CHAPTER 17

ENVIRONMENTAL MANAGEMENT ACCOUNTING PILOT PROJECTS IN COSTA RICA

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Abstract. In November 2002 a "train the trainer" program on environmental management accounting was performed in Costa Rica, following the approach developed for the United Nations Division for Sustainable Development, Working Group on Environmental Management Accounting. This programme included a public lecture and five case studies. This article describes the project organisation and applied methodology, and compares the obtained results to similar case studies in Austria.

1 INTRODUCTION

In September 2001 the Costa Rican non-governmental organisation CEGESTI initiated a project called "Increased accessibility for Small and Medium-Sized Enterprises in Central America for the implementation and maintenance of Management Systems based on the ISO 9000 and 14001 Standards". This project was financed by CEGESTI and the Dutch Development Cooperation organization ICCO. The objective of this project was to improve the access for Small and Medium Sized Enterprises (SME) to technical assistance during the implementation process of environmental and quality management systems based on the ISO standards. The target group is SMEs confronted with the impacts of globalization, such as co-operatives,

P.M. Rikhardsson et al. (eds.), Implementing Environmental Management Accounting, 343-364

small enterprises situated in rural areas or other basic structured organizations that have limited access to services that would really satisfy their needs and improve their opportunities to survive. In order to be able to maintain their competitive position, they require appropriate technical assistance to support them to increase their managerial capacity and their possibility to continuously adapt to a changing environment.

The primary aim of environmental management accounting (EMA) is to better inform and support decision-making processes that are influenced by environmental factors. Within the context of this project, the need was identified to create tools that help SME managers to define the actual environmental costs caused by their production processes, since this would help to convince them of the importance of investing in environmental management activities and cleaner technologies. Translating environmental issues into financial terms is a vital element in motivating business to take action, especially in developing countries. And even in organizations in which it would not be possible to quantify the financial benefits of environmental action, it is at least important to recognize the risks of not taking action. Environmental-related management accounting was therefore considered to be an essential tool for sustainable business development in Costa Rica.

Within this context, it is important to mention that the need to create and offer tools for EMA to Costa Rican SMEs has always existed but has grown in importance due to the increasing body of environmental legislation, efforts local government has made to reach legal compliance, and, last but not least, the economic crisis that affects the region. The economic activities in the Central American region are mostly related to agricultural and service activities. These sectors are affected by the growth in supply of agricultural products at a global level, which has caused a reduction in world market prices. A better insight ino the costs related to activities becomes more and more important in order to be able to identify opportunities to decrease them. EMA helps decision makers identify not only the basic costs of their activities but also the environmental costs and potentials for improved material efficiency.

The objectives of the project in Costa Rica were thus to

- understand and learn the methodology of EMA through real life application;
- access the applicability of the tool in the Costa Rican context in general and Small and Medium-Sized Enterprises specifically.
- define required adjustments for its implementation to be able to use the method in a Latin American context.
- determine an accounting tool that can complement and support the adequate implementation of Environmental Management Systems (e.g. those based on ISO 14001).

2 ENVIRONMENTAL MANAGEMENT ACCOUNTING BASICS

The main challenge of environmental management accounting is the lack of a standard definition of environmental costs. Depending on what one is interested in, these may include a variety of costs, e.g. disposal costs or investment costs and, sometimes, also external costs (i.e. costs incurred by parties outside the company, mostly to the general public). Of course, this is also true for profits of corporate environmental activities (environmental cost savings). In addition, most of these costs are usually not traced systematically and attributed to the responsible processes and products, but simply summed up in general overhead.

The fact that environmental costs are not fully recorded often leads to distorted calculations for improvement options. Environmental protection projects, aiming to prevent emissions and waste at the source (avoidance option) by better utilizing raw and auxiliary materials and requiring less (harmful) operating materials are not recognized and implemented. The economic and ecological advantages to be derived from such measures are not realized. The people in charge are often not aware that producing waste and emissions is usually more expensive than disposing them.

Experience shows that the environmental manager barely has access to the actual cost accounting documents of the company and only is aware of a tiny fraction of aggregate environmental costs. On the other hand, the controller does have most of the information but is unable to separate the environmental part without further guidance. In addition, he or she is limited to thinking within the framework of existing accounts. Also, the two departments tend to have a severe language problem.

In conventional cost accounting, the aggregation of environmental and non-environmental costs in overhead accounts results in their being "hidden" from management. There is substantial evidence that management tends to underestimate the extent and growth of such costs.

The UN Division for Sustainable Development has set up an EMA working group. For this group, a book on procedures and metrics for EMA (Jasch, 2000) was written, which was commissioned by the Austrian ministry of transport, innovation and technology (BM VIT), the Austrian ministry of agriculture, forestry, environmental and water management (BM LFUW) and the Austrian chamber of commerce (BWK). The objective of this book was to define principles and procedures for Environmental Management Accounting (EMA) with a focus on techniques for quantifying environmental expenditures or costs as a basis for the development of national EMA guidelines and frameworks. The intended users of these EMA metrics are national governments interested in establishing national EMA guidelines appropriate to their own countries' context and organisations seeking to install EMA systems for better controlling and benchmarking purposes.

