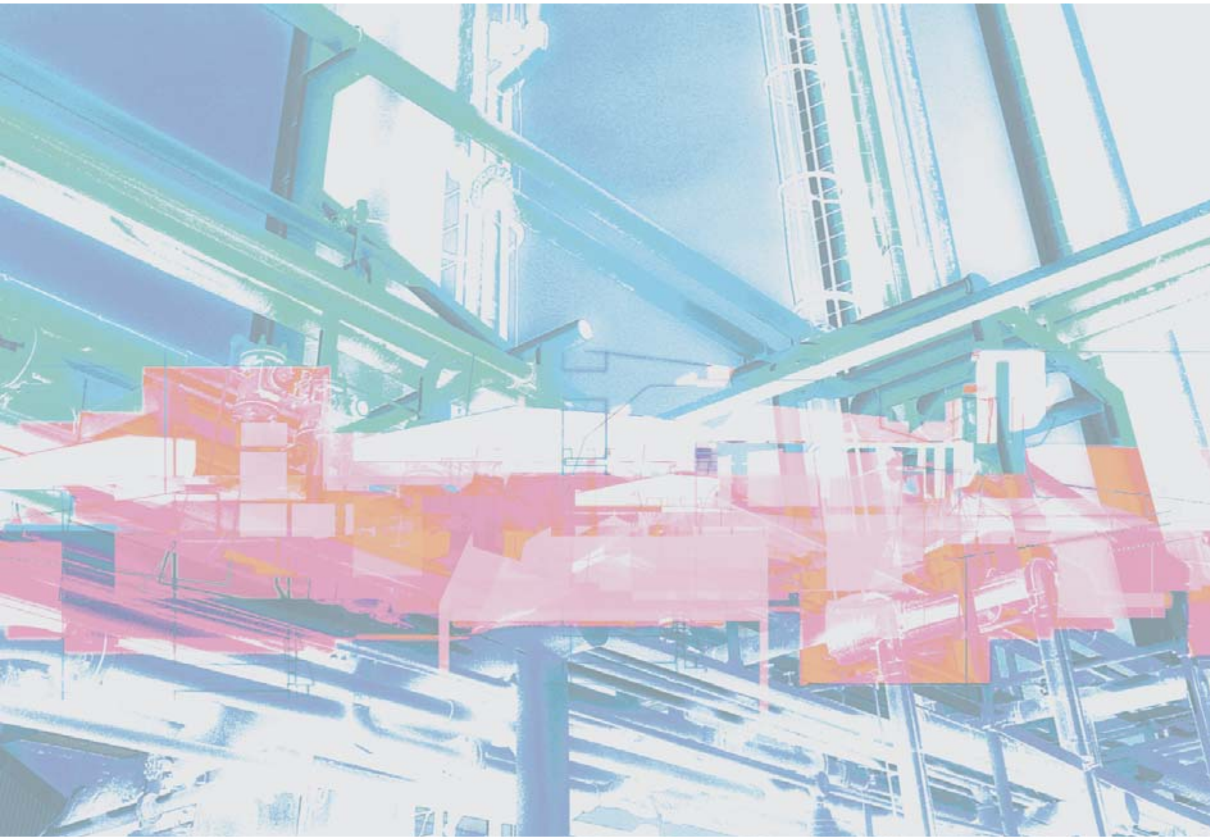
PRODUCTIVITY, VIABILITY AND IMPROVED ENVIRONMENTAL PERFORMANCE

Increasing Productivity and Environmental Performance: an Integrated Approach



Know-how and experience from the UNIDO project "Transfer of Environmentally Sound Technology **(TEST)** in the Danube river basin"

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

economy environment employment

Increasing Productivity and Environmental Performance: An Integrated Approach

Know-how and Experience from the UNIDO Project for the Transfer of Environmentally Sound Technology (TEST) In the Danube River Basin

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FOREWORD

In the Millennium Declaration of 2000, the UN 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. This volume, 'Increasing Productivity and Environmental Performance: an Integrated Approach' illustrates the TEST integrated approach to industrial environmental management developed by UNIDO, presenting the necessary tools, and shows how its adoption leads to continuous improvement of the economic and environmental profiles of companies.

CARLOS MAGARIÑOS
Director General

NOTES ON THE AUTHORS

Ms. Roberta De Palma is the designer of the conceptual framework and the main author of this publication. Since 2001, Ms. De Palma has been the Programme Manager of the UNIDO project 'Transfer of Environmentally Sound Technology (TEST)' implemented in five countries of the Danube River basin, developing an innovative approach to integrate industrial competitiveness with environmental responsibility. She has a background in industrial engineering 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. She is the author of various publications including a collection of case studies on the introduction of Environmental Management Accounting (EMA) in companies in Central and Eastern Europe (CEE).

Mr. Vladimir Dobes is the author of the chapter on Cleaner Production and has been a significant contributor to other parts of the guidance document both directly and with valuable feedback. He played an important role in the successful implementation of the TEST project in Bulgaria and Romania. Mr. Dobes is known for his promotional activities in the field of Cleaner Production especially in Central and Eastern Europe. Mr. Dobes was the Director of the Czech Cleaner Production Centre from 1994 to 1999. Since 2000, he is working for the International Institute for Industrial Environmental Economics in Sweden.

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Finally, we would like to thank the English editor, Ms. Kathy Pritchard. Full responsibility for the content of this material, including any errors stays nevertheless with the authors.

TEST Project Team, November 2003

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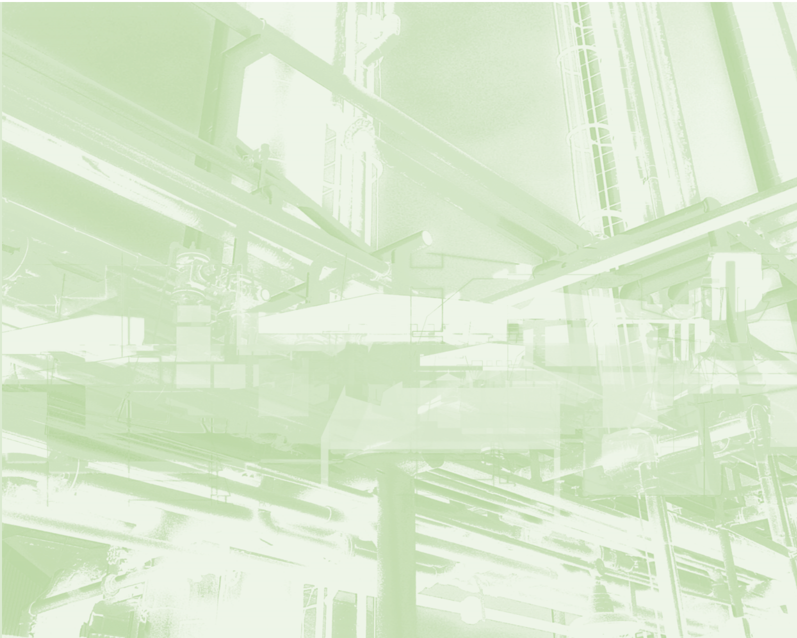
EXPLANATORY NOTES

ABC	Activity Based Costing
APF	Alcohol Production Factory
AOX	Absorbable Organic Halide
BAT	Best Available Techniques
BDt	Bone-dry tonne
BDtpd	Bone-dry tonnes per day
BGN	Bulgarian Lev (1 Lev = 0.51371 euro) 1
BOD	Biological Oxygen Demand
BSC	Balanced Score Card
BREFs	Best Available Techniques Reference Document
CC	Cost Centres
CEE	Central & Eastern European Countries
ClO2	Chlorine Dioxide
CO2	Carbon Dioxide
COD	Chemical Oxygen Demand
COMFAR	UNIDO Software for financial appraisal (http://www.unido.org/doc/3470)
CP	Cleaner Production
CPA	Cleaner Production Assessment
DfE	Design for Environment
ECO	Energy Conservation Opportunity
ECOIND	Institute for Industrial Ecology (Romania)
ECF	Elemental Chlorine-Free (as in a process or bleaching unit)
EH&S	Environmental Health and Safety
EM	Environmental Management
EMA	Environmental Management Accounting
EMAN	Environmental Management Accounting Network
EMAS	Eco-Management and Audit Scheme (http://europa.eu.int/comm/environment/emas/index_en.htm)
EMP	Environmental Management Programme
EMS	Environmental Management System
End-of-Pipe	Pollution treatment or abatement technology, NOTE: different from a procedural prevention of pollution
EPA	United States Environmental Protection Agency (www.epa.gov)
EST	Environmentally Sound Technologies
ESTA	Environmentally Sound Technology Assessment

EU	European Union
GDP	Gross Domestic Product
GEF	Global Environmental Facility (www.gefweb.org)
GRI	Global Reporting Initiative (www.globalreporting.org/)
HERBOS	Chemical plant based in Croatia
HRFU	Hydro-refining unit (a unit of the Astra company - Romania, were the TEST approach was applied)
HUF	Hungarian Forint (1 HUF = 0.004236 US dollar = 0.003881 euro)
IPPC	Integrated Pollution Prevention and Control
IR	Initial Review
IRR	Internal rate of return
ISO 14001	International Organization for Standardization Environmental Management System Standard (www.iso14000.com)
ISO 14004	International Organization for Standardization Development and Implementation of Environmental Management Systems and Principles
ISO 14031	International Organization for Standardization: Environmental Performance Evaluation
KAPPA STUROVO	Pulp and paper plant in Slovakia
MBR	Membrane Bioreactor
MCM-41	Class of Mesoporous Catalysts for Use in Petroleum Refining
MPI	Management Performance Indicators
National Counterparts	Institutions coordinating the implementation of a TEST programme on a country level
NaOCl	Sodium Hypochlorite
NCPC	National Cleaner Production Centre (www.unido.org/en/doc/4460)
NITROKÉMIA 2000	Chemical plant based in Hungary (www.nitrokemia.hu/hun/index.php)
NGO	Non-Governmental Organization
NSSC	Neutral Sulphite Semi-Chemical
OPI	Operational Performance Indicators
P2Finance	Accounting software developed by the Tellus Institute (www.tellus.org)
P	Pollution Prevention (also referred to as PP)
PB	Payback Period
PCE	Perchloroethylene (chlorinated solvent)

PER	Preliminary Environmental Review
PEST	Political, Economic, Social, Technological analysis
POI	Plan of Implementation of the World Summit on Sustainable Development (WSSD)
PP	Pollution Prevention (also referred to as P2)
Q	Quarter e.g. Q1 - 1st quarter of the year or fiscal quarter (as applicable)
RO	Reverse Osmosis
SA 8000	Social Accountability International Standard (http://www.cepaa.org)
SBSC	Sustainability Balanced Score Card
SBU	Strategic Business Unit
SO2	Sulphur Dioxide
SOMES	Romanian pulp and paper Plant, Member of the HOVIS Group
SES	Sustainable Enterprise Strategy
SME	Small and Medium-sized Enterprises
SPF	Sugar Production factory
SWOT	Strengths, Weaknesses, Opportunities and Threats Analysis
TEST	Transfer of Environmentally Sound Technology
TEST Approach	Integrated approach for introducing EST at enterprise level
TEST Programme	UNIDO programme for transferring EST at a national (country) level
TPP	Thermal Production Plant
TT	Technology Transfer
UF	Ultra filtration
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme www.undp.org
UNDSD	United Nations Division for Sustainable Development
UNEP	United Nations Environment Program www.unep.org
UNIDO	United Nations Industrial Development Organization www.unido.org
USD	United States Dollars
WSSD	World Summit on Sustainable Development www.johannesburgsummit.org
WWTP	Waste Water Treatment Plant

INTRODUCTION



INTRODUCTION

The purpose of this document is to record the methodology developed and the experience gained implementing the TEST programme in the Danube River basin. The document describes TEST, its benefits and what it can help to accomplish. The document provides a layout of how to implement this new environmental approach and relays the practical experience gained through its implementation in a number of locations. It is designed to assist other developing and transitional countries facing similar barriers in the Transfer of Environmentally Sound Technology (TEST), as well as support any follow-up and information dissemination activities in the countries where the project was undertaken.

The potential users of the guide are companies, local consultants and governments, who can use it to further develop the TEST approach and to launch other TEST projects.

Companies (the main target group) can learn from the practical experiences of the enterprises in the Danube River basin that participated in the programme, when they are exploring the areas of integrated environmental management and sustainable entrepreneurship. This guide presents examples of how they can use the challenge of environmental management to improve their overall performance, including productivity.

Consultants and other practitioners working in the field of industrial environmental management will find this guide provides both conceptual and practical information on how they can encourage and engage companies in environmental management. The TEST approach requires multi-disciplinary teamwork and cannot be accomplished on the strengths of any one person, as is possible with some traditional approaches that focus on specific sectors and/or tools. Therefore, opportunities for new partnerships[3] will be created. It is the authors' hope that consultants and other practitioners will recognize the opportunity this guide provides them to offer more effective and efficient services to industry and use this guide as a tool to assist and educate clients on the benefits and concepts of this system.
Governments also can benefit, for example, when comparing command and control regulations to different voluntary initiatives. By promoting a preventive integrated approach such as TEST, governments have an opportu-

nity to not only achieve a better protection of the environment as a whole, but also to encourage the economy on both a micro and macro level, with positive social consequences. TEST contributes to the development of effective partnerships in the field of industrial environmental management between the private and public sectors and provides win-win solutions to both sectors.

Enterprises implementing the TEST approach to environmental management will find it a learning experience that will lead to a continuous improvement of their economic and environmental profiles. The themes that run throughout and the tools provided in this guide support each other and this goal. To accomplish this, the document functions as both a text and a resource book that includes:

- A description of the TEST approach and its toolkit, and
- A description of the experience gained from the practical implementation of the TEST approach at several companies in the Danube River basin

The guide is organized into four parts. The first Part sets the framework for the whole guide starting with the chapter 'Rationale for the UNIDO TEST programme: Industry and sustainable development'. This chapter provides a description of the origins of the TEST approach, as it was developed within the framework of UNIDO's environmental programmes and explains why this approach is needed and relevant to achieve sustainable entrepreneurship. In addition, it contains a section that outlines the TEST approach's main features and benefits.

The second Part, the TEST Programme, contains an overview of how to design and implement a TEST programme. It summarizes its rationale and clearly lays out the implementation strategy. The last chapter summarizes the key results from the implementation of the TEST programme in the Danube River basin, including a section describing the barriers to, and the challenges of, introducing the TEST approach. This chapter aims at providing practical managerial advice to national authorities or national insti-

[3] The Plan of Action adopted at the World Summit on Sustainable Development in Johannesburg stresses the importance of partnerships in redirecting contemporary developments towards sustainability.

tutions that want to replicate the achievements of the countries in the Danube River basin in their own countries.

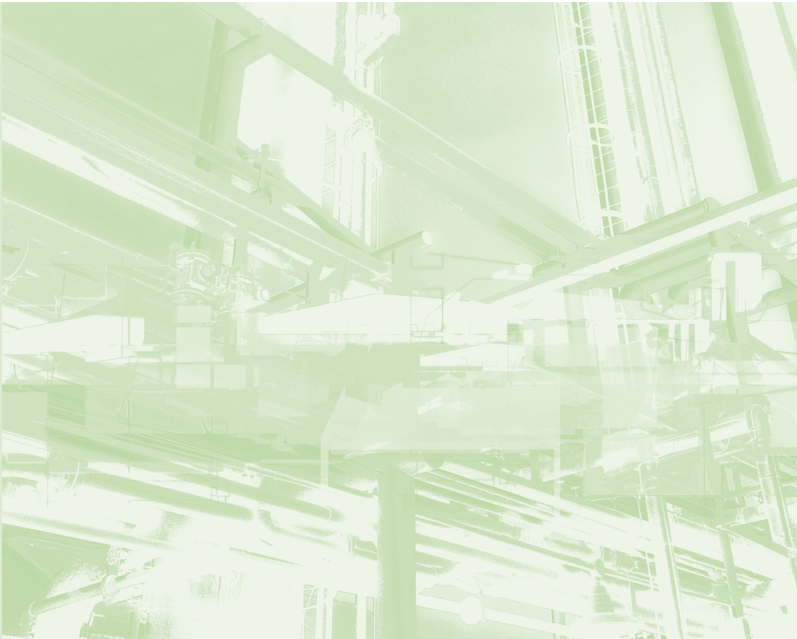
If the reader is interested in an overview of the key aspects of the TEST approach, Parts I and II summarizes the main components. Part III, TEST Tools, provides the reader with more detailed individual chapters, which expand on each component of the approach. The chapters are divided into: Initial Reviews (IR), Cleaner Production Assessments (CPA), Environmental Management Systems (EMS), Environmental Management Accounting (EMA), Technology Assessment and investment promotion (described in the chapter on Environmentally Sound Technology). Part III focuses on describing the logic behind their use within the TEST approach and the synergy created when different environmental management tools are integrated to generate maximum results. For detailed descriptions, methodologies and step-by-step instructions on how to implement each of these tools a literature and resource list is provided for the reader.

One of the strengths and unique features of the TEST approach is how it emphasizes linking the tools that work on the operational and management system levels, with those of the business strategy level. This process starts with the Initial Review and follows through all stages of the implementation. The chapters on Sustainable Enterprise Strategy (SES) and the TEST project cycle at the end of Part III describe how this is accomplished.

The practical experiences gained from the project in the Danube River basin are dispersed throughout the document and summaries of results gained through implementing the particular TEST tools are presented in text boxes at the end of each tool-specific chapter.

Finally, Part IV is a collection of annexes, including case studies from the introduction of the TEST approach in specific enterprises of the Danube River basin where the particular experiences summarized in the text boxes are further expanded to provide the reader with a detailed insight on what enterprises can achieve through the TEST approach.

PART I



FRAMEWORK FOR TEST

FRAMEWORK FOR TEST

A. Rationale for the UNIDO TEST programme: Industry and sustainable development

Industry is a vital component in any model of sustainable development, generating the wealth and employment that developed and developing countries are looking for. This is especially true in developing countries and countries with economies in transition, as was recently recognized at the World Summit on Sustainable Development (WSSD), where the delegates stated that it was necessary to ‘strengthen the contribution of industrial development to poverty eradication and sustainable natural resource management’ in their Plan of Implementation (POI). In the delegate’s conclusions, this would include actions to provide assistance and mobilize resources to enhance industrial development in developing countries.

