Moreover, the priority of some cost items, judged not significant at the beginning, might become important due to changes in regulations, input prices, etc.

2. Calculation of environmental costs

The next step is to choose a time period (quarterly for example) of which the analysis will be conducted and collect all the necessary information

for the calculation of the selected environmental cost items. The process of collecting data is time and effort consuming: different sources should be analysed to extract the relevant information.

If a cost accounting system is in place, a cost centre structure is already defined which may be very useful to collect the relevant information. These accounting systems frequently have some "environmental waste and emission treatment costs" categories already allocated to cost centres. However it is very rare that these environmental costs refer to independent account numbers within the company's bookkeeping system: generally, they are pulled in on the same account as non-environmental related information. Besides the fact that this makes the environmental-related portion of the specific cost items invisible to management, the existing allocation of environmental costs is done utilizing the same allocation keys used for non-environmental costs (like labour or machine hours) and will not generally be correct for these types of costs. For example, income statements usually combine the depreciation of environmental related equipment and non-environmental equipment on the same account. Thus, work needs to be done to extract the relevant information from existing accounts. Once the environmental costs are extracted however, they should be properly re-allocated to cost centres using environmental keys.

Even though some categories of environmental costs might have their independent account number and be allocated to cost centres, they may not be allocated to the cost centre where they actually originate or the allocation key used may not be appropriate. As an example, waste and emission treatments costs might already be allocated to the environmental department or to a specific end-of-pipe equipment only on the basis of total volume, without considering the toxicity or the pollution concentration-loads contribution of the individual costs centres. This aspect has to be checked before using the values from the existing system.

Generally expenditures related to other environmental costs categories, like prevention and environmental management costs, are not allocated to cost centres even if a cost accounting system is in place. These costs are usually hidden in various overheads and are included in the same account number as other expenditures. In such cases, different accounts and bills must be checked first to identify the environmentally related

information to be extracted. Depending on the nature and magnitude of the environmental costs, a decision can then be made on whether to allocate those costs to cost another centre, or leave them in the overheads and eventually create an environmental overheads general account.

While waste and emissions treatment, prevention, and environmental management costs can usually be found in existing accounts (more or less easily), less conventional environmental costs have to be calculated. For instance, the purchase values of product and non-product outputs are not distinguished from one another and are recorded together as direct production costs. There are different ways to calculate non-product output costs (see part II section B-2.1), however it is necessary to first have a detailed mass balance of each production step to identify where material and energy losses originate within the process. A CPA assessment is good tool to do this.

To assure consistency of the analysis, cross-checking of data should be done using different sources of information such as balance sheets, profit and loss accounts, inventories and material balances.

2.1. Calculation of non-product output costs

One of the goals of EMA is to highlight the contribution of environmental costs to unit product costs. This is particularly true for non-product output costs, which usually represent the most significant share of total environmental costs, but often are forgotten or ignored. The establishment of an EMA system will result in more control over environmental costs. This information can assist in directing decisions towards the adoption of cleaner production measures or new technologies to reduce these costs.

As can be found in literature[14] the usual practice for calculating non-product output costs is to take into consideration the entire value of inputs that do not go into to the final product. However, this approach ignores the fact that not all wastes and emissions can be eliminated even when state of the art technology (BAT) is in use, and thus, companies usually feel that this approach is too penalising. To better help managers plan

[14] This definition is used by UNDSD and by Shaltegger.

cleaner production measures and/or investments in new cleaner technologies, it can be useful to create three different benchmarks against which companies can compare their non-product output costs. The three benchmarks reflect how companies can manage and eventually reduce those costs both in the short-term as well as in the long-term.

The first, and normally least stringent benchmark, is what we can call technological norms. These represent the most efficient level of input consumption and emissions achievable by the technology that the company has in place. Technological norms allow for the fact that some wastes, emissions and scrap outputs cannot be avoided, even when the existing technology is operated in the most efficient way. These values can be found in engineering design specifications and operating parameters, manufacturer's technical manuals and process flow sheets (which have been modified to quantifiably reflect volumes where wastes are concerned). These data could be consolidated into technological flow-charts. In this case, the difference between the actual costs of the inputs and the costs of the inputs if the technological norms were adhered to, demonstrates how much companies can save in the short-term by operating their existing technology in the most efficient way.

