PRODUCTIVITY, VIABILITY AND IMPROVED ENVIRONMENTAL PERFORMANCE

Introducing Environmental Management Accounting at Enterprise Level

A contribution of the UNIDO project "Transfer of Environmentally Sound Technology (TEST) in the Danube River Basin"

Methodology and Case Studies from Central and Eastern Europe

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

economy environment employment

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FOREWORD

In the Millennium Declaration of 2000, the United Nations General Assembly asserted that current unsustainable patterns of production and consumption had to be changed, and that no effort should be spared to free all of humanity, particularly future generations, from the threat of living on a planet irredeemably spoilt by human activities, and whose resources would no longer be sufficient for their needs. They codified this in the Seventh Millennium Development Goal of Ensuring Environmental Sustainability.

In their Plan of Implementation, the delegates to the World Summit on Sustainable Development of 2002 reaffirmed the necessity for sustainable patterns of consumption and production, calling inter alia for an enhancement of industrial productivity and competitiveness as well as an intensification of efforts in cleaner production and the transfer of environmentally sound technologies.

The UNIDO Corporate Strategy responds to these challenges, affirming that for development to be sustainable environmental concerns must be systematically incorporated into the paradigms of economic development. This way the achievement of high levels of productivity in the use of natural resources becomes a central concern both in the developing countries as well as in the advanced industrial nations. As stated in the Strategy, "in the process of industrialization there has to be a shift from end-of-pipe pollution control to the use of new and advanced technologies which are more efficient in the use of energy and materials and produce less pollution and waste; and finally to the adoption of fundamental changes in both production design and technology represented by the concept of 'natural capitalism' and the 'cradle-to-cradle' approach."

This Series on *Productivity, Viability and Improved Environmental Performance* has been conceived as one of UNIDO's tools to promote the message that increased levels of productivity by enterprises in their use of natural resources enhances their environmental performance while assuring them a greater viability when affronting the challenges of the future. In particular, this volume "Introducing Environmental Management Accounting at Enterprise Level" presents the experience gained in the application of environmental management accounting (EMA) as a valuable tool to assist the corporate and organisational managers, accountants and engineers of the developing and transitional countries, in understanding how environmental issues influence accounting business practices.

Carlos Magariños
Director-General

NOTES ON THE AUTHORS

Roberta De Palma is an industrial engineer with a specialization in Cleaner Technology. She has worked for UNIDO since 1998, and has been responsible for the implementation of various technical cooperation programmes in the field of industrial environmental management and transfer of environmentally sound technologies. Since 2001, Ms. De Palma has been the Programme Manager of the UNIDO TEST project in five countries of the Danube River Basin, developing an innovative approach to integrate industrial competitiveness with environmental responsibility—a methodology that includes the introduction of Environmental Management Accounting (EMA) as a management tool. She is the designer of the conceptual framework of this publication and co-author of the introductory and methodology chapters, being also responsible for reviewing and assembling the four EMA case studies presented in this document.

Maria Csutora is an associate professor at the Budapest University of Economic Sciences and Public Administration. She was Vice-Director of the Hungarian Cleaner Production Centre between 1997-2001 and taught environmental accounting at the Rochester Institute of Technology between 1998-1992. She is member of the United Nations Division for Sustainable Development (UNDSD) expert working group on environmental management accounting and Environmental Management Accounting Network (EMAN). She has collaborated with UNIDO within the framework of the TEST project, providing methodological inputs and practical assistance to local teams during the implementation of EMA systems at enterprise level and the preparation of the case studies.

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CONTENTS

Figures

Tables

EXPLANATORY NOTES

ABC	Activity Based Costing
Al_2O_3	Aluminium Oxide
ASPEK	Association for Industrial Ecology
BAT	Best Available Technology
BDtpd	Bone-dry tons per day
BOD	Biological Oxygen Demand
CC	Cost Centres
CEE	Central and Eastern European countries
COD	Chemical Oxygen Demand
COMFAR	UNIDO Accounting Software (http://www.unido.org/doc/3470)
CP	Cleaner Production
CPA	Cleaner Production Assessment
ECOIND	Institute for Industrial Ecology (Romania)
EM	Environmental Management
EMA	Environmental Management Accounting
EMAN	Environmental Management Accounting Network
EMS	Environmental Management System
End-of-Pipe	Pollution treatment or abatement technology
EPA	U.S. Environmental Protection Agency
EST	Environmentally Sound Technologies
EU	European Union
euro	European Union Currency
EUROSTAT	European Statistics Organization
GEF	Global Environment Facility
HERBOS	Chemical producer (mainly pest control products) based in Croatia
HTS	Hygienic and Technical Safety
HUF	Hungarian Forint (1 HUF = 0.003881 euro)[1]
IAS	International Accounting Standards

1 Conversion as of 22 August, 2003. For current rates see www.oanda.com/convert/classic.

ICPDR	International Commission for the Protection of the Danube River (www.icpdr.org)
IDs	Identification numbers
ISO 14001	International Standards Organization—Environmental Management System Standard
IRR	Internal Rate of Return
KAPPA STUROVO	Pulp and paper plant in Slovakia
HRK	Croatian Kunas Currency as of May 2001 (1 HRK is approximately 0.139 euro)
MFG/PRO	Software for accounting purposes
NCPC	National Cleaner Production Centre
NITROKÉMIA 2000	Chemical producer in Hungary
NGO	Non-Governmental Organization
NPV	Net Present Value
NSSC	Neutral Sulphite Semi-Chemical
PBP	Pay Back Period
PR	Public Relations
PSA	Anhydrous phthalic acid
RAS	Romanian Accounting Standard
SSK	Slovak Crown (1 euro is approximately 41 SKK)[1]
SAP/R3	Business application software (www.sap.com)
SO_2	Sulphur Dioxide
SOMEŞ	Romanian Plant, Member of the HOVIS Group producing sulphate pulp (kraft) and wrapping paper
TEST	Transfer of Environmentally Sound Technology
UNCED	United Nations Conference on Environment and Development
UNDS	Uniform National Discharge Standards
UNDSD	United Nations Division for Sustainable Development
UNDP	United Nations Development Programme (www.undp.org)
UNEP	United Nations Environment Programme (www.unep.org)
UNIDO	United Nations Industrial Development Organization (www.unido.org)
USD	United States Currency (1 USD is approximately 0.893 euro)[1]
WWTP	Waste Water Treatment Plant

INTRODUCTION

UNIDO TEST PROGRAMME IN CENTRAL AND EASTERN EUROPEAN (CEE) COUNTRIES AND THE TEST APPROACH

The United Nations Industrial Development Organization (UNIDO) has developed a programme designed to promote competitiveness and effective environmental performance in the industrial sector by supporting the adoption and Transfer of Environmentally Sound Technology (TEST) and incorporation of Environmental Management Accounting (EMA) in an enterprise's decision-making process. With these programmes companies will finally be able to review all the factors affecting competitiveness, including the effect of environmental choices, and make better-informed business decisions based on more accurate data. This new initiative, funded by the Global Environmental Facility (GEF) and developed within the framework of the Danube River Basin Commission (ICPDR),[2] was launched in April 2001 in five Danubian countries (Bulgaria, Croatia, Hungary, Romania and Slovakia).

Seventeen industrial hot spots of the Danube river basin, representing five different industrial sectors (chemical, food, machinery, textile, pulp and paper), were selected and pilot projects were set-up to implement the new integrated TEST approach to industrial environmental management.

As a result of the TEST project's success, their national counterparts have implemented the TEST approach and programme[3] so that they can, in turn, pass on the acquired expertise to other enterprises and institutions in their own countries and throughout the Danube River Basin. These national counterparts include the UNIDO-UNEP Cleaner Production Centres in Hungary, Slovakia and Croatia, the Institute for Industrial Ecology (ECOIND) in Romania and the Technical University of Sofia in Bulgaria.

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2 www.icpdr.org.

3 R. De Palma and V. Dobes, Increasing Productivity and Environmental Performance: An Integrated Approach—Know-How and Experience from the UNIDO TEST project in the Danube River Basin, UNIDO.

The TEST approach starts with a preventative philosophy of cleaner production, (preventative actions based on pollution prevention techniques within the production process) and moves into the transfer of additional technologies for pollution control (end-of-pipe) only after other win-win solutions have been exhausted. This leads to environmental and economic optimisation of the transferred technologies.

TEST builds on company strategies of corporate sustainability. The implementation of these strategies is based on the introduction of different tools, each of which will increase the enterprise's competitiveness. With better management of existing processes and the integration of environmental considerations into new investment decision-making, enterprises will become more competitive. One of the core tools introduced within the TEST approach is Environmental Management Accounting (EMA). EMA will bring competitive advantages to the company in terms of better understanding and control of production costs, particularly environmental costs.

The TEST approach is a methodology designed to simultaneously combine the introduction of management tools like EMA, Clean Production Assessment (CPA) and EMS under one programme. The method demonstrates how combining these tools within an integrated framework will result in reaching positive synergies and better results.

The aim of this publication is to present the experience that was gained during the implementation of the EMA tool at selected enterprises within the framework of the UNIDO-TEST project in the Danube River Basin. It is meant to assist the corporate and organizational managers, accountants and engineers of the developing and transitional countries, in understanding how environmental issues influence accounting business practices.

The publication is organized into three parts. In the first, it clearly and concisely describes the principals behind EMA and the linkages between business management and other environmental management tools. The second part outlines the methodology used during the practical implementation of EMA systems at the companies participating in the project. The third and last part presents a detailed description of four case studies, which provide practical advice on how to successfully integrate EMA systems into business operations. The case studies are presented in this publication in chronological order of completion within the framework of the TEST project.

PART I

ENVIRONMENTAL MANAGEMENT ACCOUNTING

ENVIRONMENTAL MANAGEMENT ACCOUNTING

A. Definition: What is EMA?

Monetary environmental management accounting is a sub-system of environmental accounting that deals only with the financial impacts of environmental performance. It allows management to better evaluate the monetary aspects of products and projects when making business decisions.

"'EMA' serves business managers in making capital investment decisions, costing determinations, process/product design decisions, performance evaluation and a host of other forward-looking business decisions."[4] Thus, EMA has an internal company-level function and focus, as opposed to being a tool used for reporting environmental costs to external stakeholders. It is not bound by strict rules as is financial accounting and allows space for taking into consideration the special conditions and needs of the company concerned.

B. Why should companies use environmental accounting?

Companies and managers usually believe that environmental costs are not significant to the operation of their businesses. However, often it does not occur to them that some production costs have an environmental component. For instance, the purchase price of raw materials: the unused portion that is emitted in a waste is not usually considered an environmentally related cost. These costs tend to be much higher than initial estimates (when estimates are even performed) and should be controlled and minimised by the introduction of effective cleaner production initiatives whenever possible. By identifying and controlling environmental costs, EMA systems can help environmental managers justify these cleaner production projects, and identify new ways of saving money and improving environmental performance at the same time.

4 UNDSD: Improving Government's Role in the Promotion of Environmental Managerial Accounting, United Nations, New York, 2000, p. 39.

The systematic use of EMA principles will assist managers in identifying environmental costs often hidden in a general accounting system. When hidden, it is impossible to know what share of the costs is related to any particular product or process or is actually environmental. Without the ability to isolate and separate this portion of the overall cost from that of production, product pricing will not reflect the true costs of its production. Polluting products will appear more profitable than they actually are because some of their production costs are hidden, and they may be sold under priced. Cleaner products that bear some of the environmental costs of more polluting products (through the overhead), may have their profitability underestimated and be over priced. Since product prices influence demand, the perceived lower price of polluting products maintains their demand and encourages companies to continue their production, perhaps even over that of a less polluting product.

Finally, implementing environmental accounting will multiply the benefits gained from other environmental management tools. Besides the cleaner production assessment, EMA is very useful for example in evaluating the significance of environmental aspects and impacts and prioritising potential action plans during the implementation and operation an environmental management system (EMS). EMA also relies significantly on physical environmental information. It therefore requires a close cooperation between the environmental manager and the management accountant and results in an increased awareness of each other's concerns and needs.

As a tool, EMA can be used for sound product, process or investment project decision-making. Thus, an EMA information system will enable businesses to better evaluate the economic impacts of the environmental performance of their businesses.

1. Product/process related decision-making

Correct costing of products is a pre-condition for making sound business decisions. Accurate product pricing is needed for strategic decisions regarding the volume and choices of products to be produced. EMA converts many environmental overhead costs into direct costs and allocates them to the products that are responsible for their incurrence.

The results of improved costing by EMA may include:

- Different pricing of products as a result of re-calculated costs;
- Re-evaluation of the profit margins of products;
- Phasing-out certain products when the change is dramatic;
- Re-designing processes or products in order to reduce environmental costs;
- Improved housekeeping and monitoring of environmental performance.

Table 1 summarizes the main environmental cost categories[5] found in business.

Table 1. Environmental Cost Categories

Environmental Cost/Expenditure Categories				
1 Waste and Emission Treatment	2 Prevention and Environmental Management	3 Material Purchase Value of Non-Product Output	4 Processing Costs of Non-Product Output	5 Environmental Revenues
1.1 Depreciation for related equipment	2.1 External services for environmental management	3.1 Raw materials	4.1 Labour costs	5.1 Subsidies, Awards
1.2 Maintenance and operating materials and services	2.2 Personnel for general environmental management activities	3.2 Packaging	4.2 Energy costs	5.2 Other earnings
1.3 Related Personnel	2.3 Research and Development	3.3 Auxiliary materials		
1.4 Fees, Taxes, Charges	2.4 Extra expenditure for cleaner technologies	3.4 Operating materials		
1.5 Fines and penalties	2.5 Other environmental management costs	3.5 Energy		
1.6 Insurance for environmental liabilities		3.6 Water		
1.7 Provisions for clean-up costs, remediation				

[5] UNDSD: "Environmental Management Accounting, Procedures and Principles", United Nations, New York, 2001, p. 19.

The purchase value of materials and processing costs of non-product outputs play an important role in EMA. They include the cost for buying and processing that portion of production inputs that goes into the waste or is discarded as scrap such as raw materials, auxiliary materials or water, energy and the labour cost of processing. These costs are often on an average ten to twelve times greater than the waste and emissions treatment costs.[6] Savings associated with this category of environmental costs into project evaluations will make a larger number of cleaner production projects more profitable.

2. Investment projects and decision-making

Investment project decision-making requires the calculation of different profitability indicators like net present value (NPV), payback periods (PBP) and internal rates of return (IRR) or benefit-cost ratios. Recognizing and quantifying environmental costs and benefits is both invaluable and necessary for calculating the profitability of environment-related projects. Without these calculations, management may arrive at a false and costly conclusion.

Companies should take into account hidden, contingent and image costs for project appraisals. The costs recorded in bookkeeping by conventional accounting systems are insufficient to provide an accurate projection of the profitability and risks of an investment. Many cost items that may arise from long-term operations or projects must be included in the project appraisal. These environmental costs have been grouped into five categories[7] as follows:

- Raw materials, utilities, labour and capital costs are conventional costs always considered in project appraisals and cost accounting, however the environmental portion of these costs, e.g. non-product raw material costs, are not isolated and recognized as environmental.
- Administrative costs buried in the overhead costs and hidden. Examples include monitoring, reporting or training costs.

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[6] Evaluation of cleaner production projects implemented in 46 enterprises in the Czech Republic—Czech Cleaner Production Centre: Annual Report 1996, Czech Cleaner Production Centre, Prague, 1997.

[7] An introduction to Environmental Accounting As A Business Management Tool: Key Concepts And Terms, EPA 742-R-95-001, June 1995, pp. 8-11.

- Contingency costs that may or may not be incurred in the future, such as potential clean-up costs from an accident, compensations or fines: the inherent difficulty in predicting their likelihood, magnitude or timing often results in their omission from the costing process. However, these costs very often represent a major business risk for the company.
- Image benefits and costs, often called intangible or “good-will" benefits and costs, arise from the improved or impaired perception of stakeholders (environmentalists, regulators, customers, etc.). Changes in these intangible benefits are often not felt until they are impaired. For example, a bad relationship with regulators may result in prolonged licensing process or stricter monitoring.
- External costs represent a cost to external stakeholders (communities, customers, etc.) rather than to the company itself. Most accountants agree that these costs should not be taken directly into account when making project decisions. The company should be aware, however, that high levels of external costs may eventually become internalized through stricter environmental regulation, taxes or fees. A good example of this type of cost would be costs of environmental degradation (through “acid rain”), due to sulphur dioxide (SO_2) pollution, which later standards strictly regulating SO_2 emissions would internalize, as the costs of purchasing and operating a scrubbing and neutralizing system.

A profitability analysis should be done using appropriate time-lines and indicators that do not discriminate against long-term savings and benefits. Net present value and benefit cost ratios are suggested as better investment criteria than simple paybacks or internal rates of return to reflect real costs and benefits. An accurate analysis of the investment's sensitivity to environmental costs should also be carried out, which takes into consideration the impact of input price changes and future changes in the regulatory regime (fees, fines and penalties). Different scenarios can be examined, also evaluating contingency and external environmental costs reflecting the joint impact of changing several variables at the same time.

Thus, EMA is an important tool for integration of environmental considerations into financial appraisals and decision-making for new investments: environmentally friendly investments will show increased profitability in the long term if all these factors are included in the model.

C. Integration of EMA with other environmental management tools

Environmental accounting will produce the most benefits when it is integrated with other environmental management tools. In particular, EMA will increase the advantages that a company can gain through the implementation of EMS. Linking EMA with cleaner production and environmental reporting show the financial gain which can be achieved by applying these tools, since contingent liabilities represent major environmental, business and financial risks for companies. EMA is a good supplement for risk management programmes as well.