This belief in the importance of the transfer of EST for the sustainable industrial development of developing and transitional countries had also been given great prominence in 1992 at the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro. There, the delegates devoted considerable space (Chapter 34) to EST in Agenda 21, the formal output of the Conference and provided the first official definition to EST[4]. Chapter 34 of Agenda 21 states, ‘ESTs encompass technologies that have the potential to significantly improve environmental performance relative to other technologies’. Broadly speaking, these technologies protect the environment, are less polluting, use resources in a sustainable manner, recycle more of their wastes and products and handle all residual wastes in a more environmentally sound manner than the technologies they are designed to replace. It is important to note that Agenda 21 stresses that ESTs are not just individual technologies, but they are total systems and therefore are not restricted to just the technology or equipment. ESTs include the application skills, the procedures, the goods and services and the organizational and managerial procedures needed. With this definition, EST covers cleaner production[5] (CP) options, cleaner technologies (CT) and end-of-pipe technologies.

[4] Agenda 21, chapter 34 -Transfer Of Environmentally Sound Technology, Cooperation And Capacity-building - http://habitat.igc.org/agenda21/a21-34.htm

[5] Cleaner production is used in this context to cover a family of similar terms, such as eco-efficient toxin-use reduction, waste minimization, pollution prevention, source reduction etc.

With this influential history of international support, it is not surprising the POI of the WSSD has a strong emphasis on the promotion of the transfer of ESTs. In particular, the POI reconfirms the conclusions in Agenda 21's Chapter 34 and calls on the world community to 'promote, facilitate and finance, as appropriate, access to and the development, transfer and diffusion of environmentally sound technologies and corresponding know-how, in particular to developing countries and countries with economies in transition on favourable terms'. It goes on to urge the world community to 'improve the transfer of technologies to developing countries, in particular at the bilateral and regional levels, including through urgent actions at all levels to:

- Improve interaction and collaboration, stakeholder relationships and networks between and among universities, research institutions, government agencies and the private sector
- Develop and strengthen the networking of related institutional support structures, such as technology and productivity centres, research, training and development institutions, and national and regional cleaner production centres
- Create partnerships conductive to investment and technology transfer, development and diffusion, to assist developing countries, as well as countries with economies in transition, in sharing best practices and promoting programmes of assistance and encourage collaboration between corporations and research institutes to enhance industrial efficiency, agricultural productivity, environmental management and competitiveness
- Provide assistance to developing countries, as well as countries with economies in transition, in accessing environmentally sound technologies (that are publicly owned or in the public domain), science and technology information (available in the public domain) and in accessing the know-how and expertise required to enable them to make independent use of this knowledge in pursuing their development goals
- Support existing mechanisms and where appropriate, establish new mechanisms for the development, transfer and diffusion of environmentally sound technologies to developing countries and economies in transition.

Within the broader need to render world consumption and production patterns sustainable, the POI also emphasizes the need for improved industrial productivity and efficiency in a manner that will attain a sustainable use of resources, a reduction in the degradation of natural resources and a reduction in pollution and waste generation. To this end, the POI calls for an increase in cleaner production and eco-efficient activities. Specifically, the POI endorses:

- Supporting cleaner production programmes and centres to assist enterprises, especially small and medium-sized enterprises (SME's) in developing countries, to improve their productivity
- Providing incentives for cleaner production investment in all countries, for example state-financed loans, venture capital and technical assistance and training programmes for small and medium-sized enterprises
- Collecting and disseminating information on cost-effective options in cleaner production, eco-efficiency and environmental management and promoting the exchange of best practices and know-how on environmentally sound technologies between public and private institutions

The Corporate Strategy of UNIDO, which bases itself on the fundamental principle that a continuous increase in productivity is the key to sustainable economic growth in the developing and transitional countries, dovetails with the WSSD POI position emphasizing both productivity and the transfer of environmentally sound technology. UNIDO sees its primary goal as being to promote productivity in these countries, but in a manner consistent with these goals. The Corporate Strategy sees productivity as having two dimensions related to the protection of the natural environment:

1. A real-time dimension, where the focus is on the efficient use of natural resources in production (rate of natural resource inputs per unit of output), at the time of use. This is the area where CP and CT contribute directly by increasing the efficiency of processes, products and services.

2. A temporal dimension, where the focus shifts to the impact that today's use of natural resources has on future productivity (through the impact that current technologies have on the quality/quantity of natural resources). EST contributes by promoting the conservation of natural resources (through CP/CT) and by reducing the deterioration caused by pollution (through End-of-Pipe Technologies).

The Corporate Strategy sees UNIDO's focus on productivity in it's work being translated in two broad areas of intervention: technology diffusion, whose definition fits very closely with that of EST, and market access. Technology diffusion is not an end in itself; it contributes to market access. Market access will be the motor for the growth of economies in developing and transitional countries, but in a way that ensures the economic growth is both socially and environmentally sustainable.

Despite the strong belief at the international level there is a natural bond between the principles of productivity enhancement, efficiency improvement and the transfer of environmentally sound technologies on one hand, and the principles of sustainable industrial development on the other (where one supports the other), many entrepreneurs in the developing and transitional countries have a quite different perception. Many feel that the values related to economic and industrial performance and those that promote environmental and social performance must always be in conflict. Therefore entrepreneurs trying to run a successful business often see themselves faced with a terrible either-or situation: either they are environmentally friendly and/or socially responsible (running an 'ethical business') at the expense of lower profits and lessened competitiveness, or they have competitive prices and higher profits, but at the expense of increased pollution and poor social conditions. This perception of a trade-off is primarily based on the belief by almost all enterprises (and governments) that the only solution to environmental problems is through largely non-productive investments in waste and pollution treatment and disposal technology, the so-called End-of-Pipe technologies.

Companies in the developing and transitional countries often struggle daily for survival and feel that they simply cannot make these 'ethical business' investments due to this misconception on their profitability. Nor is it acceptable to many of their governments, which are afraid of undermining their own social policies, in the belief that strict enforcement of environmental standards will jeopardize people's livelihoods; lost productivity and profitability will force enterprises to lay off workers or close down completely.

It is still not generally understood, in the developing and transitional countries that the delegates to the WSSD were correct in their conclusion that environmental strategies can actually result in considerable competitive advantages and can reveal significant potential to maximize profits. Economic activities and environmental concerns are not diametrically opposed, but can actually complement one another and provide positive incentives for industry to play its full role in the drive towards the sustainable long-term socio-economic development of a country.

The overall aim of UNIDO's TEST programme is to demonstrate this possibility and potential to enterprises in a practical and easily understood manner. In developing countries and countries with economies in transition, the TEST programme also supports national institutions by providing them with tools and expertise with that can assist enterprises be both viable and environmentally responsible at the same time.

B. The transfer of EST: an overview of different approaches and tools

The transfer of any technology involves two components: technological and managerial. Failure to address both of these components together will result in sub-optimal solutions and results. Historically this has been the fate of many of the transfers of EST, which traditionally focus on only the technological aspects. This can be attributed to the fact that they have primarily involved end-of-pipe technology, which it is widely believed can simply be 'bolted on' to existing production processes. Even transferred cleaner technologies, which are integrated into production processes, often suffer from this inattention to the managerial aspects of its transfer.

The transfer of EST is usually done on an ad-hoc basis, rather than as part of an integrated approach to environmental management and the choices of what ESTs to transfer are usually made without a complete understanding of the root causes of the pollution, or wastes being generated. Proceeding in this manner inevitably leads to sub-optimal results and both higher investment and operational costs and lower environmental performance, simply because the tools or systems are not in place to ensure good management practices.

To overcome this deficiency, using a managerial tool such as Cleaner Production Assessment (CPA) for the optimization of an industrial process can be very effective. CPA focuses on systematically identifying potential applications of preventive techniques for pollution sources (where pollution is seen as a symptom of process inefficiency). The measures that result in preventing pollution at the source will both reduce operational costs (by increasing process efficiency) and reduce pollution (this is often referred to as a double benefit and/or a win-win strategy). CPA is a powerful tool that can identify both minor improvements (housekeeping practices or small process modifications) and significant improvements, which require a substantial investment in cleaner technologies. In the latter case, this can include tools for technology transfer, although in the majority of cases where CPAs have been undertaken, it has been in a context where the enterprises have chosen not to change their basic production process system, choosing rather to focus on the minor improvements.

One of the main challenges to the proper use of CPA is that it is often viewed as, or treated as, a one-time deal. It is a common misconception that once a CPA has been completed, the problems have been found and the corrective actions have been identified. When applied in this manner, CPAs cannot take into account the continually changing factors influencing the enterprise and therefore cannot be applied as changes occur, or be reviewed for its currency as technology changes. As a result, improvement will not be continuous but will halt after the 'low hanging fruits' have been gathered. In addition, this static view of CPAs means that the CPA process is never integrated into the enterprise's operational methods or culture. Therefore, even the 'low hanging fruits' have problems in being effectively implemented because they require changes to those same methods and culture. For instance:

- Particular steps are labour intensive and changes in these require the active involvement and creativity of personnel from a series of different departments
- CPAs often recommend changes to modify existing operating procedures. Unless these changes are codified and monitored in some way, there is the inevitable problem of both sustaining the imple-

mented measures and preventing operations from reverting to their previous state

CPA is an ambitious process involving different parts and individuals of an enterprise in a creative process focused on innovation. Implemented as a stand-alone system, CPA can face many additional barriers, in particular, the resistance to change and preference to adopt proven solutions that take less work, cause less stress and have less inherent risk; all factors which are especially important when investment capital is limited. In cases where CPAs identify CT options, a lack of finances can result in sub-optimal measures being enacted, or measures not fully implemented and sustained. Compounding this problem is the traditional period for completing a CPA, which is often too short to allow a detailed technology assessment to be undertaken.

Another important tool in the field of industrial environmental management is the Environmental Management System (EMS). Since its introduction in the early nineties, views of its potential effectiveness have been mixed: many hoped that EMS could make a significant contribution to improving industry's environmental performance, while others were doubtful it would make a difference. Based on more than a decade of experience it appears two basic uses of EMS have evolved:

1. There are industries that use EMS as a catalyst for cultural change within the enterprise, with the objective of achieving real and significant ongoing improvements in environmental performance. These EMS's usually go far beyond the relevant international standards' basic requirements and are put-in- place by enterprises that build their policies and procedures on a preventive approach and use proactive strategies and tools to implement their goals.

2. Then there are industries that use EMS as a marketing device or a smokescreen, to pacify their customers and other stakeholders (who might have concerns regarding their environmental performance) or - at best - use it primarily as a tool to ensure compliance with environmental standards, which is not much better, as a reason, to implement.

Unfortunately, this latter group currently seems to represent the majority of enterprises that have implemented an EMS and is most common where the EMS is not integrated with the other systems of the enterprise. By not building on a proactive vision or strategies, these companies underutilize the potential of the system and leave the real potential for an EMS, to increase overall competitiveness, unexplored.

The transfer of EST is often particularly less than optimal because of the very nature of the traditional approach to environmental management in many enterprises. For these enterprises, environmental management means focusing primarily on pollution control i.e. the process of identifying, processing and disposing of pollutants through a very technology-driven process. When industrial pollution control was in its infancy, these approaches were relatively inexpensive. However, as environmental legislation has increased in scope and severity, they are rapidly becoming much more costly. In addition, because of the 'bolt-on' mentality that comes with the traditional transfer of end-of-pipe technology, little or no attention is given to the costs of pollution emanating from the production process itself.

A recent tool, adopted by very proactive enterprises in the field of environmental management, is Environmental Management Accounting (EMA), which focuses on the optimization of production and products by tracking all environmental costs back to their sources. In the early stages of its development, EMA focused on finding the 'hidden' costs related to the treatment of generated pollutants. However, it now focuses even more on the other costs of pollution that are 'hidden' in production costs, such as those associated with the costs of raw materials, energy that goes wasted and the value that is added from the process but which does not enter into the final product. Experience with EMAS has shown that, on average, these hidden production-related costs can be ten to twelve times higher than waste and emissions treatment costs[6], such as the operational and investment costs associated with pollution treatment equipment and the transport of waste and its disposal at a dumping site.

Environmental management strategies have traditionally overlooked these system costs when assessing pollution costs. EMA is filling this gap today

[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.

by providing a diagnostic tool to maximize the profitability of the entire process responsible for creating a particular product. The same process of analysis can be applied to identify costs buried in the life cycle of a product.[7]

As in the case of CPAs or EMSs, stand-alone EMA initiatives are less than optimal when they are not fully incorporated into the management system and culture of a facility: the data it generates are not automatically considered in all aspects of an enterprise's decision-making. An EMA can generate data that can be used for more than just assigning total costs to particular products; the data can also be used for the optimization of the production process, products and/or product-service systems. Without this integration, EMAs can be difficult to maintain, as their full potential and value to the company is not realized.

If the approaches and tools discussed above are integrated with the technological aspect of the transfer of EST, they can assure a transfer that is much more optimal and thus a more continuous improvement of the environmental performance of a company. However, to reach their true potential, these approaches and tools and the technological decisions taken, must be closely linked to the business strategy and the values of stakeholders, otherwise there is a risk that they will take the company in a direction that is in conflict with its strategic objectives. This will only result in a waste of resources that could have been better spent achieving the desired goals.

Unfortunately, many activities in the narrow field of industrial environmental management do not integrate with the crucial, strategic dimension. Focusing exclusively on technical issues and on the operational level, they often lack a connection to the strategic needs of the enterprise: lacking answers to basic questions such as 'what is the strategic necessity that requires the changes be initiated and that they should be continued and maintained'? Given this lack of a fundamental strategic reasoning behind the changes, it is not surprising that many solutions are sub-optimal, not implemented, or simply fade away.

[7] For example, the costs associated with the disposal of packaging discarded by distributors or customers, or, the additional costs bore by customers when they use products that produce pollution or waste energy. There are also the costs that customers pay (directly or indirectly) when they dispose of the products: the disposal cost itself and the shadow cost related to the value of the materials in the product that could be re-used but are not.

The challenge that faces us is that while strategic industrial management has recognized the importance of businesses' non-production functions in the environmental and social fields, integration of these concerns into strategic planning is still quite rare.

C. TEST: an integrated approach for the transfer of EST

The experience that has been gained with the approaches and tools mentioned in the previous sections shows that each could provide important information for use in developing more sustainable business operations. Used separately, however, they have difficulty initiating and maintaining the desired changes. Fundamental managerial and cultural changes are needed to redirect existing developments towards sustainability and each tool, alone, cannot bring these changes about.

The challenge therefore is to combine the strengths of each of these individual approaches and tools, to accommodate the two needs entrepreneurs see as conflicting: the objective of improved environmental and social performance versus improved economic performance. Only through integration can the obstacles in the managerial culture of an enterprise be overcome. UNIDO developed the integrated TEST approach to address this challenge.

The design of UNIDO's integrated TEST approach grew from the positive experiences the Organization has gained from the implementation of these approaches and tools individually, especially in the fields of cleaner production (through its National Cleaner Production Centre (NCPC) programme), environmental management and in the fields of business development and entrepreneurship. The integrated TEST approach was introduced for the first time, within the framework of the UNIDO TEST programme, which focused on a series of medium and large industrial polluters in the Danube River basin. The experience from this first TEST programme implementation has positively contributed to the refinement of the integrated TEST approach and its methodology.

The integrated TEST approach is based on three basic principles:

1. First, it gives priority to the preventive approach of cleaner production (systematic preventive actions based on pollution preven-

tion techniques within the production process) and considers the transfer of additional technologies for pollution control (end-of-pipe) only after the cleaner production solutions have been explored. This leads to a transfer of technologies aimed at optimizing environmental and financial elements: a win-win solution for both areas.

2. Second, the integrated TEST approach addresses the managerial aspects of environmental management as well as its technological aspects, by introducing tools such as EMS and EMA.
3. Third, it puts environmental management within the broader strategy of environmental and social business responsibilities, by leading companies towards the adoption of sustainable enterprise strategies (SES).

1. Integrated TEST approach and the management Pyramid

The relationship of the various components of the integrated TEST approach to each other and to the business operation can be depicted in the form of a management pyramid[8], as seen in figure 1 The pyramid shows the hierarchical structure of the TEST approach, where each level of the pyramid receives its inputs and directives from the level below. The values of the stakeholders of a business and the relationships between them form the base of the pyramid. Stakeholders can include owners, customers, coworkers, suppliers, authorities and communities. This web of relationships serves as the source on which to build the next level.

The business derives it vision, mission and core principles from the underlying stakeholder values and expectations enacted formally (for example, as written policies or business plans) and/or informally (non-documented 'common knowledge'). This level represents the principles and intentions that guide the business.

The next two levels of the pyramid are formed first by the strategies for achieving the vision and goals of the business and then by the manage-

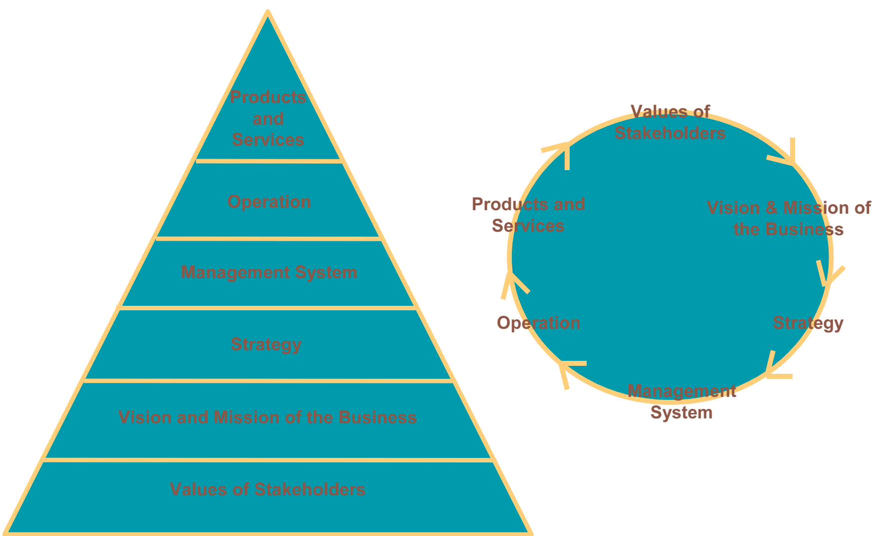
[8] Usually the management pyramid is in the opposite order, with values and vision at the top and operation systems at the bottom. Here, the order is reversed, with the values and expectations being placed as the underlying core layer on which all the others are built, following the logic of the Corporate Sustainability Report of ITT (Flygt: www.flygt.com/sr01) as this better reflects reality.

ment systems that direct how a company operates to achieve these strategies. Management systems include the organizational structure and the means to make decisions.