The determination of total annual environmental expenditure for the last business year is a prerequisite for calculating improvement options. If the total annual en-

vironmental costs have not been assessed, the savings potential cannot be calculated. After the determination of the total annual environmental costs, the calculation can be done for specific cost centres or production processes.

The above-mentioned book defines the following environmental cost categories, which are hardly ever systematically assessed. The environmental cost categories follow the historic development of awareness for environmental cost categories and require clearly different improvement actions.

The first block of environmental cost categories comprises conventional waste disposal and emission treatment costs including related labour and maintenance materials. Insurance and provisions for environmental liabilities also reflect the spirit of treatment instead of prevention. The first section corresponds to the conventional definition of environmental costs comprising all treatment, disposal and clean-up costs of existing waste and emissions.

The second block is termed prevention and environmental management and adds the labour costs and external services for good housekeeping as well as the "environmental" share and extra costs of integrated technologies and green purchase, if significant. The main focus of the second block is on annual costs for prevention of waste and emissions, but without calculated cost savings. They include higher pro-rata costs for environment-friendly auxiliary and operating materials, low-emission process technologies and the development of environmentally benign products, if significant.

Conventionally, three production factors are distinguished: materials, capital (investments, related annual depreciation and financing cost) and labour. The next two blocks consider the costs of wasted material, capital and labour due to inefficient production, generating waste and emissions.

In the third block, the wasted material purchase value is added. All non-product output is assessed by a material flow balance. Wasted materials are evaluated with their material purchase value or materials consumed value in case of stock management.

Lastly, the production costs of non-product output are added with the respective production cost charges, which include labour hours, depreciation of machinery and operating materials. In activity-based costing and flow cost accounting the flows of residual materials are more precisely determined and allocated to cost centres and cost carriers.

Environmental revenues derived from sales of waste or grants of subsidies are accounted for in a separate block.

Costs that are incurred outside the company and borne by the general public (external costs) or that are relevant to suppliers and consumers (life cycle costs) are not dealt with.

Figure 1 shows the total annual environmental costs assessment scheme developed for UN DSD.

	Air and climate	Waste Water	Waste	Soil and ground water	Noise + vibrations	Biodiversity + landscape	Radiation	other	Total
1. Waste and Emission treatment☐									
1.1. Depreciation for related equipment									
1.2. Maintenance and operating materials and services									
1.3. Related Personnel									
1.4. Fees, Taxes, Charges									
1.5. Fines and penalties									
1.6. Insurance for environmental liabilities									
1.7. Provisions for clean up costs, remediation									
2. Prevention and environmental management									
2.1. External services for environmental management									
2.2. Personnel for general environmental management activities									
2.3. Research and Development									
2.4. Extra expenditure for cleaner technologies									
2.5. Other environmental management costs									
3. Material Purchase Value of non-product output									
3.1. Raw materials									
3.2. Packaging									
3.3. Auxiliary materials									
3.4. Operating materials									
3.5. Energy									
3.6. Water									
4. Processing Costs of non-product output ☐									
∑ Environmental Expenditure									
5. Environmental Revenues ☐									
5.1. Subsidies, Awards									
5.2. Other earnings									
∑ Environmental Revenues									

Figure 1. *Total annual environmental costs*

During the Austrian pilot projects (Jasch and Schnitzer, 2002), the environmental cost assessment scheme (Figure 1) was adapted to an Excel file that is available for download at www.ioew.at. The Excel file consists of three sheets – Detail, Sum, and Structure. Information is only inserted into the Detail sheet. All the cost categories are already set. The environmental media can be modified if necessary. The column Account is to keep the same cost centres and accounts for the years to come without having to spend a lot of time finding them again. It is also practical to document the type of calculation used to acquire a certain figure. It is possible to add lines into the sheet. The sum of the costs of all categories in the sheet Detail is transferred to the sheet Sum for overview purposes and a better presentation layout. The sheet Structure merely calculates the costs in percentages to show the most relevant environmental costs.

3 PROJECT ORGANISATION

The assessment of environmental costs under the guidance of an Austrian expert took place at Costa Rican companies during the period November 8-22, 2002. The first part of the "train the trainers" seminars consisted of a half-day lecture on EMA and the UN DSD methodology. This lecture was aimed at the common public, and was followed up by another half day used for a preparatory workshop in which just staff from the five SMEs participated. These SMEs were selected as the pilot group to train CEGESTI consultants on applying the UN DSD methodology in a Costa Rican business context. The training was followed by a one-day site visit to each of the selected companies. Through the period, the expert and involved CEGESTI consultants got together several times to share doubts, analyse the results thoroughly, and share the lessons learned.

Though the initial plan was to organise two workshops just focused on small groups of SMEs, after which some of them would be visited afterwards, it was decided to change this method in order to invite a bigger audience to an open lecture, consequently sharing the methodology with more people. Besides, this increased the available time that could be used for the company visits and analyses, which was necessary, since the visits had to be confidential which limited the number of people that could participate in each visit. In total 61 people participated in the general lecture, of which eight were CEGESTI consultants and 53 external participants.