The TEST project has the major advantage of applying different tools within an integrated framework. Below is a brief discussion on how the different tools support each other and can be integrated with EMA.

1. Environmental Management Systems (EMS) according to the ISO standard

The ISO14001 standard requires the evaluation of environmental aspects during the planning phase of the environmental management system. In ISO 14001 environmental aspects are "elements of an organization's activities, products and services that can interact with the environment."[8] The company shall:

- Identify the aspects which have an impact on the environment and
- Assign a level of significance to each environmental aspect

"When establishing and reviewing its objectives, an organization shall consider the legal and other requirements, its significant environmental aspects, its technological options and its financial, operational and business requirements, and the views of interested parties".[9]

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[8] ISO 14004: 1996 Environmental management systems—general guidelines on principles, systems and supporting techniques, normative references, p. 2.

[9] ISO 14001: 1996 Environmental management systems specification with guidance for use, section 4.3.3.

Experience shows that financial implications play a very important role in companies decisions about significant environmental aspects they choose to tackle first. Measures that will bring higher savings will most likely be implemented first. By clarifying the environmental cost structure of a process or of a product, EMA will allow managers to have an accurate understanding of where to focus to make processes more cost efficient.

When EMA is in place, environmental costs are calculated and traced back to the source of their generation within the production process. In this way, environmental costs can be associated to specific environmental aspects, and can provide additional quantitative criteria for the setting of priorities, targets and objectives within an EMS. Thus, having an EMA system in place will help managers to effectively implement the EMS.

2. Cleaner production

When cleaner production is combined with an EMA system, significant synergies can be reached. The optimum time to build up the EMA is just after completing a cleaner-production detailed analysis, where the input/output analysis and the material flows analysis can provide basic information on the amount of production inputs physically lost. These data are essential for assessing the non-product output costs.

A cleaner-production assessment (CPA) can be a major source of data during the design of an EMA information system: especially in companies that do not have a well-established management accounting system and environmental controlling system to provide information on material flows and the costs associated with them. This is especially true for small and medium sized companies. If neither a CPA nor EMA exists, it is recommended a company perform the CPA before the EMA, especially if the company does not have accurate data on the process.

Regardless of whether any of these systems have been implemented or assessments performed, the adoption of an EMA would immediately result in the adoption of tools like CPA to identify measures to reduce environmental costs on a continual basis.

3. Environmental performance evaluation and sustainability reporting

The calculation of the financial impacts of environmental performance has recently been introduced within the environmental performance evaluation and reporting.

According to ISO 14031 financial costs and benefits are a sub-group of management performance indicators. Examples for financial indicators in the standard include: costs that are associated with environmental aspects of a product or process, return on environmental investment, savings achieved through reductions in resource usage, prevention of pollution or waste recycling, etc. While most companies have an estimate of their environmental costs, it is usually underestimated. Moreover, savings and profitability of waste reduction programmes cannot be reliably estimated without a proper EMA in place.

An EMA system can separate end-of-pipe costs from prevention costs. It also helps in calculating the savings gained through the reduced use of raw materials and energy. Without these data from environmental programmes, companies will continue to think of environmental management as a strictly non-profit-generating part of business that always costs money. Cleaner production can save money and thereby increase profits. With an EMA these savings can be captured and reported.

EMA generated data improves the bargaining power of environmental managers with a company's top managers and shareholders, to create or obtain funding for environmental programmes, CP projects and EST investments. It will also provide precise numbers on environmental costs, when required by external stakeholders. While shareholders are concerned about their liabilities, external stakeholders (authorities, civil societies, NGOs, etc.) are interested in seeing the company's efforts toward environmental management supported by substantial environmental expenditures. Data generated by an EMA will help demonstrate these efforts.

D. Conclusions

EMA is a relatively new tool in environmental management. Decades ago environmental costs were very low, so it seemed wise to include them in the overhead account for simplicity and convenience. Recently there has been a steep rise in all environmental costs, including energy and water prices as well as liabilities. In Europe the Pollution Prevention Pays programme of 3M played a crucial role in the spread of the EMA concept, while in the United States the high level of potential liabilities pushed companies to better evaluate their environmental costs. Now, especially transition economies are going through a fast change that will impose a requirement for more accurate control of production inputs and outputs.

Environmental costs are no longer a minor cost item that can be pooled together with other costs: the use of EMA saves money and improves control.

Still, many companies need external help in creating or improving their EMA, as those skills are not widespread and rarely available internally. EMA has to be tailored to the special needs of the company rather than be applied as a generic system. The costs and benefits of building such a system has to be considered and the scope of the EMA properly selected. Building the EMA incrementally is a common implementation strategy among companies.

PART II

THE METHODOLOGY

THE METHODOLOGY

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.

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[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.

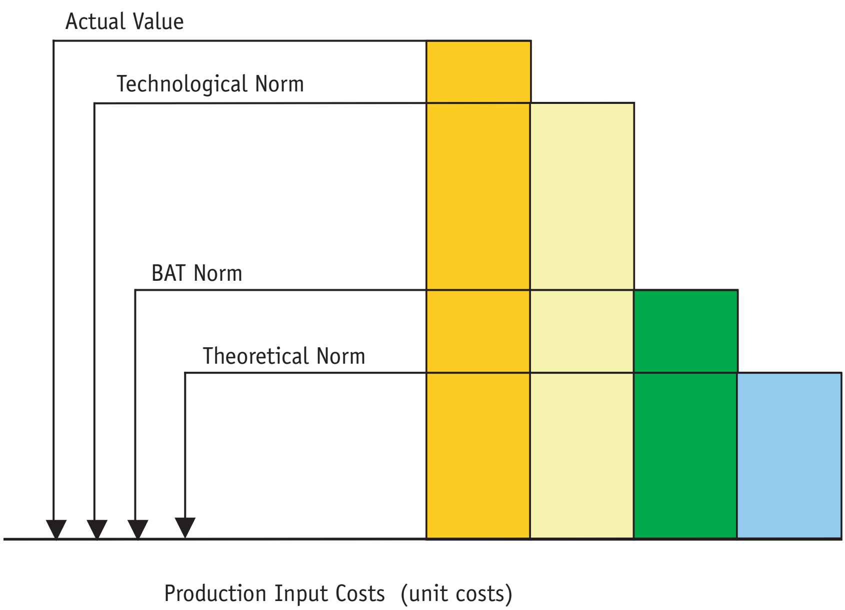
The next, and usually more stringent benchmark, is the Best Available Technology (BAT) levels. These will be technologies, that for particular sectors and/or products, are considered the most efficient and/or protective of the environment currently available on the international market. By using this 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.

PART III

CASE STUDIES

CASE STUDIES

A. Introducing EMA in CEE countries: the experience of the TEST project

EMA systems were introduced in four companies located in the Danube River Basin, namely HERBOS (herbicide producer—Croatia), Kappa (pulp and paper sector—Slovakia), Nitrokémia 2000 (chemical sector—Hungary) and SOMEŞ (pulp and paper sector—Romania).

EMA systems were introduced as part of the TEST integrated approach, together with other management tools such as CPA and EMS. The TEST project showed that the best time to introduce the EMA is after the CPA has been completed and while the EMS is under development: significant synergies were achieved in terms of data collection and setting up of the information system.

The introduction of EMA at the four enterprises was conducted by teams of national consultants and employees of the selected companies working under the supervision of an EMA expert. At the request of the participating companies, environmental costs data reported in the case studies have been modified slightly to protect confidentiality.

As part of the TEST project, capacity was already built into the overall system for implementing EMA at the national counterparts and at the participating enterprises. The national TEST counterparts found the EMA such a significant business asset that they decided to include it within their available technical services and disseminate it to other enterprises within the countries. For instance, the Hungarian Cleaner Production Centre hosted a national seminar on EMA that was attended by more than 80 participants, including 20 companies' representatives.

Two new projects to implement EMA were launched by UNIDO and are in progress at the time of writing:

- The first, within the framework of the TEST project, aims to incorporate EMA at both an institutional level and at selected Bulgarian enterprises. Completed case studies are expected by December 2003.
- The second, financed by the Hungarian Government and executed by UNIDO, involves the Hungarian and Croatian Cleaner Production Centres applying EMA at selected Croatian enterprises.

B. Use of EMA

EMA was used to achieve different goals, depending on the specific needs of each enterprise. In two companies (HERBOS and Kappa), the goal was to calculate the total environmental costs of the enterprise. At SOMEŞ and Nitrokémia the goal was to allocate environmental costs to products for product pricing and for comparing different products.

The scope of the EMA was customized at each of these companies to meet their individual needs and circumstances. A comparison of the four case studies shows that the factors that may influence the scope of the EMA include:

- The type of processes (industrial branch);
- The commitment of the management;
- The existing accounting practices;
- The skills of the accounting department;
- The communication between the environmental department and accounting department;
- The position and recognition of the environmental function by the top management.

Nitrokémia 2000 decided to focus on three processes/products with high environmental impacts for the company. Each of the three products concerned is produced by a separate technology (although productions are interlinked); therefore, the costs could be allocated directly to products.

In the case of SOMEŞ, the scope of the EMA was initially restricted to one production unit (bleaching process). Later, the company decided to allocate environmental costs to the product (pulp), especially with respect to non-product output. In order to do that, the scope of the EMA had to be broadened to the whole company.

At Kappa, due to the wide range of products, all with similar characteristics (different variations of cardboards), the trade-off between costs and benefits of segregating these products under these circumstances led to the decision not to allocate the environmental costs to each product.

It is unlikely that a company would change its complete accounting practice just to accommodate EMA. Thus, EMA has to adjust to the current practice. Certain companies do not have a separate management accounting function; instead, they use the financial accounting information for internal control purposes. Data collection and calculation of environmental costs would be much more time consuming and expensive in such cases and the company might decide to set a less ambitious goal for EMA to save time and effort. HERBOS is an example of this situation: it was decided to calculate environmental costs at the company level and specifically for the most problematic plant, the atrazine plant. Even though the environmental costs were not allocated to products and the EMA project required a significant effort from the plant and consultants, it proved to be very beneficial for the company. However, due to the lack of an internal cost accounting system, it was not possible to allocate environmental costs to products and implement the EMA system on a continuous basis.

The actual environmental costs (calculated after implementation of EMA system in the four enterprises) were much higher than originally estimated at the start of the project by a factor of 2 to 10 times. It should be mentioned that this estimate is still conservative, since not all environmental costs categories were considered during the pilot introduction of EMA in the four companies.

In general, the calculation of environmental costs studies focused on the raw materials and auxiliary materials portion of the non-product costs (the energy and labour portion related to non-product output costs were not considered in any of the four case studies). The studies revealed that raw material costs associated to non-product outputs are in average three times higher than the waste and emission treatment costs.

Overall the environmental costs in the four companies were shown to be significant if related to the total production costs, varying between 5 and 10 per cent of total variable production costs and this was a surprise for the companies.

Looking back, some companies felt they would have preferred to devote less energy to EMA implementation and have decided they will develop it further only if it offers definite benefits. Support from top management is a crucial issue in applying EMA. Without this support, EMA will probably be a one-time exercise rather than everyday practice. It should be noted that in some companies, management is restricted by the internal regulations set for the entire corporate group, so it cannot make a decision that would make its management accounting system depart from the group standards. EMA is more easily introduced in companies without this kind of obligation.

By the end of the project, three of the four companies had established an information system and were controlling environmental costs on a continuous basis. The information system for the EMA differed from one company to the other, depending on existing cost accounting practices and systems. The identification of cost centres for the allocation process was done using existing cost centres classifications and in most cases the existing allocation keys. EMA became integral part of the existing systems.

Two of the four participating enterprises in the EMA-TEST project, given the positive results achieved within the project, decided to extend the system to other processes or to their entire plant utilizing their own internal resources.

C. Further application of EMA in CEE: barriers and challenges

One of the main findings of the TEST project that was not expected when it was started, is that EMA as a management tool is initially much easier "to sell" to enterprise managers than for example CPA, although it requires considerable resources for its practical implementation. It seemed that managers immediately recognized the benefits of using an EMA.

Environmental managers found it very useful to have an EMA in place, and consider it to be a very useful tool for justifying environmental projects within the company. The bargaining power of the environmental managers increased significantly as they were able to show managers the economic significance of environmental costs with respect to the total production costs. By allocating environmental costs to the production steps where they originate, it was possible to show which portion of the environmental costs could be reduced by implementing a CP option and which portion of environmental costs could be avoided if significant investment in BAT's were undertaken.

EMA can be applied in any company, but the benefits that can be gained can vary considerably depending on their particular conditions. This fact was underlined by the experience of TEST project companies. The factors that most influence the future adoption of EMA on a wide scale in CEE countries are related to the price of input materials, regulatory regimes and enforcement, and the stability of the business environment.

High input prices encourage the use of EMA since significant savings opportunities can be revealed. On the other hand, in countries with low input prices, savings in these materials (identified using input efficiency programmes) are small and often insignificant. Experience from SOMEŞ showed that water represents a negligible input cost for industries in Romania due to extremely low water prices. This situation would not change even if a tenfold increase in prices occurred.

Strict environmental regulations and enforcement encourages the use of EMA, where savings can be realized from reduced environmental fines, fees and liabilities. Lax or frequently relaxed regulation and enforcement discourages its use. Relaxed environmental regulations were a problem in most of the TEST project countries.

In the near future all the countries involved in the TEST project in the Danube River Basin are planning to accede to the European Union (EU). This will have a significant impact on these countries' economies. Enforcement of environmental regulations is likely to be taken seriously, even in those countries where the lack of enforcement was mentioned as a problem during the project, and environmental liabilities for not meeting regulations are expected to rise. Subsidies will be cancelled in many areas and the currently depressed prices for raw materials, energy and water may rise, which would significantly increase environmental costs in all the CEE countries. These developments will increase the importance of EMA: in a business environment where input material costs and environmental fines are high, enterprises will likely be interested in adopting management tools such as EMA, which will enable them to control those costs.

Thus, the adoption of EMA, especially in CEE countries which are characterized by economies in transition and under growing environmental pressure, can support managers to be pro-active by enabling them to forecast increases in production costs from environmental impacts and changes in the regulatory regime, a fact confirmed in all the TEST countries.

CASE STUDY 1: NITROKÉMIA 2000, HUNGARY

Authors: ***Mária Csutora*** **and** ***Ágnes Kajdacsy***

The EMA team in Nitrokémia 2000 consisted of the Environmental Manager, the Plant Engineer and the Chief Controller from the company and the national consultant from the Hungarian Cleaner Production Centre.

A. Brief description of the company

1. About the company

Nitrokémia 2000 Rt. was founded in 1997 as a 100 per cent subsidiary of Nitrokémia, an old state-owned chemical company that started in 1928 and accumulated numerous environmental problems and liabilities during its long life. Nitrokémia 2000 was established as an entirely new legal body in 2000, thereby not inheriting any of the environmental liabilities of its parent, but it was left operating most of its obsolete technologies. The new company purchases wastewater treatment and hazardous waste incineration services from the still existing state-owned Nitrokémia.

Nitrokémia 2000 sites, two in Balatonfüzfö and one site in Papkeszi, are located in valuable surroundings close to Lake Balaton, both the most visited recreational area in Hungary and near to prospective conservation areas. These sites are ones listed by the International Commission for the Protection of the Danube River (ICPDR) as industrial hot spots in the Danube River Basin. The company is an important private enterprise in the Hungarian chemical industry, operating 54 technologies in five different divisions.

The product structure and the volume of production changed significantly due to major transformations in the economic system, ownership and market demand after the company was formed. The volume of production declined for most product types during the first two years of operation. Major economic indicators of the company for the year 2002 are as follows:

Revenue:	11-12 billion HUF (approximately 42 million euro)
Registered capital:	4.653 billion HUF (approximately 19 million euro)
Export:	approximately 65 per cent of turnover
Number of employees:	700-800
Contact Person:	Ágnes Kajdacsy, environmental manager
Telephone:	(+36)-88-543-723
Email:	akajdacsy@nitrokemia.hu

Core business units:

- Manufacture of organic and inorganic chemical base materials;
- Manufacture of pesticides;
- Manufacture of intermediates for the chemical industry;
- Manufacture of fine chemical products;
- Energy generation and supply;
- Wholesale trade in chemical products.

Company sales revenues in 2001 showed a 4 per cent increase compared with the previous year. This consists of a small decrease in domestic sales and an increase of 9.6 per cent in export sales. The intermediate business unit produces about half of the turnover of the company.

The main objectives for 2002 were to radically improve efficiency and immediate improvement in productivity. A goal of efficiency emphasises the importance of better-cost control within the company.

2. Environmental aspects of the company and results of the CP programme

Nitrokémia 2000 is struggling with two major areas of environmental problems:

- *Odour*—The organization is located in the most visited recreational area of Hungary (next to Balaton, Balatonfüzfö), so odour raises many public concerns. The production processes causing the odour problems are shut down during the summer season when tourists arrive to spend their holiday at the lake. By 2004 these processes will be shut down permanently until new ones are developed that would prevent the odour problem.
- *Wastewater*—The wastewater contains mainly salts and compounds difficult to decompose. It is treated using biological wastewater treatment, at the still existing state-owned Nitrokémia Inc. facility. There are 10 wastewater-emission points in the area of the factory.

The wastewater fines paid are significant due to the salts, high COD and NH_4-N discharged in the water. A large amount of process water is used, resulting in a large volume of wastewater discharge. Wastewater, after treatment (neutralization and biological treatment) at Nitrokémia, flows into spring Séd, then into the River Danube.

Various environmental problems were inherited from the former Nitrokémia Corporation. These include past liabilities like polluted soil, 10-40 year-old technologies, outdated infrastructures for water, wastewater and other networks and waste.