The production level (the top two levels of the pyramid) describes the company's operations: its means and its performance. The outputs it generates are the products and services the business offers.

A pyramid structure effectively demonstrates how each element of a business is built on the more fundamental levels below, with the products and services deriving ultimately from the stakeholder relations and the strategies. However, the pyramidal structure does not show how the product and services themselves can influence the very base of the pyramid, modifying the relations with the stakeholders. In this sense, the connections between the different levels of the pyramid can also be represented in the form of a closed loop, where the output from the products and services level affects the perception stakeholders have of their relationship with the business and ultimately of the business itself.

Figure 1. The Management Pyramid



It becomes obvious from this that the causal loop built through the management pyramid can easily create a vicious circle, which is difficult to break. Problems with economic performance (e.g., sales) and/or environmental performance (e.g., problems with the enforcement authorities) in an underlying framework of uncertain socio-economic conditions reinforce or induce a short-term reactive vision and business strategy. The short-term reactive vision prevents important strategic decisions from being made and risks are taken. This pressure also blocks changes needed in the management system and prolongs the use of inefficient operating systems. Crisis management is the impetus for change here, not well thought-out analysis that considers long-range implications. Low-quality products and/or uncontrolled pollution degenerates the relationship between the business and its stakeholders, which in turn results in continuously short-term crisis-based actions in an effort to quickly appease the stakeholders. The cycle continues in a downward spiral of dissatisfaction, reduced productivity and increased pollution.

The integrated TEST approach breaks this vicious circle by allowing enterprises to merge the two seemingly conflicting goals - that of reducing environmental risks and increasing company competitiveness simultaneously.

Table 1 summarizes how the main characteristics of a business (identified in the Management Pyramid in figure 1) are typically managed, from an environmental point of view, in developing countries and countries in transition (‘start-up situation’) and compares it to what can be achieved by implementing UNIDO’s integrated TEST approach (‘desired target’). Note that the desired target described here is broader in scope than what would be set for a first-time implementation of a TEST programme.

Table 1. Comparison of a Typical Start-up Situation in Devloping/Transitional Countries vs. Desired Situation

Management Level	Typical Start-up Conditions	Desired Target
Values of Stakeholders 	Perceived conflict between the values related to economic performance (promoted by the management and owners) and the values related to environmental performance promoted by authorities and the public.	Stakeholder values translated into business values: a communication platform for the exchange of information is in place.
Vision, Mission and Core Values of a Business 	A lack of vision and reactionary environmental management. The Mission is vague and defensive. Core business values are driven by the effort to survive. Corporate culture rarely reflects the values of stakeholders.	Employees share a strategic vision, related mission and core business values. There is a proactive and innovative company culture, which is needed to implement preventative environmental strategies.
Strategy 	Business is managed, based on short-term reactive strategies. Pollution control, not pollution prevention, is the prevailing approach to environmental management. This is due to the perception that economic and environmental performance conflict.	Business integrates long-term proactive environmental management strategies into its operation. Environmental costs are taken into account and long-term environmental benefits and criteria are integrated into business decision-making functions.
Management Systems 	The company does not have an efficient and effective management system or a commitment for business operation. Assigned responsibilities, communication mechanisms and other components of a management system necessary for their achievement are not in place. Management of environmental aspects is usually a last priority.	Efficient and effective management systems are in place, built on strong driving principles from the previous levels of the management pyramid. Environmental management is integrated into the system and considered a natural part of the overall management system.

Management Level	Typical Start-up Conditions	Desired Target
Processes/Operations 	The technologies are outdated, poorly maintained and inefficiently operated. Production efficiencies are typically low. This goes hand-in-hand with low control over the material and financial flows of the production process and leads to excessive pollution.	A combination of organisational and well-planned technological measures leads to the introduction of good production practices and the process of continuous improvement. This can also be described as the introduction of best available techniques9.
Products and Services 	Companies lack the expertise to improve their products and marketing strategies in the new market. They can only compensate for this and compete by lowering prices (often achieved by reducing wages and taking operational short cuts), but this will only work temporarily. Sub-standard product designs, quality, delivery and other characteristics, in conjunction with high pollution levels, create a fatal barrier and the company will eventually fail.	Market strategy and product development (including product design10) leads to increased competitiveness.

2. TEST tools

The integrated TEST approach uses a number of tools, including, but not limited to the following:

- Initial review (IR)
- Environmental Management System (EMS)
- Cleaner Production Assessment (CPA)

[9] The term best available techniques is used in its broad sense here and it is not limited to BATs only, as defined in the Integrated Pollution Prevention and Control Directive of the EC.

[10] New product design does not have to be limited only to the product itself; it can include the entire product service system.

- Environmental Management Accounting (EMA)
- Environmentally Sound Technology Assessment (ESTA)
- Sustainable Enterprise Strategy (SES)

These tools are applied at different levels of the management pyramid, as represented in figure 2. Initial review is the basic (first) tool used and is applied at all the levels of the management pyramid, (see Part III - A for details on IR).

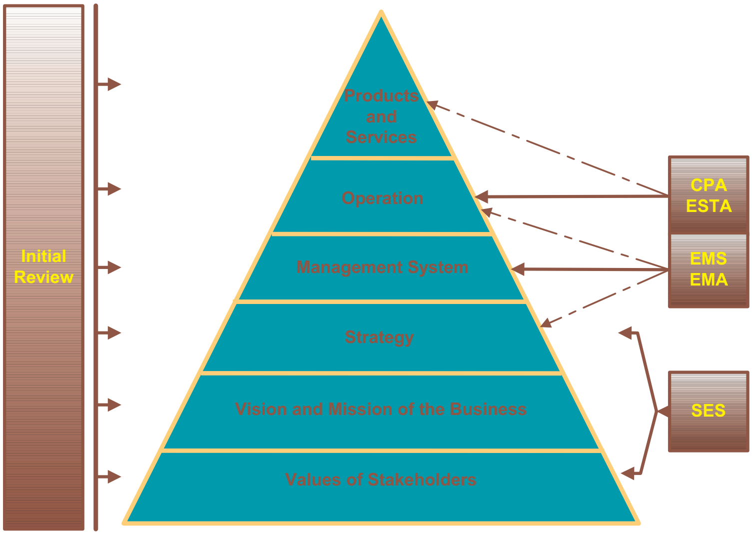
SES is applied primarily to the bottom three levels of the management pyramid (values of stakeholders, business visions and strategy), although all the tools provide some input into these three levels.

EMS is applied primarily at the management system level and provides a link between the strategic and operational levels[11]. EMS provides the means for identifying and managing the significant environmental aspects and impacts of the business. The EMS decision-making process is enhanced by using EMA, which provides a more accurate financial picture of a company's source of losses and a better understanding of the economic impacts it incurs from these environmental aspects and their management (or lack thereof).

IR, EMS, SES and EMA are not designed to provide specific direct improvements in production. Rather, their purpose is to determine actual productivity and environmental performance and communicate this through the management system. The strength of the integrated TEST approach lies in the introduction of two additional tools, CPA and ESTA (which are supported by IR, EMS, SES and EMA), whose aim are to optimize the operational system and link the improvements there with the management system and the business strategy.

[11] The EMS should be linked to the overall existing management system of the company

Figure 2. TEST Tools Applied to the Management Pyramid



The products and services at the top level of the management pyramid are partially addressed by the CPA and ESTA assessments. However, depending on the situation at the company, additional tools e.g., design for the environment (DfE) could be introduced to promote the creation of environmentally friendly products.

PART II

THE TEST PROGRAMME

THE TEST PROGRAMME

A. Principles

A UNIDO TEST programme, with its integrated approach, is designed to assist enterprises in the developing and transitional countries to effectively adopt EST. The TEST programme acts at three levels:

1. It addresses the need to enhance the existing expertise within a country with respect to industrial environmental management skills, thereby enabling local institutions to offer enterprises an integrated package of technical, managerial and strategic services best tailored to their needs.
2. It demonstrates the effectiveness of the integrated TEST approach at pilot industrial sites.
3. It supports the dissemination of the TEST approach and results at a national and regional level.

The sustainability of a TEST programme is assured by two mechanisms:

1. Developing demand at the business level: the successful results achieved through the use of the integrated TEST approach by the pilot industrial sites are used as examples to other enterprises, thus generating demand for similar services in this area.
2. Building national expertise in the application of the integrated TEST approach: to successfully replicate the positive results. TEST programmes include a 'train the trainers' mechanism. The experts created from this training can then provide the requisite services to other enterprises in the participating countries on how to implement the integrated TEST approach.

The TEST programme is based on the following principles:

- It requires a voluntary commitment from the pilot enterprises to proactive environmental management

- It is problem-driven, focusing on the needs of enterprises and/or countries
- It is flexible and open to innovative solutions - the specific tools used in the TEST projects (enterprise-level) are selected and introduced based on the results of the initial review of the needs of the enterprise
- It uses the Integrated Pollution Prevention and Control (IPPC) and Best Available Techniques (BAT) approaches
- It optimizes production processes by focusing first on material efficiency strategies, followed by incorporating what are now less onerous, end-of-pipe solutions (if required)
- It ensures that environmental costs are properly allocated to their source, identified measures are implemented, and TEST project results are monitored
- It analyses problems in all their economic, social and environmental complexity

B. Implementing a TEST programme

A TEST programme is tailored to the unique conditions of the industrial sector as well as the institutional framework of the country where it is implemented. Implementation at the project (enterprise) level is in the following sequence: first, the existing situation is improved by better management of the existing processes, then the introduction of new technology or of end-of-pipe solutions is considered. Finally, the lessons learned from each TEST project's implementation is reflected in the respective company's business strategy.

It may be argued that optimizing existing processes is an unnecessary step that wastes valuable time and financial resources if new, environmentally sound technology is to be installed. However, it must be remembered that there is usually a significant time lapse between when technological assessments and financial appraisals are conducted and when the new technology is actually put in place and operational. This time lapse can vary significantly from case to case and in some situations, it is worth investing modest resources in the existing processes to improve their environmental performance, until the final changes are installed and operational.

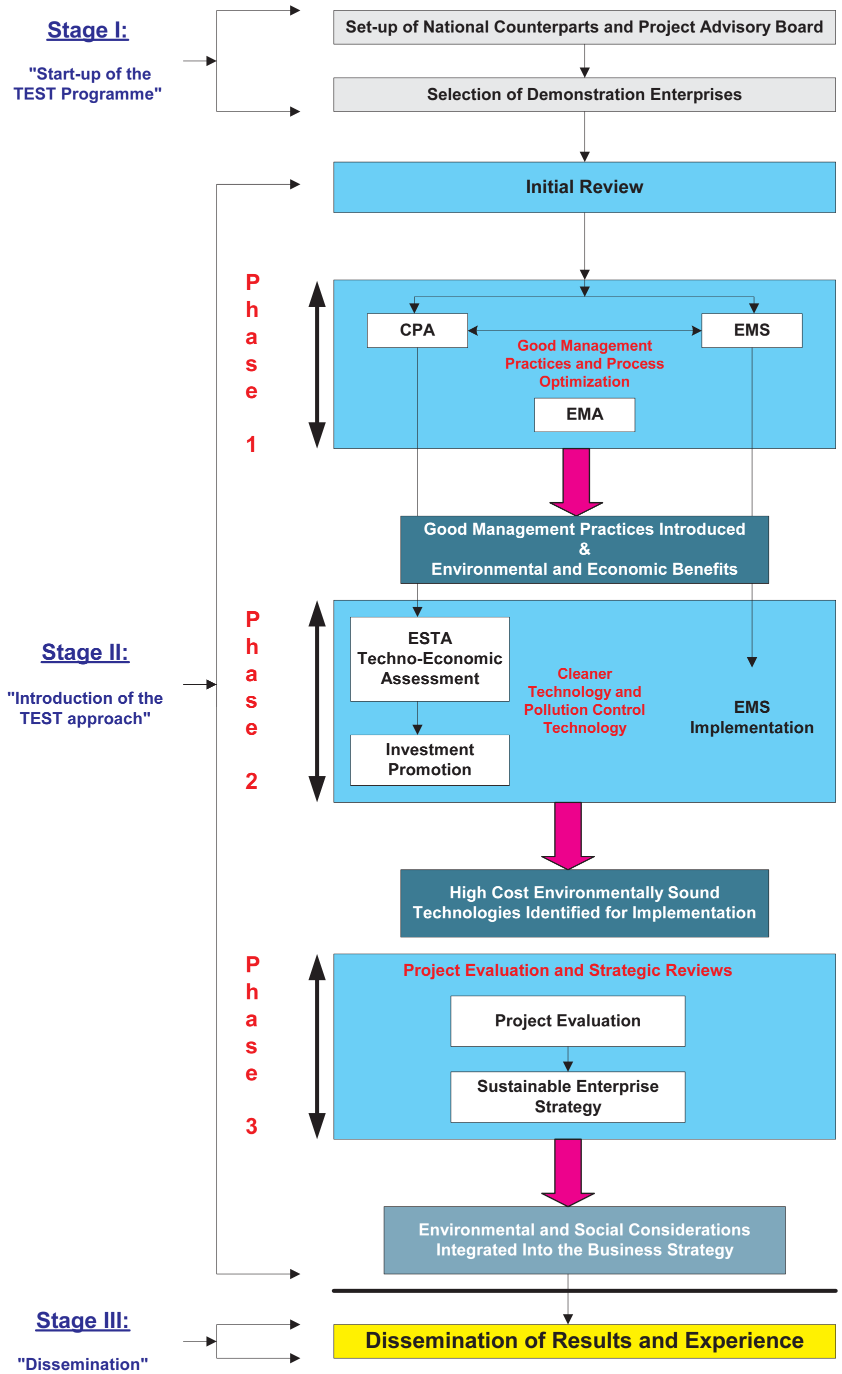
By following this rationale, the money saved from the implementation of low, or no-investment CP options can be used to help fund the more expensive EST investments. Likewise, implementing the lower investment CP options may also reduce pollutant loads to a level where smaller-scale end-of-pipe equipment can be installed, or ideally, perhaps even avoided altogether. Companies should also remember that the transfer of skills (on how to use the TEST tools) is part of the overall EST process and these skills are not bound strictly to the specific technology being installed. It is critical that employees master the skills to use these system tools if the technology is to operate to its desired capacity.

The implementation strategy of a TEST programme is broken down into three main stages.

1. Stage I: initiate the TEST programme and customize its implementation strategy to meet country/industry needs.
2. Stage II: introduce the integrated TEST approach in individual projects at the pilot enterprises.
3. Stage III: share and disseminate the TEST programme results.

Figure 3 shows the overall approach as well as the individual tools used at each stage of implementation and shows the links between the different tools. A detailed description of each project tool is provided in Part III, TEST Tools.

Figure 3. Implementation Scheme of the TEST Programme



1. Stage I: start-up of a TEST programme

As a first step, national institutions and associations are selected and introduced to the integrated TEST approach (they are further trained, as necessary, at each stage of the project).

Particular attention is paid to the selection of the national TEST counterpart, which plays one of the most important roles of the implementation, that of being responsible for coordinating the local activities and the work of the local experts. Local counterparts chosen must already have basic skills in cleaner production and industrial environmental management as well as good access to both national authorities and the industrial sector, to ensure the objectives of marketing the project's concept, obtaining and keeping top management's commitment and disseminating the project's results can be accomplished.

A National Project Advisory Board is also set up at the start-up of a TEST programme, at a national level , which includes: national and local authorities (e.g. representatives from the Ministries of Industry, Environment, Economics, etc.), academia, industrial associations, Chambers of Commerce and NGOs. The National Project Advisory Board is a platform, which includes all the major stakeholders of the programme in the country, established to assure that the implementations will focus on national/local priorities and that the results are properly disseminated throughout the country.

A two level diagnostic phase (macro and micro) is performed, identifying and assessing the needs and desired changes at both a national and industrial level. The first phase is at the macro level and is usually assessed when the project is being formulated. It is done in close cooperation with the local governments and is further discussed within the Project Advisory Board when the programme is launched.

The second level of diagnosis, is at a micro level where the integrated TEST approach is promoted within the chosen industrial sectors or sub-sectors, with the aim of identifying a group of pilot enterprises[12] where it may be introduced. Enterprises are assessed as candidates for the project and a

[12] Depending on the size, it is recommended to select not more then 4 to 5 medium to large enterprises, for the first TEST programme in a selected country.

short-list of the potential enterprises is prepared. The short-listed enterprises are then analyzed within the first part of the initial review through a market and financial viability study, aimed at determining which of the enterprises will be finally chosen as pilot locations for the project. After it has been agreed upon that a particular enterprise is an appropriate candidate in which to introduce the TEST approach, the second part of the initial review, involving an initial environmental review of the business operations can be initiated. This is the starting point for the introduction of the TEST approach (Stage II - Phase I), leading to the formalization of the overall project plan for that enterprise (See figure 6 for more details on the initial review structure).

An agreement/contract should be signed between a selected enterprise and the assisting/consulting body. The contract can be broken down into two discrete stages:

1. Stage One - Perform the environmental component of the initial review and provide the enterprise with a 'diagnostic report' and proposal for the implementation of the TEST approach, and
2. Stage Two - Assist in implementing the integrated TEST approach itself

The comfort level the enterprise has with the national counterpart (that will assist with the initial review) will affect the actual goals chosen for the individual steps in the review. Comfort can often be a function of familiarity and the trust familiarity brings. Where the necessary level of trust with the counterpart is yet to be developed, sensitive questions related to the enterprise's business strategy and performance could be postponed to the later stages of the review, if necessary. However, it must be stressed that if sufficient information to allow for an effective initial diagnosis cannot be gathered, for whatever reason, a TEST project should be not started in that company.