During the general lecture the following issues were discussed:

- What are environmental costs of production and how can they be reduced?
- Environmental costs in normal accounting practices
- Definition of environmental costs and cost categories
- How to determine and calculate environmental costs
- Assessing prevention and cost reduction potentials

- Checklists for site assessments
- Linking mass balances to financial accounts and cost calculation
- Defining environmental performance indicators

After the lecture, the participants were supposed to be able to identify in a practical way the costs and benefits of the environmental management practices used in a company. They learned the basics of linking accounting and cost calculation to material flow analysis, mass balancing, using checklists and other assessment tools, which help define environmental costs and saving potentials.

The workshop took place in English, but simultaneously translated into Spanish to avoid language being a restraint for interested parties to participate.

The four-hour workshop in the afternoon was only open for the five companies selected for the site visits and the CEGESTI consultants to be trained. The selection criteria for the companies was based on the level of awareness of environmental management issues, size and availability of an environmental management system. This means that all the companies should have a reasonable level of interest in environmental management issues and have implemented a number of related improvements. Additionally, the pilot group had to be diverse, so the tool would be applied in different business environments. For this reason two small, two medium-sized and one big company were selected. Three of these companies already employed environmental management systems based on ISO 14001, two a quality management system based on ISO 9002: 1994, and one had just started identifying its environmental management strategy.

The workshop was participatory and was meant to make the participants understand through practical application the theory explained in the morning. Furthermore the companies were instructed which data had to be available during the visit. A practical exercise was done using the Excel sheet format designed in the Austrian case studies to facilitate the data collection process. After the workshop the companies completed this sheet, which was part of their preparation for the site visit.

The agenda of the workshop with the five pilot companies covered the following issues:

- Explanation of how to proceed by practical examples
- Mass balancing methodology and implementation (the companies were requested to bring their own accounts and calculations)
- Integration into data assessment and accounting routine

After the workshop the expert and three CEGESTI consultants visited the five selected SMEs during a period of six days. The companies selected were: ETIPRES, a company producing stickers, RESINTECH, a producer of plastic pallets, Coopro-Naranjo, a coffee co-operative, PIPASA, a chicken products company and ROMA

PRINCE, a pasta producing company. The objective of the visits was two-fold. First, to analyse the cost accounting system available, and to apply the US DSD methodology to the companies' situation. Second, to give in-company training to the environmental manager, the controlling department and the involved CEGESTI consultants, by applying the tool in practice and analysing the results obtained with the participants.

In each company the environmental costs and the technical and financial information system were assessed. This was carried out by representatives of the organisation under the guidance of the expert. The results were documented by a CEGESTI consultant. The company team consisted of at least the general manager, the environmental/operational manager and the controller/accountant. Each company received a protocol of all issues raised and the Excel file with the assessment of the total annual environmental costs of the previous business year.

The workshop and the site visits created in each company the basic skills required to apply the EMA methodology, for them to repeat the exercise in future years. Moreover, it increased the awareness of top management of the environmental costs generated by inefficiencies in the production processes, waste generation and poorly functioning equipment. The direct relation between the accounting system and the material flows of the production site, improved knowledge on the information necessities, and the willingness of management to invest in environmental management, cleaner production and cost accounting tools.

4 THE PARTICIPATING COMPANIES

The following five companies were selected for the application of the tool:

4.1 Pipasa Corporation

Pipasa was founded in 1969; it is the largest poultry company in Costa Rica with about 50 per cent market share. The company is registered at the NASDAQ New York Stock Market. In Costa Rica, Pipasa is amongst the 10 largest companies in reference to its total assets, total incomes, revenue and shareholders equity. The company has 2480 employees.

Activities include production and sale of fresh and frozen poultry, processed chicken products, commercial eggs, and concentrate for livestock and domestic animals. Pipasa has an extended distribution net with 100-per cent coverage of the national area. The company is vertically integrated. The production process starts with the fertilized egg and finishes with the preparation and distribution of fresh whole chickens, fast-frozen and cooked chicken patties and sausages.

Pipasa has looked for efficient ways to prevent pollution and to protect the environment. For this purpose, the company has started emission control systems.

Also, a waste water treatment systems was built. Organic waste from the production plants is used to produce organic fertilizers. Recycling of packaging and handling materials is promoted. Additionally, the company maintains more than 500 hectares of primary and secondary forests. Lastly, the company has launched a consciousness campaign regarding the environmental and social impacts of its activities. However, the company has not yet implemented an environmental management system.

The EMA study was focused on the San Rafael slaughtering plant. This plant produces 41,300 tons of poultry per year. The process is relatively simple, consisting mainly of animal slaughtering, clean-up, cutting and separation of parts, packaging, freezing, stocking and transportation of poultry. The plant has 499 employees. The accountability, as many other controls and services, is provided and controlled by the central corporation.