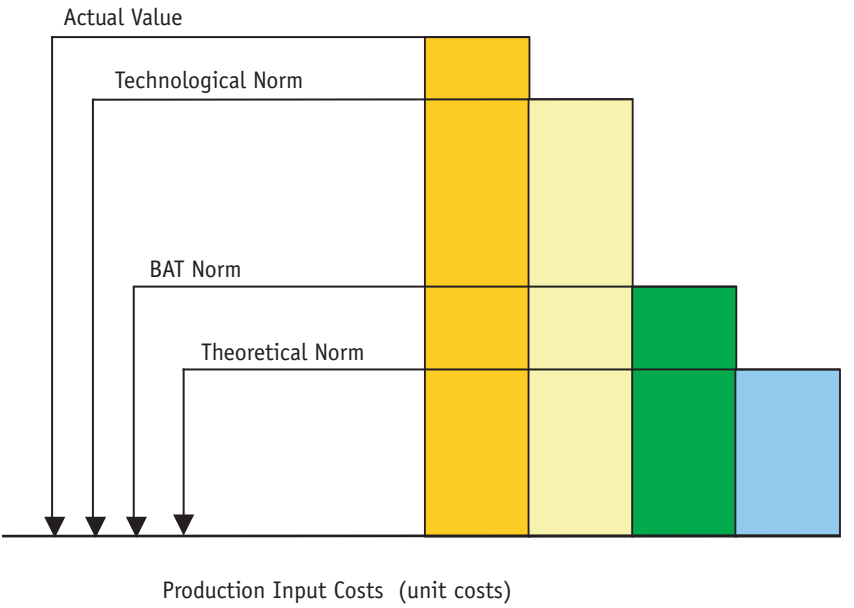
The next, and usually more stringent benchmark, is the Best Available Technology (BAT) levels. These will be technologies, that for particular sectors and/or products, are considered the most efficient and/or protective of the environment currently available on the international market. By using this benchmark to calculate non-product output costs, a company is signalling that it recognizes that it could switch to the best available technology (BAT), or at least implement technological changes to come closer to BAT levels (by purchasing equipment with efficiencies closer to BAT) or significantly modify its current technology. The difference between the actual costs of the inputs (or between the input costs for the technological norms) and the costs of the inputs for BAT norms shows how much companies could save by switching to BAT (or close to BAT). The use of this benchmark, like the technological norms, recognizes that some waste and pollution will always be generated (although lower in quantities). This cost difference is the one that companies should definitely use when important decisions are made regarding the choice of new technologies and is best addressed in an analysis over a medium-longer time line.

The final benchmark is the theoretical norms. Theoretical norms assume 100 per cent efficiency and do not allow for any wastes or emissions. As such, they can never be achieved, only approximated. As mentioned above, this is implicitly or explicitly the benchmark used in most literature on the calculation of non-product output costs. In the chemical industry this amount is determined by the reaction equation. In other industries a thorough input-analysis could be required to show the portion of the inputs that would directly become part of the product. Technological flowcharts can also be used for this purpose in non-chemical based operations.

In the end, as technology develops, BAT can change and move closer to the theoretical norm efficiency levels, so the gap between the last two benchmarks will continue to narrow.

The relationship between the above-mentioned norms to calculate non-product output costs are shown in figure I, where the technological norm is higher than BAT and BAT is higher than the theoretical norm.

Figure I. Comparative Short-Term Normative and Actual Product-Based Environmental Costs



For operational purposes, companies are most likely to be interested in the difference between the actual non-product output costs and the costs for the technological norms. This information shows how much they deviate from the cost they could achieve by using their existing technology in accordance with its technological descriptions. In these cases, the non-product output costs can be used to highlight those areas where a company can usually reduce its wastes and emissions by better housekeeping e.g. better monitoring of raw material consumption, avoiding/reducing scraps and wastes and reducing energy and water consumption. Companies need this information on a monthly basis to be able to react quickly.

The difference between the actual non-product output costs and the non-product output costs for BAT could also be interesting for a company, although on a less frequent basis as the difference cannot be reduced in the short term. The difference shows the point up to which it is economically feasible to perform technological improvements. This information is very important when a company considers changing technology, so it must be calculated every time such a decision is to be made, probably every 3-7 years depending on the technological life cycle of the equipment. In cases where a company is reporting total environmental costs, the latter is only correct when the non-product output costs related to BAT are considered. A good practice would be to calculate these costs annually, when the information can be used for internal reporting purposes to facilitate stakeholders' decision-making for new investments.

Non-product output costs tend to be very high when they are calculated in relation to theoretical norms, because first, 100 per cent efficiency is not achievable, and second, many inputs are never meant to go into the product (they are auxiliary inputs or "helpers" in the process) and so inevitably become 100 per cent waste. For example, catalysts are needed in chemical reactions, but 100 per cent of them become non-product output costs because they do not go into the product and eventually become spent and need to be replaced. Another example would be the energy that is required to maintain temperatures in the company buildings at a certain level: that energy never goes into the product and eventually is all wasted (with respect to the product). This comparison can be discouraging for companies, because these costs are considered inevitable and non-controllable. On the other hand, a calculation of very high values of non-product output

costs in relation to theoretical norms can represent a strong motivation for better use of resources and innovative thinking. They can spur the adoption of BAT and in the case of auxiliary inputs the levels of use can often be reduced and sometimes completely eliminated.

Table 2 shows the calculation methods of material purchase value of non-product costs and their relationship with cost controllability. It is important that the company have access to all of these costs when EMA is introduced for the first time. The final selection of which calculation method to use for non-product output cost will depend on the specifics of the company.