At the completion of the initial review, the areas requiring improvement are identified and the pilot enterprise's initial project targets are set. It is during the initial review stage when the most appropriate set of tools to use during the TEST project, at that company, are also selected. With these tasks completed, the implementation plan for the overall TEST programme is then prepared.

2. Stage II: Introduction of the TEST approach at the enterprise level

Stage II of the programme occurs when the initial reviews are completed and the pilot enterprises chosen. The integrated TEST approach is introduced at the participating pilot enterprises in three phases.

2.1. Phase I - Good management practices and process optimization

The first phase aims at improving the operation of the existing processes and technology by introducing and integrating three different 'soft' and complementary environmental management tools into the company's daily operations: Cleaner Production Assessment (CPA), Environmental Management Systems (EMS) and Environmental Management accounting (EMA). The TEST approach includes a methodology that introduces the tools simultaneously and in an integrated fashion to take advantage of the synergies this creates. Although they can still be quite effective when implemented independently, this streamlining of data flows simplifies the work required and increases the overall effectiveness of the tools by generating more results that are positive. However, depending on the specific situation of the company, a step-by-step implementation may be the best option.

The CPA module looks at production processes as a system where pollution flows represent resources that are ineffectively, incompletely or inefficiently used after they were purchased. This strategic view of material flows changes the old perception of financial flows, the values associated with the final product and the unwanted outputs (in the form of losses and pollution). This is consistent with one of the main premises of the integrated TEST approach, that pollution cannot be separated from the resources it came from.

The detailed analysis within CPA (or energy audits - a sub-set of a CPA; which is chosen depends on the focus of each TEST project) identifies the material and energy flows that can be used for tracing environmental costs back to the main process areas (cost centres), where they originated. This is an important input for the EMA system's allocation process. At the same time, EMA plays a key role in 'revealing' (to top management) the real costs of production, including conventional environmental costs like non-product output costs (wasted raw material and related processing costs).

Once a company has an EMA in place, it can then set up priorities that will allow detailed CPAs to be done more effectively. Thus, CPA, with support from EMA, is the tool used to identify the very causes of pollution. These sources must be identified before the potential opportunities for material and energy efficiencies within the targeted process can be effectively explored.

CPA and EMA together are tools for implementing and measuring continuous improvement. However, these tools focus on the operational level only and they need strong links to evaluation and planning activities. This is provided through the EMS module, which forms the backbone of the integrated TEST approach. CPA and EMA must use some sections of the EMS to sustain their advantages.

The EMS module integrates the company's environmental management efforts into the company's overall management system. EMS plays crucial role in introducing, sustaining and continuously improving management practices. It also provides the communication network to direct the information to the necessary people and decision-making processes. However, EMS also needs CPA and EMA. It requires the information available through CPA and EMA to develop objectives and targets and to identify, improve and implement programmes to manage the company's significant environmental aspects. EMS provides the procedures and resources to ensure that the outputs of these programmes are implemented, sustained and further developed.

By providing detailed economic data, EMA strongly supports the implementation of CP and EMS at the stage when priorities are set, and provides the necessary feedbacks on the economic viability of the implemented changes. This is the key point to demonstrate the real impact that CP programmes have on medium to long-term decisions, which is needed to promote their continuous application.

Based on the above-mentioned considerations, it is clear that CPA, EMA and EMS are mutually beneficial and combining their introduction will result in a substantive long-term improvement of the company's environmental performance and its competitiveness.

The methodology for each of these tools and the procedures for their integration are described in Part III - TEST Tools.

At the end of this phase, good management practices will have been identified and implemented and processes optimized. These results of this phase produce the first tangible environmental and economic benefits that the company achieves from the project.[13] This is very important, since it allows the pilot enterprises to see results, quite quickly and can give them the added impetus and enthusiasm to go on to the next phase.

2.2. Phase II -Technology change (EST): cleaner technologies and end-of-pipe solutions

The overall objective of the second phase is to identify the higher capital investment requirements for environmentally sound technologies (EST). At the end of the CPA module, the company will have collected a large amount of information about its production processes and on opportunities for improvements, some of which will require little-to-no finances to implement and others that will require some capital investment. Traditional CP projects assume that companies will perform a technology assessment using their own resources. This has normally resulted in very general prefeasibility studies of investments needs. In addition, these projects usually do not provide any assistance with respect to evaluating or choosing end-of-pipe solutions; these are often still needed (although to a lesser degree) in order to meet specific environmental standards, regardless of the improvements achieved implementing the CP recommendations.

These are the core reasons why the second phase starts with an Environmentally Sound Technology Assessment. The ESTA module continues where the CPA ends, to broaden the scope to include both large cleaner technology investments (technology change) and end-of-pipe solutions. ESTA modules can build on information supplied from the CPA and EMA modules. Practical experience shows that separating CP assessments and EST assessments into two steps has very positive results. This approach demonstrates the importance of providing sufficient resources for the finan-

13 CP/EST measures identified in this phase that require a higher capital investment are forwarded to Phase II for further investigation (EST Module).

cial appraisal of large investments to address both issues in an integrated way.

The ESTA module primarily consists of technical and economic evaluations of potential EST investment projects, which take into account long-term environmental savings and benefits. To do this, computational tools[14] are used and the following activities are undertaken:

- Preparation of a pre-feasibility study
- Preliminary identification of possible suppliers
- Preliminary identification of inexpensive sources of capital for the technology investment

Contingency environmental costs that arise from expected changes in regulatory regimes or from potential risks to the environment are also considered. At the end of this phase, the EST options are incorporated into the investment decision-making process and managers are provided with pre-feasibility studies showing the higher profitability of the combined CP/EST investments. Incentive schemes for EST investments (e.g. environmental funds, green loans, etc.) are also identified and limited technical assistance is provided to the enterprises within the framework of the project on how to access these schemes.

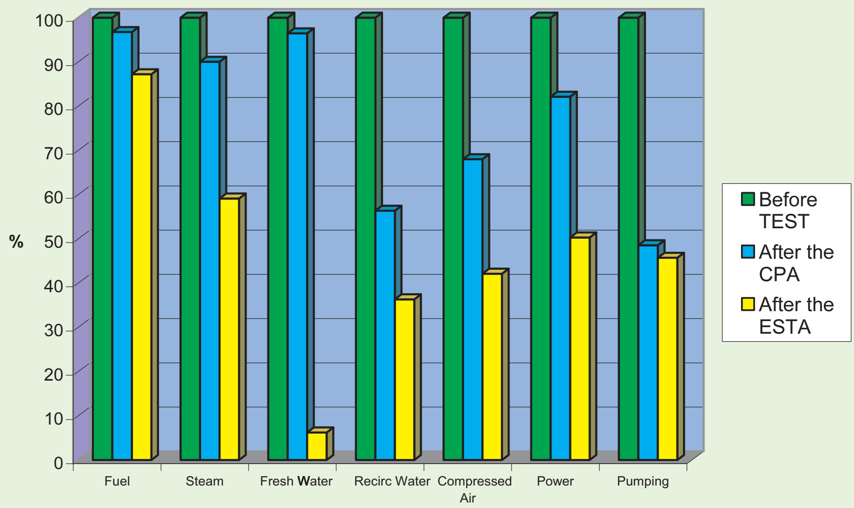
Text Box 1 describes the benefits achieved at a hydro refining unit at a petrochemical facility, before and after implementing CP and ESTA.

[14] Similar to the UNIDO-COMFAR software for financial appraisals

Text Box 1. Comparison of Benefits Before TEST, After CPA and After ESTA, in a Hydro Refining Unit at a Petrochemical Enterprise

The graph in figure 4 shows changes in the consumption of specific inputs: methane (kg. of equivalent conventional fuel), steam (kg.), fresh water (m^3), recirculated water (m^3), compressed air (m^3), power (kWh) and costs of internal pumping (in USD) per tonne of hydro-refined lubricating oil.

Figure 4. Comparison of Benefits Before TEST, After CPA and After ESTA



These specific consumptions are compared at three stages:

- *Before TEST:* *Average 2001 values before the start of the TEST project*
- *After CPA:* *Average results after good management practices and process optimizations were implemented during Q1-Q3, 2002*
- *After ESTA:* *Estimated results after the measures requiring high investment became operational (these results include already implemented measures from the previous CP stage).*

The decreased need for the specified inputs to the hydro refining unit leads to a significant decrease in related pollution flows and in significant increase of the productivity.

2.3. Phase III: Evaluation and Sustainable enterprise strategy

The third phase aims at ensuring the continued use of the TEST approach at the pilot facilities. For the approach to be continued, the experience must be reflected in a facility's strategic level (e.g. business plan development), which should in turn also lead to new insights and desired changes in the enterprise's values and strategies. The sustainable enterprise strategy (SES) is the module, in the integrated TEST, aimed at accomplishing this integration of environmental and social dimensions into the enterprise's culture. In principle, the objective of the SES module is two-fold:

1. To integrate the TEST approach into the enterprise's strategies (business and functional) and formalize its principles within these strategies.
2. To provide a platform from which to evaluate and communicate the enterprise's performance, as it relates to processes and products, to the stakeholders (shareholders, employees, local authorities, civil society, customers, etc.) and establish a baseline from which to initiate and build ongoing dialogue. This will provide valuable feedback on company values and strategy.

This phase of the project builds on:

- Project indicators, which should be selected to best reflect the goals of the enterprise and of its environmental management
- An effective management system, which will ensure continued measurement and evaluation of enterprise performance against the selected project indicators, and
- Relaying the experience that was gained on how to bridge the gaps between the old and new values, goals and strategies; how the experience was integrated into their business; and how any related challenges were overcome

During this phase, the performance indicators set up at project's start and during the project's implementation should be measured, evaluated and the results analyzed, interpreted and reflected upon.

Project evaluation and reflection can be done both internally and externally. Reporting plays a role in both. In order to gain from TEST's real-life learning experience, the reporting cannot be just a one-way or one-time transfer of information. It has to be followed by dialogue and further reflection. This stage presents an opportunity to improve the company's relationship with the stakeholders and to learn more of their expectations. It is also an opportunity to educate the stakeholders about the experience and lessons learned, which may in turn alter their opinions and expectations. All this is crucial to further improve company performance.

3. Stage III - Dissemination of TEST programme results

The assistance, given to the pilot enterprises is to be used to demonstrate the advantages of adopting the integrated TEST approach. Provision is made in the TEST programme to provide case studies to national institutions (counterparts), which in turn are to share the information in these case studies with companies in the country or region. Relaying the successful results made possible at the pilot locations will demonstrate its value to other companies. It is expected that this will generate a demand for TEST-related services from the national institutions.

There are a number of ways to disseminate the results and achievements at the pilot TEST enterprises:

- Preparation of information material on the integrated TEST approach along with case studies
- Hosting national seminars in the country
- Offering one-day assessments at companies with environmental issues, to show them the potential benefits of applying the integrated TEST approach at their enterprises
- Hosting regional seminars to support twinning arrangements for introducing the integrated TEST approach in other countries of the region

C. The TEST programme in the Danube River basin

1. Background

Enterprises in the countries of the middle and lower Danube River basin are facing numerous challenges as they go through a radical reshaping in their move towards market economies. At the same time, they are in the process of responding to the environmental objectives of the Danube River Protection Convention (DRPC) and the environmental requirements that come with accession to the European Union; the most significant of these is the EU's Integrated Pollution Prevention and Control (IPPC) Directive. The DRPC and the EU's IPPC Directive both require enterprises to apply best available techniques (BAT) and best environmental practices (BEP).

In 1997, the United Nations Development Programme (UNDP), with the financial support of the Global Environment Facility (GEF), launched the 'Pollution Reduction Programme for the Danube River basin', through which it identified 130 major manufacturing enterprises known as 'hot spots' that were significant sources of pollution to the waters of the Danube River basin. A significant number of these enterprises were contributing to transboundary nutrient and/or persistent organic pollution.

In April 2001, in response to the needs of the countries of the Danube River basin, UNIDO launched a TEST programme in five countries (Bulgaria, Croatia, Hungary, Romania and Slovakia) (see figure 5).

The project's primary financial supporter was GEF, with some participation from UNIDO and other donors (the Hungarian and Czech Governments). The project's national partners (counterparts) were the National Cleaner Production Centres (NCPCs) of Croatia, Hungary, and Slovakia (members of the UNIDO/UNEP network of NCPCs), the Institute for Industrial Ecology (ECOIND) in Romania, and the Technical University of Sofia in Bulgaria.

The TEST programme in the Danube targeted 17 hot spots of industrial pollution, from various industrial sectors (chemical, food, machinery, textile, pulp and paper) in the Danube River basin (the river itself and its tributaries). The list of enterprises is reported in table 2. Through the programme, these industrial polluters have been introduced to the integrated TEST approach. The results of the programme in these locations will be used to show other enterprises that it is possible to reduce environmental impacts to acceptable levels while remaining, or even becoming more, competitive.

Figure 5. Map of the Danube River Basin

Table 2. List of Enterprises Participating in the Danube River Basin TEST Programme

	Country	Selected Enterprise	Industrial Sector – Focus of Project
1	Croatia	Agroproteinka	Meat Rendering
2		Gavrilovic d.o.o.	Integrated meat processing
3		Herbos	Pesticides- Atrazine plant
4		IPK Tvornica Secera Osijek	Sugar
5	Romania	ASTRA Romana	Petrochemical - refinery
6		Rulmentul	Machinery – bearing production
7		Chimcomplex	Intermediate Chemicals -Isopropyl-amine
8		SOMEŞ	Pulp and paper
9	Slovakia	AssiDoman Sturov	Pulp and paper
10		Zos Trnava	Machinery - repair railway wagons
11	Hungary	Gunter – Tata Kft.	Machinery - repair railway wagons
12		Indukcios es Vedogazos	Steel heat treatment
13		VIDEOTON Audio Company	Electronic products, plastic and wood processing
14		Nitrokemia 2000	Intermediates Chemicals
15	Bulgaria	Yuta JSC	Textile
16		Slavianka JSC	Fish processing
17		Zaharni Zavodi AD	Sugar - Alchool production

2. Private sector participation and start-up of the TEST programme in the Danube River basin

One of the major challenges implementing the TEST programme in the Danube River basin was the identification and selection of demonstration enterprises.

The main criteria for selecting demonstration sites included, but were not limited to, the enterprises being:

- Located within priority pollution hot spots and contributing to the pollution in those areas
- Interested in participating in the project and
- Financially viable

Finding industrial hot spots was not difficult, given the previous UNDP project, but being in a hot spot was not a sufficient reason to be considered for the project. The challenge was to identify good pilot sites that would participate effectively in the project and that were financially viable.

To assure the ultimate success of the project (i.e., implementation of identified measures and sustainability of the results obtained), final selection was also based on enterprise viability, defined as the potential for an enterprise to remain in business for more than five years, given its market position and costs of production. Only financially viable companies will undertake the necessary investment and upgrades in EST and will really be interested in having a long-term sustainable strategy. This criterion eliminated several candidates at the start of the programme.

At the start of the enterprises selection process, it appeared that some of the major industrial hot spots of the Danube River basin, especially in Romania, were still state owned. In addressing the request from the Romanian National Advisory Board, these enterprises, although undergoing a privatization process, were included in the list of potential enterprises. Additional information on the barriers and challenges faced during the implementation of the TEST approach in state owned enterprises is included in Text Box 2.

As indicated in Section A of Part II of this document, one of the major principles of a TEST programme is that involvement as a pilot enterprise is voluntary. Therefore, as enterprises in the Danube River basin had to be convinced that they would gain from their participation in the project, marketing the programme was a crucial activity for its successful start-up. Considerable effort was required, since it was particularly important to find enterprises with a strong commitment to avoid the possibility that they would withdraw during project.

The marketing activities took four months to complete. Different marketing tools were used: web advertisements, newsletters, informative seminars and other existing channels proposed by the National Project Advisory Boards in each country. Potential enterprises were visited and a short-list of 4 to 10 enterprises was finalized for each country. The first four short-listed enterprises undertook the first part of the initial review (market and financial viability study). Only after this was completed, could the necessary financial and market viability of an enterprise to qualify be verified and the final selection of enterprises to participate in the full implementation of the integrated TEST approach be made. Agreement letters were signed with all the enterprises that underwent the review.

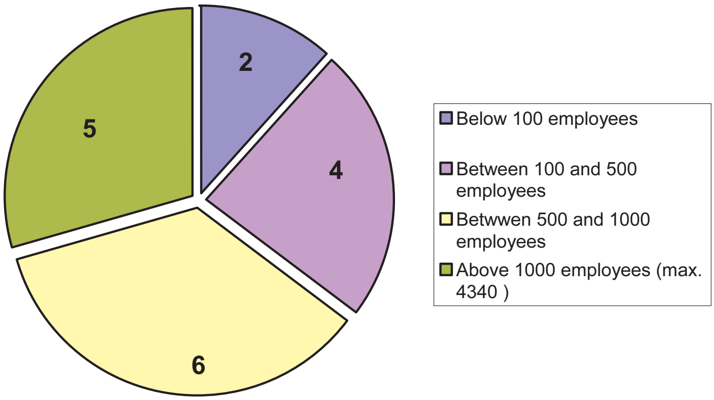
The identification of the correct drivers was very important, not only during the first stage when the project was being marketed and pilot sites were being selected, but also during the overall implementation of the programme, to maintain the commitment of the managers.

For instance, the possibility of achieving potential savings through the introduction of CP measures was difficult to explain to managers (although they were convinced by the end of Phase I of the second stage). This resistance was mainly due to the fact the costs in this part of the world, for utilities and many raw materials, are low as are wastewater and solid waste disposal fees and penalties.

Low stakeholders interest in a companies' environmental performance, low awareness of stakeholder interests at the companies and limited external motivating factors to improve the environmental performance of the companies, represented serious impediments to persuading companies to participate in the programme.

In spite of the difficult economic situation in these countries and despite the lack of enforcement of environmental legislation, the required number of pilot enterprises was identified (see table 2). The average size of the selected enterprises varied from one country to another. Figure 6 shows the distribution of the TEST companies, according to the number of employees.

