CHAPTER 10

IMPLEMENTING ENVIRONMENTAL COST ACCOUNTING IN SMALL AND MEDIUM-SIZED COMPANIES

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Abstract. As a result of increased corporate environmental costs since the 1970s and steadily rising costs and innovation pressure in globalised competition, corporate environ-mental cost accounting (ECA) is continuously under attention. Cost management decisions – and ensuing entrepreneurial decisions – will increasingly depend on successful acquisition and transfer of information and data that consider ecological as well as economic effects. Sustainable future-oriented corporate governance will not function without an ECA to support the planning, management and control of the company.

Within the framework of the project Integration of ECA into environmental management systems in SME's sponsored by the German Federal Foundation for the Environment (Deutsche Bundesstiftung Umwelt – DBU), Osnabrück, ECA was successfully implemented in more than ten companies. The project was carried out in co-operation between the Institut für Ökologische Betriebwirtschaft (IöB), Siegen, and the Internationales Hochschulinstitut (IHI), Zittau, both Germany. The objective of this project was to show economic and ecological advantages of, but also barriers to, ECA implementation by examples of German companies on the one hand and Czech and Polish ones on the other. The selection criteria as regards the companies were on one hand the size of the enterprise and on the other the willingness of management to implement an ECA. The project was especially focused on the operational use in SMEs and represents a further development of existing flow cost accounting systems (see e.g. Burritt and Schaltegger, 2000).

The following describes the implementation methodology developed in the project and illustrates how this method was applied in one of the companies which participated in the study.

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1 ENVIRONMENTAL COST ACCOUNTING IN SMES

Since its inception some 30 years ago, Environmental Cost Accounting (ECA) has reached a stage of development where individual ECA systems are separated from the core accounting system based an assessment of environmental costs with (see Fichter et al., 1997, Letmathe and Wagner , 2002).

As environmental costs are commonly assessed as overhead costs, neither the older concepts of full costs accounting nor the relatively recent one of direct costing appear to represent an appropriate basis for the implementation of ECA. Similar to developments in conventional accounting, the theoretical and conceptual sphere of ECA has focused on process-based accounting since the 1990s (see Hallay and Pfriem, 1992, Fischer and Blasius, 1995, BMU/UBA, 1996, Heller et al., 1995, Letmathe, 1998, Spengler and Hähre, 1998).

Taking available concepts of ECA into consideration, process-based concepts seem the best option regarding the establishment of ECA (see Heupel and Wendisch , 2002). These concepts, however, have to be continuously revised to ensure that they work well when applied in small and medium-sized companies.

Based on the framework for Environmental Management Accounting presented in Burritt et al. (2002), our concept of ECA focuses on two main groups of environmentally related impacts. These are environmentally induced financial effects and company-related effects on environmental systems (see Burritt and Schaltegger, 2000, p. 58). Each of these impacts relate to specific categories of financial and environmental information. The environmentally induced financial effects are represented by monetary environmental information and the effects on environmental systems are represented by physical environmental information. Conventional accounting deals with both – monetary as well as physical units – but does not focus on environmental impact as such. To arrive at a practical solution to the implementation of ECA in a company's existing accounting system, and to comply with the problem of distinguishing between monetary and physical aspects, an integrated concept is required. As physical information is often the basis for the monetary information (e.g. kilograms of a raw material are the basis for the monetary valuation of raw material consumption), the integration of this information into the accounting system database is essential. From there, the generation of physical environmental and monetary (environmental) information would in many cases be feasible. For many companies, the priority would be monetary (environmental) information for use in for instance decisions regarding resource consumptions and investments.

The use of ECA in small and medium-sized enterprises (SME) is still relatively rare, so practical examples available in the literature are few and far between. One problem is that the definitions of SMEs vary between countries (see Kosmider, 1993 and Reinemann, 1999). In our work the criteria shown in Table 1 are used to describe small and medium-sized enterprises.