The plant is registered as a cost centre, which helped define clear boundaries. The process of recycling the chicken waste to produce animal food is done in the Rendering process. Although physically this process takes place inside the plant, there is a different cost centre where this process is captured. Therefore this process was kept out of the assessment. Analysed from the EMA methodology this also implies that the process is clean in terms of waste generation, as waste that is recycled internally leaves the company as a separate product. All materials that leave the boundaries of the system as non-product are considered waste. For this reason, the recycling of waste within the process is not considered as long as it goes back into the product.

4.2 Etipres

Etiquetas Impresas, Etipres S.A., is a Costa Rican company dedicated to the design and printing of labels. It started its operations in October 1985. The company has 23 employees.

Since the beginning, the company has tried to lead the labels market with a tailor-made system of printing and production, with no limitation on style and form. The Art and Design Department has state-of-the-art software technology and highly trained staff in graphic design. The company also has a perforation system for continuous printer paper and capacity to print on film and foil.

Recently the company bought advanced equipment for label printing and production. Besides its increase of production capacity, additional selection criteria of the equipment were environmental considerations, since the equipment has a more reliable emission capturing system.

In 1998, Etipres implemented ISO-9002:1994 and ISO-14001:1996. That same year the company obtained the locally developed “Ecologic Flag” award in recognition of its environment-friendly performance. In 1999, the company received the “Eco-Label” award for its continuous efforts on improvements of the environmental

impact of the production process. This label is awarded by the Costa Rican Ministry of Environment MINAE.

4.3 Resintech

Resintech started operations in 1970 as a subsidiary of the BFGoodrich Company, the world's largest producer of resins and PVC compounds. Resintech supplies PVC compounds in grains and powder for the processes of extrusion, injection, blow and lamination. The company has tried to continuously develop new formulas and to enhance its production systems to ensure prompt response and high quality in the final products. The company has 84 employees.

The company has several production lines with specialized equipment in PVC production and an advanced quality laboratory. Some of their products are shod products, isolating material, plastic fabric, thermo-shrinking film, hose, and various packaging material.

The company implemented ISO-9002:1994 in 1998 and is working on the implementation of an environmental management system based on the ISO-14001 norm.

4.4 Coopronaranjo

In May 1967 the Cooperativa de Caficultores de Naranjo R.L. (Naranjo's cooperative of coffee farmers) was created. In 1968, Coopronaranjo bought a coffee mill in order to provide a coffee processing service to its associated farmers. Currently, Coopronaranjo is the biggest coffee cooperative of Costa Rica with more than 4500 associated farmers. The cooperative has six departments: coffee mill, accounting, marketing and sales, cooperative education, supermarket, and agricultural technical assistance.

The focus of the EMA study was related to the activities of the coffee mill. The coffee mill works only in the harvest season, approximately four months per year. At the time of the visit, the plant was at the start of the harvest period and had just increased its plant personnel from 15 to 85 people (which represents 36 people on a yearly basis). The rest of the year the plant is stand-by, and equipment maintenance and enhancement is done.

Since 2002 the company has had a certified, integrated management system based on the ISO 9001: 2000 and ISO-14001:1996 norms. Several improvements have been implemented focussing on waste reduction and reuse, water treatment systems and energy efficiency programs. The company has implemented an anaerobic waste water treatment reactor through which it is able to recover the escaping methane gas and convert it into energy for its drying process. Additionally the plant has adapted its boilers to burn the dry husk (the thin outer layer of the coffee bean) and use it as a fuel for the drying process. The plant has also implemented a worm-compost plant

where part of the organic waste (mainly pulp and husk) is transformed into organic fertiliser. Furthermore the plant has implemented water recycling systems which has resulted in a significant reduction in water consumption.

4.5 Roma Prince

In 1961, Pastas Alimenticias Roma, S.A. began its operations in Costa Rica, with the purpose of manufacturing pastas, using as the main ingredient 100 per cent durum wheat semolina. Pasta Roma entered the market, using Italian technology and strict quality control. Within a few years they became the company with the highest sale rate of pastas in the country. In 1973, the corporate name "Pastas Alimenticias Roma, S.A." was changed to "Roma Prince, S.A.". The company has 250 employees.

By the year 2000, Roma Prince was a mayor player in the Costa Rican, Central American and North American markets, as well as some Caribbean countries. Roma Prince S.A. exports its products to many countries such as Nicaragua, Honduras, El Salvador, Guatemala, Panama, Jamaica, Trinidad & Tobago, Barbados and the United States.

The continuing high consumer demand for Pastas Roma created the need to change and modernize the manufacturing equipment. Thus, in 1987 it was decided to acquire the best machinery available for the manufacture of pastas; at this time the company acquired very high temperature equipment with the brand name "Pavan". Environmental criteria were not really considered during the selection process.

Roma Prince has implemented a quality management system based on ISO 9002:1994 and is interested in implementing an environmental management system based on ISO 14001.