The cleaner production assessment provided input-output analysis for the chosen processes: several cleaner production options were identified during the TEST project.

All the material flows that appear in the input-output analysis also show up as raw material or waste costs in the cost structure of the product. In Nitrokémia 2000, the cost structure of products follows the structure of the input-output analysis, as do other items like processing costs. The input-output analysis also provides the basis for defining technological standards within the company.

EMA information was used to assign a value to the material and waste streams and evaluate the profitability of cleaner production measures. In this way these tools were linked and multiplied the benefits of each other.

3. Current accounting practice

Nitrokémia 2000 has a control department separate from the financial accounting function and uses variable costing[21] for cost accounting. The company is improving its management accounting system by allocating variable costs to products. The share of variable costs within the costs of sales increased from 74.2-80.4 per cent in 2000. This was due in part to increasing raw material prices and in part by broadening the scope of variable cost.

The company applies the MFG/PRO software for accounting purposes. The software has the advantage of capturing material flows both in monetary and physical terms. This proved to be a very good starting point for EMA, enabling tracking and pricing of material flows within the company.

There was an existing EMA system within Nitrokémia 2000, before the TEST project started, focusing on the end-of-pipe costs of wastewater treatment and hazardous waste disposal. These costs were treated as variable costs and were allocated to products. Fines and penalties were recorded as environmental overhead. For simple processes, allocation keys are based on volume of discharge, contribution to the toxicity or acidity of discharge and calculated using the material flow diagram. Processes that are more complicated used material flow diagrams and technological norms to compute allocations. As a result, allocation keys are closely connected to the actual contributors of the wastewater problem. Costs for the management of non-hazardous waste, environmental personnel or environmental fines were kept as overhead. Some environmental costs were missing from this system and non-product outputs were not considered as environmental costs.

In summary, the conditions were very good for developing EMA in Nitrokémia. The environmental manager was committed and the chief controller seemed interested and helpful.

[21] Also called marginal costing or direct costing.

B. Scoping EMA

1. Objectives

The Papkeszi site was the Nitrokémia 2000 site chosen for the TEST EMA project. There are six technologies representing six cost centres.[22] Three chemical products and related processes were selected. The scope was based on the high environmental impact of the processes as well as the availability of the results from the cleaner production assessment.

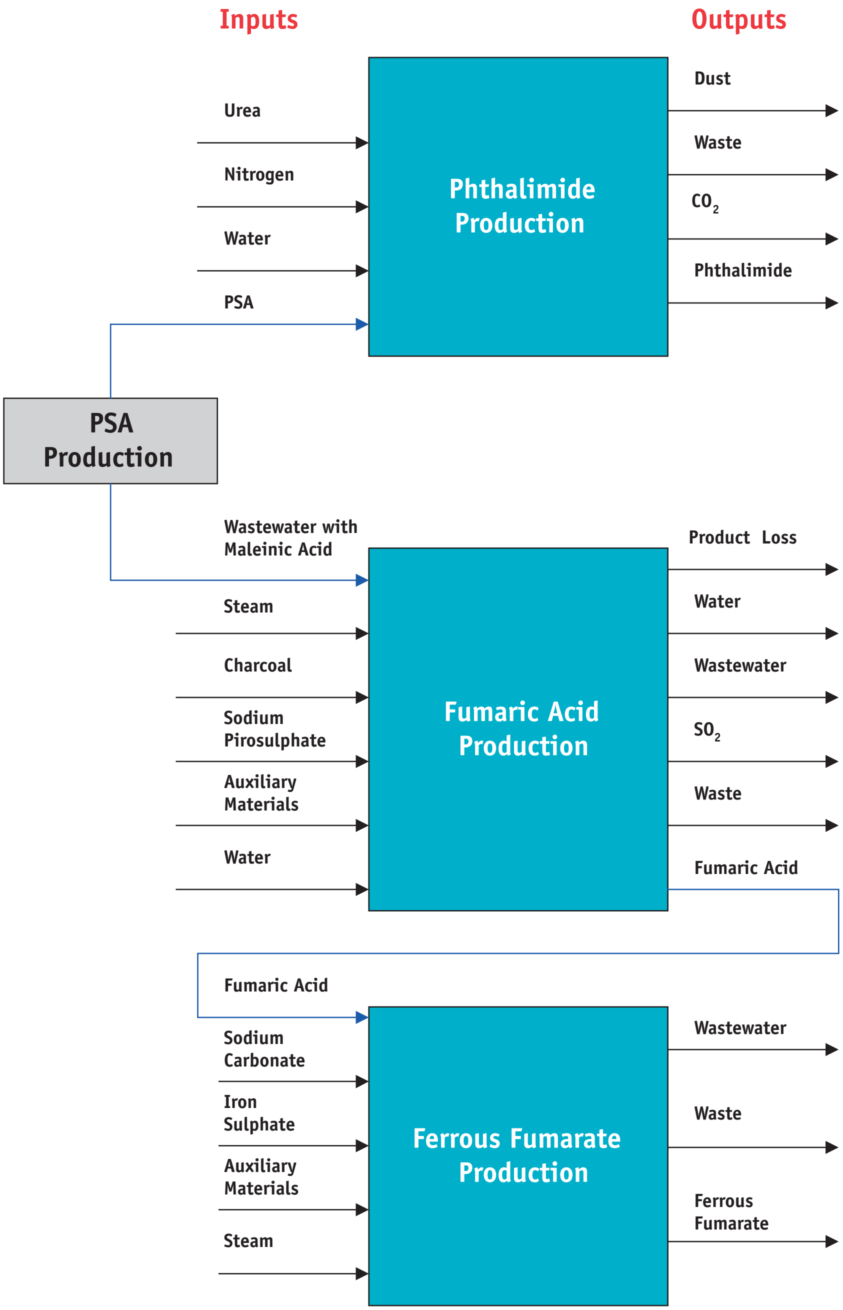
The following products with high environmental impacts were selected: fumaric acid, phthalimide and ferrous fumarate. The technology used was developed within the company, so the detailed flowcharts for these processes are confidential.

The production of the three products is interconnected (figure II): fumaric acid is the raw material used for ferrous fumarate production. The products of the anhydrous phthalic acid (PSA) production are the raw materials for the phthalimide production and produce the waste generated by the technology. This wastewater is a maleinic acid-containing solution used as a main input, and raw material, for fumaric acid production. All three products are sold on the market.

There is a tendency for managers of Nitrokémia 2000 to think of raw materials as necessary and inevitable costs. They are often not consciously aware of the fact that some of the materials purchased will never become part of any product. Yet, they might leave the company with the wastewater or be wasted in some other way. These unused materials burden the environment and represent an unnecessary loss to the company. One of the goals of EMA at Nitrokémia 2000 was to enable managers to better control material and processing costs by splitting them into necessary and wasted designations. The aim of the project was to isolate the cost of wasted raw material from the cost of raw materials in the product in order to encourage source reduction measures within the company.

[22] In the chemical industry, technologies are very closely related with the specific products. This is the reason why Nitrokémia use the technologies as cost centres.

Figure II. Phthalimide, Fumaric Acid and Ferrous Fumarate Production at Nitrokémia 2000



2. Environmental cost items selection

The company decided not to calculate and allocate environmental costs initially estimated below 5 per cent of direct production costs. Treating small cost items like auxiliary materials as overhead, is consistent with common practice in management accounting.

Most end-of-pipe environmental costs were already measured and allocated to products and were treated as variable costs within the system. These included wastewater treatment costs and hazardous waste incineration costs. Wastewater costs were burdened on products using allocation keys based on volume as well as on COD and the acidity of the wastewater. Treatment of sludge, however, was hidden in overhead.

Table 3 shows the impact of the UNIDO TEST EMA project on the environmental accounting of Nitrokémia 2000.

There are items that are easily identifiable as environmental costs but cannot be allocated to products for practical reasons. Some annual costs fall into this category. The premise of variable costing dictates however, that all environmental variable costs should be allocated to products.

For instance in Hungary wastewater fines for 2002 activity are to be charged in May 2003 and paid afterwards. For this reason they cannot be allocated to products when they occur and will continue to be included in overhead accounts. This cost item should be considered however in project appraisal procedures and calculations as contingency costs and future costs. Labour costs of environmental personnel were originally treated as indirect labour. The controller agreed to treat this cost item as an environmental cost.

The focus of the EMA project at Nitrokémia 2000 was the calculation of material purchase values of non-product costs and their allocation to the three selected products. The processing costs of non-product outputs, like labour, is an important issue for this company that has yet to be quantified. It is planned to do this in the future.

Table 3. Impact of the UNIDO TEST EMA Project on Nitrokémia 2000 Accounting system

Environmental Cost/ Expenditure Categories	Costs Considered for the EMA Project	Costs Considered for the EMA Project	Costs To Be Considered in the Future
1. Waste and Emission Treatment			
1.1. Depreciation for Related Equipment	X[a]	X	
1.2. Maintenance and Operating Materials and Services	X	X	
1.3. Related Personnel		X	
1.4. Fees, Taxes, Charges			
1.5. Fines and Penalties		X	
1.6. Insurance for Environmental Liabilities			
1.7. Provisions for Clean-up Costs, Remediation		N.A.	
2. Prevention and Environmental Management			
2.1. External Services for Environmental Management			
2.2. Personnel for General Environmental Management Activities		X	
2.3. Research and Development	X		
2.4. Extra Expenditure for Cleaner Technologies			X
2.5. Other Environmental Management Costs			
3. Material Purchase Value of Non-Product Output			
3.1. Raw Materials		X	
3.2. Packaging		X	
3.3. Auxiliary Materials		X	
3.4. Operating Materials		X	
3.5. Energy			X
3.6. Water			X
4. Processing Costs of Non-Product Output			X
5. Environmental Revenues		N.A.	

Note: Some items, such as remediation, liabilities or environmental revenues, were not applicable for the company.
[a]Depreciation of environmental equipment was allocated to the products, but it was not recognized as an environmental cost.

C. Calculation of environmental costs and allocation method

In Nitrokémia, the chemical processes are defined as cost centres. It quite often happens that one process will produce one or several products. However, for the three technologies within the EMA project scope, each technology defines one product.

The cost control department was the main source of data on direct costs and allocated indirect costs. The plant engineer and the environmental manager worked together on quantifying the environmental cost of non-environmental personnel. The latter, with about 1 per cent of direct costs, turned out to be too small for allocation purposes.

The chief controller and the environmental manager identified data for the material purchase values of non-product outputs, defined as the top priority area for improving the EMA. Actual data, as well as theoretical and technological standards were needed to accomplish this. The job of finding the information was crucial to the project.

1. Waste and emission treatment costs

The following costs were considered for allocation:

- *Emission treatment*

  While treatment costs of hazardous waste and wastewater were already allocated to products using the correct allocation keys, management costs of non-hazardous waste were not allocated to products, although they are becoming increasingly more significant. Starting in 2003, the treatment cost of sludge will be allocated to products.

- *Depreciation*

  Product related depreciation, including environmental equipment, is allocated to products. Depreciation of the electrostatic precipitator, ventilation, cyclone and research costs was treated as direct product costs together with other product-related depreciation. Older equipment has very low or zero depreciation. Depreciation of environmental equipment vs. total depreciation for the three processes is indicated in table 4.

  Depreciation was found to be a relatively small item, if related to unit of production.

Table 4. Depreciation of Phthalimide, Fumaric Acid and Ferrous Fumarate Production Equipment at Nitrokémia 2000

Product	Depreciation of Environmental Equipment (thousands of HUF)	Environmental Depreciation Share vs. Total Depreciation
Fumaric Acid	2,463	53%
Ferrous Fumarate	614	14%
Phthalimide	41	15%

- *Wastewater fines.*

  Wastewater fines are proportional to the extent the effluent concentrations exceed the regulatory limits and the volumes discharged. These costs cannot be allocated to products within the regular monthly reporting system but have been calculated at product level for future decisions.

2. Labour costs

The labour costs of environmental personnel used to be lumped together with other indirect labour as part of the general overhead. As such, environmental costs did not include the labour costs of environmental personnel. Nitrokémia 2000 has two full-time people directly responsible for environmental management, with other environmental duties and responsibilities divided between various employees. It did not seem practical to allocate all these costs to products. However, after discussing this issue with the controller and the environmental manager, this practice was immediately changed and these items were moved to the environmental overhead account.

3. Purchase value of non-product output

The purchase price of non-product output is a major issue for the company as input prices account for the majority of the production costs. The share of material costs within the production costs of the three products is shown in table 5.

Table 5. Raw Material Costs vs. Total Production Costs of Major Products—Nitrokémia 2000

Product	Raw material costs as share of the total production costs
Fumaric Acid	39%
Ferrous Fumarate	74%
Phthalimide	88%

Material costs represent a relatively low percentage of the overall production costs for fumaric acid because one of its main raw materials (maleinic acid wastewater) is produced internally with the PSA production process, rather than being purchased. As a result, this material is available at a nominal price compared to other input costs. The contribution of raw materials to overall costs for the other product is higher than would normally be expected. It was due to the significant impact raw material costs have on the production costs that EMA at this site was developed to focus on quantifying non-product output. Two major steps were taken in this regard:

- Quantification of the total purchase price of non-product output;
- Splitting these costs into categories based on their controllability.

The company was interested not only in quantifying the total amount and value of non-product outputs, but also which of these costs can be controlled in short or long term. To achieve this non-product output value, costs were calculated in two different ways:[23]

- In relation to the consumption of raw materials exceeding the technological norm;
- In relation to the consumption of raw materials exceeding the theoretical norm.

Best Available Technologies (BATs) are available for several of Nitrokémia 2000's processes, but not for the three areas within the scope of EMA. Therefore, this part of the cost analysis was not calculated.

The technological norms used for calculation of non-product-output costs were based on information from the equipment designers and represent the capacities and capabilities of the equipment under optimal operational and maintenance practice conditions.

[23] For detailed description of the methodology, please refer to section II.

Nitrokémia 2000 itself developed the vast majority of its technologies. The company has technological standards in place, which define the raw material consumption (per unit of product) under normal operation of the technology. These standards are based on the technological flowcharts and were defined by the plant engineer, the quality manager and the environmental manager. The company is struggling with resource usage often exceeding the technological norm. At first, they considered changing technological standards to better reflect actual raw material use. After discussing this issue in the framework of the TEST EMA project, however, it was decided to use technological standards to identify possible sources of inefficiencies in the system and calculate the material cost of waste.

4. Processing costs of non-product output

These costs were not added to the EMA system for two reasons:

- They were very hard to calculate for a company operating in the chemical industry;
- Direct labour is a relatively small item within the cost structure of products. If isolated and allocated as an environmental cost, their proportion of non-product output would only increase the environmental costs by 4.72, 3.29 and 0.66 per cent for the three products respectively (as compared to the theoretical norms for fumaric acid, ferrous fumarate and phthalimide). These percentages are even smaller when technological norms are used.

However, the company planned to calculate these costs items in the near future and include them into the EMA system.

5. The results of allocation of environmental costs to products

Calculating environmental costs using technological versus theoretical norms differs only in how non-product output is taken into account.

Table 6 provides a summary of the EMA project: environmental cost items (per ton of product) calculated for each of the three products (first quarter 2002). For fumaric acid, ferrous fumarate and phthalamide, the results

Table 6. Environmental Costs (in HUF) per ton of Fumaric Acid, Ferrous Fumarate and Phthalimide at Nitrokémia 2000

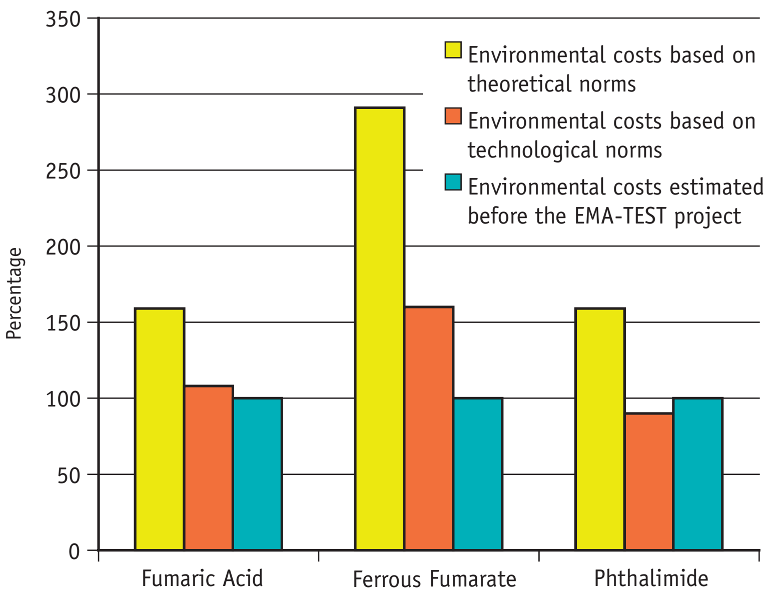
	Environmental Costs Based on Theoretical Costs			Environmental Costs Based on Technological Norms		
Cost Items	Fumaric Acid	Ferrous Fumarate	Phthali-mide	Fumaric Acid	Ferrous Fumarate	Phthali-mide
Waste and Emission Treatment Costs						
Emission Treatment Costs	29,054	15,858	7,430	29,054	15,858	7,430
Waste Disposal		3,450			3,450	
Wastewater Fine	1,200	2,400	500	1,200	2,400	500
Energy Costs of Environmental Equipment	240	240	0	240	240	0
Material Purchase Value of Non-Product Output						
Purchase Cost of Non-Product Output	15,133	21,337	3,433	83	457	-1,718
Environmental Part of Indirect Material	310	2520	50	310	2520	50
Total Environmental Costs	45,937	45,805	11,413	30,887	24,925	6,226
Actual Variable Production Costs	98,766	227,080	150,409	98,766	227,080	150,409
Environmental Costs share [%] of Variable Costs	47%	20%	8%	32%	11%	4%

from the non-product output costs calculations were much lower when based on the technological norms versus those from the theoretical norms. These results revealed that there were few cost reductions to be gained by implementing better housekeeping measures. Large positive numbers would indicate serious non-compliance with the technological prescriptions, while very negative numbers would be a sign of technological norms being out-dated. Small oscillations around the norm are normal due to measuring error and other factors of incidence. Phthalimide had a relatively small negative number showing that a decline was experienced compared to the consumption norm and the ratio of raw material costs within direct costs is very high (88 per cent). With such a high material cost percentage, even small savings or small percentages of input wastage would have high impact on costs. This approach can be used daily for monitoring control to ensure wastes do not exceed the technological norm.