Table 1. *Criteria of small and medium-sized enterprises*

Number of employees Up to 500 employees	*Turnover* Turnover up to EUR 50m
Management - Owner-cum-entrepreneur - Varies from a patriarchal management style in traditional companies and teamwork in start-up companies - Top-down planning in old companies;	*Organization* - Divisional organization is rare - Short flow of information - Strong personal commitment - Instruction and controlling with direct personal contact - Delegation is rare - Low level of formality - High flexibility
Finance - family company - limited possibilities of financing	*Personnel* - easy to survey number of employees - wide expertise - high satisfaction of employees
Supply chain - closely involved in local economic cycles - intense relationship with customers and suppliers	*Innovation* - high potential of innovation in special fields

Keeping these characteristics in mind, the chosen ECA approach should be easy to apply, should facilitate the handling of complex structures and at the same time be suited to the special needs of SMEs.

Despite their size SMEs are increasingly implementing Enterprise Resource Planning (ERP) systems like SAP R/3, Oracle and Peoplesoft. ERP systems support business processes across organisational, temporal and geographical boundaries using one integrated database. The primary use of ERP systems is for planning and controlling production and administration processes of an enterprise. In SMEs however, they are often individually designed and thus not standardized making the integration of for instance software that supports ECA implementation problematic. Examples could be tools like the "eco-efficiency" approach of IMU (2003) or Umberto (2003) because these solutions work with the database of more comprehensive software solutions like SAP, Oracle, Navision or others. Umberto software for example (see Umberto, 2003) would require large investments and great background knowledge of ECA – which is not available in most SMEs.

The ECA approach suggested in this chapter is based on an integrative solution – meaning that an individually developed database is used, and the ECA solution adopted draws on the existing cost accounting procedures in the company. In contrast to other ECA approaches, the aim was to create an accounting system that enables the companies to individually obtain the relevant cost information. The aim of the research was thus to find out what cost information is relevant for the company's decision on environmental issues and how to obtain it.

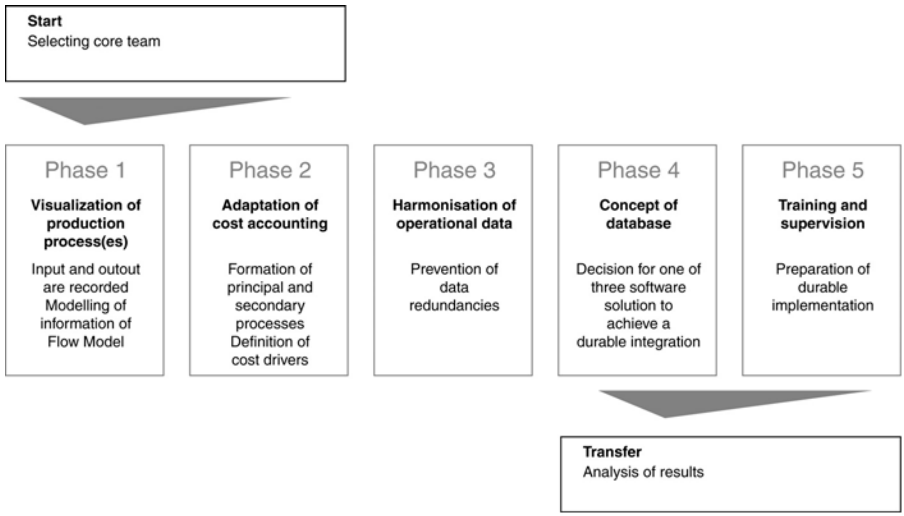

Figure 1. *Method for implementing ECA*

2 METHOD FOR IMPLEMENTING ECA

Setting up an ECA system requires a systematic procedure. The project thus developed a method for implementing ECA in the companies that participated in the project; this is shown in Figure 1. During the implementation of the project it proved convenient to form a core team assigned with corresponding tasks drawing on employees in various departments. Such a team should consist of one or two persons from the production department as well as two from accounting and corporate environmental issues, if available. Depending on the stage of the project and kind of inquiry being considered, additional corporate members may be added to the project team to respond to issues such as IT, logistics, warehousing etc.