5 RESULTS FROM THE ASSESSMENT OF TOTAL ANNUAL ENVIRONMENTAL COSTS

The following section compares the results of the case studies in Costa Rica to the Austrian experience. The Austrian case studies (Jasch and Schnitzer, 2002) were performed with 12 companies, 10 of which were in the production sector, ranging from breweries, galvano shops, pulp and paper, sport equipment to hydropower and caloric energy plants. In Austria, environmental awareness and resulting legislative pressure started in the 70s. So most companies had introduced environmental management installed and published environmental reports. The main goals of the project were to arrive at a consistent information system to fulfil all the disclosure requirements by the statistical agency, the environmental protection agency and the financial disclosure requirement, which also ask for information on environmental performance. In addition, about half of the companies published an environmental report and were to report about being a pilot company in a research project. To give two examples:

The brewery *1. Obermurtaler Brauereigenossenschaft* (www.murauerbier.at) with about 120 employees and 245,000 hl beer production was the first Austrian EMAS site to register in December 1995. They have since annually published environmental statements with mass balances, performance and eco-efficiency indicators and quantified improvement targets and calculate their environmental cost savings based on the improvements shown by the performance indicators.

Due to their high environmental awareness they significantly increased their output and decreased their relative performance indicators over the last years. The monitoring of their key indicators for material input and waste figures is also used to calculate the saving of environmental costs. This is done by comparing the relative performance indicators of 2000 with actual prices and amounts of 2000 as well as with actual purchase and disposal amounts in 1995. The question easily answered by this method is: What would we have to pay today, if we hadn't acted and improved our performance? The total savings from 1995 to 2000 have been estimated at about USD 186,000.

The history of the *paper manufacturer in Laakirchen* dates back to 1874. In 1988 the company became part of the Swedish group "Svenska Cellulosa Aktiebolaget" (SCA). The Laakirchen factory specialises in the production and development of super-calendered (SC) paper (www.sca.at).

The company was one of the first EMAS sites (registration number 23) and is often the one to test pilot projects, which then get implemented throughout the corporation worldwide. The company was the pilot project on environmental management accounting for developing the UN DSD EMA approach in 2000 and since then publishes their environmental cost distribution to environmental media in their annual environmental statement.

The corporation has introduced a resource management system for the consistent tracking and reporting of material flows, which was amended in consistence with the EMA approach and now links physical and monetary data.

It is obvious that quantitative results based on ten companies in Austria and five in Costa Rica, all from the production sector, but from different industries, should not be over-interpreted. The aim of this chapter is not to compare the companies, which act in very different sectors and circumstances, but to compare the information systems, the distribution of costs in the different cost categories and show the range of costs in different cost categories. There are some very clear tendencies and general results with regard to costs distribution, information systems and cost awareness.

As all company data are always managed in a confidential way, only the percentage distributions of costs and general observations are published. It should be noted that actually the value of total annual environmental costs is an important figure for the companies, but not so much an important result on the applicability of a method. Also for the companies, the value of total annual environmental costs becomes more significant, when changes can be seen when comparing different years. The most

important results for the companies mostly relate to the improved and consistent information system.

However, the Costa Rican companies showed high interest in receiving benchmark information on the industry sector and process level performance. The continuous application of the tool will help to generate such information and useful transferable experience. Statistical agencies and environmental protection agencies in some countries already require some of this information. Nevertheless, it is clear that benchmarking information is often misleading, as system boundaries are hardly ever identical. In effect, comparison is most valuable from one year to the other and within an organisation, based on a consistent information system for financial and physical data.

5.1 Distribution of cost categories from the profit and loss account

The expenditure distribution taken from the profit and loss accounts of the Austrian and Costa Rican case studies are different, even though they are all related to the production sector. An analysis of the profit and loss accounts shows the following distribution: For the Austrian production enterprises the material purchase accounts from 16 to 60 per cent, also the personnel expenses have a large margin of fluctuation from 15 to 40 per cent.

Figure 2. *Expense distribution in production enterprises*

	Austria			Costa Rica		
Production Sector	Min	Average	Max	Min	Average	Max
Materials	16%	44%	60%	42%	62%	84%
Personnel	15%	24%	39%	2%	16%	35%
Depreciation	1%	7%	16%	0%	3%	9%
Interest	0%	1%	3%	0%	5%	11%
Other Expenses	11%	24% 4	3%	4%	15%	35%

In the production sector materials in general account for 40-60 per cent of all expenditure in the profit and loss accounts and therefore all projects focusing on improving material efficiency are very important. In Austria, the average costs are 45 per cent for materials and 25 per cent for staff. The figures for Costa Rica are 62 per cent for materials and 16 per cent for staff. The reasons are that in comparison Austrian wages including social security are much higher than in Costa Rica. Due to this difference, the motivation in Costa Rica for improving material efficiency is thus much higher than on improving labour conditions. Since the pressure on compliance of environmental regulation is limited in Costa Rica because the compliance control capacity of the regulatory body is very limited, also the other costs categories are not

so important in Costa Rica. Most of the sites had very old equipment that was depreciated a long time ago, so there are hardly any costs in the other cost categories, material purchase becomes extremely important and a methodology highlighting the importance of purchase costs of wasted material input actually works just as well or even better.