Total non-product output costs calculated using the theoretical norm-based approach, indicate areas for longer-term possibilities involving major technological change. These costs appear much higher than the technological norm based costs. With environmental costs at 47 per cent, 20 per cent and 8 per cent of variable costs, respectively, the company could consider major technological changes at least for fumaric acid and ferrous fumarate production. The company has hired a consultant to assist them in examining the technological possibilities of changing the inputs for two processes.

Environmental costs are significant cost items for fumaric acid and ferrous fumarate. Comparatively, the total environmental costs for fumaric acid production are almost five times those for the phthalimide, and therefore seems a less environmentally friendly product. This is mainly because fumaric acid production absorbs the environmental costs of phthalic acid production, the major raw material of phthalimide. Treatment of maleinic acid water discharged from the PSA would be very costly if it was not used in the production of fumaric acid, and would result in a significant increase of environmental costs for production of phthalimide.

Figure III. Nitrokémia 2000 Product Environmental Costs—Before EMA and after EMA (percentage)



This comparison leads to the conclusion that all three products should be considered simultaneously when addressing environmental cost issues because the products are so interdependent.

The definition of environmental costs of Nitrokémia was broadened during the TEST EMA project. Figure III shows the changes at the product level. The new definition will give cleaner production projects a better chance as a wider range of non-product outputs is taken into account.

D. Findings and suggestions

Improving efficiency in the future is a major goal for Nitrokémia 2000. The project demonstrated that EMA could promote this objective by improving its cost controlling system and revealing savings options for the company.

1. Integration of EMA with management accounting

As a result of the TEST-EMA project, the monthly reporting structure of direct costs was changed to the following:

- Non-product output costs are now calculated as direct environmental costs on a monthly basis using the technological norms;
- Waste disposal costs were identified as a significant cost item and will be allocated to products on an on-going basis. (Note: before the project, only hazardous waste costs were allocated);
- The environmental portion of indirect material costs will be allocated to products as direct costs.

Some cost items were either deemed too small for allocation to products, or, were redirected to the direct product costs category due to the time constraints of the project. These costs include environmental fines, environmental labour and laboratory costs. These costs will remain in the environmental overhead account. The EMA project resulted in a redefinition of non-allocated environmental overhead to include certain cost items that were not considered environmental costs in the past: the salaries of environmental personnel that were formally hidden in indirect labour was redefined as environmental cost.

2. Actions based on EMA

Since completing the TEST EMA project, the company has continued the process and used the approach for re-calculating the environmental costs of further products. One of those products was found to be so costly in environmental terms that its production was stopped.

An expert has been hired by the company to investigate the possibility of changing some of the raw materials used for two of the processes being tracked by the TEST EMA. The company hopes to achieve a reduction of both pollution and environmental costs.

3. Future oriented decisions

Certain environmental cost categories could not be incorporated in to the production cost structure for practical reasons. Regardless, the costs items can still be calculated or estimated and will be taken into account when important, long-range decisions are made regarding the products or projects within the company.

For long-range decisions where investment evaluations or product related decisions are made, all environmental cost categories will be calculated and reported in a structure "parallel" with the existing cost control system.

The information provided by EMA will support the:

- Preparation of budgets.
- Actions when production efficiency has dropped below acceptable levels i.e. when the difference between planned and actual costs is too large. Improved housekeeping and maintenance measures are usually needed in these cases.
- Modification of technological standards. Some technological standards are outdated and require changes. Practices can change and new alternatives for saving inputs should be developed and reflected in the technological norms. This modification is identified by consumption staying below technological norms for an extended period of time.

- Analysis of project alternatives. Process changes are currently under consideration for the three products examined in the project and the calculation of non-product output costs will give environmental projects a better chance for support.
- Making strategic decisions on products and projects. These include production decisions as well as costing and pricing decisions.

The company will continue to use the modified 2003 EMA system on a regular basis. Based on the results of the project, the company decided to extend the EMA to include further products without using external assistance.

E. Conclusions

Environmental costs are rising all the time. For example, in 2000 there was a 42 per cent increase in environmental costs for Nitrokémia 2000. This was due to increasing service costs, wastewater treatment costs and incineration, increasing volumes of production and a 41 million HUF one-time cost for sludge disposal. This emphasises the need for more control over them.

Waste disposal costs are rapidly increasing and sufficiently significant to have been mentioned in the annual financial report as a problem area. This fact underscores the importance of allocating these costs directly to products.

The above-mentioned development is characteristic of Hungarian environmental protection in general: environmental-service prices, as well as fines are increasing at a rapid rate. The approaching EU accession and the need to harmonize all environmental laws have accelerated this development. This new situation underlines the importance of organizing environmental management more efficiently and EMA is an excellent tool for doing that.

Input prices are also increasing, as subsidies were removed subsequent to their country signing international agreements. Higher water and energy prices made the former practice of using technologies in a wasteful way unacceptably expensive.

After the transition and restructuring of the economy that has been going on, companies are much more subject to competition than they were 10 years ago. Strong competition encourages the search for efficiency, which is a major short-term goal for many companies, not just Nitrokémia 2000. Efficiency can be improved by improving the management and control of material flows. This can result in a switch from the old absorption-costing model to a variable costing or ABC costing model, which creates a favourable climate for EMA.

CASE STUDY 2: SOMEŞ S.A., ROMANIA

Authors: *Adrian Timar, Maria Bǎcǎran* and *Adela Olaru, Mihai Svasta, Oana Tortolea, Maura Teodorescu* and *Lucian Constantin*

The EMA team consisted of Adrian Timar, chief accountant SOMEŞ, Maria Bǎcǎran and Adela Olaru, SOMEŞ Technical Department, Mihai Svasta and Oana Tortolea consultants, Maura Teodorescu and Lucian Constantin, CP consultants ECOIND-Bucharest.

A. Brief Description of the company

1. *About the company*

SOMEŞ Dej is a Romanian integrated pulp and paper plant, producing:

- Bleached/unbleached sulphate pulp (kraft), from softwood—60,000 t/yr
- Bleached/unbleached wrapping paper—34,000 t/yr

Name:	SOMEŞ S.A. DEJ, Member of the HOVIS Group	
Location:	Romania, Transylvania, Dej city	
Established:	1963	
Privatized:	2000	
Shareholders:	MFC Commodities GmbH Austria	74.99 %
	SIF Banat Crişana	17.64 %
	Others	7.37 %
Turnover (2001):	34,108,000 euro	
Profit (2001):	496,000 euro	
Export:	16,749,000 euro	
Liquidity (quick ratio):	0.69	
No. of employees:	1,184	
Contact Person:	Adrian Timar, chief accountant SOMES	
Telephone:	0040 744-674-894	
Email:	atimar@hotmail.com	

2. Environmental aspects of the company and results of the CP programme

In April 2001, the management of SOMEŞ, recognized the importance of being able to manage the current environmental aspects of the company, and for the sake of future operations and competitiveness decided to join the UNIDO-TEST project.

After the initial environmental review the bleaching unit was identified as the area causing the most significant environmental impacts of the whole plant, due to:

- Hazardous pollution generated by the creation of chlorinated organic compounds;
- High water consumption compared to BAT;
- High material losses (chemicals, product and resources: water, energy) there were not very well quantified.

A number of investment projects were initiated during the TEST projects, which were revealed to be an important catalyst in implementing technological solutions and spreading the environmental culture to employees. The effects of implemented cleaner production measures resulted in:

- A decrease of flow and effluent loading from the mill;
- A decrease in specific consumption of chemical at the bleaching unit;
- Product quality improvement;
- A decrease in maintenance and repair expenditure;
- A consumption reduction.

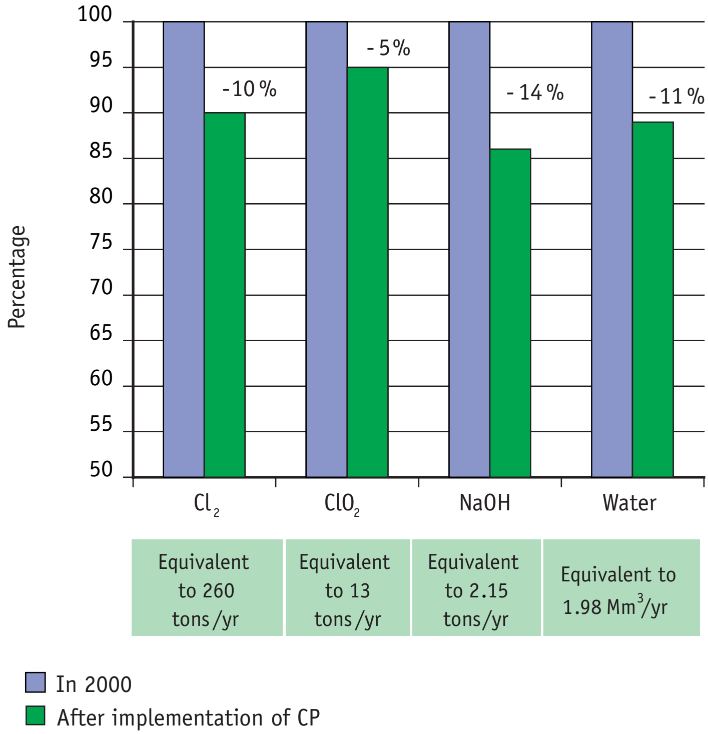
The material balances conducted at the bleaching unit, within the TEST project, revealed significant losses of raw materials that should have been regarded as environmental costs. Figure IV shows the impact of the implemented CP measures on the consumption of chemicals and water at the bleaching unit.

In early 2002, the company became ISO:9002 certified, according to the SR EN ISO 9002/1995 standard[24] and implemented an environmental management system in accordance with SR EN ISO 14001/1996 standards.

[24] The system certification audit was conducted by the Germanischer Lloyd Company.

Figure IV. Effects of Implemented CP Measures at SOMEŞ: Reduction of Chemicals and Water Specific Consumption

[May 2003 — Bleaching unit : total production 42,000 tons per year]



As part of the TEST project, management decided to expand the EMA to have a better and more comprehensive approach to management accounting, with a particular focus on costs related to wasted raw materials and other environmental issues.

3. Management Accounting: current practices, cost centres structure and existing allocation keys

Along with other large industrial companies from Romania, SOMEŞ has changed its cost accounting system from one that was compatible with the previous political structure in Eastern Europe (but is now obsolete), to one that is more in line with international accounting standards that provide management with better information.

The current method used for costing is generally known as Absorption Costing (AC). The company is organized into five main cost centres, five main auxiliary sections and five minor auxiliary sections as summarized in table 7 and figure V. The method is conducted in several steps:

- First, direct costs (direct materials, labour and energy consumption) are allocated directly to the appropriate cost centres;
- Second, the overheads (auxiliary sections) are allocated among them through different allocation methods;
- Third, the allocated overheads are absorbed into the cost centres, through several absorption keys (proportion of production value, labour, etc.) chosen by department managers.

Table 7. Absorption Costing at SOMEŞ

Cost Centre Number	Main Cost Centres	Main Auxiliary Sections	Other Auxiliary Sections
1	Chipping	Regeneration	Finishing
2	Kamyr Digester (Boiling)	Bleaching Agents	Packaging
3	Bleaching	Chemicals	Deposit
4	Pulp Machine	Water Treatment	Administration
5	Paper Machine	Wastewater Treatment	Management

The main advantage of the system used in SOMEŞ S.A. Dej was that at the start of the project all the expenses and costs incurred during the production process were traced and periodically reported in internal company documents. The switch from the previous accounting system to absorption costing at SOMES should therefore be considered as a real step forward. However, in environmental management accounting literature, direct costing or activity based costing (variable costing) is considered preferable to absorption costing.[25]

The only environmental cost category recognized in the management accounting system at SOMEŞ, before the EMA project started, was the wastewater plant treatment costs. These costs were allocated to cost centres and to products as overheads. Non-product output environmental costs were not recognized as environmental costs, but were included in the direct material costs, while fines and penalties were part of the general overheads. In table 8 the main environmental cost items and their allocation method are reported as they were before the EMA project start.

[25] For a more detailed explanation see Stefan Schaltegger and Roger Buritt: *Contemporary Environmental Accounting*, Greenleaf Publishing 2000.

Figure V. SOMEŞ Production Cost Flow

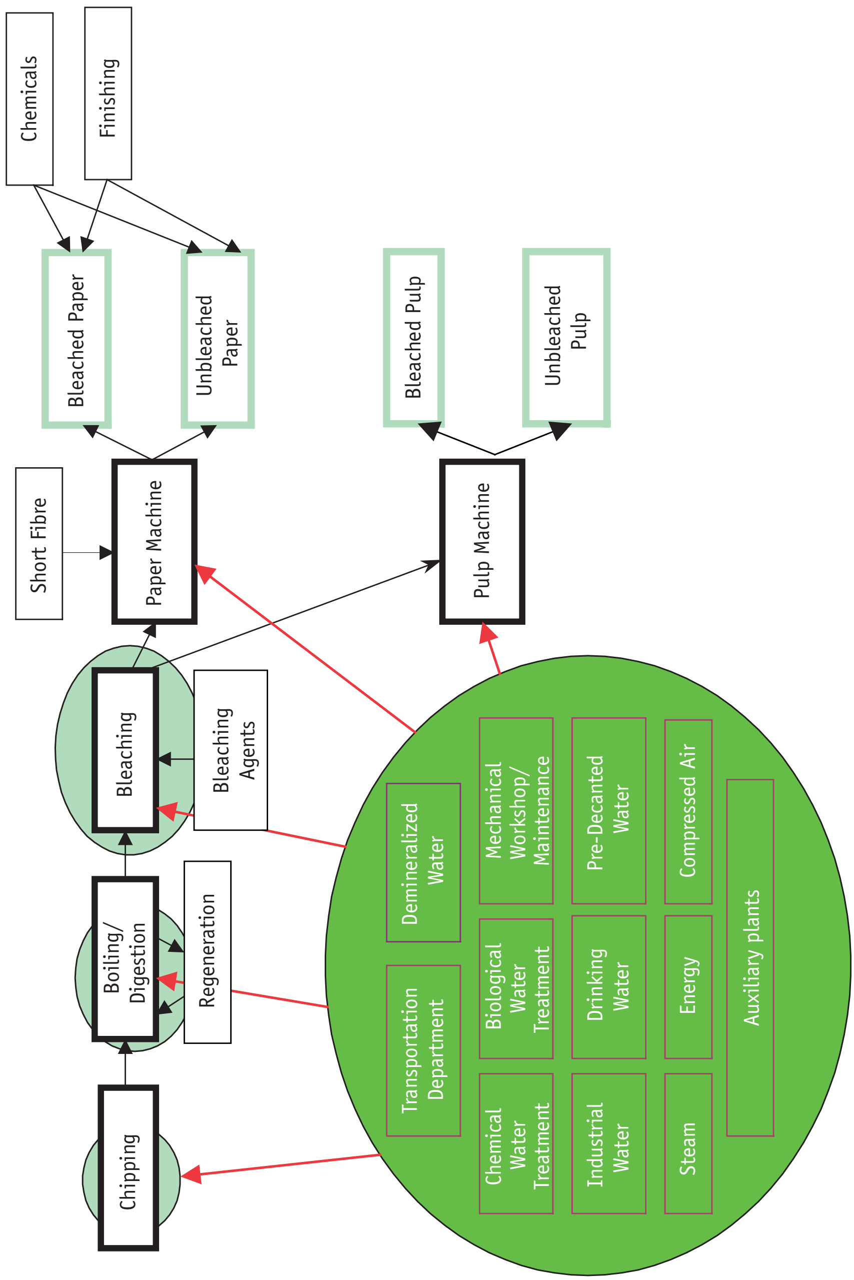


Table 8. Management Accounting System Allocations (Before the EMA Project) at SOMEŞ

Cost Item	Allocation Method
Non-Product Raw Material	Direct Cost As Raw Material
Fines and Penalties	Non-allocated Overhead
Environment Related Labour	Non-allocated Overhead
Solid Waste Disposal Cost	Non-allocated Overhead
Waste Water Treatment Cost	Allocated Overhead (un-appropriate allocation key)
Contingency Cost/Provisions	Unavailable

Modification of the existing management cost accounting system at SOMEŞ, to accommodate any environmental costs category, had to take into consideration the country's financial accounting regulations. The way that production costs are calculated affects the financial performance of the company (the profit) and in turn, the taxes the company has to pay (profit tax). Therefore, there is close link between managerial accounting and financial accounting.

The Romanian accounting legislation is in the process of adapting to the International Accounting Standards (IAS). As a result, currently, both Romanian Accounting Standard (RAS) and IAS are applied within SOMEŞ. According to the RAS and IAS, some categories of environmental costs, such as fines and penalties or environment related overhead labour cannot be considered production costs and are not allocated to products. In addition, the regulations that permit the accrual of contingency costs are still unclear.