Phase 1: Production Process Visualization

At the beginning, the project team must be briefed thoroughly on the current corporate situation and on the accounting situation. To this end, the existing corporate accounting structure and the related corporate information transfer should be analysed thoroughly. Following the concept of an input/output analysis, how materials find their ways into and out of the company is assessed. The next step is to present the flow of material and goods discovered and assessed in a flow model. To ensure the completeness and integrity of such a systematic analysis, any input and output is to be taken into consideration. Only a detailed analysis of material and energy flows from the point they enter the company until they leave it as products, waste, waste water or emissions enables the company to detect cost-saving potentials that at later stages of the project may involve more efficient material use, advanced process reliability and overview, improved capacity loads, reduced waste disposal costs, better transparency of costs and more reliable assessment of legal issues. As a first approach, simplified corporate flow models, standardized stand-alone models for supplier(s), warehouse and isolated production segments were established and only combined after completion. With such standard elements and prototypes defined, a company can readily develop an integrated flow model with production process(es), production lines or a production process as a whole. From the view of later adoption of the existing corporate accounting to ECA, such visualization helps detect, determine, assess and then separate primary from secondary processes.

Phase 2: Modification of Accounting

In addition to the visualization of material and energy flows, modelling principal and peripheral corporate processes helps prevent problems involving too high shares of overhead costs on the net product result. The flow model allows processes to be determined directly or at least partially identified as cost drivers. This allows identifying and separating repetitive processing activity with comparably few options from those with more likely ones for potential improvement.

By focusing on principal issues of corporate cost priorities and on those costs that have been assessed and assigned to their causes least appropriately so far, corporate procedures such as preparing bids, setting up production machinery, ordering (raw) material and related process parameters such as order positions, setting up cycles of machinery, and order items can be defined accurately. Putting several partial processes with their isolated costs into context allows principal processes to emerge; these form the basis of process-oriented accounting. Ultimately, the cost drivers of the processes assessed are the actual reference points for assigning and accounting overhead costs. The percentage surcharges on costs such as labour costs are replaced by process parameters measuring efficiency (see Foster and Gupta, 1990).

Some corporate processes such as management, controlling and personnel remain inadequately assessed with cost drivers assigned to product-related cost accounting. Therefore, costs of the processes mentioned, irrelevant to the measure of production activity, have to be assessed and surcharged with a conventional percentage.

At manufacturing companies participating in the project, computer-integrated manufacturing systems allow a more flexible and scope-oriented production (eco-nomies of scope), whereas before only homogenous quantities (of products) could be produced under reasonable economic conditions (economies of scale). ECA inevitably prevents effects of allocation, complexity and digression and becomes a valuable controlling instrument where classical/conventional accounting arrangements systematically fail to facilitate proper decisions.

Thus, individually adopted process-based accounting produces potentially valuable information for any kind of decision about internal processing or external sourcing (e.g. make-or-buy decisions).

Phase 3: Harmonization of Corporate Data – Compiling and Acquisition

On the way to a transparent and systematic information system, it is convenient to check core corporate information systems of procurement and logistics, production planning, and waste disposal with reference to their capability to provide the necessary precise figures for the determined material/energy flow model and for previously identified principal and peripheral processes. During the course of the project, a few modifications within existing information systems were, in most cases, sufficient to comply with these requirements; otherwise, a completely new software module would have had to be installed without prior analysis to satisfy the data requirements.

Phase 4: Database concepts

Within the concept of a transparent accounting system, process-based accounting can provide comprehensive and systematic information both on corporate material/ energy flows and so-called overhead costs. To deliver reliable figures over time, it is essential to integrate a permanent integration of the algorithms discussed above into the corporate information system(s). Such permanent integration and its practical use may be achieved by applying one of three software solutions (see Figure 2).

For small companies with specific production processes, an integrated concept is best suited, i.e. conventional and environmental/process-oriented accounting merge together in one common system solution.