In Costa Rica another indicator was calculated: the percentage of environmental costs in relation to total expenditure. The average value was 4.2 per cent with a maximum value of 10.4 per cent in one company. This figure is distorted by Etipres' data, which has a high percentage due to the recent purchase of new equipment that led to high depreciation. Without considering Etipres, the average decreases to 2.7 per cent, with a fluctuation of +/- 1 per cent. Considering that material purchase value makes about 50 per cent of all environmental costs (3 per cent of total costs), this equals about 1.5 per cent of total annual expenditure, which is quite a large amount for potential costs savings.

5.2 Structure of the environmental costs

Also differences appear in the structure of the environmental costs. The environmental cost block "material purchase value of non-product output (NPO)" is most strongly weighted in the production enterprises (with 39-85 per cent in Austria and 46-92 per cent in Costa Rica). The NPO is by far the largest part of the environmental costs and this cost factor is generally not considered in the environmental costs inquiry.

The expenses for the waste and emission treatment follow with values between 13 to 52 percent in Austria and 6 to 38 per cent in Costa Rica. This includes disposal costs, depreciation and partly the operating materials for end-of-pipe technologies. In the case of Costa Rica, the expenses are lower, due to the non-existence of a waste disposal and collection tax (Environmental taxes have an average of 9 per cent in Austria and only 1 per cent in Costa Rica).

The cost block "prevention and environmental management" causes 1 to 14 per cent of the environmental costs in Austria and 1 to 17 per cent in Costa Rica. Companies with installed environmental management systems score high in this category, nevertheless the effort for prevention taken by the environmental team also helps to reduce the costs in the other cost categories (emission treatment and material purchase value of non-product output).

The fourth and last block "processing costs of the NPO" could be assessed only in some companies. It represents the production scrap evaluated by manufacturing costs of production, which is usually exposed during the stocktaking, and has a portion of approximately 3 per cent of the environmental costs, whereby sector-specific values of up to 20 per cent are possible.

The environmental revenues predominantly result from selling scrap and other material for recycling but also from selling capacity of the wastewater treatment system, energy production, and waste treatment plants to related or external companies. These revenues are about 0 to 9 per cent for Austria and 0 to 13 per cent for Costa Rica.

	Austria			Costa Rica		
	Min	Average	Max	Min	Average	Max
1. Waste and Emission treatment	13%	29%	52%	6%	18%	38%
2 Prevention + environmental m'ment	1%	6%	14%	1%	9%	17%
3. Material purchase value of NPO	39%	64%	85%	46%	72%	92%
4. Processing costs of NPO	0%	5%	17%	0%	5%	20%
5. Environmental revenue	0%	3%	-9%	0%	-4%	-13%

Figure 3. *Distribution of the cost categories by cost blocks*

	Pipasa	Resintech	Etipres	Coopro-naranjo	Roma Prince
1. Waste and Emission treatment	7%	20%	21%	38%	6%
2 Prevention and environmental management	4%	17%	13%	10%	1%
3. Material purchase value of NPO	91%	66%	46%	63%	92%
4. Processing costs of NPO	1%	0%	20%	3%	1%
5. Environmental revenue	-2%	-4%	0%	-13%	0%

Figure 4. *Distribution by cost categories in the five Costa Rican companies*

Figure 5 shows the extreme and average values of the individual cost categories of the Austrian and Costa Rican case studies.

	Austria			Costa Rica		
	Min	Average	Max	Min	Average	Max
1. Waste and emission treatment						
1.1. Depreciation for related equipment	2%	9%	25%	6%	18%	38%
1.2. Maintenance and operating materials and services	1%	5%	15%	0%	7%	20%
1.3. Related personnel	1%	5%	20%	0%	6%	15%
1.4. Taxes, Fees, Charges	4%	9%	14%	0%	1%	2%
1.5. Fines and Penalties	0%	0%	0%	0%	0%	0%
1.6. Insurance for environmental liabilities	0%	0%	0%	0%	0%	0%
1.7. Provisions for clean up costs, remediation, etc.	0%	0%	64%	0%	0%	0%
2. Prevention and environmental management						
2.1. External services for environmental managemen	0%	1%	4%	1%	3%	7%
2.2. Personnel for general environmental management	0%	4%	10%	0%	6%	16%
2.3. Research and development	0%	1%	4%	0%	0%	1%
2.4. Extra expenditure for IPPC equipment	0%	1%	3%	0%	0.2%	1%
2.5. Other environmental management costs	0%	0%	25%	0%	0%	0.1%
3. Material purchase value of the NPO						
3.1. Raw materials	3%	21%	54%	9%	19%	33%
3.2. Packaging	0%	3%	12%	0%	1%	4%
3.3. Auxiliary materials	0%	7%	31%	0%	0%	0%
3.4. Operating materials	0%	9%	37%	0%	5%	17%
3.5. Energy	16%	24%	31%	10%	45%	66%
3.6. Water	0%	1%	1%	0%	1%	3%
4. Processing costs of the NPO	0%	5%	17%	1%	6%	20%
5. Environmental revenues	0%	-3%	-9%	0%	-4%	-13%

Figure 5. *Detailed distribution of the cost categories*

Material purchase value of NPO is the most important cost category in all the companies analysed. However, in companies without EMS the amount is considerably higher (91-92%). This category includes raw materials as well as auxiliary and operating materials plus energy and water consumption cost. Nevertheless, it is

important to mention that these results are very much influenced by the quality of the information system.