Figure 6. Distribution of TEST pilot enterprises based on the total number of employees



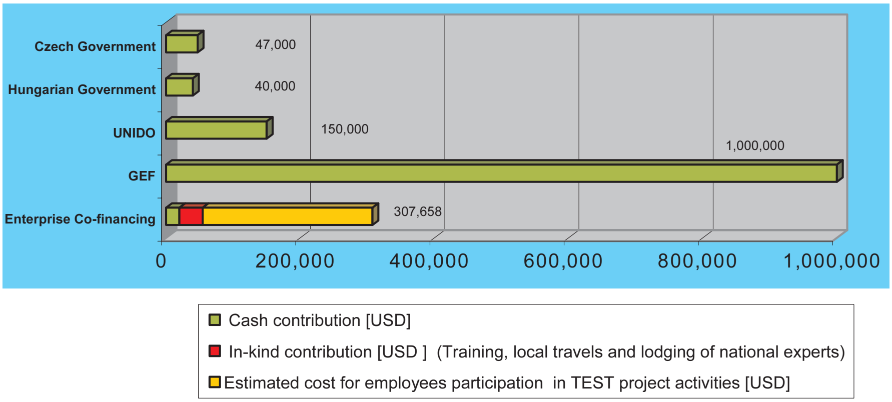
What this stage of the project showed was that in this region of the world, economic drivers[15] are much stronger than environmental ones and it is these economic drivers that are pushing companies to improve the efficiency of their operations and to acquire EMS certification.

The pilot enterprises that were finally selected were required to make a small (token) financial contribution (to strengthen their commitment to the programme), even though their participation was mostly subsidized by funds from the programme itself. All companies provided their financial contributions to the overall programme implementation, either as cash or as in-kind contributions (in terms of participation costs of employees to training, seminars organized during the programme or lodging for national experts), or both.

[15] The pre-accession process to the European Union undertaken by many countries in the Central and Eastern Europe has created a very favourable condition for the development of economic drivers in the direction of a more sustainable industrial development.

However, apart from the direct financial contributions to programme activities, the total contribution provided by the companies includes the cost of the employees used to implement each step of the TEST approach at enterprise level, which was quite considerable considering the complexity of integrated TEST approach. In fact, this represents the most significant share of cofinancing provided by the participating companies towards the success of the project. Figure 7 provides a breakdown of the total TEST project financial contributions, including the total cofinancing provided by the 17 Danubian companies, divided into three categories: cash, in-kind and labour cost (estimated by the total number of man days of labour force involved in TEST-related activities, including training, multiplied by the average daily salary). However, contributions from the individual companies varied significantly, depending on the number of tools applied at that company and its size.

Figure 7. TEST Project in the Danube River Basin: Financial Contributions (USD)



3. *Barriers and challenges*

As a group, the companies which took part in the Danube River basin TEST programme can be characterized as using outdated equipment and plants (at least partly), which are in the process of being replaced by new machinery and infrastructure - albeit slowly in most cases. Changes in the market situation are forcing the companies to continuously change their business strategy to keep up, creating uncertainty and a need for well thought-out planning that will last, regardless of the economic situation.

The privatization programmes and the shift in the economic and social environment have meant that many companies are feeling the impact, at least to some extent, from the misuse of resources and from polluting the environment.

This means that while awareness of environmental problems could be found in all the enterprises, it was usually to varying degrees, depending on the level in the company. Environmental managers - where such experts are employed - were usually the most aware of the environmental problems of the operations, while the top management was the least aware and the least eager to carry out actual measures. Management at the operations level took different viewpoints at different companies, ranging from seeing the environment as an important factor of operations to treating environmental problems as a very low priority.

The transition of these companies to private entities that operate in open markets has pushed them to gradually start modernizing their operations, but prior to the TEST programme, environmental considerations were only taken into account as a by-product of these measures. Despite having performed a thorough market and financial viability study prior to making the final selection of the participating companies, some of them have been struggling with market problems, due to the market instability of the region during the two and half years of the duration of the programme. This has presented a barrier to the implementation of the TEST programme that, combined with the antiquated organizational thinking of the management as a whole, stifled progress towards more environmentally sound operations. Progress in some companies was very slow.

The replacement of top management and the continuous search for new products and markets had a direct impact on the implementation of environmental management tools at the companies. Companies were much less willing to undertake any environmental measures with long-term consequences - which in an unstable environment might represent a high risk for future company operation.

Most of the companies took the first steps on the road to environmentally sound operations before the TEST programme ended but it took a considerable time for the local experts to have a real impact on the operations of the companies (e.g., one company started to show real interest in CP measures only at the end of the project). This may not necessarily be a problem. Changing the way employees and management relate to environmental problems usually takes a considerable amount of time, which means that results may come long after the TEST programme has formally been finalized.

In retrospect, it may have been too ambitious to expect that companies struggling for survival in the market would implement and use the environmental management tools provided by the TEST programme. The companies' position in the market had a very important influence on the implementation of environmental measures and the willingness to undertake actions for the environment in general. Despite this, through continuous discussions and training it was still possible to influence the companies to move in the direction of more environmentally sound operations. These interactions with different employees may not have had an immediate result; still, they are important in the end and the heightened awareness may affect their future actions and attitudes.

The modular approach for the implementation of the TEST programme proved to be a good strategy, since each company was faced with different problems. Each company was interested to varying degrees in the different modules of the TEST approach, depending on their needs. For this reason, some modules were implemented at all companies while others were implemented in only a few. The introduction of the integrated TEST approach, instead of the traditional sequential implementation of individual tools or systems, represented a serious challenge, both for the participating enterprises as well as for the national counterparts assisting in the implementation. It required careful planning and organization of project activities and considerable coordination efforts by the national focal points: different activities were running in parallel and different teams of experts had to be guided simultaneously.

Moreover, the underlying principle of integration in the approach requires a significant involvement of an enterprise's human resources, from different departments. Two major barriers had to be overcome here. One was a lack of communication and cooperation between different departments, while the other was conflict with mid-level managers for the use of human resources (for them, production was often the first priority, particularly in the smaller enterprises, not TEST-related activities).

All of the above mentioned barriers and challenges were encountered at the 17 enterprises during the TEST programme implementation . However, a particular situation was experienced while introducing the TEST approach in two SMEs in Hungary. For additional information on this topic please refer to Text Box 3.

It should be noted that none of the selected enterprises withdrew from the project and even though there were different levels of success in each of the enterprises, all of them achieved measurable results by implementing the integrated TEST approach. The primary reason for this is because the project was able to confirm one of the basic theses of the TEST approach, namely that improving environmental performance does not have to be at the expense of competitiveness. The most financially feasible measures, both organizational and technical, were identified and partially implemented to bring the enterprises into compliance with the environmental norms of the Danube River Protection Convention and the EU's IPPC Directive, while also accommodating their need to remain competitive.

4. Key results of the programme in the Danube River basin

The implementation of the TEST project in the Danube River basin was started in May 2001 and completed in December 2003. As a result, the TEST approach was successfully introduced in 17 pilot enterprises. Tangible results were achieved, both in terms of increased productivity and in terms of improved environmental performance. The threats identified in the business environment, often perceived by the companies as survival threats connected with environmental compliance issues and production costs were reduced and new opportunities were identified.

Increased productivity was achieved through the implementation of identified CP/EST measures, leading to a reduction of specific production inputs costs (increase of profit margins), increased production capacity, better control of production costs related to process inefficiencies and better labour conditions. In many of the participating companies, the identified measures also resulted in improved quality of the final product.

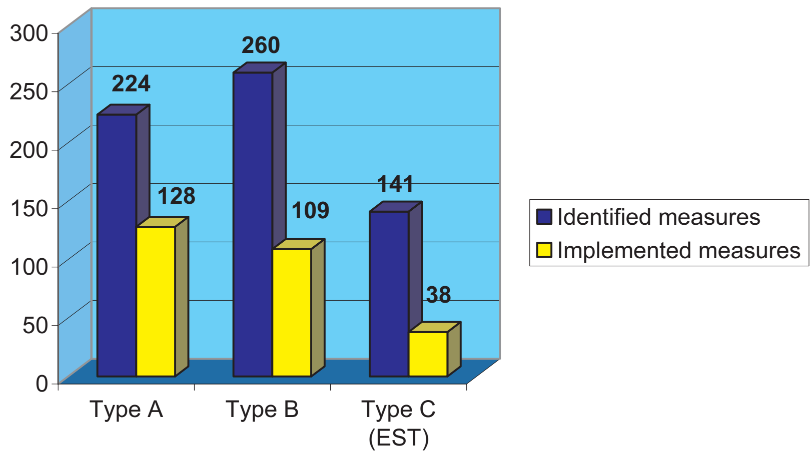
Other less tangible benefits, like improved relationships with stakeholders leading to the projection of a better image towards local authorities and customers were also achieved. This was especially true in those companies that introduced a full EMS and obtained the ISO 14001 certification (for additional information on the results of the EMS component of the TEST project please refer to Text Box 7).

Both the tangible and less tangible benefits contributed to strengthen the position of the enterprises and their competitive advantages, thus reducing the existing barriers to access to both local and foreign markets (especially the EU market).

The results achieved by each of the 17 enterprises varied because of a number of different factors. The net result was that some enterprises were more successful in implementing soft management tools (CPA, EMS, EMA), while others achieved significant results in the implementation of new EST.

Figure 8 summarizes the total number of CP/EST measures that were identified vs. the number that were implemented. Types A and B are no cost/low cost CP measures implemented by the end of the project. The total investment entered into by the 17 enterprises to implement the 109 type B measures was 1,686,704 USD, while the total estimated financial savings were 1,277,570 USD per year (for additional information on the results of CP module please see Text Box 6).

Figure 8. TEST Project in the Danube River Basin: Total Number of Measures identified vs. Those Implemented (by category) in the 17 enterprises



Type C (EST) measures are those requiring a significant financial investment. The 38 'implemented measures' represent those that were evaluated technically and financially within the scope of the TEST project and approved (by the top management) for implementation. Table 3 provides a summary of the investments required, the related financial benefits, the value of the related financial indicators (IRR, NPV), and the expected implementation date[16] of the type C measures at each company.

As shown in table 3, the investments total, required[17] for the Type C measures evaluated during the TEST project for the 17 enterprises is 47,325,171 USD. These investments include both CTs (requiring large investments) and some end-of-pipe investments. Although the latter are characterized by negative NPVs, they are needed to comply with existing environmental legislation, including the EU's IPPC Directive. The indicated savings are an initial estimate, representing the minimum financial savings that can be expected after implementation of the ESTs.

[16] These expected implementation dates have been set in accordance with the IPPC Directive implementation schedule and deadline fixed in the national regulatory framework.

[17] These cost estimates are based on preliminary calculations and will need to be confirmed in the final feasibility study.

Table 3. Financial Figures of the EST Investments Identified at the 17 Enterprises Participating in the TEST Programme in the Danube

Country	Enterprise	Total Investments [USD]	Total Yearly Savings [USD]	Financial Indicators (IRR, NPV, PBP)	Expected Date of Implementation
Croatia	**Agroproteinka**	7,500,000	1,500,000	**IRR:** 33%	April 2007
	Gavrilovic d.o.o.	3,500,000	440,000	**IRR:** 26%	September 2006
	Herbos	800,000	0 (end-of-pipe)	-	Mid-2006
	IPK Tvornica Secera Osijek	800,000	400,000	**IRR:** 110%	September 2004
Romania	**Astra Romana**	3,162,000	1% reduction of product cost	**NPV:** 319 - 943. Eur **IRR**: 10.45-11.2%	2004/2007
	Rulmentul	400,000	2,500,000	**NPV:** 2.4 Mill Eur **IRR:** 1002%	2003
	Chimcomplex	270,000	220,000	**NPV:** positive after 4 yrs. **IRR:** positive after 6 yrs.	To be determined
	Somes	11,500,000	1,370,000	**NPV:** Mill. Eur: 3.3-4.4 **IRR:** 14-18%	2004 - 2006
Slovakia	**AssiDoman Sturov**	4,050,000	2,293,000	**NPV:** 0.228 - 4.725 Mill. Eur **IRR:** 38.42% - 60.85%	2005
	Zos Trnava	7,167,500	75,000 only for penalties, 4 times increased production	**NPV:** 40 - 626 kUSD **IRR:** 4% - 17%	2009
Hungary	**Gunter – Tata Kft.**	898,828	0 (end-of-pipe)	-	2007
	Indukcios es Vedogazos	18,560	0 (end-of-pipe)	**PBP:** 6.8 yrs.	2004
	VIDEOTON Audio Company	35,783	0 (end-of-pipe)	-	2007
	Nitrokemia 2000	265,500	171,817	**PBP:** 1.54 yrs. **NPV:** 206,749 USD	2006
Bulgaria	**Yuta JSC**	2,500,000	Not available	min. **PBP:** 4 yrs. max. **PBP:** 5.3 yrs.	To be determined
	Slavianka JSC	Confidential			
	Zaharni Zavodi AD	4,700,000	350,000	min. **PBP:** 3.5 yrs. Max. **PBP:** > 5 yrs.	To be determined
TOTAL		**47,568,171**	**5,361,817**		

The environmental benefits were significant in terms of reduced consumption of natural resources (including fresh water consumption and energy), reduced wastewater discharges and pollution loads[18] into the Danube River and its tributaries, as well as reduction of waste generation and air emissions[19].

Figure 9. Specific Water Consumption at the TEST Enterprises, at Project Start, at Project End (November 2003), After Implementation of EST

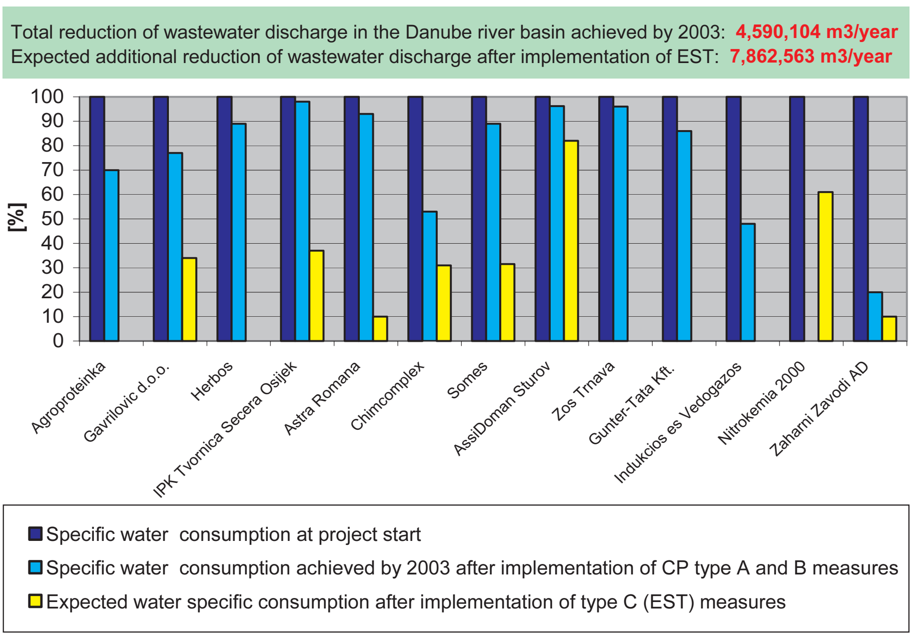


Figure 9 provides a summary of the reductions in specific water consumption at each TEST enterprise after implementation of the identified CP/EST measures. As of the end of 2003, the range of reduction varied between 2 and 89 percent of the initial value, leading to an impressive total reduction in wastewater discharges, into the Danube River basin, of 4,590,104 m^3/year. It is expected additional reductions in wastewater discharges, after full implementation of the large EST investments, would be 7,862,563 m^3/year.

[18] Pollution loads in the wastewaters were reduced in most of the companies, including COD, BOD, oily products, TSS, heavy metals, toxic chemicals (e.g. PCE), herbicides (Atrazine) and nutrients.

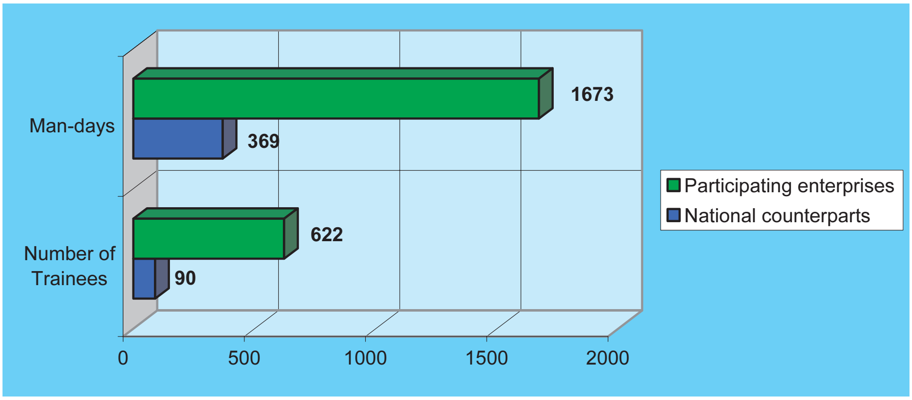
[19] Significant reductions were achieved in terms of VOC and H2S emissions as well as CO^2.

For more detailed information on the results of the TEST project (at each enterprise) can be found in the TEST national publications, available from UNIDO upon request.

Besides the tangible economic and environmental benefits achieved at the 17 pilot enterprises, other important results need to be mentioned, especially in relation to capacity building and awareness raising, both at the national counterpart level and at the level of the participating enterprises.

Figure 10 shows the total number of trainees and the total number of training man-days that were undertaken within the framework of the TEST programme in the Danube River basin, by both the participating enterprises and the national counterparts.

Figure 10. TEST Project in the Danube River Basin: Capacity Building Indicators



In terms of the capacity built in the national counterpart institutions, it should be mentioned that one of the major benefits of the TEST programme for them, was the training and the hands-on experience they gained in new environmental management tools. The TEST programme presented a great opportunity to reinforce the skills of the national counterparts and the possibility of expanding the range of technical services they could offer to local enterprises. Table 4 summarizes the new tools that were provided to each of the five TEST counterpart institutions. Since the Slovak, Hungarian and Croatian counterparts (UNIDO-UNEP CP centres) were the already familiar with some of the tools used in the TEST approach, the capacity building component in Romania and Bulgaria was more relevant than in the other countries.