For medium-sized companies, with already existing integrated production/ accounting platforms, an interface solution to such a system might be suitable. ECA, then, is set up as an independent software module outside the existing corporate ERP system and needs to be fed data continuously. By using identical conventions for inventory-data definitions within the ECA software, misinterpretation of data can be avoided.

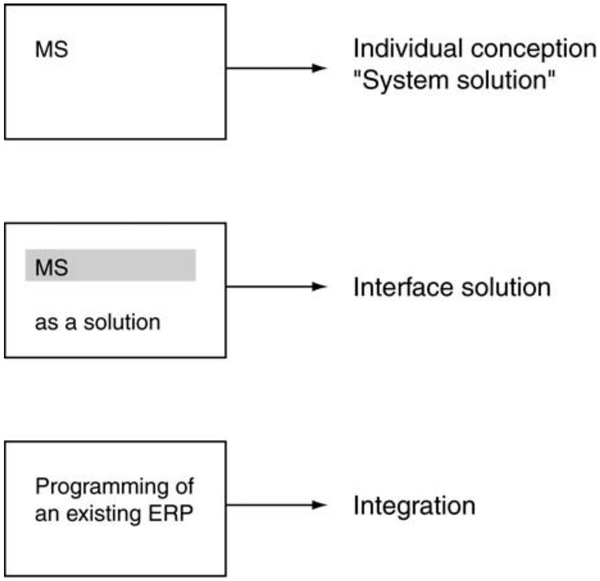

Figure 2. *Different software support solutions*

For large companies with complex ERP systems, the existing platform may be used to run an individually programmed ECA, to give relevant process figures on the one hand and to satisfy ecological requirements on the other (integrative solution).

Process-based ECA may respond to individual needs of surveying corporate user groups and guaranteeing adequately designed reports. Consistent and evident data is assessed in a transparently functional and numerical context of corporate inventory data, all stored and processed in database applications. Combining all of these data, controlling environmentally relevant figures may be put into practise successfully.

Phase 5: Training and Coaching

For the permanent use of ECA, continuous training of employees on all matters discussed remains essential. To achieve a long-term potential of improved efficiency, the users of ECA applications and systems must be able to continuously detect and integrate corporate process modifications and changes in order to integrate them into ECA and, later, to process them properly.

3 SOME PRACTICAL IMPLICATIONS: THE SURFACE OFFTEC INC. CASE

Surface Offtec was founded in 1996. In recent years, the company has expanded continuously, increasing the number of employees from 15 in 2000 to 45 in 2003.

This company focuses on surface finishing of metal pieces of various kinds and sizes. The services range from de-edging and de-greasing to ready-to-paint characteristics of workpieces. Core activities are oriented to suppliers in the automotive industry.

The implementation of ECA in the companies focused on

- systematic data acquisition of material and energy flows;
- individually-tailored database design for bid calculation and survey of environmental data;
- determination of relevant (peripheral and principal) corporate processes;
- design of a to-do concept for the implementation of a production planning system;
- detection and localization of potential to optimise production and administration to cope with future guidelines DIN EN ISO 14000.

Phase 1: Production Process Visualization

At project start, corporate material and information flows were acquired in a tailored corporate flow model by a task force covering all company departments. It became obvious that there were numerous non-planned and non-standardized corporate activities parallel to the regularized standard procedures. Although the company's technical process of de-greasing and de-edging could be described in a very simple model, a precise assignment of processing times and resources used, of consumption of electrical energy and emulsion to costs was not possible. Accordingly, the company failed to assess the exact price of a single workpiece or order. Orders were assessed and calculated on the basis of estimations derived from orders that had been successfully completed before. A post-calculation of processed orders was performed only to a small extent, as data was often missing.