B. Scoping EMA

1. Objectives

The following objectives were set at project start:

1. *To identify additional environmental costs, focusing on non-product output costs.*

- This will result in the identification of hidden environmental costs, within the Management Accounting System. The exact quantification of total environmental costs will reinforce management commitment to the implementation of Cleaner Production measures and EST investments.

2. *To reorganize the accounting system to include "Environmental costs" in the final cost structure (allocation of environmental costs to products).*

- The reorganization of the management accounting system will provide the management with the necessary information for creating a better public image. By showing that the company is tracing its environmental costs and is acting to reduce them it demonstrates the company's commitment to environmental responsibility.

2. Environmental Costs items selection

The bleaching unit was initially selected as the focus for the implementation of the EMA project. However, it was necessary to extend the boundaries of the EMA project to the entire plant, in order to conduct a proper allocation to products.

Considering the existing cost management practices and main environmental aspects of the company, the following environmental costs items for calculation were chosen:

- *Direct environmental costs:*

  Material Purchase Value of non-product output.

- *Allocated environmental overheads:*

  Wastewater Treatment costs;

  Solid waste disposal costs.

- *Non-allocated environmental overheads:*

  Environmental studies and research;

  Cost of personnel from the environmental department;

  External services;

  Fines and penalties;

  Contribution to the environmental fund.

Once environmental costs items were selected, all cost centres, including all process overhead generator centres, were analysed to collect information on the environmental costs and the existing allocation keys.

The calculation of non-product output costs, as well as end-of-pipe costs, was done using data provided by the material and energy balances from the cleaner production assessment. It was also possible to define, for each cost item, what kind of information would be necessary for the EMA system and who would provide it.

The company accounting department discussed two calculation methods for the correct allocation of raw materials and non-product output costs that use either:

- The entire value of the non-product output compared to the theoretical norms; or
- The difference between the present consumption value and the consumption value indicated in the technological norms of the existing technology.

They chose to use both methods, choosing the most appropriate method for each cost centre based on the type of process and on the practicality of controlling those costs in a short to medium period. The first alternative was used for the wood chipping unit, while the second was used for the bleaching section. The method for calculating the purchase value of inputs exceeding consumption norms at the bleaching unit was selected for operational control purposes.

C. Calculation of environmental costs, allocation keys and information system

Once mass balances were completed, the environmental costs were identified, allocated to the respective cost centres in the main production flow and the cost information system was then modified to integrate the EMA. The following is a brief description of the allocated cost items, by main cost centres.

1. Chipping

The wood-waste produced has two destinations: the refuse boiler for burning wood-waste and producing steam, or the dumpsite. The following environmental costs were identified and allocated:

- Transport cost to the dump site;
- The cost of dump site maintenance;
- Transport and purchasing costs of the wood that becomes a waste;
- Environmental earnings: the value of steam produced using wood-waste.

Data on the waste quantities were derived from the difference between the quantities of wood entering the chipping section and of chips transferred to the Cooking Section. Wood-waste transports were monitored by the Mechanical-Energy and Maintenance Service departments and reported to the Accounting Department. Purchasing transport costs were allocated in accordance with the value of the raw materials.

2. Wastewater treatment

All these costs were considered environmental costs. Monitoring was the basis for establishing the amount of wastewater discharged by each plant section. Where monitoring was not possible, due to lack of monitoring equipment, mass balances were used. Environmental costs for WWTP were re-calculated and the allocation key changed. Before the EMA project these costs were allocated based on the volume of water; after EMA the costs were allocated to individual cost centres, based on both the concentration of pollutants and the quantity of wastewater. Table 9 shows the allocation key of WWTP costs before and after the EMA project at each main cost centre.

Table 9. SOMEŞ WWTP Cost Allocation Comparison—Before vs. After EMA

	Chemical WWTP		Biological WWTP	
Department	Before EMA	After EMA	Before EMA	After EMA
Bleaching	39%	15%	39%	50%
Recovery Boiler	14%	3%	14%	5%
Paper Machine	15%	70%	15%	0%
Pulp Machine	7%	2%	7%	5%
Boiling/Washing	25%	10%	25%	40%
Total	**100%**	**100%**	**100%**	**100%**

3. Bleaching and bleaching reagents

The following environmental costs were identified:

- Purchase value of chlorine exceeding technological norms;
- Purchase value of industrial water exceeding technological norms;
- Purchase value of caustic liquor exceeding technological norms;
- Transport and handling cost of non-product output;
- Depreciation of storage tanks for hazardous substances;
- Maintenance and repair cost for storage tanks for hazardous substances.

Additional information about environmental costs was obtained from consumption sheets and warehouse's records.

4. Recovery boiler

The following costs were considered non-product output costs:

- Purchase value of sodium sulphate exceeding technological norms;
- Purchase value of soft water exceeding the technological norms;
- Transportation costs for above-mentioned raw materials exceeding the technological norms.

Information about environmental costs was obtained from consumption sheets, warehouse's records and consumption norms.

5. Paper machine

The following costs were considered non-product output costs:

- Purchase value of sizing reagents exceeding technological norms;
- Purchase value of aluminium sulphate exceeding technological norms;
- Purchase value of optical brightener exceeding technological norms;
- Transportation costs for above-mentioned raw materials exceeding technological norms.

Information about environmental costs was obtained from consumption sheets, warehouse's records and consumption norms.

D. Allocation of environmental costs to cost centre and to products

As a result of EMA, several modifications occurred within the managerial accounting registration system. New accounts were created for each environmental costs item, both for direct costs (to make them visible within the direct production costs) and for each type of environmental category included in the overheads (in order to emphasis the "environmental overheads" within the total overheads).[26] However fines and penalties, as well as all the other non-allocated overheads, were revealed to be almost insignificant and also cannot be allocated directly to products according to the Romanian law.

Solid waste disposal costs were calculated and properly allocated to the cost centres that generate them.

The environmental costs were first allocated at the cost centre level and then at the product level. Tables 10 and 11 summarize the structure for the bleaching cost centre (computed on a monthly basis):

The first column in table 10 represents the bleaching production costs by each cost category, while the second and the third columns represent the part of each cost item related to non-product costs. In particular, the second column refers to production costs generated in the bleaching unit from

Table 10. SOMEŞ Cost Structure of the Bleaching Unit (thousands of ROL)

Bleaching Unit Production Cost Structure			
		Value of Non-Product Output	
Cost Item	Total	Exceeding Consumption Norms	Final Product in Wastewater
Caustic Liquor	2,069,815	561,403	12,067
Chlorine	1,066,200	79,497	7,894
Industrial Water	773,701	71,262	5,620
Hydrogen peroxide (H_2O_2)	667,811		5,342
Chemicals	351,631		2,813
Wages	648,548		5,188
Electricity	1,236,320		9,891
Steam	3,485,994		27,888
Repair Works	197,856		1,583
Transport and Handling	420,257		3,362
Depreciation	140,181	4,572	1,085
Treatment Cost	**1,078,016**		**8,624**
Total	**12,136,330**	**716,734**	**91,357**

[26] These costs were analysed as separate costs in overheads and not used to compute the production cost (not allocated to cost centres). Later these costs were allocated to products in order to compute the total cost and calculate the profitability of each of the product.

Table 11. SOMEŞ Treatment Cost Structure—Bleaching Unit (thousands of ROL)

Bleaching Unit Treatment Costs	
Cost Item	**Total**
Chemicals	184,684
Depreciation	61,269
Wages	236,025
Electricity	279,235
Discharge Fees	211,249
Electricity	48,143
Repair Works	26,412
Transport and Handling	30,998
Total	**1,078,016**

exceeding technological norms, which represent costs that do not contribute to the final product. The third column represents the fraction of bleaching production costs that are associated with the consumption of inputs to produce bleached pulp, which however gets lost in the wastewater.

A similar calculation was made for all main cost centres. Once the production cost structures of all centres were finalized, it was possible to calculate the product's cost structure. Tables 12 and 13 show the product cost structure generated for bleached pulp.

Table 12. SOMEŞ Product Cost Structure—Bleached Pulp (thousands of ROL/ton)

Bleached Pulp: Product Cost Structure			
		Environmental Costs	
Cost Item	**Total**	**Non-Product Output Costs**	**Treatment Costs**
Wood	5,773	376	
Chemicals	1,373	166	
Wages	874	26	
Steam	3,384	18	
Air	116	2	
Energy	1,319	9	
Water	446	19	
Maintenance	905	20	
Other Indirect Costs	720	14	426
Other Material Costs	63	7	
Total Cash Cost	**14,973**	**657**	**426**
Depreciation	**176**	**1**	**-**
Total Production Cost	**15,149**	**658**	**426**
Overheads	**1.363**	**59**	
Total Cost	**16,512**	**717**	

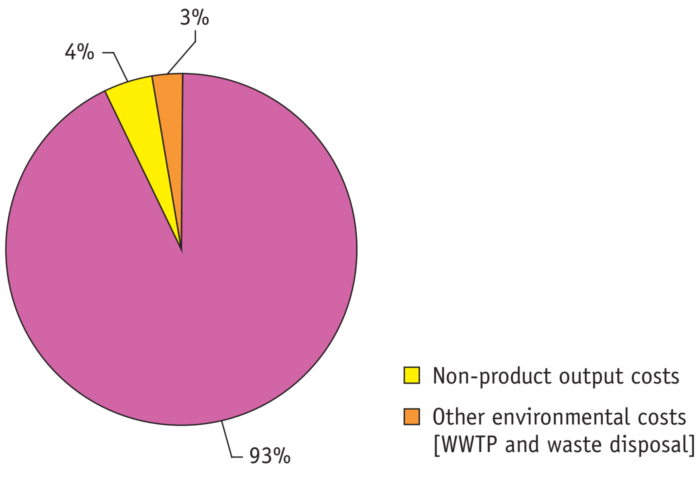
Note: Other indirect costs represents: costs of small inventory, tools, dispatch, etc.

Table 13. SOMEŞ Breakdown of Treatment Costs for Bleached Pulp

Breakdown of Treatment Costs: WWTP and Solid Waste Disposal Costs (per ton of product)	
Cost Item	Total (thousands of ROL)
Chemicals	73
Depreciation	24
Wages	93
Purchased Electricity	110
Discharge Fees	83
Electricity	19
Repair Works	10
Transport and Handling	12
Total	**426**

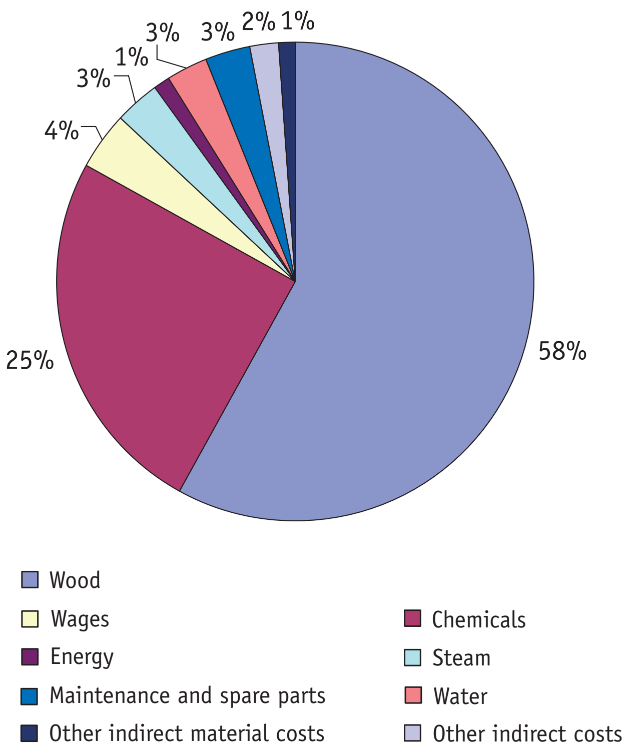
The total value in table 13 represents the cost of WWTP and solid waste disposal cost per ton of product [thousands of ROL]. Before EMA, this portion of costs from "Other indirect costs" was not visible. The overheads cost category includes the financial cost, extraordinary costs like fines, penalties and the costs for the administration of the company. The environmentally related overhead costs that were mentioned previously are analysed monthly (there is separate account for environmental overheads) but do not appear in the final product cost structure (because their value as percentage of total overheads is negligible). In figure VI the SOMEŞ production cost structure for the bleached pulp is reported: it appears that non-product costs are equal approximately to 4 per cent of product costs while total environmental costs are 7 per cent of product costs.

Figure VI. SOMEŞ Product Cost Structure: Bleached Pulp



The breakdown of the non-product output reported in figure VII shows that more than 70 per cent of the non-product cost is represented by the purchase value of raw material (mostly wood).

Figure VII. SOMEŞ Non-Product Cost Structure: Bleached Pulp



E. Total environmental costs

The EMA system was designed to compute environmental cost on a monthly basis.

Table 14 shows the results from March 2003. From the table it is clear that non-product output is a larger issue than treatment costs, demonstrating the company should focus on decreasing these costs.

Table 14. SOMEŞ Environmental Profit/Loss—March 2003

Expenditure/Cost Roll-over	Value (thousands of ROL)
1. Waste and Emission treatment	
1.1. Depreciation for Related Equipment	74,568
1.2. Maintenance and Operating Materials and Services	693,079
1.3. Related Personnel	287,256
1.4. Fees, Taxes, Charges	260,302
1.5. Fines and Penalties	
1.6. Insurance for Environmental Liabilities	
1.7. Provisions for Clean-up Costs, Remediation	
TOTAL I	**1,315,205**
2. Prevention and Environmental Management	
2.1. External Services for Environmental Management	66,000
2.2. Personnel for General Environmental Management Activities	60,750
2.3. Research and Development	
2.4. Extra Expenditure for Cleaner Technologies	
2.5. Other Environmental Management Costs	
TOTAL II	**126,750**
3. Material Purchase Value of Non-Product Output	
3.1. Raw Materials	1,864,055
3.2. Packaging	-
3.3. Auxiliary Materials	326,912
3.4. Operating Materials	915,735
3.5. Energy	-
3.6. Water	96,845
TOTAL III	**3,203,547**
4. Processing Costs of Non-Product Output	**386,478**
Environmental Expenditure (1+2+3+4)	**5,031,980**
5. Environmental Revenues	
5.1. Subsidies, Awards	
5.2. Other Earnings	
5.2.1 Sales of Waste	205,955
5.2.2 Production of Steam from Wood Waste	1,602,756
5.2.3 Pulp Recovered from Wastewater and Sold	565,000
TOTAL IV	**2,373,711**
Environmental Result	**- 2,658,269**

F. Sensitivity analysis

A sensitivity analysis was conducted to analyse the variation of the most sensitive production inputs and their relative influence on the product cost structure, in particular on the non-product costs. The input parameters selected were based on both their significant (large) cost factors and their wide range of maximum and minimum estimated values. The following parameters were considered:

- Water costs; and
- Wood costs.

The sensitivity analysis showed that the variation in pulp's cost is sensitive to increase in water prices. Given that the current cost of water in Romania is very low, it would not be unrealistic to see an increase of 200 per cent[27] would not be unrealistic in the not too distant future. This will have a significant impact on pulp cost.

Figure VIII shows the impact of the variation of wood cost on both pulp cost as well as the impact on non-product costs. A 10 per cent increase in wood price will generate an increase of 4 per cent of pulp cost and a 6 per cent increase of non-product costs. It seems then that non-product costs are more sensitive to wood price variation than pulp cost.

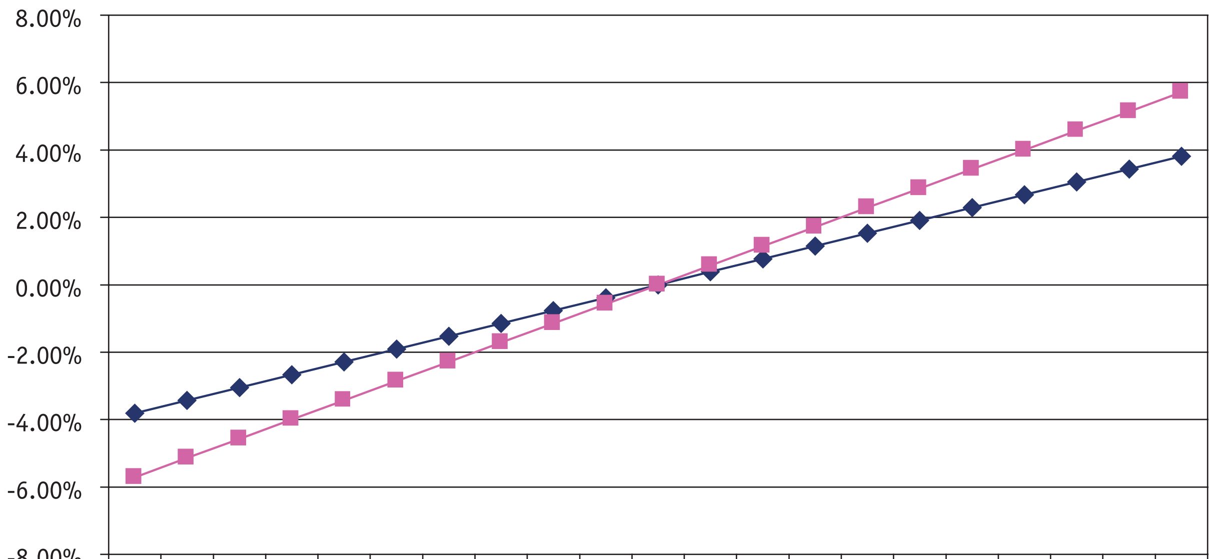
G. Conclusions

SOMEŞ S.A., is a member of the HOVIS Group, a company with much potential. The Organizational culture of the company and the level of the existing human resources are an excellent basis for the company's future development. A tool like the one EMA has successfully introduced to help it attain that potential.
At its conclusion, the EMA project achieved the following:

- EMA human skills were built within the company and the EMA project was extended from the bleaching unit (initial focus area) to the entire plant.