Table 4. New Tools Provided to the Five TEST Counterpart Institutions

Country	New Tools Provided to National Counterparts (by TEST Project)
Romania	EMA, CPA, ESTA, SES
Slovakia	EMA, SES
Croatia	EMA, EMS, ESTA, SES
Bulgaria	EMA, CPA, ESTA, EMS, SES
Hungary	ESTA, SES

In terms of capacity building, an important aspect of the implementation of the TEST programme was the use of international sector-specific expertise from the CEE Region, where needed, in the various stages of the individual projects. Using a 'south-south' cooperation model, several twinning agreements for the transfer of know-how from the central Danubian countries to the southern, less developed Danubian countries were successfully created amongst the five TEST counterparts.

The capacity built at the enterprise level and the increased awareness among the employees and mangers led to the following improvements:

- Empowerment and reorganization of the environmental function within the company
- Improved internal communication between top managers/middle management and employees
- Improved external communication with local authorities and the ability to communicate the environmental performance of the company to all its stakeholders
- Environmental considerations taken into account during investment decision making processes (increased bargaining power of the environmental function)
- Adoption and continued use of CPA, EMS, EMA as evidenced by

fact that several companies replicated the use of these tools in other production units, at their own expense (using the skills developed during the TEST project).

- Integration of environmental considerations at the level of individual companies' business strategies

Text Box 2. Implementing the TEST Project in State Owned Enterprises: The Romanian Experience

At the start of the TEST project in Romania, several of the enterprises in the chosen industrial hot spots were still state-owned. Initially there was a question of whether or not to include these types of enterprises in the project. Despite the initial concerns and taking into consideration the request of the Romanian national authorities, two state-owned enterprises were selected.

Implementing the TEST approach in state-owned enterprises proved complicated, but still possible. There was a general lack of motivation in the middle management, a situation which revealed itself to be a critical barrier to overcome given the:

- *Uncertainty about the company's future, the restructuring needs, and actions to be decided by the new owner*
- *Lack of financial resources*
- *Relatively low influence of company management on the investment decision-making process*

The ownership status and the economic importance of the two enterprises were comparable. However, their performance in the TEST programme and their impact on the programme differed significantly.

One of the two companies was in relatively good financial condition and was a good prospect for privatization: several potential owners had already shown interest in acquiring the company. This company's top management maintained a real commitment throughout, and some concrete progress and benefits were achieved. They reached the EMS-related objective within the *programme's timeframe and became ISO14001 certified in March 2003. Implementation of cleaner production options led to a reduced consumption of specific raw materials (ammonia and methane) in the thermal treatment section and to off-site reuse of different types of sludge generated in the metal processing. An EST investment for changing the bearing-washing technology from a chlorinated solvent-base (PCE) to a new aqueous based technology of biodegradable detergents was implemented at a pilot plant before the TEST project end and has been included in the privatization information package for the remaining production locations.*

In the other enterprise, the privatization process was still at an early stage. The future of the company was very uncertain and downsizing of personnel had started. Top management commitment was only formal but the facility's professional team continued the work initiated within the project. While only a few of the proposed CP measures were implemented, they showed measurable reductions, mainly in energy consumption but also in the consumption of raw materials and water. Recognizing the value of the CP approach, middle management extended CPA to other processes, with interesting results (although with limited top management recognition or support). The estimated EST investment was calculated at less than $300,000, but the pay back period was quite long (more than 6 years) due to the very low rate of operating capacity, compared to the nominal capacity. Even though it was decided not to undertake the proposed EST investment, the most important aspects of the analysis were included in the company's privatization package.

Because of this endeavour in state-owned facilities enterprises, it was concluded that the existence of an ongoing privatization process could create favourable conditions for starting a TEST project. Under those circumstances, a TEST project provides the company with the mechanisms to help it prepare for the privatization in a more efficient way, allowing it to also take into consideration the environmental and social aspects of its operations. At the same time, the TEST approach can provide the government with the necessary tools it needs to quantify the liabilities and expenditures related to environmental issues that potential purchasers will have to bear, thus increasing the government's leverage in the negotiation process for privatization.

Text Box 3. Implementing the TEST Approach in Small and Medium-Sized Enterprises (SMEs)– The Hungarian Experience

The implementation of the TEST project in Hungary involved one large chemical plant and 3 small to medium-sized enterprises (SMEs), ranging from about 40 to 500 employees. This characteristic, of having SMEs involved, was unique compared to the other countries participating in the TEST programme and offered an interesting opportunity for applying the TEST approach to such companies.

Environmental strategy and actual environmental performance are greatly influenced by the size of an enterprise. Therefore, most of the tools used in the implementation of the TEST approach, initially developed for medium to large corporations, had to be adjusted in order to properly match the needs of SMEs. For instance, the detailed CPA was replaced, in some cases, by a quick-scan approach (especially for unified processes) and the EMS was implemented using simplified schemes. The scope of EMA was limited to the calculation of total environmental costs, without allocation to cost centres or products

Generally, SMEs are less formally structured than their larger competitors are. This can mean a lack of written strategy and procedures and/or an informal approach to planning activities and decision-making.

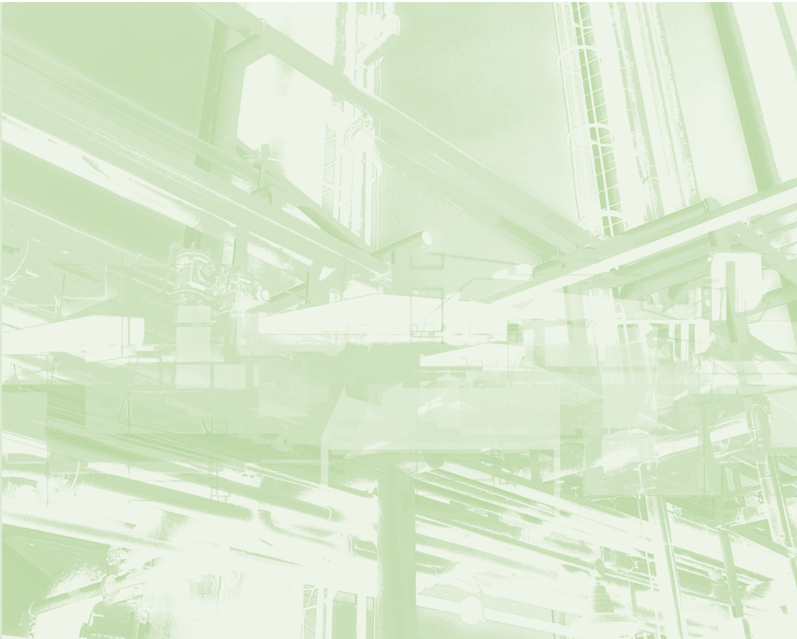
The priority of other functions in the organization of SMEs, such as production or sales (sometimes even quality) often hinders environmental measures more than in larger enterprises. In such cases - as happened in the three Hungarian SMEs participating in the TEST programme - the environmental function was usually pushed into the background when other problems surfaced. Moreover, the resources available to the environmental representative/expert for the implementation of environmental programmes are more limited in SMEs. The method adopted to overcome these barriers in these SMEs was to introduce the CP/EMS (the two most resources intensive project activities) as one integrated activity and by limiting the involvement of company teams to only one project activity at a time. Continuous communication with managers and additional technical assistance was required and *provided throughout the implementation of each tool to successfully complete the TEST projects in these companies.*

An additional barrier to success was the fact that enforcement of environmental legislation is even weaker against SMEs than against large polluters that might be exposed to a higher social pressure. This results in SME managers paying less attention to environmental protection. The lack of measurements quantifying existing emissions, discharges and wastes presented a major barrier when setting the baseline for environmental performance of the company and a significant barrier when trying to quantify the environmental and economical benefits of the TEST projects.

Access to financial resources also represented a major obstacle for SMEs, especially for the implementation of major technological changes. This remains a major obstacle that is likely to be overcome only in countries where national incentives programmes, for promoting the increased adoption of ESTs in SMEs, are in place and easily accessible.

In conclusion, the implementation of a TEST programme in SMEs would need to address all the above-mentioned barriers and the TEST approach should be amended as required. The development of the TEST package for SMEs is still a challenge and the Hungarian approach was the first step in this direction.

PART III



TEST TOOLS

TEST TOOLS

This Part of the guidance document provides a summary of the individual TEST tools presented in Part I. It's purpose is to describe each tool in more detail and provide basic information on how to use them and on how to link them within the framework of an integrated approach. If the reader requires more information on how to apply each of the tools, a list of resources is provided at the end of each section to assist them.

The last section of this chapter provides a description of the TEST project cycle, including the links between the different tools: comments and considerations are provided in the summary table in Annex VI.

A. Initial Review

1. Overview

1.1. Purpose and scope

The purpose of the initial review is to assess the existing situation at the company, from both an economic and an environmental point of view[20] and to determine the right combination of tools to address them. The assessment uses a three-fold approach:

1. Acquire preliminary information on the company's market and financial viability and the basic elements of its business strategy in order to assess if it is a viable partner for a TEST project and, if so, to identify its major weaknesses and major competitive advantages.
2. Assess the company's starting point, focusing on the challenges posed by environmental legislation and on the potential to implement solutions with both environmental and economic benefits.
3. Set priorities for intervention and prepare the overall workplan of the TEST project.

[20] The social performance will be addressed during the SES project module with particular focus on the impact of major EST investment.

1.2 Main Steps of the Initial Review

With this purpose and scope in mind, the main questions to be considered during the initial review are:

1. Is the enterprise sufficiently viable, financially, to undertake the TEST project?
2. How does the enterprise's strategy for products and marketing relate to the existing business environment? Is it a viable strategy?
3. Which processes are of strategic importance to the company's future? What is the level of the technology in place in these processes?
4. How is the enterprise's environmental performance? What is its level of legal compliance with the regulations and what are the main environmental impacts?
5. Are energy and material flows (processes) efficient? What is the potential for improvements?
6. How effective are the existing management practices, primarily with respect to environmental issues?
7. How are environmental costs allocated in the current costing / accounting system? What kind of management accounting system is in place?

These questions can be organized into two main steps (see figure 11):

1. The first step addresses the issues related to questions 1-3 regarding the market and financial viability of the company. The answer to these questions will determine if the company has the potential to remain in business for at least another 3-5 years: a minimum criteria for a company to be a suitable candidate for the TEST project. This step of the initial review is critical in identifying the most fundamental problems in the functional areas of the company as well as the critical success factors for enhancing its performance. This step is also important in revealing areas needing management restructuring.

2. The second step of the initial review is the preliminary environmental review (PER), which addresses all the remaining questions (4-7). The aim of this second step is to assess the current environmental performance of the organization.

A third and final step of the initial review follows, where the overall implementation plan for the TEST approach and its tools are finalized and submitted to the top management.

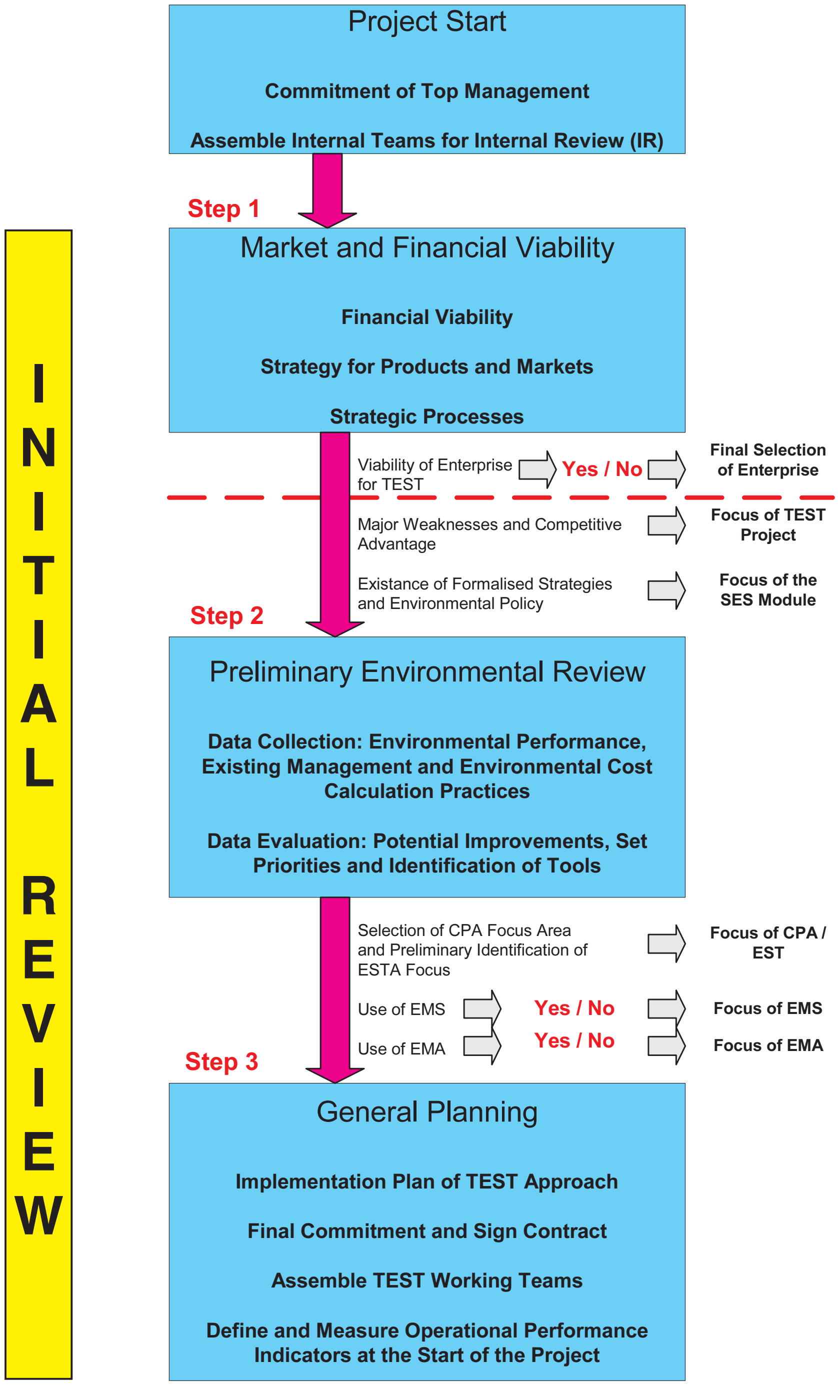
1.3 Planning during the Review

To start the initial review, an internal team should be appointed by the top manager to undertake the relevant assessments. The team should include representatives from the marketing and financial departments, as well the operational/environmental departments.

At the end of the initial review, the overall implementation plan for the company's TEST project is developed and formalized. At this stage, the top management must commit itself and sign a contract with the group(s) providing the technical assistance before the main part of the project starts. Once commitments are in place, the necessary human resources (the TEST team[21]) are brought together from both internal personnel (employees) and external sources (expertise needed from the assisting institution).

[21] Size and composition of the TEST team should match with company's organization.

Figure 11. The Initial Review Steps and Main Outcomes



2. Step I: Market and financial viability

There are obvious connections between the business strategy of a company and the selection of the focus areas for introducing the TEST tools, particularly with respect to the implementation of major technological changes (EST) requiring large investments (see Text Box 4). Information gathered at this level will reduce the risk that the programme resources (financial and human) are spent optimizing production processes that are likely to be decommissioned in the near future or in a company that is likely to close down.

A number of issues need to be discussed in this step:

- The position of the enterprise in the current business environment and its competitive position in the market
- The company's 3-5 year investment plan may also be discussed
- The company's vision and strategy toward sustainability (if one has been developed) and how it is being achieved and communicated internally
- The relationship the company has with key stakeholders
- External communication channels
- The existing environmental policy

It is a good practice to start the TEST project analyzing the business environment, identifying any external threats and opportunities the company faces and internal strengths and weaknesses it possesses. With this information, the company's general business strategy (in particular the market, financial and operational strategies) can be analyzed in the context of the current business environment.

By the end of this market and financial viability step, it is possible to conclude whether or not it is viable to initiate the TEST project at that company. This decision requires a skilled expert and business consultants with this expertise, who should be contracted to assist in making this critical decision.

Additionally, the market and financial viability study will confirm which EST investments will help give the company a competitive advantage, thereby providing a direction and focus for TEST project, which is crucial for its long-term success.

NOTE: For a better understanding of the terminology used in this section the reader can refer to 'The general principles of enterprise strategies and its development' in Annex I.

2.1. The business environment

The business environment should be analyzed on two levels: the general business environment and the specific business environment.

One of the most popular methods of analyzing the general 'grand' business environment of a company is the Political, Economic, Social and Technological (PEST) analysis. It consists of grouping the business environment into four main areas:

1. Political/Legal factors (attitude of the government toward specific business- incentives/funds, licensing barriers, dynamics of legislation).
2. Economic factors (GDP, unemployment, exchange rates, cost of capital, inflation, business cycle, disposable income, etc.).
3. Social/cultural factors (social attitude of consumers, general level of education, attitude of labour unions).
4. Technological factors (availability of technology, infrastructures for transportation/ energy/communication).

Once the general environment has been analyzed, the scope of the investigation narrows to the specific environment directly affecting the company (industry branch specific). The five forces model developed by Michael Porter (see figure 12) is a good guide for this analysis[22] as it analyses the following aspects:

- Internal competition (among the existing competitors) New entry (e.g. how difficult it is for a new competitor to enter the market?

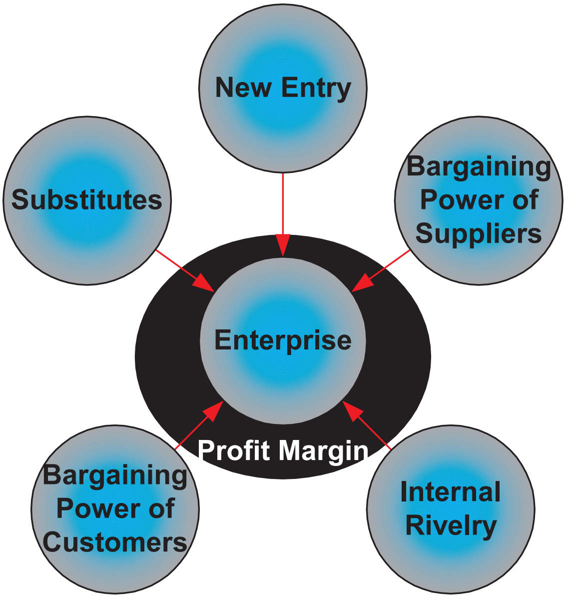
[22] http://www.quickmba.com/strategy/porter.shtml

- this includes entry barriers (e.g. natural monopolies, access to resources), regulatory barriers (licensing, tariffs), criminal or legal barriers etc.) * Bargaining power of the consumers (customers)

- Bargaining power of the suppliers and
- Substitute products (possibility of the existing product to be replaced on the market by one with similar use/utility)

Weak forces are considered opportunities for the business, while strong forces are considered threats and reduce the profitability margin of the business.