The manufacturing process is as follows: Customers ship metal work pieces to the factory site; the pieces stored are temporarily at two warehouses for wire-mesh boxes and one for handling of small pieces. One area outside the factory provides space for very greasy or oily work pieces; a second area is used for the less greasy ones. Dry pieces are moved temporarily to a third area. From each storage area, forklifts transport work pieces to their processing access point inside the factory. In special machines, workpieces get de-greased and de-edged by abrasives, emulsion, water and other additives such as sand or pearls of glass used with special applications. Workpieces are then dried by adding corn-straw granulate to the machines or by hot air fanned onto the work pieces when leaving the machines. Process water circulates in a closed system equipped with a water-treatment system. Continuously, water is separated from induced metal particles in a centrifuge and chemically treated before re-entering the system feeding the centrifuge machines. Process water may be used until its defined life cycle has been reached. Then the batch of process water is exchanged with fresh water and a small amount of additives. Waste water is stored in an intermediate tank and disposed of at fixed intervals by a waste disposal company.

Processed work pieces are packed and re-shipped to the customers in cartons for small pieces or wire-mesh boxes wrapped in paper. Just in time shipment to customers may require intermediate storage at delivery storage areas. Customer and suppliers may be identical. Processed workpieces are also delivered directly to the assembly lines of the automobile industry.

Some of the processed goods are transported by company-owned vans, others are transported by the customers themselves.

Figure 3 shows Surface Offtec's process flow model.

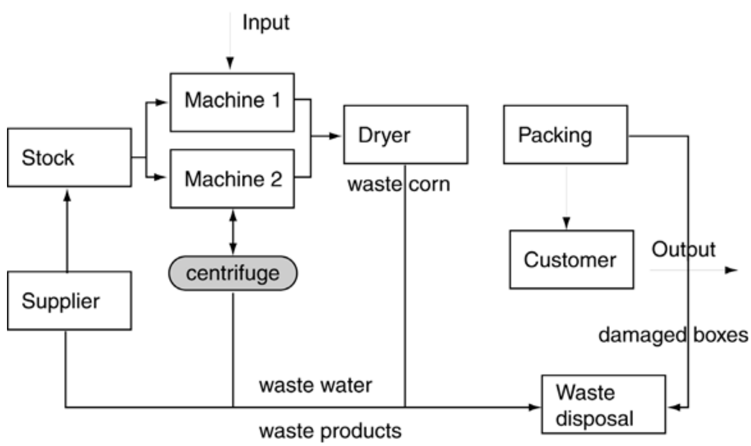

Figure 3. *Offtec's process flow model*

Phase 2: Modification of accounting

The weaknesses of conventional accounting schemes were illustrated in phase 1 regarding definition of cost types as well as cost centre structures. Due to the high number of repetitive activities in the company production process, a process-based accounting system was called for. Following the process model, the existing conventional production parameters in the accounting system for secondary ('de-edge', 'degrease', 'in-house transport') and primary ('storage', 'finishing', 'drying', 'shipment') processes were replaced by parameters such as 'level gauge', 'degree of pollution', 'set-up times for processing steps', 'processing machinery capacity' etc. As mentioned above, several partial processes were in functional context with each other which results in one primary process and improves the basis of realistic production cost assessment and calculation. Production activities with cost allocation irrelevant to the quantity produced are surcharged to the price of processed work pieces by the database application.

Phase 3: Harmonization of Corporate Data – Compiling and Acquisition

At Surface Offtec, relevant data to determine the material/energy flow model is derived from for instance company information systems, various corporate inventory records and individually-recorded forms and tables, both on paper and in electronic format. To facilitate the integration between ECA and the conventional accounting system at a later date, the ECA database design follows a data model that, by its conventions and applied software standards, allows integration of the existing company-conventional accounting system, including for example with human resources, billing, material supply and output planning.

Phase 4: Database concepts

For the permanent use of ECA, the system solution discussed above was selected. As the conventional accounting system is an MS Access application, the ECA has the same software format. At any time, all of the software can be used in one application. The structure of the database designed mirrors the corporate structures worked out in flow models. The advantage of such programming becomes particularly evident, as the use, care and further development of software can easily be assigned to the corporate user at later stages. Figure 4 shows the basic concept of the database application.