[27] An increase of 200 per cent of the current water price in Romania would bring the water fee to a value comparable with the EU countries.

Figure VIII. Sensitivity Analysis: Wood versus Pulp and Non-product Costs—SOMEŞ



	-10.00%	-9.00%	-8.00%	-7.00%	-6.00%	-5.00%	-4.00%	-3.00%	-2.00%	-1.00%	0.00%	1.00%	2.00%	3.00%	4.00%	5.00%	6.00%	7.00%	8.00%	9.00%	10.00%
pulp cost variation	-3.81	-3.43	-3.05	-2.67	-2.29	-1.91	-1.52	-1.14	-0.76	-0.38	0%	0.38	0.76	1.14	1.52	1.91	2.29	2.67	3.05	3.43	3.81
non-product cost variation	-5.71	-5.14	-4.57	-4.00	-3.43	-2.86	-2.29	-1.71	-1.14	-0.57	0%	0.57	1.14	1.71	2.29	2.86	3.43	4.00	4.57	5.14	5.71

Wood cost variation

- Management Accounting and Data Collection System were re-organized and Procedures were prepared to highlight the environmental costs.
- Continuous application of CPA for reduction of the environmental costs was adopted.
- CPA was extended to the entire plant to support environmental cost controlling information system (EMA).
- Integration of environmental criteria in EST investments analysis (both present and contingency costs/benefits).

The reorganization of the management accounting system was done in the following steps:

- Existing cost allocation methods and allocation keys were revised to take into account environmental criteria.
- Total environmental costs were calculated and allocated to the appropriate cost centre and to the products.
- The existing accounting information system was modified by the creation of environmental accounts.

The information from the newly created environmental accounts will result in the presence of two categories within the product cost structures: one for "environmental cost" (end-of-pipe related costs) and another one for "non-product output". Table 15 shows the relative importance of non-product output compared to environmental treatment costs (end-of-pipe) for each product. It appears that non-product material costs are more important for the company. However, a reduction of total environmental costs by 50 per cent will generate an average increase in profitability of approximately 3 per cent. For a turnover of 31,600,000 euro, the amount of savings will be 948,000 euro.

Table 15. Non-Product Output Costs Compared to Environmental Treatment Costs (end-of-pipe) For Each Product—SOMEŞ

	Total Production Cost	Non-Product Output		Environmental Costs (End-of-pipe)	
Products	Value: ROL/kg	Value	%	Value	%
Natural Pulp	8,779	440	5.01	233	2.65
Bleached Pulp	15,149	658	4.34	426	2.81
Unbleached Paper	15,295	633	4.14	233	1.52
Bleached Paper	18,126	617	3.40	318	1.75

Additionally, the management recognized the following benefits from implementing EMA:

- The increase of efficiency in the use of the raw materials became the most important objective at the cost centre level for product profitability (reduction of non-product material costs);
- Increased commitment for the development of new environmentally friendly products, technologies and work procedures;
- Increase in the quality and consistency of the information offered to management;
- Fostering of communication between company plants and cost centres including the involvement of top management in structuring and controlling the material flow within the company;
- Environmental reasons became critical for investment decisions (three large environmental investments are in progress: a chlorine-free bleaching unit-EST component of the TEST project, Wastewater Treatment Plant, Solid Waste Incineration plant).

Based on the results of the project, the following actions are planned:

- Material balances for the other auxiliary cost centres will be prepared.
- Determination and tracing of the non-product raw material costs for the other auxiliary cost-centres will be carried out.
- Study the possibility of taking into account other environment related overheads.

CASE STUDY 3: HERBOS D.D. CROATIA

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The EMA team consisted of Katica Blaškovic, Andreja Feruh, Darko Kobal, Ivan Smolčić, Vlatko Zaimović from HERBOS, Morana Belamaric from the Croatian Cleaner Production Centre and Boris Bjedov consultant.

A. Brief description of the company

1. About the company

HERBOS d.d. is a joint stock company (i.e. both privately and publicly owned), for the production of chemicals, mainly pest control products.

The company was founded in 1946. At that time, it was a manufacturer of tartaric acid and oxygen. Over the past 50 years, the company changed its name to "HERBOS d.d." and has grown into a major manufacturer of pest control products, construction materials, paints and coatings and reagents for clinical diagnostics

The company statistics include:

Employees:	Presently 340 employees
Annual Revenue:	Approximately 150 million HRK.
Ownership:	Approximately 70 per cent owned by small share-holders
Contact Person:	Mr. Ivan Smolèiæ
Telephone:	+385 (0) 44 543 333
Email:	ivan.smolcic1@sk.tel.hr

HERBOS d.d. operates as one unit, regardless of its various production programmes.

2. Environmental aspects of the company

The main environmental problem at HERBOS is wastewater discharge that originates from atrazine synthesis. At full operational capacity (approx. 450 m3/day), atrazine concentration in discharged wastewaters is 93.3 mg/l, which exceeds the permitted concentration level (10 mg/l) by almost ten times. In addition, regulations are to change by 2005, which will have an atrazine level of 0.05 mg/l, 200 times stricter than the current limit. Different, cleaner production measures are planned to solve this problem.

Air pollution limits are covered by the law on Limit Values of Pollutant Emission from Stationary Sources into the Air.

Hazardous wastes generated in the processes include:

- Tin drums, which are collected and kept separate until returned, or pressed and sold as secondary raw materials;
- Glass packaging (from laboratories), which is kept in separate containers and returned as a secondary raw material;
- Other hazardous wastes removed from the point of generation and sent for destruction at the company's incineration plant;
- Ash from the incineration plant, which is sent to a class IV site for off-site disposal after physical and chemical analysis, classifies it as a process waste.

3. Current management accounting practice

There is a financial accounting department within HERBOS, supported by an automatic data processing system. The majority of existing environmental costs are allocated to cost centres, or to products, according to pre-determined keys, usually through the management or supporting services overhead. Allocation keys are not always clearly defined and there is no mechanism to regularly check them. Until now, there had not been an instance where environmental protection costs had been separated from other overheads in order to determine their real value and to enable correct allocation to cost centres and cost carriers.

The company as a whole is organized into six sectors, and each sector has several organizational units. Out of 66 total cost centres, 19 can be recognized as having environmental costs/revenues. Table 16 shows these cost centres:

Table 16. Cost Centres with Environmental Costs/Revenues—HERBOS

Code	Cost Centres
10	Sector of Executive Director
11	Services Sector
1110	General Services Dept. with General Manager Office (Ecological Laboratory included)
1111	Safety Department
1112	Fire Safety Department
1120	Department of Mechanical Maintenance
1130	Electrical Department and maintenance
1140	Department of Energy (Incineration plant)
1150	Department of Safety at Work
1160	Department of Transport
1170	Restaurant
12	Sector of Finance
2	**Pest Control Programme**
21	Pest control preparation and purchasing sector
2220	Atrazine Synthesis Plant
2230	Dusting-powder Plant
23	**Sector of Pest Control Production**
3	**Construction Materials Production Programme (CM)**
30	Office of Director (CM)
31	Commercial Sector
32	Controlling Sector (CM)
33	Production Sector (CM)

B. Scoping EMA

1. Objectives

This project focused on the chemical synthesis of atrazine, a key product of HERBOS, whose concentration in discharge water significantly exceeds the permitted limits. In certain areas, however, broadening the project scope to include the whole company was inevitable to provide a high quality analysis of all atrazine related environmental protection costs: this broadening refers to items documented at the company level.

The project scope was finally defined as follows:

- Calculating environmental costs at a company level to include all emission treatment and prevention costs categories, but not including non-product outputs. Non-product outputs could have been calculated only after analysing all processes within the company. This was not possible within the framework of the project, since a cleaner production assessment and input/output analysis was only available for the atrazine synthesis plant.

- Calculating environmental costs for the atrazine plant, including emission treatment and prevention costs, as well as the purchase value and processing costs of non-product outputs. This job relied heavily on the results of the cleaner production assessment previously performed within the TEST project.

2. Cleaner Production Assessment

The Cleaner Production Module of the TEST project was based only on one product-atrazine. The calculation of losses is based on the raw material consumptions that exceed the technological norms. The latter are derived from the technological flowchart. Raw material consumption and final product quantity is determined through measurements wherever possible. Estimates were used where no monitoring of flows is performed. It was estimated that 46,260 m^3/year of process water is lost in the atrazine production process.

Direct data are not recorded in the books for the volume of water used in the atrazine production. These costs appear in different positions. Table 17 shows the breakdown of industrial water costs in 2001.

Table 17. Breakdown of Industrial Water Costs in 2001 (in HRK)—HERBOS

Cost Category	Amount/m^3	Unit Price HRK	HRK/m^3	Calculation Method
Electric Energy	0.4 kWh	0.40	0.16	On the basis of technical characteristic of pumps
Hypochlorite	0.05 l	2.20	0.11	Consumption norm
Amortisation			0.50	Estimation
Salaries			0.11	Estimation
Other Overhead Costs			0.20	Estimation
Net Price of Water			1.08	Part of the costs of Department of Energy
Sewage Fee			1.39	For the whole plant
Water Consumption Fee			0.72	For the whole plant
Wastewater Discharge Fee			1.70	For the whole plant
Concession Fee			0.08	For the whole plant
River Basin Water Fee			0.41	For the whole plant
Municipal Fee			0.26	For the whole plant
Fees Total:			4.46	
Total:			**5.64**	

Only two of these cost items are directly allocated to the herbicide synthesis facility (the surface run-off and the water consumption fees). All other fees are recorded as overheads and are allocated through uniform keys not related to environmental protection.

C. Calculation and allocation of environmental protection costs

Calculation of environmental costs required a significant effort, and several recommendations were provided to the company for improvement and for building up the EMA information system. The total environmental protection costs for HERBOS in 2001 were calculated as shown in table 18.

Some examples of calculations and suggestions made are reported in sections 1-4 in this chapter.

1. Waste and emission treatment

1.1 Solid non-toxic waste

Existing way of calculation: There is a separate account for this cost and it is allocated to the organizational unit that disposes the waste in its own container.

Suggestion/Idea: No suggestions were made.

1.2 Sewage water fee (industrial and sanitary)

Existing way of calculation: Both costs are recorded on the same account as overheads. Estimation was done in breaking down these costs.

Suggestion/Idea: The discharge of industrial and sanitary water used at the site should be measured separately and separate accounts set up to record these costs. It is estimated that significant water savings is possible (today 420 l/day per employee are used).

Table 18. Total Environmental Protection Costs in 2001 (thousands of HRK)—HERBOS

Cost Items	Value (thousands of HRK)
Waste and Emission Treatment	
Solid Non-toxic Waste	78
Sewage System	200
Pre-treatment Costs (scrubbers, filters etc.)	
Pre-treatment Costs Related Personnel	
Incineration Plant	200
Fines	0
Insurance	92
Surface run-off Fee	311
Water Consumption Fee	-
Concession Fee	-
Wastewater Discharge Fee	153.3
River Basin Water Fee	8
Municipal Fee	2,800
Prevention and Environmental Management	
External Services	234
Education and R&D	44
Environmental Laboratory (personnel included)	300
Cleaner Production Planning Costs	100
Decoration of the Area	97
Premises Cleaning	497
Safety	253
Maintenance	112
Material Purchase Value of Non-Product Output	
Water	
Main raw materials	
Auxiliary materials	
Other materials	
Packaging	
Processing costs of non product output	
Total	**5,471.3**
Total costs of production	**150,000**
Of which environmental costs	**3.65%**

1.3. Wastewater discharge fee, water consumption fee and river basin water fee

Existing way of calculation: All these fees are recorded in the same overhead account. Water consumption is a fee that exists as a kind of concession for the use of a natural resource and the water supply systems.

River basin fees are used for the continual maintenance and improvement of the river basin water systems.

Suggestion/Idea: Separate individual fees by setting up new accounts. Fees for water protection and water consumption should correlate with the amount of water consumed and the sewage water fee, and should be related and allocated to their respective cost centres based on industrial usage.

1.4. Incineration plant

Existing Way of calculation: The incineration plant operates as part of the Department for General Services. There is an initiative to build a new incineration plant that would comply with legal emission limit values. The new plant is proposed to operate as a separate firm.

Suggestion/Idea: If the initiative for a new firm were refused, the incineration plant should be organized as an individual cost centre in the future. All costs should be identified and quantified, since this plant offers services to the public as well.

1.5. Insurance

Existing Way of calculation: These costs are on the overhead account.

Suggestion/Idea: Processes within HERBOS have different inherent risks. For that reason, a risk evaluation would be interesting for the different processes.

2. Prevention and environmental management

2.1. External control services

Existing Way of calculation: Costs include emissions monitoring, are on an overhead account and are allocated using pre-determined keys to different products.

Suggestion/Idea: Identify which activity belongs to which specific cost centres. For example, operating and monitoring costs of the incineration plant should be allocated to the plant. These costs influence the price of the services provided by the incineration plant.

2.2 Environmental laboratory

Existing Way of calculation: Presently all laboratory costs are pooled together with other overhead costs.

Suggestion/Idea: A separate cost centre should be set up. This would be especially important as certain services of the laboratory are provided to external partners.

2.3 Hygienic and technical safety (HTS)

Existing Way of calculation: These costs are currently hidden in the overheads.

Suggestion/Idea: Separate accounts for personal protective equipment and other means of HTS should be set up.

3. Material purchase value of non-product output

This focus is exclusively on atrazine synthesis plant data. This was the only plant where a cleaner production assessment provided a detailed material flow analysis, which could be used for estimating the value of non-product output.

3.1 Packaging waste

Existing Way of calculation: Packaging waste costs are currently a part of the direct costs of the production.

Suggestion/Idea: Packaging waste costs should be represented separately as environmental cost.

3.2 Auxiliary raw materials and other materials losses

Existing Way of calculation: These costs are either on overhead accounts, or part of the direct costs, but not recognized as environmental.

Suggestion/Idea: All costs from this category should be in a separate account.

3.3 Purchase value of water going to the wastewater

Existing Way of calculation: These are direct costs of production, but not recognized as environmental costs.

Suggestion/Idea: In preparing environmental reports these costs should be taken into account.

3.4 Raw material losses in atrazine production

Cleaner production assessment of material losses (table 19):

Table 19. Raw Material Losses in Atrazine Production—HERBOS

Raw Material	Material Losses kg/year	Within the Process (%)	Total Financial Losses (thousands of HRK)
Cyanuric Chloride	73,554	5.3%	876,300
Isopropyl amine	56,884	11.9%	450,400
Monoethyl amine	13,082	2.8%	89,000
TOTAL:	**143,520**		**1,415,700**

Losses were calculated as consumption exceeding the technological norms. The company can achieve significant cost savings in the short term by making a better job of maintaining operations within the technological norms.

4. Revenues

4.1 Income from the environmental laboratory

It is a secondary activity in HERBOS today, but it could become more significant.

4.2 Income from the incineration plant

The incineration plant is used mostly by HERBOS. With a new incineration plant, additional income could be gained by offering incineration services to the public. For this purpose, a separate company might be set up.

D. Allocation process and Information system for EMA

Since costs were being hidden in overheads or recorded as part of direct costs they were not recognized properly. This situation can be changed by:

- Setting up separate analytical accounts;
- Adding a special indicator for environmental expenditures while registering the business events in the accounting department;
- Thoroughly registering the value of internal services by recording the quantities and unit prices.

In this way the total environmental protection costs, at the company level, can be obtained. It is far more complex and difficult to obtain this information at cost centre or product levels.

From the problems and suggestions described, the following factors were important when deciding on allocation of environmental costs:

- Measurability of the parameters for cost allocation;
- Consistent recording of costs in the cost centre where they appear;
- Compatibility with existing methods and techniques of billing;
- Implementation only in cases where it is economically justifiable.

The information system for EMA was set up as described in table 20.

Table 20. EMA Information System—HERBOS

Cost Item		Account	Method	When	How
1.1.	Solid Non-toxic Waste	Exists	Counting number of containers	Monthly	Analysis and allocation to CC[a]
1.2.	Drainage Water Fee	New	On the basis of m^3 of total amount of water	Monthly	Analysis and allocation to CC
1.3.	Wastewater Discharge Fee, Water Consumption Fee	New	On the basis of m^3 of total amount of water	Monthly	Analysis and allocation to CC
1.4.	River Basin Water Fee	New	On the basis of m^2 of area		
1.5.	Costs of Sewage System	New	Estimation on the basis of m^3 of water	Quarterly	Analysis and allocation to CC
1.6.	Pre-treatment Costs	New	Estimation	Quarterly	Analysis
1.7.	Incineration Plant Costs		Estimation	Quarterly	Analysis and allocation to CC
1.8.	Costs of Environmental Personnel		Estimation	Quarterly	Analysis and allocation to CC
1.9.	Insurance	New	Cost centre	Quarterly	Analysis and allocation to CC
1.10.	Municipal Fee	Exists	On the basis of m^2 of area	Quarterly	Analysis and allocation to CC
2.1.	External Services	New	Cost centre	Quarterly	Analysis and allocation to CC
2.2.	Education and R&D	Special indicator	Cost centre	Quarterly	Analysis and allocation to CC
2.3.	Environmental Laboratory		Estimation	Quarterly	Analysis and allocation to CC
2.5	Decoration of the Area	New	Cost centre	Quarterly	Analysis and allocation to CC
2.6	Premises Cleaning		Estimation	Quarterly	Analysis and allocation to CC
2.7	Safety	Exists	Cost centre	Monthly	Insight to business books
2.8	Maintenance of Working Outfit			Quarterly	Analysis and allocation to CC
3.1	Water		Estimation	Quarterly	Evaluation
3.2	Raw Materials		Estimation	Quarterly	Analysis
3.3	Auxiliary Raw Materials		Estimation	Quarterly	Analysis
3.4	Other Materials		Estimation	Quarterly	Analysis
3.5	Packaging		Estimation	Quarterly	Analysis
4.1	Environmental Laboratory	New	Cost centre	Quarterly	Analysis
4.2	Incineration Plant	New	Cost centre	Quarterly	Analysis

[a]Cost Centre.