Figure 12. Five Forces Model



2.2. Analyzing the company

The next step is to analyze the company through a marketing and financial audit[23]. The financial audit focuses on assessing the accounting system

[23] An operational audit can also be included, depending on the scope of the TEST project and the available financial resources. The audit of the operational function would include production, processes, location,

of the company, its profitability, the risks it is exposed to (interest and exchange rate exposure), its leverage (debt and equity), its liquidity, its credit policy, its working capital and cash management and access to capital (credit rating, collateral etc.). The marketing audit assesses the following main elements of the business: products, pricing strategy, place (distribution), promotion (communication), marketing system and procurement.

The necessary information can be gathered through a set of guided interviews, using ad hoc questionnaires as supporting material. Top managers should also provide a short description of the company's ownership and organizational structure, sales and operating profits, key production processes and technology.

Within the context of the market and financial viability, it is important to evaluate the current decision-making practices used for new investments and the financial evaluation process used to assess profitability. This aspect of the Review might reveal needs for training in financial appraisal preparation, relevant for the implementation of the EST project module.

The market and financial viability investigation should not go as deeply as a traditional market and financial audits. The information collected needs only to identify the major weaknesses and major competitive advantages of the enterprise, in relation to the threats and opportunities of the existing business environment. Once the critical success factors of the business' key functions have been identified, a set of recommendations for improvement can be provided.

2.3. Business Strategy Formulation.

Ideally, it is at this initial stage of the project, general (preliminary level) information on the company's business strategy, development processes and existing environmental strategies should be gathered. The important questions to be answered concern how strategies (business and function-

layout, quality, production scheduling, maintenance, and inventory management. The assessment of the environmental performance could then be integrated within the operational audit. The first application of the TEST Programme in the Danube River basin did not include a broad operational audit: only selected components were considered for the assessment.

al) are formulated, formalized and implemented, and how performance is measured within the company. An informal guided interview can help accomplish this.

However, more specific (and probably more confidential) discussions and advice on company strategy may only be possible after sufficient trust has been built up between the enterprise and those who are providing technical assistance, a trust that will build over time as the project progresses. Therefore, it is expected that in most cases, the strategy aspects of the enterprise will be discussed in more detail within the final project module, SES.

Nevertheless, the Initial Review process should supply the project team with sufficient information on management competence, strategic management attitudes and the existence of a formal or intuitive strategy (or lack thereof), to later plan the goals and set the outputs for the SES module.

Text Box 4. Experience From the TEST Project in the Danube: Influence of the Company Strategy on the Selection of the Project Focus Area

The Initial Review performed at one TEST enterprise, from the chemical sector, revealed a location processing an intermediate chemical, which the management identified as a priority for its TEST project as a pilot facility. It had a large potential for improvement, significant environmental risks and there was a strong concern that it was significantly impacting the Danube River basin. The potential for the product to retain their markets was questioned during the company's market and financial viability evaluations. It was pointed out that the market for the chemical concerned is very limited due to the fact that it is mostly used in other processes to produce another chemical that is already being banned in some countries due to its dangerous properties and is being substituted in other companies by chemicals that create fewer risks to the environment. The enterprise, however, insisted on focusing on cleaning-up the related production process and the CP module was focused there.

The initial work of the CP module revealed a large potential for improvement in the process line and for the prevention of pollution at source. However, it was not possible to complete the detailed analysis because the line was not in operation during this review period: its start-up had had to be repeatedly postponed due to a lack of orders for the product concerned. It is difficult to determine the extent to which this problem was a result of the dangerous character of the product. Eventually, the focus of the CP module had to be changed and was implemented for another production unit with higher market potential. Practical results were gained with the second unit, however, the false start (produced by a flawed company strategy), regrettably wasted time and financial resources of the programme.

3. Step II: the Preliminary Environmental Review (PER)

The PER should cover different aspects of the organization and could follow either the structure of the Initial Review recommended by the ISO 14001 standard (when designing an EMS) or the structure of that required by EMAS[24]. Whatever the structure, it should be remembered that this is a preliminary review and it should not go into too much detail. For instance, if one of the goals identified at the end of the Initial Review is to go for full EMS implementation and international certification, the analysis undertaken in the PER can be deepened in the EMS module.

At the end of the PER, the team should have a basic understanding of the components of the existing management system and should have identified which parts can be used for the implementation of TEST and which probably require the most urgent attention for improvement (with respect to the company's most important environmental problems). It is now the choice of which TEST tools to use can be made. In particular, the following key decisions need to be made:

- Selection of the CPA focus area(s) and CPA planning (goals, targets and indicators)

[24] For detailed structure and content of the Initial Review recommended by ISO14001, refer to the ISO 14004 (http://www.iso14000.com), while for EMAS refer to: http://europa.eu.int/comm/environment/emas/index_en.htm

- The ESTs to focus on (including end-of pipe options), following a preliminary identification process
- How EMS will be used
- The use and scope of EMA

3.1. Data collections for PER

The PER should start with a brief assessment of the company's local characteristics and history. The assessment should identify the potential risks to human and environmental receptors and the vulnerability of the site itself and its surroundings to contamination.

The next step is a review of the local environmental compliance requirements applicable to the facility. Once identified, compliance with existing environmental regulations should be evaluated. Current waste management practices including inventory, handling, storage, monitoring and final disposal, should also be analyzed.

The next step is to collect data on the production processes. Production processes are, together with the management systems, the two areas that will be the most time consuming for the reviewers. A walk-through of the enterprise is a necessary part of the review here. A review of the processes should reveal which are core to the company and its products, as well as their:

- Main inputs and outputs, efficiency in the use of the inputs and an estimation of the financial losses caused by important losses of materials or energy
- Main problems linked to the unwanted outputs of pollution and waste
- Other core characteristics, such as problems with maintenance, quality, health and safety etc.
- Basic characteristics of the technology used and its mode of operation

All core processes should be listed and their linkages mapped.

From data collected, a flow chart with the main process steps and a list of the main inputs and outputs (raw materials, auxiliaries, fuels, energy, water, waste, emissions and final products), with related costs, should be prepared. This should include the most recent energy bills, going back three years, to see any trends in energy consumption in relation to production.

Equipment and facilities should be listed and checked for how current they are, technologically. This check should include monitoring equipment, energy and steam supplies, energy distribution systems, utilities and end-of-pipe equipment.

Questions on products are usually asked only as they relate to the review of particular processes.

Additional information should be collected on organizational systems, including existing process, quality and safety management systems and the basic elements of environmental management systems (environmental policy, environmental documentation, communication and operational control). These data are important for the design and implementation of an EMS (either in full or in part).

Attention should be paid to the existing accounting system and product pricing methods, especially the current practices for allocating environmental costs, existing data and the information system. The main environmental costs associated with the company's environmental impacts should be discussed to allow a decision to be made as to whether an EMA can be introduced and if so, what would be its scope.

Once these data are gathered, the processing and interpretation phase should start. Priorities will be identified and tools chosen. Some of the data gathered during the PER will be common inputs CPA, EMS, EMA, and EST[25] and will assist in deciding if/how
each tool is used and their relative focus.

[25] Some data are common inputs for the initial planning step of each TEST tool. Therefore, to avoid duplication of efforts during data collection at each project tool, most of the common input data are being grouped and collected at the stage of the initial review. Links between the different steps and data requirement for implementation of CPA, EMS and EMA are provided in the table Annex VI.

3.2 Data evaluation - selection of the tools

One of the core principles of the implementation of the TEST approach is that the enterprise-level projects should focus on a company's needs and be problem driven. The scope of the project must be modified and limited to the scale required, taking into consideration the available time and existing resources. Therefore, one of the core challenges in the choice of tools and degree to which each will be implemented, is to restrict the focus to only the important issues and not overload the enterprise with either too many tools or activities. Using the initial review findings, the team tailors the TEST approach to meet the company's needs, setting a reasonable focus and reasonable targets for each of the project modules.

3.2.1 Use of CPA

CPA is a tool that can generate savings quickly, helping to increase management 'buy in'. For this reason, CPA will be undertaken in almost all cases and the question becomes not whether a CPA will be done, but to what extent.

Data collected during the PER provide a basis from which to identify the areas of the business that are experiencing the highest losses (high CP potential) and from there determine the scope of a CPA. Since the CPA cannot be applied to all material and energy flows in the company at the same time, it is advisable to implement it in the area where the CP potential is the highest first. This is called the CPA focus area.

Three main criteria can be used to set the priorities for choosing the CPA focus area[26]:

1. The amount and character (degree of danger or risk) of wastes and pollution: the most important raw materials, auxiliary materials and energy sources (fuels) should be reviewed to determine what wastes or emissions are the most critical to the enterprise with regard to volume, danger, compliance, safety in the work place, etc.

[26] Additional criteria can be derived from the ISO standard (significant environmental aspects identification - reference ISO14004) (URL http://www.iso14000.com/)

2. The financial losses incurred by generating pollution and from energy consumption: the overall costs connected with the generation of particular wastes and pollutants (including the wasted raw material and energy), calculated to identify overall losses connected with the use of individual inputs for the most important raw materials and energy uses.
3. Technical considerations: evaluate technical feasibility and expected improvement potentials. Benchmarking of the key process-performance indicators (including energy efficiency indicators) with industrial specific indicators should be undertaken[27].

To select which flows to include in the focus areas, it is best to examine and analyze the main material inputs and outputs at the company level, costs related to raw material losses (generation of waste) and to the treatment of the waste and pollution generated[28]. Focus areas such as energy supply facilities or energy distribution systems can be selected primarily on a technical basis, using straightforward indicators for benchmarking such as the specific consumption of fuels, efficiency of energy generation or efficiency of the distribution system.

The selection of a CPA focus area depends also on the size of the enterprise and the type of processes it uses. In a large company with many processes, the 'boundary' of the CPA can be drawn to only encompass specific units/parts. In smaller companies, the CP focus area is usually the whole of the production process (or perhaps the whole company). Within this boundary, the CPA can focus on specific flows of material and/or energy whatever criteria are used to choose the CPA focus area; the final selection should also take into consideration top management's decisions and priorities (input from the market and financial viability assessment).

[27] Examples of sources of information for benchmarking indicators are: US EPA, World Bank Pollution Prevention Handbook, UK -ETBPP, BAT-BREFs, and eco-efficiency sectoral indicators.

[28] CP practitioners use different tools for processing data. One example is the TOP 20 approach. This tool consists in listing the 20 most important raw materials, toxic auxiliaries and wastes (STENUM Graz, Okoprofit: Helft 1 - 5, Magistrat Graz und Magistrat Glagenfurt, Graz - Klagenfurt, 1994).

Ultimately the focus area of a CPA will described:

- The specific flows (material flows, energy flows, water, etc.) that will be covered, and
- The applicable boundary line for inclusion in the assessment, whether it is around the entire facility or only around specified units/production lines, energy generating facilities or energy distribution systems.

However, it is advisable to avoid extremes in the selection of the focus areas:

- Too large and ambitious a range for the CPA means that the efforts required are disproportionately greater than the resources that can be made available for its implementation
- Too small a range: there is a danger of losing context and connection with a higher unit. It is better therefore to not focus on any area smaller than a production line in scope. The selection of a fragment in an area (e.g. a machine) hampers finding the real causes of pollution generation, which are closely connected within the higher unit (i.e. the entire line).

Once the focus area has been chosen, the project's orientation is effectively defined and the implementation parameters delineated. The preliminary, process optimization targets can then be set.

3.2.2. Use of ESTA

As in the case of the CPA, the issue again is not whether to do an ESTA, but what will be its scope. At the conclusion of the initial review level, where there is access to information from the market and financial viability review, it should be possible to estimate the need for technological changes in the processes and/or the need for end-of pipe technologies. In fact, if very outdated technology or processes are in place and technology that is more efficient is well known to the company (from some earlier investigations by the management in this direction), the ESTA focus area may have been identified already within the initial review. However, it is important that the market and financial viability confirm that this direction for investment is correct and will strengthen the competitive advantage of the company (see Text Box 4).

3.2.3 Utilization of EMS.

The major issue to be considered at the end of the initial review, with respect to EMS, is whether a full or a partial EMS should be introduced. The introduction of a full EMS should be carefully evaluated before initiating any activities. The final decision should be based on the existing management practices and the motivation of the top managers. Usually, the implementation of a full EMS, according to existing international standards like ISO14001 or EMAS, should be pursued only if management has declared a strong commitment to achieving the goal and has allocated enough resources (human and financial). If the company does not have a quality management system in place and if the overall resources are limited, the introduction of a full EMS is not recommended. Alternatively, only selected elements of the EMS should be introduced, which will sustain the cleaner production measures identified during the CPA.

The detailed planning of the EMS takes place as part of the EMS module and can follow existing standards. The traditional steps of the planning and implementation of an EMS are summarized in Part III - C.

If following the outline proposed by ISO 14001, the initial review process will provide inputs for the environmental policy and will fix the time when the policy will be drafted. The final policy can then be prepared within the EMS module.

Independent of whether a full EMS will be implemented or not, an environmental policy should be prepared. The first draft should be prepared after the initial review and be finalized by the end of the project.

3.2.4. Utilization of EMA

The decision about whether or not to introduce EMA is decided at the end of the initial review. Managers have to be convinced that introducing EMA can help them save money by improving their control over environmental costs. One important argument in favour of EMA and one that should be discussed with the enterprise's management is that an EMA system will reveal what will probably be a significant part of the material and processing costs that actually go into waste instead the product. Additionally, according to several surveys, the total environmental costs tend to be at least three times the costs initially estimated by the company (See Text Box 8)[29].

Where it is decided that an EMA system will be introduced, its scope should be defined at this early stage. To do this, the following three questions should be answered:

- Where should the EMA be introduced (focus area)?
- To what depth should the analysis go?
- Which environmental cost categories should be considered for calculation?

The selection of the focus area (which processes or group of products) is based on the company's most important environmental impacts. Usually, the EMA and CPA focus areas are selected together.

The goal of the EMA project will determine how in-depth the analysis must be. For example, each of the following possible goals will require quite a different depth of analysis:

- Calculation of the total environmental costs
- Allocation of costs to cost centres
- Allocation of costs to products that lead to the establishment of an appropriate information system

[29] Reference examples can be found in:
- Martin Bennet and Peter James, 'The Green Bottom Line - Environmental Accounting for Management: Current Practice and Future Trends', 1998;
- Stefan Shaltegger and Roger Buritt, 'Contemporary Environmental Accounting, Issues, Concepts and Practice', 2000,
- Roberta De Palma and Maria Csutora 'Introducing Environmental Management Accounting at Enterprise Level - Methodology and case studies from Central and Eastern Europe', 2003 -

The criteria used for deciding the EMA goal includes the type of production processes and product mix, as well as existing cost accounting procedures. For instance, if the company does not have a cost accounting system in place, a full allocation of environmental costs, to cost centres or to products might not be a realistic or able to be implemented.

The next step in defining the scope is the preliminary selection of which environmental costs should be considered. At this stage, the company managers, with the assistance of an EMA expert should select the relevant environmental cost items for the EMA project.

The detailed selection of environmental cost items will depend directly on the availability of data on environmental costs, but should be finalized in the EMA module, not at this stage.

Additional information on how to scope an EMA is provided in the chapter 'TEST tools', Part III - D.

4. STEP III: general planning for introduction of the TEST approach

The scheduling timeline for the application of the tools and related activities should also be defined and the overall work plan of the enterprise-level TEST project prepared. Additionally, operational performance indicators will be selected and measured at the start of the project to provide a baseline from which to assess the TEST project's results throughout and when completed.

The TEST approach can be started either with the CPA or with the EMS: it is not recommended to start both activities at once especially, in large enterprises.

Guidance and recommendations on when to use one approach or the other, as well as coordination arrangements between these two project modules and between all project activities are provided in the EMS chapter (Part III - C).

The experience gained implementing the TEST programme in the Danube River basin made it clear that it is crucial to create good records describing the conditions before the project starts and to maintain records on the effects of changes as they are implemented. Only then will the enterprises continue to implement the TEST approach. Therefore, a set of operational performance indicators should be selected and measured at the start of the project, to offer a baseline for assessing the impact of measures identified during the implementation of the TEST approach.

Depending on the focus area(s) of the project that were selected in the previous step, a set of eco-efficiency indicators should also be set at this stage. The use of eco-efficiency indicators, instead of just environmental indicators, reflects the need to link the environmental and economic performance of the enterprise. Moreover, traditional environmental indicators fail to provide a real estimate of the impact of the implemented measures when the production capacity changes from the project's start and it is completion.

For additional information on how to select appropriate operational performance indicators and eco-efficiency indicators at this early stage, please refer to Section F, 'Evaluation of implemented measures' within PART III.

Once the work plan is finalized, the commitment of the top management should be requested and a contract signed for the provision of the technical assistance required. This should occur even where the programme is partly subsidized by a Government or an international organization. This arrangement will assure the full commitment and participation of the company throughout the project. The contract should include specification on the human resources internal to the company needed for implementing the TEST approach.

Here again, the results of the initial review can help. The information collected identifying both the core problems and the potential improvements act as incentives to reinforce management's commitment to implement the TEST project.

B. Cleaner Production Assessment

1. Definition of cleaner production

Cleaner production (CP) is the continuous application of an integrated preventive environmental strategy applied to processes, products and services to increase overall efficiency and reduce the risks to humans and the environment[30]. For processes, CP includes conserving raw materials, water and energy, eliminating toxic and dangerous raw materials and reducing the quantity and toxicity of all emissions and wastes.

This definition stresses the need for the ongoing application of CP as an integrated preventive strategy in order to achieve the goal of continuous improvement in environmental performance, in an eco-efficient way. It is a problem solving strategy rather than a solution. CP is built firmly on the understanding that the environmental problems faced by modern society must be solved at the root of their origin, by preventive means[31].