Table 2. Relationship between Non-Product Output Costs, Calculation Methods and Cost Controllability

Material Purchase Value of Non-Product Outputs	Calculation Method	Ability to Control Costs
Material consumption Exceeding the Technological Norms	Actual Value—Technological Norms	Controllable in the shorter term
Material consumption Exceeding the BAT Norms	Actual Value—BAT Norms	Controllable in the medium to long run
Material consumption Exceeding the Theoretical Norms	Actual Value—Theoretical Norms	Controllable in the longer run

3. Allocation of environmental costs

To summarize, the calculation of environmental costs, as presented in the previous section, can be divided into the following steps:

- Analyse the existing costs data information system;
- Organize costs data according to the technology flow;
- Understand the major allocation keys in use;
- Identify environmental cost items within overheads;
- Extract environmental expenditures information from accounts;
- Complete detailed mass-balances of the process;
- Calculate environmental costs related to direct production costs (non-product output costs).

Once all the relevant information on environmental costs has been collected, the allocation process should start. Initially, environmental costs will appear in the production cost structure of each cost centre, and then be placed in the product cost structure.[15] At this point, it will be possible to decide which environmental costs are more important (compared to total production costs) for the future operation of the company. Once chosen, they should be monitored on a continual basis within the EMA system.

Whenever possible, environment costs should be allocated directly to the activity that generates the costs, again first to the respective cost centres and then to the products. As a result, for example, the costs of treating the toxic waste arising from a product should directly and exclusively end up allocated to that product.[16] Proper allocation keys must be developed for this purpose.

The choice of an accurate allocation key is crucial for obtaining correct information for cost accounting. It is important that the chosen allocation key be closely linked with actual, environment-related activities. In practice, the following four allocation keys are often considered for environmental issues:[17]

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

The choice of the allocation key must be adapted to the specific situation, and the costs, caused by the different kinds of wastes and emissions treated, assessed directly. Sometimes a volume-related allocation key best reflects the costs, while in other cases a key based on environmental impact is appropriate. The appropriate allocation key varies depending on the kind of waste treated or emissions prevented.

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[15] During the allocation of costs to products, overheads are also allocated.

[16] Stefan Shaltegger and Roger Buritt, Contemporary Environmental Accounting, Issues, concepts and practice, Greenleaf Publishing 2000, p. 131.

[17] Ibid., p. 136.

The information needed for calculating and allocating environmental costs can be acquired relatively easily if a cost managerial accounting system is in place. There are different methodologies for managerial cost accounting,[18] such as "activity based costing (ABC)",[19] "full cost accounting", "process costing" and "material flow costing".

4. Building the information system for EMA

The information flow of environmental costs should be organized and structured to allow for regular monitoring. An effective information system should reinforce existing communication links between the accounting, environmental and production departments of a company to enable the systematic evaluation of environmental costs.

The EMA information system should build on existing information systems and should be harmonized with the overall cost management accounting in terms of responsibility (e.g. environmental manager), controlling frequency of environmental cost evaluation (e.g. quarterly or monthly), format and calculation method. The existence of an EMS can help to organize the necessary structure of the EMA information system into a set of procedures and work instructions.

The existing cost centre structure is usually maintained, as it could be complicated for the company to change it, however, implementing an EMA project could highlight the necessity to reorganize the existing cost centre structure. For example, end-of-pipe operations (wastewater treatment plants (WWTP), incinerators, etc.), laboratories or environmental departments could be organized as independent cost centres.

Environmental allocation keys will then be assigned to environment-related expenditures and new accounts can be created for certain environmental costs. If the EMA project reveals that some environmental costs included in overheads are not significant compared to total production

[18] UNDSD: Improving Government's Role in the Promotion of Environmental Managerial Accounting, United Nations, New York 2000, p.14.

[19] ABC represents a method of managerial cost accounting that allocates costs to the cost centres and cost carriers based on the activities that caused the costs. 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.

costs, then these costs may remain in general overheads, depending also on existing accounting regulation.[19] Regardless, companies can choose to make environmental overheads visible within the general overheads.

Existing information related to environmental costs can also be re-organized into a parallel environmental cost sheet. In the case of allocation to a product for example, a new category "environmental costs" could be created within the product cost structure.

The information base needed for flow-cost accounting is gathered from the material flow model and a defined database. The material flow model maps the structure of the material flow system and is relevant for the calculation of non-product output costs. The database contains data needed to quantify the material flow model. It is used as the basis for calculating the quantities, values, and costs allocated to the material flow model.

5. Reviewing EMA

An EMA system is to be implemented using a step-by-step approach, and reviewed and updated on a continual basis as new developments occur or with the addition of new cost items not considered during previous allocation phases. Changes in production, products or in the regulatory regime can occur that make certain environmental cost items previously not considered significant, relevant for the business operation.

[20] In some countries, there are cost accounting regulations that forbid the allocation of fines and penalties to products. This has to be taken into account.