E. Results and conclusion

1. Environmental costs in the Atrazine Synthesis Plant

Since technical grade atrazine is the focus of the project, estimation of environmental costs were prepared for this plant, and non-product costs were calculated as consumptions exceeding the technological norms (see table 21).

This was the first attempt ever made to identify environmental costs for technical atrazine. The largest percentage (approximately 2/3rds) of envi-

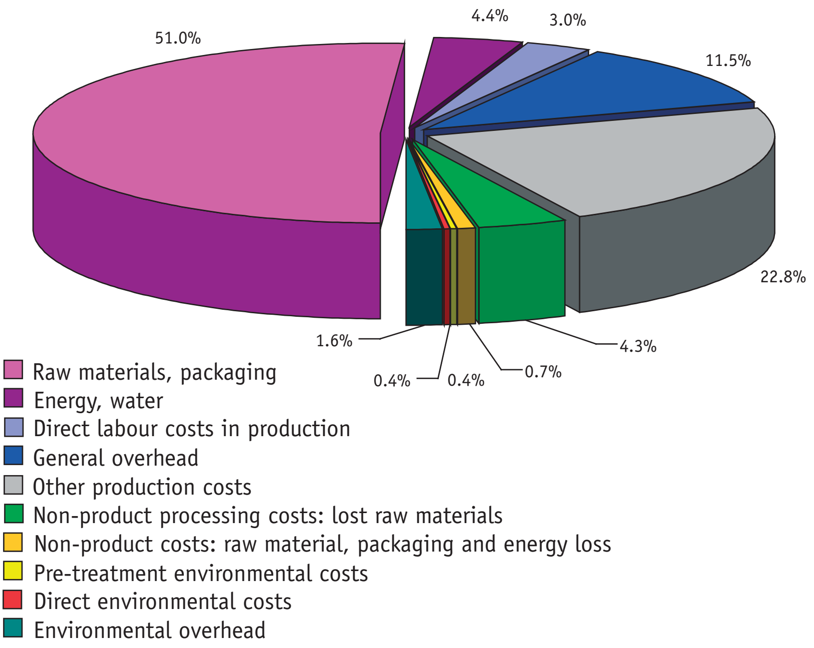
Table 21. Atrazine Plant Environmental Costs (thousands of HRK)—HERBOS

Cost Item	Value	Remarks
Solid Non-toxic Waste	0	Not significant
Sewage System	20	Estimation
Pre-treatment Costs (scrubbers, filters etc.)	63	Estimation including: depreciation, maintenance, energy
Pre-treatment Costs Related Personnel	96	Estimation
Incineration Plant	160	Estimation
Fines	0	
Drainage Water Fee	114	Estimation based on physical amounts
Water Consumption Fee	15	Estimation
Wastewater Discharge Fee	31	Estimation based on measured pollution loads
River Basin Water Fee	8	
Municipal Fee		
External Services	122	
Environmental Laboratory (personnel included)	300	
Cleaner Production Planning Costs	64	Estimation
Decoration of the Area	13	Estimation
Safety	35	Requisition slips
Water	257.5	Estimation (CP project)
Main Raw Materials	1,415.7	Estimation (CP project)
Auxiliary Materials	60.5	Estimation (CP project)
Other Materials	21.9	Estimation
Packaging	165.0	Estimation
Processing Costs of Non-product Output	322.1	Estimation based on production costs of technical atrazine
Total	**3,283.7**	
Total Costs of Production	**44,854**	
% Environmental Costs	**7.32%**	

ronmental costs stem from the material purchase value costs of non-product outputs. These costs are expected to be reduced by implementing cleaner production measures. Environmental costs for technical atrazine make up 7.32 per cent of total production costs.

Figure IX provides a breakdown of atrazine product costs, highlighting environmental costs.

Figure IX. Breakdown of Atrazine Product Costs (percentage)—HERBOS



2. Future development of EMA

The loss of raw material refers to raw materials, packaging and water that are not included in the final product. Considering the fact that the combined costs of materials, packaging, energy and water is almost 60 per cent of total costs, the 7.32 per cent of this which represents environmental costs is a relevant number.

Most environmental costs were estimated or calculated. Only 5 per cent of their actual amount (170,000 HRK) could be found as explicit items in the books of HERBOS.

The analysis has shown that the environmental protection costs of atrazine synthesis are equal approximately to 7 per cent of production value, which is an relevant percentage considering that direct costs give 63 per cent of total costs. This amount is actually even higher, as some items were left out of the analysis. These values demonstrate that costs can be significantly reduced by better housekeeping measures and by complying with the technological norms.

Financial expenses for environmental protection are increasing as a general trend. The new legislation on an Environmental Protection Fund, which anticipates new fees, was passed by the Parliament and will come into force in 2004. The new law requires that everybody who directly or indirectly pollutes the environment pay fees. HERBOS therefore will be incurring new environmental costs.

The need to know environmental protection costs and revenues calculation is recognized within HERBOS as an important tool for business decision-making. It also has relevance for public relations, since the public closely follows the environmental protection measures in this factory.

CASE STUDY 4: KAPPA STUROVO, SLOVAKIA

Authors: ***Viera Feckova, Helena Mališová, Zdenka Kozempelova*** **and** ***Michal Hrapko***

The EMA team consisted of Helena Mališová, accountant, Zdenka Kozempelova, head of department of management systems from Kappa and Viera Feckova and Michal Hrapko, external consultants from the Slovak Cleaner Production Centre. Several employees in the Kappa accounting department have participated actively in the discussions, data collection and data processing.

A. Description of the company

1. About the company

Name:	Kappa Štúrovo a. s.
Address:	Továrenská 1, 943 03 Štúrovo, Slovak Republic
Sector:	pulp and paper
Contact Person:	Zdenka Kozempelová (Head of Department of Management Systems)
Telephone:	+421-36 756 1111
Fax:	+421-36 752 4886
E-mail:	zdenka.kozempelova@kappapackaging.sk

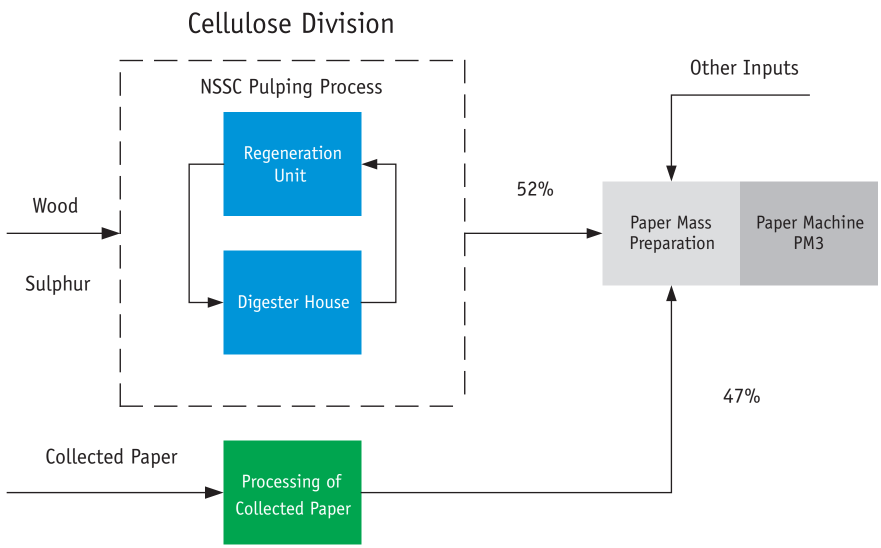
The company started in 1960 as a state owned company. After privatization in 1992, the company was converted to a Joint Stock Company and a new strategic investor (Swedish corporation AssiDomäin Aktiebolag) made the company a member of one of the most important multinational corporations in the field of wood and cardboard production.

Company data:	In 2001 AssiDomäin sold all its pulp and paper sites to the Netherlands based multinational and focused on fluting and cardboard production
Production:	166,104 tons of fluting 35,592 tons of plain and pasted cardboard
Export:	74 per cent of fluting production 56 per cent of cardboard production
Turnover:	72,355 million euro
Profit:	11,144 million euro
Employees:	825
Certificates:	ISO 9001, ISO 14001

Kappa is the largest recycled paper processing company in Slovakia. Its main activity is cellulose and cardboard production (see figures X and XI). Main products are:

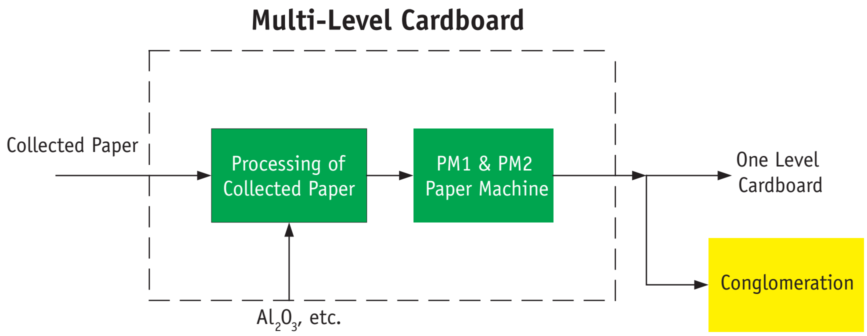
- Fluting;[28]
- Cardboard.

Figure X. Production of Fluting Flowsheet—Kappa



[28] Undulate layer of cardboard.

Figure XI. Production of Cardboard Flowsheet—Kappa



Fluting is used primarily in the food processing and consumer industry and is produced in three types: Sturovo Flute SC, Sturovo Flute EX and Semi-Fluting SE.

Sturovo Flute SC and Sturovo Flute EX are produced with the primary (virgin) fibres and with recycled paper, almost in equal percentages.

2. *Environmental aspects of the company and results of the CP programme*

Since 1997, Kappa a.s. has both a certified quality management system (ISO 9001) and a certified environmental management system, (ISO 14001). The management of the company is generally skilled and very well acquainted with existing environmental aspects: many joint projects with the state administration and broad activities in ASPEK (Association for Industrial Ecology) have been implemented over the past years. However, Kappa is also the largest Danube river water consumer and polluter in Slovakia.

Most of technology dates from the late 1960s and the 1970s. The pulping section is responsible for the main environmental problems from hydrogen sulphide (H_2S), sulphur emissions from the recovery boilers and the status of the alkali tanks.

Other environmental problems include chemical pollution of wastewater i.e. no sludge reported from production, an over-sized energy production department, flue ash generation, etc.

The company produces an Annual Report, which contains environmental and health and safety performance related data.

In May 2001 the company decided to join the TEST project and started the implementation of the CPA with a focus on water as follows:

- In terms of consumed and discharged volumes at the cardboard production line;

- In terms of pollution load, especially chemicals (sulphur consumption) in the pulping unit.

More than 25 feasible cleaner production measures were identified and proposed to the management. Water consumption in the cardboard production line decreased from 120 m^3/ton (May 2001) to 76 m^3/ton (April 2002).

The CPA assessment revealed the following two factors as main causes of environmental problems:

- The non-existence of a process water-settling tank and open water loops results in a large water consumption without water re-use capacity.
- Frequent variations of product mix at the cardboard line. This reduced the utilization capacity of the cardboard line by 50 per cent, caused higher environmental problems and reduced the quality of the final product. This resulted in lower return on sales.

The costs associated with the first cause of pollution are not treated as environmental costs, but are hidden within direct production costs. Likewise, the costs due to breaks in production at the cardboard line are hidden in the general overheads of the company, and not seen as in environmental cost.

As a follow-up to the CPA the company realised that causes of environmental inefficiencies generates significant economic losses and that a sound tracking of environmental costs would be of great benefit for the company. Therefore, they decided to start the EMA project. CPA provided data in several physical units related to water and chemical issues, necessary for EMA. Although identified, many other factors were out of the scope of CPA project, such as raw material (wood and recycled paper) consumption.

3. Current accounting practices and information system

The company's overall information system is supported by SAP/R3 software. The process based control and internal accounting system is linked to a formal double book system as prescribed by Slovak law (the national system is not fully compatible with international standards). Additionally, the company follows international standards. Most of the company departments have individual cost centres.

All transactions among cost centres are based on internal pricing, e.g. each cost centre "purchases" and "sells" its service and products to other centres. Only a few of costs centres are traditional overhead cost on company level. Product costing is based on consumption norms, direct costs of relevant production cost centres and proportion of costs allocated to overheads.

Even during initial discussions with the chief accountant, it appeared that environmental costs were not reflected in the existing system. The only environmental costs that were allocated to the respective costs centres were waste treatment costs (fees and operational costs of WWTP)

Most other environmental related cost items such as depreciation of environmental related equipment or external services for environmental management are currently allocated to cost centres but they were not highlighted and regarded as environmental costs.

There were two issues regarding environmental costs-those costs hidden (buried) in other costs where the company never realised how large the environmental costs could be since this information was not available from their existing system. The allocation to the costs centres, in most cases, was appropriate regarding the material and equipment but not correct regarding services. Costs of management system departments are considered as general costs. Maintenance costs were partly allocated to cost centres and partly included in overheads: the environmentally related value was not available from the information system. Table 22 summarizes the accounting practices of environmental costs at Kappa before the EMA project started.

Table 22. Kappa—Accounting System For Environmental Costs

Environmental Cost/Expenditure Categories	Accounting Practice Before EMA Project
1. Waste and Emission Treatment	
1.1. Depreciation for Related Equipment	Currently allocated to relevant cost centres—Not regarded as environmental costs
1.2. Maintenance and Operating Materials	Allocated to cost centres—Not regarded as environmental costs
1.3. Related Personnel	Currently allocated to cost centre WWTP[a]—Not regarded as environmental costs
1.4. Fees, Taxes, Charges	Currently allocated to cost centre MS[b]
1.5. Fines and Penalties	Overheads
1.6. Insurance for Environmental Liabilities	Overheads
1.7. Provisions for Clean-up Costs, Remediation	Overheads
2. Prevention and environmental management	
2.1. External Services for Environmental Management	Allocated directly to MS—Not regarded as environmental costs
2.2. Personnel for General Environmental Management Activities	Personnel of the MS department directly allocated to cost centre MS, other personnel costs related to time spent on environmental issues allocated to respective costs centres—Not regarded as environmental cost
2.3. Research and Development	NA
2.4. Extra Expenditure for Cleaner Technologies	NA
2.5. Other Environmental Management Costs	
3. Material Purchase Value of non-product output	
3.1. Raw Materials	Included in Direct Costs, not regarded as environmental cost
3.2. Packaging	Included in Direct Costs, not regarded as environmental cost
3.3. Auxiliary Materials	Included in Direct Costs, not regarded as environmental cost
3.4. Operating Materials	Included in Direct Costs, not regarded as environmental cost
3.5. Energy	Included in Direct Costs, not regarded as environmental cost
3.6. Water	Included in Direct Costs, not regarded as environmental cost
4. Processing Costs of Non-Product Output	Included in Direct Costs, not regarded as environmental cost
5. Environmental Revenues	
5.1. Subsidies, Awards	
5.2. Other Earnings	Allocated to respective cost centres (WWTP and MS) providing service also to external companies

[a]WWTP—Wastewater Treatment Plant.
[b]MS—Management System department.

B. Scoping EMA

The system boundary was confined to the company site, with the intention of further analysing the other production sites where the CP project was implemented. Pulping, as a part of fluting production (which represents 90 per cent of the total company turnover), was the primary focus of study. Cardboard production was originally also targeted as a second production line.

The objective of the EMA was to calculate total environmental costs and highlight them by categories, within the already existing cost centre allocation structure. Allocation to product was not conducted within the first application of EMA at Kappa. The company in fact produces a range of products, which are very similar.

To calculate the overall environmental costs of company, it was decided to take into account the following cost items:

- Depreciation of environmental related equipment;
- Maintenance and operating material costs;
- Costs of WWTP (since this was directly available);
- Fees, charges and taxes;
- Fines and penalties;
- External services for environmental management;
- Costs of the Management system department (this was also directly available); and
- Non-product output costs: water and energy above the BAT levels.

Raw material purchase values of non-product outputs were not considered within the first EMA project at Kappa. These costs were estimated to be of a higher amount and must be calculated within further application of the system.

C. Calculation of environmental costs and information system

The following steps were necessary to identify relevant costs items within the existing information system.

Depreciation and maintenance were identified as important issues, so special attention was paid to them. Depreciation and maintenance costs of waste and emission related equipment had not been tracked independently in the company information system, but it was, at least partially, possible to identify and calculate them using the physical fixed assets numbers. In order to calculate depreciation of environmental equipment and maintenance costs, it was necessary first to define what was environmental equipment and to list all the existing environmental equipment. For definition, the recommendation of Eurostat (June 2001) was used.[29]

The maintenance and depreciation of environmental equipment could be precisely traced only if the pieces and technological units have their own property identification numbers (IDs). If this is the case, an additional separate analytical account reflecting only environmental property could be created and would provide an exact picture of costs linked to environmental equipment.