Basic data are recorded in the four units 'Supplier', 'Customer', 'Raw materials', and 'Article'. To enter an order, the data sheet 'Order' is used. This data sheet accesses the stored data and drafts a specific order. The calculated data are used for an archival data backup. From these data, all relevant reports, such as 'Labour costs', Waste balance', 'Energy use' etc., can be generated. The reports can focus on either the environmental or the economic situation.

4 IMPLEMENTATION EXPERIENCES AND CONCLUSIONS

The use of the database software and its advantageous realization of integrated accounting generally provided improved transparency and better comprehension of intra-corporate processes and contexts. By combining both conventional accounting and the ECA system, the company was also able to fill in information gaps relevant to environmental management.

Experience gained while implementing ECA involves not only positive aspects. One of the great problems was the time consumption in the early stages. To devise a useful flow model for the start requires a substantial space of time. There were also some problems involving personnel because the project demanded work in a team across company divisions. At first, the internal changes in the company were not seen as positive, but, later on, they provided greater satisfaction for the employees.

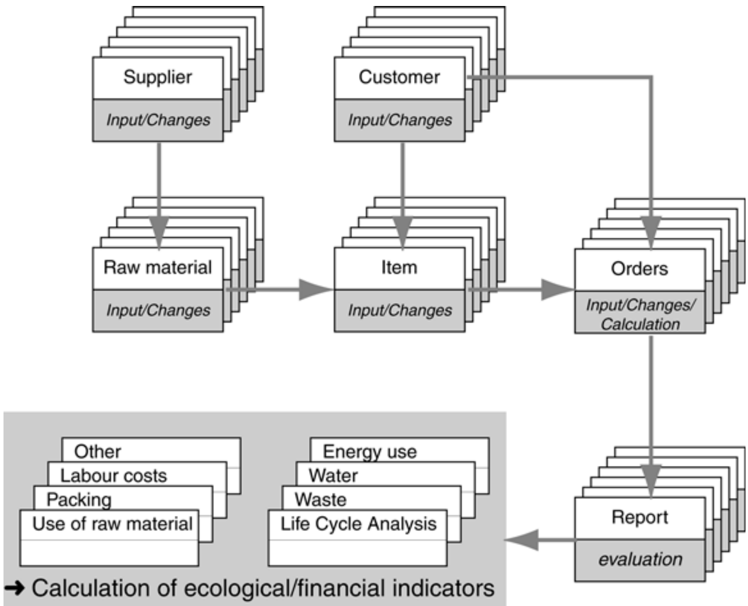

Figure 4. *The database application*

With the detailed representation of single orders in the order processing cycle, an efficient cost-control system was set up to compare profitability and efficiency of every single item; this allowed proper allocation of costs accumulating within an order. There are also positive effects involving the following aspects:

- improved certainty on delivery time;
- increased flexibility to respond to short-term customer requirements;
- reduced processing cycles for all orders as a result of improved production planning;

- improved segmentation of ordering, depending on the basis of the work piece characteristics specified by the customer;
- data and trend acquisition for future investments (i.e. consideration of waste heat or regenerative energy for heating systems of additional/new building enlargement/construction).

As shown in the example discussed above, software-based implementation for the permanent use of process-based ECA is important if ECA is to be applied in the organisation on a permanent basis. A tailored software solution was presented as an initial and substantial measure. Process-related analysis of corporate processes, the adaptation of existing accounting systems in selected corporate areas and the effective use of existing corporate information systems disclose potentials for environmental protection measures and, especially, for cost reduction to an extent which should not be underestimated.

The implementation of process-based ECA in the companies which participated in the project has resulted in several enhancements of the existing accounting system. In addition to being able to identify weaknesses in the existing accounting system, the user can obtain a clear and consistent basis for planning and decision making with data generated from the appropriate database application.

The broad conclusion of the project is that ECA is a natural part of how environmental management accounting develops and can contribute to its further innovation and evolution.

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