The low percentage of depreciation costs in Costa Rica is a result of the limited pressure experienced by the companies to renew their equipment frequently and some of the companies lack budget, so old machinery is used and little investment is made in new technology. This fact further supports the cost structure as material-intensive, increasing the importance of the materials used but also increasing the requirement of energy efficiency measures. A clear example was the case of de-pulping drums in the coffee mill. This technology is 40 years old: heavy iron-made drums were rotated to de-pulp the coffee beans. Low labour cost justifies intensive maintenance without affecting the competitive position of the company.

The cost of waste and emission treatment ranges between 6 and 38 per cent. The maximum level is mainly reached by the investment in wastewater treatment systems (Pipasa and Coopronaranjo), obligatory requirement for the Costa Rican food industry since 1995, and for which the compliance is controlled intensively by the Ministry of Health. End-of-pipe equipment, staff and related operating costs have an important position in the cost structure. In general, it could be concluded that the trend is to still use end-of-pipe technology to tackle environmental issues.

The cost category "prevention and environmental management" causes between 1 and 17 per cent of the environmental costs. The companies with an EMS score considerably higher in this category (Resintech, Etipres and Coopronaranjo).

"Material purchase value of NPO" is by far the most critical component of the environmental cost structure in the case of the Costa Rican companies. Due to relatively higher cost rates of consumption of old fashion machinery, poor maintenance and insufficient insulation of heat transportation systems; energy is the most significant element in the EMA structure.

Raw materials on NPO are the second most important element. Together with operating materials, these elements offer important opportunities for improvement.

Water does not represent a significant cost in the structure, as most of the companies extract their water from wells, and no consumption tax is paid.

In both non-EMS companies the data on environmental impact and resource consumption is scarce and based on estimates.

It is expected that increasing "Prevention and Environmental" costs will help reduce costs of "lost material value".

The cost of "waste and emissions treatment" is considerably lower in the Costa Rican companies in comparison with European companies due to the fact that the fees of waste collection are still very low or do not exist, and enforcement is weak.

As general environmental awareness grows and tighter regulation and enforcement capacity are developed, it is expected that "emission treatment" costs will increase.

5.3 Distribution by environmental media

Apart from the distribution into the individual cost blocks, the distribution of costs into the environmental media as defined by the statistical department of the United Nations has also been regarded. Costs in the categories 'soil and groundwater', 'noise and vibration', 'biodiversity and radiation' do not occur in most companies. However, from an environmental point of view they are very sensible issues and therefore Environmental Protection Agencies put strong emphasis on separate recording. The shares of the cost of the other media vary strongly and will allow more useful interpretations once disclosed extensively on a sector-specific level. The column "other" was used whenever the costs could not be attached clearly to a medium (e.g. general environmental management).

	Austria			Costa Rica		
	Min	Average	Max	Min	Average	Max
Air & climate	14%	28%	41%	32%	54%	86%
Waste water	0.5%	30%	56%	1%	16%	47%
Waste	3%	36%	83%	3%	21%	54%
Other	0,2%	7%	17%	0%	9%	20%

Figure 6. *Distribution of the costs by environmental media*

	Pipasa	Resintech	Etipres	Coopro naranjo	Roma Prince
Air & climate	49%	52%	32%	51%	86%
Waste water	47%	4%	1%	28%	1%
Waste	3%	23%	54%	10%	12%
Soil / Ground Water	0%	0%	0%	0%	0%
Noise / Vibration	0%	0%	0%	0%	1%
Biodiversity	-1%	0%	0%	0%	0%
Health & Safety	0%	0%	0%	1%	0%

Figure 7*. Distribution of costs by environmental mdia in five Costa Rican companies*

Waste disposal fees are non-existent or very low in Costa Rica. As other spheres present relatively low costs, energy impact in the cost structure rises to a very high level. This fact is reflected in the Air/Climate sphere.

Pipasa and Coopronaranjo have significant wastewater treatment costs. Wastewater treatment is typically an end-of-pipe technology. An important percentage of valuable material (usually raw material) is being deposited and drained in the water.

In the case of the Costa Rican companies, other environmental media are insignificant, but still have some related costs. Biodiversity even has a positive value (earnings) due to an award Pipasa received from the government for reforesting and maintaining the forest areas in its surroundings.