In reality, environmental equipment is either:

- Hidden under the ID of a larger technological unit (in case when the investment was procured as a unit); or
- Has a unique ID in the system (if the whole technology itself is end-of-pipe, for example WWTP); or
- Could have more than one ID, if reconstruction, renovation or modernisation occurred more than once, such that it impacts depreciation models according to the law.

Backtracking to calculate environmental costs is only applicable in the latter two cases i.e. large end-of-pipe plants.

In this case study, many smaller end-of-pipe units (like flue gas treatment, stripper, etc.) were identified as part of production technology in the company. However, the evaluation of depreciation would require extensive detective work in the records, utilizing original project documents and invoices. Maintenance costs cannot be backtracked. Data presented reflects

[28] Environmental equipment is equipment used for pollution treatment due to legal pressures and where the company could technically produce the product without this equipment, i.e. we considered only end-of pipe as environmental equipment.

the last two cases. It is expected that in reality, the environmental equipment maintenance costs and depreciation is significantly higher than reported here.

In parallel to the identification of depreciation costs, the external services for environmental costs had to be calculated. Environmental services had to be identified and listed. Respective accounts numbers where the costs had been allocated were then identified for each environmental service related expenditure. One of the main problems was that neither the account number nor the IDs referred to purely environmental records, e.g. in most cases their identification does not mean direct identification of a financial item, the information should have read: "part of this financial item if environmental".

The total amount of water discharged by the process was considered as an environmental cost.

Despite of the existence of a well-developed information system, it was necessary to search data and information from different departments, especially within the accounting department. Sources of data were (ranked according to priority):

1. Information System SAP/R3,
2. Records of individual departments and
3. Collection of single data.

1. Depreciation and maintenance environmental costs

Fifteen different pieces of equipment were defined with their corresponding economic cost centres and ID numbers. Table 23 describes all devices and units used at the company to treat the pollution and thus generating environmental costs.

There are two different independent cost centres devoted purely to environmental costs: the wastewater treatment plant and the Department of Management systems. All other equipment related environmental costs are part of generic costs centres, either in production or energy departments. The equipment is installed in the pulping unit, energy department or warehouse of combustible chemicals storage areas.

Table 23. Kappa—Environmental Equipment/Organization Section

	Categories of Environmental Equipment	Cost Centre	Remark
1.	WWTP	WWTP	Individual CC
2.	Electrostatic Precipitator in the Energy Department	Energy	
3.	Electrostatic Precipitator at the Pulping	Pulping	
4.	Separator (Duster)	Energy	
5.	Gas Scrubber—Water	Pulping	
6.	Gas Scrubber—Alkaline	Pulping	
7.	Management Systems Department	Administrative Building	Individual CC
8.	Ash Sludge Including the Laboratories	Energy	
9.	Green Liquor Centrifuge	Pulping	
10.	Chemicals Overflows—roof, tank, pump	Pulping	
11.	Continual Measurement of Emission	Pulping	
12.	Emergency Tank—Chemicals Warehouse at Regeneration	Pulping	
13.	Underground Water Monitoring System	Pulping	
14.	Waste Warehouse	Combustibles Warehouse	
15.	Electrostatic Precipitators Fly-ash Tanks	Energy	

In a second stage, company properties were analysed. A list was generated of all material and non-material property with a description of the material, ID numbers, year and purchase value and economic cost centres (all issued from the SAP information system). At the beginning, all listed properties were reviewed to determine which equipment would be considered as environmental, and those were they copied into a separate table: their cost centres, ID numbers, years and purchase cost were also identified, and the list sorted by ID numbers. The related depreciation and value of maintenance for each piece of equipment was then determined.

Looking at the calculation, the total value of all properties represents 839,868,000 SKK.[30]

- Fifteen per cent of this amount is an expert's estimate of the environmental equipment value (app. 126 million SKK).
- The value of the pulping cost centre is equal to 25.6 million, of which environmental equipment represents app. 40 per cent (10.4 million SKK).
- The independent WWTP cost centre is an end-of-pipe technology and its purchase value was 90.7 million SKK. Similarly, the duster was 25 million SKK.

[30] Calculations are in Slovak currency (Slovak Crowns). See explanatory notes for conversion.

The purchase costs are reflected differently depending on the age of the equipment and type of depreciation classification prescribed by law.

Most of the equipment had been purchased in the 1970s or the 1980s, thus the entire value had already been depreciated. Internal depreciation policy indicates that investment should be depreciated within 10 accounting years.

2. Environmental services

Among environmental activities, a number of external and internal trainings, various courses, seminars and meetings are available to increase the capital of staff and the workforce of the company. They are also active in a variety of environmental activities such as maintaining the grass and gardens surrounding plants, issuing of environmental reports, publications and documents, translation of ecological documents, etc.

It was discovered that several different services are recorded under the same account. For instance, contractual penalties and fines were assigned to the same accounts as other fines and penalties.

Table 24. Kappa—Account Codes Where Expenditures for Environmental Service Could Be Found

	Environmental Services Categories	Account
1.	External Measuring of Emission	518197
2.	External Measuring of the Underground Waters Quality	518197
3.	External Measuring of Overflow	518170
4.	Appraisals in the Division of Environment	518197
5.	Gardening Service	518180
6.	External Audits and Certification (together with Quality Management Services)	518197
7.	Attendance at the Environmental and Management Systems Seminars, Courses, Trainings and Conferences	518160
8.	Environmental Documents Translation	518190
9.	Waste Disposal	518180
10.	Environmental Administration, Certification, Documents and Publications	518197
11.	Submissions—ASPEK Membership Dues	518172
12.	Charges, Funds Contribution	538112
13.	Contract Fines and Penalties	544101
14.	Other Fines and Penalties	545101

The interesting part is, that waste disposal costs are recorded on the same account number as the lawn and garden services. The proposal is to split end-of-pipe, pollution fees and other costs into analytical accounts to achieve better understanding and management of costs, as well as proper allocation.

In this way, the company will be able to deal with these environmental costs and reduce them through higher effectiveness.

3. Non-product outputs

Material purchase value of non-product outputs is tracked for each cost centre, within the scope of technical economic norms.

The largest cost items that have arisen from these problems are:

- High water consumption without internal recycling; and
- High sulphur consumption and its losses into the water and air.

Both materials are used as auxiliary items, e.g. they are used during the process but theoretically could be fully recycled. This means that the total amount appears in non-product output. Other material streams were not considered.

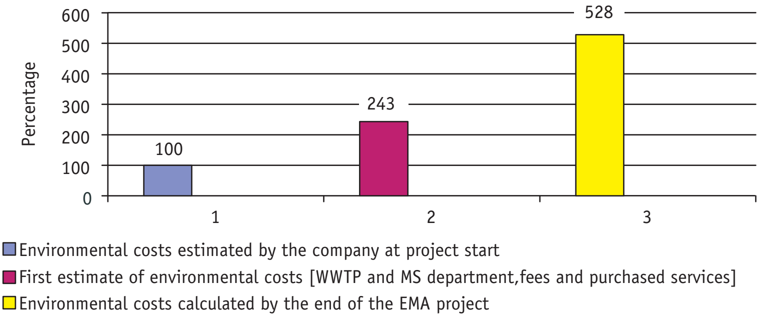
All products have few modifications, thus it is not necessary to allocate environmental costs to products.

D. Results of the EMA project

In figure XII, the results after the first data collection and analysis cycle are shown as the amount of environmental costs occurring by the whole company in the year 2001.

Within the initial steps of the EMA project, a second rough estimate of environmental costs was prepared. This time it included only the most important and easiest to assess data for the wastewater treatment plant and management system department (direct environmentally related costs, already in information system). Already at this intermediate stage of the project environmental costs appeared to be 2.5 times higher than the company's initial estimate. By the project's end, the total environmental costs were still five times higher the initial estimates, but lower than real costs, since much of them cannot be retrieved from system.

Figure XII. Kappa—Environmental Costs Chart—Beginning vs. End of Project



Environmental costs reported by company before the EMA project consisted mainly of waste treatment costs purchased as services and are reflected in figure XII and table 25.

Further analysis showed that the depreciation of environmental equipment, allocated to two independent costs centres (WWTP and EM), represented only 0.67 per cent of total depreciation. Depreciation of environmental equipment traceable directly to production adds 1.58 per cent (representing a factor of 136.8 per cent times more than that of the WWTP and EM combined).

Maintenance and operating materials of environmental equipment allocated to environmental costs centres created 38.3 per cent of waste and emission treatment costs. However, it is expected that maintenance of environmental equipment costs create a higher proportion, which could not be easily identified from the existing records.

This is not unexpected given the age of the technology and by the fact that number of calculated environmental costs is still relatively low and much of costs were not possible to be traced back.

The structure of costs is provided in Table 26.

What this means is that real, properly evaluated and monitored environmental costs especially if including all categories of non-product output costs that were excluded from the first calculation, could mount to as high as 10 per cent or even more of total costs.

Table 25. Kappa 2001—Total Environmental Costs by Category (thousands of SKK)

Environmental Cost/Expenditure Categories	Cost
1. Waste and Emission treatment	**57,773**
1.1. Depreciation for Related Equipment	3,708
1.2. Maintenance and Operating Materials and Services	22,414
1.3. Related Personnel	3,285
1.4. Fees, Taxes, Charges	28,366
1.5. Fines and Penalties	0
1.6. Insurance for Environmental Liabilities	0
1.7. Provisions for Clean-up Costs, Remediation	0
2. Prevention and environmental management	**7,519**
2.1. External Services for Environmental Management	3,442
2.2. Personnel for General Environmental Management Activities	4,077
2.3. Research and Development	0
2.4. Extra Expenditure for Cleaner Technologies	0
2.5. Other Environmental Management Costs	0
3. Material Purchase Value of Non-Product Output	**33,020**
3.1. Raw Materials	3,659
3.2. Packaging	0
3.3. Auxiliary Materials	0
3.4. Operating Materials	3,183
3.5. Energy	0
3.6. Water	29,361
4. Processing Costs of Non-Product Output	**21,674**
Subtotal 1	**119,986**
5. Environmental Revenues	**498**
5.1. Subsidies, Awards	0
5.2. Other Earnings	498
TOTAL	**119,488**

Table 26. Kappa 2001—Environmental Costs Structure (thousands of SKK)

Summary of Results	thousands of SKK	Percentage of Production Profit	Percentage of Production Costs
1. Waste and Emission Treatment	57,773	1.80	2.21
2. Prevention and Environmental Management	7,519	0.23	0.29
3. Material Purchase Value of Non-Product Output (water)	33,020	1.03	1.26
4. Processing Costs of Non-Product Output	21,674	0.67	0.83
Total Calculated Environmental Costs	**119,986**	**3.73**	**4.58**

E. EMA and investment decision on EST

Future company strategy focused on expansion, thus proposed major investment projects target on increased profitability, increased production output, improved environmental performance and compliance with EU regulations.

The identified priority areas for investments are aimed at three areas:

1. Change the main process in the pulp mill: simplify and increase efficiency of chemical recovery plant by switching to non-sulphur pulping;
2. Increase the capacity of paper mill and degree of utilization of recycled paper as one of the main raw materials;
3. Expand the WWTP by including the biological treatment;

Within the frame of the EST module of the TEST project, the NCPC remade the company's vision of its future operations and helped to integrate environmental issues in investment considerations: utilizing the principles and the results of the EMA project.

Two investment activities were also assessed using the COMFAR tool[38]:

1. Neutral Sulphite Semi-Chemical (NSSC) Pulp washing (Investment size 1.960 million euro),
2. Green liquor sludge disposal (Investment size 239,300 euro).

These investments will improve the company's environmental performance and increase its productivity. During the preparation of the pre-feasibility study, a sensitivity analysis was performed taking into consideration contingency environmental costs like future liabilities, expected future increases of pollution fees, future fines and expected increases in the costs of raw materials. The sensitivity analysis revealed relevant changes in the financial indicators of the proposed project. Fees and fines were estimated/determined based on information provided by the Ministry of Environment and documents of Slovak Environmental Inspection.

Here is a brief description of the two projects.

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38 www.unido.org/doc/3470

1. NSSC pulp washing

The current pulp washer has a very low washing efficiency. The main problem is that a large volume of wash substances are carried over from the inflow of the NSSC production line, thus a large amount of contaminated white water leaves the system to the Effluent Treatment Plant. The main purpose of the investment in the NSSC pulp washing is to reduce the COD and BOD discharge to the River Danube.

The objectives of the project are:

- De-bottleneck the washing line i.e. increase the washing line capacity, measured in bone dry tons per day (BDtpd) from current 300 BDtpd (peak 330 BDtpd) to 350 BDtpd (peak 370 BDtpd) levels;
- Improve the quality of the product by better washing;
- Enhance the efficiency of the cellulose production by closing the loop of chemicals;
- Improve environmental performance by reducing COD and BOD loads in effluent discharge.

The ability of the investment to reduce the pollution in the wastewater and reduce wastewater discharge fees is considerable (Kappa pays charges of over 11.8 million SKK annually for BOD_5). The proposed investment will have a significant influence on reducing BOD_5.

Operation is scheduled to start in the first half of 2004. The assumed life span is eight years. Table 27 summarizes the basic assumptions and savings related to environmental costs.

The financial benefits of this project strongly depend on an increase in production. In financial terms, the production has to increase from 25,000 euro to 41,000 euro to obtain zero NPV. Moreover, Table 28 shows that by considering contingency environmental costs, the proposed EST investment is more profitable.

Table 27. Kappa—NSSC Pulp Washing Project Assumptions and Projected Annual Savings (thousands of euro)

Cost Item	Yearly Savings [thousands of euro]	Basic Assumptions
Chemicals	27	7% Annual growth
Fees for COD Discharges	93	In the first year 2004
	291	Starting from 2005
Steam	65	3% Annual growth
Environmental Fines	34	Estimated

Table 28. Kappa—NSSC Pulp Washing Project Financial Indicators (thousands of euro)

Description		Environmental Risks and Contingency Costs Considered	Base Situation
PBP	normal	2 years 2003	3 years 2005
	dynamic	3 years 2004	3 years 2005
IRR %	normal	60.66	49.50
	modif.	60.66	49.50
NPV [thousands of euro]		4714.20	3018
NPV ratio		2.47	1.58

2. Green liquor sludge disposal

This proposed investment focuses on recovering chemicals from the green liquor, which is produced in the sludge washer in the Recovery plant. This will result in improved water quality and reduced pollutant levels. Due to current loss of chemicals and water contamination, the plan is to install the new equipment consecutive to the existing sludge washer, ensuring maximum sludge separation and thickening of sludge from suspension to dumping consistency. All obtained filtrates will be re-used in the technology.

The device started operating in the first half of the year 2003. The assumed life span is 15 to 20 years.

Table 29 and 30 provide an overview how important the consideration of environmental benefits is in project appraisals, especially in terms of internal rate of return.

Table 29. Kappa—Green Liquor Project Assumptions and Projected Annual Savings (thousands of euro)

Cost Item	Yearly Savings [thousands of euro]	Basic Assumption
Waste Treatment Costs	5.3	Fees for storage of the sludge
Recovery of Chemicals from Sludge	74.9	7% annual growth
Fees for Wastewater	10	Starting from 2004
Fines	34	

Table 30. Kappa—Green Liquor Project Financial Indicators

Description		Environmental Risks and Contingency Costs Considered	Base Situation
PBP	normal	4 years 2006	5 years 2007
	dynamic	4 years 2006	7 years 2007
IRR %	normal	37.13	14.65
	modif.	15.83	6.39
NPV [thousands of euro]		224.03	31.53
NPV ratio		1.03	0.13

F. Recommendations

As a multinational corporation, KAPPA a.s. has developed an advanced and modern control system. Only the environmental factors were not taken into account appropriately. In this area the control system could be modified and enhanced.

Based on the experience of the pilot EMA project, modifications in the design and structure of the internal information system and structure of accounts with special focus on the analytical accounts should be undertaken, as well as the development of written procedures. The latter, either as an independent document or as part of other relevant documentation systems in the company, should define what are considered environmental expenditures and revenues, how they are identified within the administration and bookkeeping processes and procedures, in which form, how and to whom these costs are reported and with what frequency.

As stated, it is necessary to create separate accounts for the maintenance of environmental equipment, raw materials of non-product outputs as well as re-think the depreciation policy of the company.

G. Conclusions

As shown in figure XII, environmental costs, even though perceived by the company as high, were still much lower than the real costs. The first rough calculation proved that real costs to be more than 2.5 times higher, than the company originally thought.

A more detailed look inside the structure and nature of the costs does not allow breaking down the environmental costs into great detail, also due to lack of identification within the existing information system. However, the environmental costs calculated were revealed to be 5 times higher than originally estimated by the company.

The results emphasise that environmental costs should be tracked much more carefully due to the fact that:

- Proper allocation, understanding the nature and size of costs and their reflection in everyday routine data serves as a background for appropriate evaluation and decision-making processes, and consequently for the correct identification of reduction measures.
- More and more attention is being paid by state administrations and the public on the environmental actions and expenditures of companies, including new statistical requirements. Proper reflection of real environmental costs in the internal information system of the company then serves as basic resource for: formal reporting demands both present authorities and future (EUROSTAT), voluntary reports (environmental reports by the company), PR and other forms of communication.

The following important lessons were drawn from the EMA project:

- EMA implementation needs to be treated and operated as a process. At the pilot stage: EMA requires personnel involvement from different organizational units and a strong commitment of all involved employees, regardless of their level in the company hierarchy.
- This process should go throughout both the horizontal and vertical levels of the company.
- The time line for full EMA implementation is estimated at 8-12 months.

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