5.4. Awareness about the amount of the environmental costs

Apart from the distribution of the environmental costs, its absolute amount is also of great importance. This project has shown that the environment-relevant costs in most enterprises are underestimated manifold. At the beginning of the project the participating companies in Costa Rica hardly knew the costs of waste management and energy consumption. After the method used in the project was presented in the first lecture, the participants of the selected SMEs were requested to estimate the environmental costs that would be determined at the end of the workshop and site visit.

The answers given showed that the environmental managers and technical managers had insufficient information about the size of the operational costs. The accountants had a benefit here, yet the estimation on average was far from the actual result after applying the method.

Thus it becomes obvious that increased awareness of the size of the environmental and material flow costs, and above all the material purchase value contained in waste must be established and with it coherently also measures for the increase of the material and energy efficiency. It is important that environmental protection is not only regarded as a nuisance by enterprises, but that the often-significant saving potentials, which also result in an improvement of the environmental performance, do not remain concealed.

6 Concluding Remarks

The application of the UN DSD EMA method in the Costa Rican business environment was met with large interest, and interesting results that will motivate management to invest in environmental management activities. It is feasible to conduct the cost assessment in one or two days. The project resulted in suggestions regarding the improvement of the accounting information system, and the reduction of the material and energy loss. All enterprises showed their interest in the continued use of the instrument.

In all companies there is a lack of information and/or accuracy on resource flows in the accounting systems. Almost all the cost data had to be estimated based on production data. Most of the information was held by cost centres and thus, the information was diffused and segregated into different accounts. Some information did not exist, and some was captured in an account where several other costs were captured, not allowing to clearly define the specific cost.

As a general conclusion, it is considered that the methodology is very applicable for SMEs in Costa Rica. It helps decision makers identify the environmental costs generated in the production processes and to defend possible investments with data. The method is especially useful for Costa Rican companies with a certain level of environmental awareness and interest in investing in improvement processes, and very useful for ISO 14001-certified companies to connect environmental management issues at operational level with the financial system. The method helps SME to identify operational potential factors to reduce environmental costs

General management has a very limited idea of the environmental costs produced by the company. The tool is useful to create awareness amongst general management about the importance of having quantified information for decision-making processes regarding environmental and material flow management.

The results obtained in Costa Rican SMEs have some very clear differences to the ones obtained in Austria. This is partly due to the fact that European companies have already implemented many efficiency improvements in their processes, while Costa Rican companies still tend to have considerable opportunities for improving efficiency through good housekeeping. Besides this, the regulatory framework in Europe is more extensive and compliance more strict, based on fees and taxes, while the environmental legislation in Costa Rica is still very general, lacking clear parameters, and the compliance control entity lacks the budget to carry out intensive controlling activities. Therefore for Costa Rican companies it is still more attractive not to comply then to meet all the existing legal requirements. This results in very limited environmental management costs, since there are few external factors that force them to invest in pollution prevention.

However, analysing the cost structure, the companies became aware of the cost of wasting natural resources, which creates an internal impulse to invest in waste reduction practices. Finally, three of the companies had implemented ISO-14001 while two others did not. As a result it was much easier to work with companies with EMS already implemented, as their awareness and data availability is higher.

On the other hand, the deficiencies of the accounting information system are quite similar. The suggestions during the workshops raised a few general recommendations for the improvement of the data collection of the environmental and material flow costs.

- Data collection of material purchase by material groups in financial accounting

In some enterprises the entire material purchase is booked on one account only and it is only possible to evaluate by hand the extensive cost centre accounts or stock-taking lists to divide the actual material use into the material groups. As an aid, the recordings of the production manager were multiplied to the assigned quantities with average prices, in order to at least be able to indicate orders of magnitude. The fact

that such a system cannot strengthen cost consciousness in handling raw, auxiliary and operating materials is obvious.

- Estimation and recalculation of material scrap percentages

The loss percentages for raw materials, packing material, auxiliary materials and the final product are often based on outdated estimated values and are only recalculated for a few material groups. The employees on-site usually have more precise estimated values than the accountants. A correct recalculation mostly lead to frightening results.

- Consistency of system boundaries for material flow accounting in technical and accounting information systems and definition, which accounts, cost centres and cost categories must be consistent by amount and value

The input-output material balance disclosed in the environmental statement is hardly ever consistent with the system boundaries of the accounts and cost centre reports. As a consequence, the data could not be audited for consistency. For the recording of the costs and amounts of waste three different values and records on one site (record of the environmental manager without the costs for weighing, transportation and rent of disposal cans, the financial account with some wrong postings and the accounts of several suppliers with additional services) were found.

- Depreciation of projects/investments before the first year of cost assessment

During the first cost assessment, the question is often posed how to deal with missing values of the previous years. If these can be estimated or assessed easily, it should be done. But, the main goal of the first assessment is to improve the data basis for the next years and not detailed and cumbersome assessment of previous values.

- Distinction to Health and Safety and Risk management

Designing a system appropriate to the company involved is the most important target. Some companies have added a column for safety and risk prevention, as this duty is also part of the job description of the environmental manager. Health is mostly the responsibility of other departments. Coopronaranjo included a new environmental medium “Health and Safety”, as this is considered a significant environmental factor in the company.

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