A company achieves CP through two basic techniques:

- Reduction - decreasing the need for input materials through increased efficiency
- Substitution - decreasing the need for dangerous substances through their substitution

2. Implementation of cleaner production

The CP implementation process involves a continuous identification and implementation of CP measures, which range from simple good housekeeping and good operational practices to complex technical solutions, from well proven available techniques to innovative solutions requiring research and development, and from no and low-cost measures to large investments.

The implementation of CP faces a set of attitudinal, institutional and technological barriers. As it focuses on the root causes of environmental prob-

[30] As defined by UNEP. See http://www.unep.org

[31] Karlsson M., Hakan R.: Textbook on Cleaner Production, IIIEE, Lund University, Lund, 2002, p.2.

lems within the enterprise (and/or the supply chain), it requires the involvement of virtually all the employees of the enterprise, since they can all influence the enterprise's environmental aspects in some way.

To implement CP on a continuing basis means to integrate and institutionalize it within an enterprise, on two levels:

1. CP as a strategic approach and guiding idea: the CP has to be integrated into the enterprise's strategy.
2. CP as a skill: CP methodologies should be integrated into the enterprise's procedures, and the employees of the enterprise have to be trained how to implement it.

The role of CP as a strategic approach and/or a guiding idea needs to be stressed. Inserting CP into the enterprise's strategy and thus linking CP to the enterprise's goals and interests of its stakeholders creates a driving force for its implementation on the operational level. If CP does not penetrate the culture of an enterprise, the CP skills acquired in the CPA will disappear. Therefore, integration of a CP approach into the enterprise's strategy is a precondition for linking CP to the core interests of the enterprise and values of its stakeholders. In order to integrate and institutionalize CP on an enterprise level there should be an emphasis on the desired process of a strategic change from the very beginning[32].

For integration of a CP strategic approach into the enterprise's operations it is important that:

- A long-term strategy and strategic priorities (and/or the desire to develop such a strategy) exist
- There is reflection on experience gained from implementation of CPA from the perspective of this strategy

[32] Strategic discussion should be facilitated throughout the project, not only at its end. In the course of implementing CPA, the results can initiate discussion on questions like:

- What are the lessons learned from detailed analysis - can systemic implementation of the CP approach bring better understanding of our processes and their bottlenecks?
- Why was such information was not available earlier?
- What systemic steps have to be taken to have better control over important flows in the processes?
- What are the prevailing causes of inefficiencies and pollution generation? What are the consequences for existing priorities and strategies?

Text Box 5 discusses the integration of CP into business strategy, and compares this with the Total Quality Management approach.

The SES module of the TEST project has been designed to reflect and incorporate the experience gained from the practical implementation of the TEST tools (including CP) at a strategic level. SES provides the necessary structure and tools for the formalization of sustainable enterprise strategies: its full implementation will assure that the CP approach will be integrated into the business strategy (PART III-G).

Text Box 5. CP Integration into Business Strategy: A Parallel with the Total Quality Management

The importance for, and the difficulties with, integrating CP as a strategic approach and/or guiding idea into the overall business strategy can be illustrated with the experience from the quality movement. Following the success demonstrated by the quality movement in Japan, there was a problem in bringing the same desired 'change' to quality management in the US. The US enterprises trained their staff in the new tools and introduced new organizations to quality management (through Quality Circle programmes) following the Japanese blueprint. However, this did not bring the desired improvements in quality.

The problem was that the new tools and skills were being used within the context of the old guiding idea - that quality is inherent to the product and is of concern only to selected employees. It was only after integrating the new idea that came from Japan, that quality is inherent to the customer that the US enterprises were able to make the desired qualitative changes in their quality management. One example of change was the adoption and cultivation of the 'market-in' approach, or making the quality aspects core business concerns that all employees are responsible for.

Using this broader understanding of quality, process inefficiencies and the generation of pollution that could otherwise be a product can be considered as a sign of non-quality as well as an adverse environmental impact on stake-

holders. From another perspective, waste and pollution can also be considered 'products' which the enterprise has to ensure reach certain standards of quality.

CP therefore ties in with Total Quality Management (TQM) and enterprises using TQM can easily integrate CP into their existing management system. A similar situation exists with environmental management systems, which can be used for integrating CP into an enterprise's strategy and operations. However, whichever useful tools and synergies will be utilized for implementation of CP, these efforts will bring the desired breakthrough in the improvement of productivity and environmental performance only if CP will penetrate as a guiding idea in the enterprise culture.

3. CPA methodology

The CP concept applied to processes[33] is called a CP assessment (CPA). It is based on the principle of an understanding of the cause-effect relationship related to environmental aspects of an enterprise's operations, products and services , as CP aims to identify and address the very causes of pollution generation through preventive techniques.

Application of the CPA methodology starts in situations where the commitment to implement CP is strongly endorsed by the enterprise's top management. This commitment is a critical precondition for success and is usually further strengthened as work on CPA progresses.

Next sections highlight some important aspects to be considered in implementation of CPA.

3.1. Priority setting

The root causes of environmental problems that are hidden in production processes can be very complex. For example, there can be hundreds of

[33] The TEST approach, as applied in its pilot implementation, focused only on the production processes within the whole complex of cause-effect relationships in pollution problems (which can include, for example, supply chain management, product design or product-service systems).

inputs entering a process, any or all or which may be partially converted into some type of pollution. Because of this complexity, a CPA has to focus on specific priorities. These priorities are usually selected based on two criteria:

1. Significant environmental aspects.
2. The potential for increased process efficiency and/or economic savings.

Within TEST, an initial selection is done during the initial review, where the focus area for the CPA is first selected.

The same criteria should continue to be used during the implementation of the CPA, to identify the appropriate depth of analysis required (where to focus in the identification of pollution sources and causes). What is an appropriate level of analysis differs from case to case and it is important to focus only on issues that can bring interesting and beneficial findings. Priority-setting tools should be used to confirm whether the effort expended on detailed analysis is justified by what is expected to be needed (effort, costs etc.) for achieving the goals of the CPA.

If an enterprise has mapped its processes very well (with a good overview on material and energy flows) or if the process is unified (like in some SMEs where a few indicators can point out core inefficiencies and their causes), a quick-scan approach, based on benchmarking may be all that is required. This approach can identify the sources and causes of pollution and what to implement. It should be stressed that the quick-scan and benchmarking are superficial approaches, which can provide a good orientation in certain situations, but can also limit case-specific innovation. This can lead to the development of sub-optimal solutions.

3.2. Cause-effect relationship

The root causes of pollution hidden within particular process steps must be identified first. Usually flowcharts and material/energy balances are used here as the main tools to develop a 'map' of pollution sources. This is one of the most labour-intensive activities within a CP assessment, as processes, when viewed in this detail, are complex (often more so than originally thought) and there are usually data missing which have to be collected.

The core question of CP assessment - 'why?' - should be asked repeatedly, so that the root causes of pollution generation can be identified. Only then will the enterprise know the answer to the initial question of where pollution is generated. Possible factors (sources) can be grouped into the following categories:

- Materials - input materials and energies
- Machines - process hardware
- Methods - procedures for operation of technology
- Man - human factor in management and operation of technology
- Product - design of the product

3.3. Developing CP options

3.3.1 Option generation

CP options are based on preventive techniques. These techniques directly address the particular factors influencing waste and pollution generation as follows:

- Materials: through changes in input materials and energy sources
- Machines: through modifications of the existing equipment, or their with new equipment
- Methods: through changes in operational procedures
- Man: through changes to the implementation of procedures and other activities, by training, skills upgrading, etc.
- Product: through changes in the design of products

The primary objective of a CPA is to identify the options that prevent pollution and waste at its source. Where pollution and waste continue to be generated there are two more families of options that can be considered, which are generally considered part of CP:

- On-site recycling
- Development of sellable by-products.

These two techniques are not as efficient as reduction at the source, because additional material and energy resources are needed to make them happen. Note also that when all the costs are calculated, frequently the sellable by-products still represent a loss for an enterprise. These techniques are nevertheless considered CP techniques as they do increase the overall efficiency of the process and reduce the consumption of raw materials, when compared to off-site recycling, land filling or other techniques for treating pollution and waste.

3.3.2. Screening of CP options

The CP options identified can be divided into the following categories:

- 'A' options - good housekeeping options (no investment needed)
- 'B' options - measures that require a small investment and that can therefore be implemented within the enterprise's budget and are characterized by a short pay-back period (usually considered to be up to 6 months, however, this has to be determined on a case-by-case basis)
- 'C' options - measures that require significant investment, with longer pay-back periods and which will require more a complex feasibility study as well as external sources of capital
- Measures that can improve environmental performance but are obviously technically and/or financially not feasible

In the TEST approach, the 'C' options are further investigated in the ESTA module. While feasibility studies for these options are not completed in the CP module, a preliminary evaluation of their technical and environmental suitability is done here in order to justify their suitability for the EST module.

Type 'A' and type 'B' CP options should be implemented within the time-frame of the CPA, so that the enterprise can see rapid and obvious financial benefits from the work they are doing. This both motivates employees and strengthens the interest of management in the TEST approach.

3.4. Step by step implementation of a CPA

A CPA is only one element of a larger programme that identifies and implements feasible CP options. There are different ways of structuring such programmes. However, experience shows that the most of these programmes usually need to include the following basic steps:

- Getting started - planning and organizing the CPA
- Analyze process steps - in order to identify sources and causes of pollution and waste
- Generate CP options - options based on preventive techniques to address the identified causes of the pollution or waste, so as to eliminate or at least reduce their quantity/toxicity
- Select the CP options to implement - screening of the options identified
- Implement the selected CP options
- Sustain the CP effort by starting the process again in a different part of the enterprise and/or on a different set of pollution/waste streams

These steps are further illustrated in table 5, which provides the characteristics of particular steps of CPA and related activities[34]. Table 5 also it shows examples of tools, which can be utilized for implementing particular activities, illustrating briefly the richness and creativity of this process. (Many tools listed in this toolkit were adopted from the quality management).

[34] The starting point for this description is the steps and activities used by the Indian Cleaner Production Centre within the UNIDO/UNEP Program of NCPC's.

Table 5. Summary: Main Steps of CPA and Its Activities, Including Examples of Tools that can be Used for Each Step

Step of CPA		Purpose	Activities		Toolkit to Achieve Each Step
1	Getting Started	Map all significant problems. Narrow down the list, identifying the most important problems to be addressed immediately. NOTE: The CPA focus is chosen at the end of the initial review	1.1	Designate CP Team	Team building
			1.2	List process steps	• Process mapping: ○ Walk through process ○ Quick scan ○ Benchmarking ○ Input-output analysis ○ Preliminary audit ○ Preliminary energy efficiency review· • Planning: ○ Strategy development ○ Project planning ○ Target setting
			1.3	Select assessment focus	
			1.4	Prepare plan of CP assessment	
2	Analyse Process Steps	Identify the pollution sources (within the CPA focus) and develop an understanding of the causes of the pollution. Narrow down the list to important sources. NOTE: should provide guidance if investments are required for measuring equipment for data collection	2.1	Prepare a flow chart of the processes	• Process mapping: ○ data collection ○ measuring and balancing • Multi-criteria analysis to set-up priorities ○ Benchmarking ○ Assigning costs to material flows ○ Pattern diagrams ○ Sankey diagrams • Identify pollution sources and more detailed process mapping: ○ Worksheets for data collection ○ Interviews ○ Observations ○ Material balances ○ Measurements ○ Experiments • Consider Cause-Effect relationships ○ Review the trends in performance over time using statistic methods ○ Stratification ○ Gap identification (for example comparison of theoretical and measured data or a Control Chart) ○ Fish bone diagram ○ Relational diagram ○ Scatted diagram ○ Repeating WHY analysis (3 – 5 times) ○ Experiments
			2.2	Perform material and/or energy balances – compare theoretical and measured data	
			2.3	Assign costs to material and / or energy flows	
			2.4	Determine data requirements and collect additional data	
			2.5	Complete material and energy balances – compare theoretical and measured data	
			2.6	Review pollution sources and sources of energy inefficiencies	
			2.7	Identify pollution causes and causes of energy inefficiencies	
3	Generate CP Opportunities	Start defining the scope of possible solutions	3.1	Develop CP opportunities including energy conservation opportunities (ECOs).	• Use expert techniques: ○ Brainstorming (after completion of detail analysis). ○ External expertise (advise from sector experts, sector specific CP manuals, BREFs etc.).

Step of CPA		Purpose	Activities		Toolkit to Achieve Each Step
4	Select CP Opportunities	Narrow down opportunities to those which are feasible (including amendments to the existing technology where appropriate) NOTE: See also Part II, Section B-6.2 – investment-needing 'C' measures.	4.1	Assess technical feasibility.	• Tools for technology assessment (including investment appraisal) are found in the EST module • Evaluation data gathered in the step 2 • Total costs assessment and pay back period
			4.2	Assess environmental feasibility.	
			4.3	Assess economic feasibility.	
			4.4	Select solutions (CP measures) for implementation. NOTE: Measures requiring investments are further developed and evaluated within the EST module	• Review results from 4.1 – 4.3 • Consider social consequences / impacts
5	Implement CP Solutions	Prepare an action plan	5.1	Prepare implementation plan	• Project planning • Development of indicators utilising data gathered within the step 2
			5.2	Execute CP implementation	
			5.3	Monitor and evaluate results	• Monitoring of performance • Evaluation of performance (using indicators) • Internal reporting
6	Sustain CP	Establish mechanisms, which will sustain CP at strategic and operational levels.	6.1	Top management review and reflect on results of CP implementation	• Presentation of results and experience gained • Interpretation of gained experience • Strategic discussion (starting by conceptual reflection of gained experience and guiding ideas) • Integrating CP approach into the enterprise operation (using, for example, the EMS structure and its tools for continuous improvement). • External reporting and dialogue with stakeholders.
			6.2	Sustain CP solutions	• Developing system for monitoring material and/or energy efficiency (for example through EMA module)
			6.3	Select new focus area(s) and continue in implementation of CP	• Integrating material and energy efficiency into the enterprise operation (using, for example, the EMS structure and its tools for continuous improvement) • Considering options which originally were placed as a lower priority after the most important items are corrected

4. CPAs and energy audits

CPAs can also include an energy audit, depending on the focus that has been given to the CP module by the enterprises (Text Box 6 describes an example of a combined CPA and energy audit). The main difference between a traditional CPA (that generally focuses more closely on material flows) and an energy audit is that in the latter it is usually much more straightforward to identify sources of energy losses than it is in a CPA to identify, with precision, the sources and causes of material pollution/waste streams. Energy-using equipment (for example, electric motors) and/or the distribution lines are obvious sources of losses, which can be further investigated. Energy conservation options (ECO's) are also much more standardized than is the case for CP options that are aimed at the conservation of material flows. Finally, in an energy audit, it is relatively easy to quantify the economic value of energy losses and the financial benefit associated with the implementation of ECO's (energy bills).

On the other hand, it should be noted that energy audits require that the local consultants have quite specific technical skills, reinforced by in-plant employees with working experience on energy efficiency aspects. Performing an energy audit also requires that specific energy measurements be taken at the facility, using the necessary measurement equipment.

5. Resources on Cleaner Production

5.1. General references

- Important Internet resources for CP are the UNIDO and UNEP websites (http://www.unido.org/NCPC/ and http://www.uneptie.org/pc/cp/)), which, among other things, provide information on the network of the National Cleaner Production Centres (NCPCs) and the UNIDO CP database.
- The CP practitioners website www.cleanerproduction.com, provides a good overview of up-to-date information, documents and links in the field.

5.2. CP Assessment methodology

Manuals describing the CPA methodology focus on the operational and management levels of the management pyramid. Information on more approaches towards CPAs are provided in:

- An Organizational Guide to Pollution Prevention, EPA/625/R-01/003, U.S. Environmental Protection Agency (U.S. EPA) 2001, which is downloadable from http://www.p2ric.org/CachedPages/printguid.pdf

The traditional approach towards CPAs are described, for example in:

- Audit and Reduction Manual for Industrial Emissions and Wastes, UNEP IE and UNIDO 1991
- PREPARE Manual for the Prevention of Waste and Emissions, ISBN 9034625656, NOTA 1991
- Facility Pollution Prevention Guide, EPA/600/R/92/088, U.S. EPA 1992

Note that in the US, CP is referred to as 'Pollution Prevention' (PP or P2).

5.3. Sector specific CP information

- Pollution Prevention Clearing House: http://www.epa.gov/oppt/library/ppicindex.htm contains among other things the Sector Notebook Reports (Sector-specific CP guides) of the U.S. EPA: http://es.epa.gov/oeca/sector/index.html Note: This Clearinghouse is part of a larger U.S. EPA website on CP: http://www.epa.gov/p2/.

- International Cleaner Production Information Clearinghouse (ICPIC) - contains among others, CP case studies from different industrial branches from around the world: http://www.emcentre.com/unepweb/tec_case/index.htm

- ENVIROWISE is an assistance programme focusing on the promotion of CP. It is supported by the UK government and its publications include sector specific notes, benchmarking studies, guides and case studies:
  http://www.envirowise.gov.uk/

- Green Profit is a database of CP case studies and techniques:
  http://www.greenprofit.net

- A similar database is the Cleaner Production Case Studies Directory:
- Similar information can be found at ENVIRONET:
  http://www.environet.ea.gov.au/topics/solutions.html

- An important resource is the handbook developed by the World Bank: Pollution Prevention and Abatement Handbook, ISBN: 0-8213-3638-X, World Bank 1999. This handbook contains general characteristics of particular industrial branches and is accessible through:
  http://www-wds.worldbank.org/servlet/WDS_IBank_Servlet?pcont=details&eid=000094946_99040905052283

- General environmental and health and safety sector specific guidelines are available at:
  http://www.ifc.org/enviro/EnvSoc/pollution/guidelines.htm

- Information on energy conservation options is provided in: Guide to Industrial Assessments for Pollution Prevention and Energy Efficiency, EPA-625-R-99-003, U. S. EPA 2001.

Text Box 6. Example of Combined Application of a CPA and Energy Audit at a Bulgarian Enterprise

In all TEST enterprises, implementation of the CP module showed the possibility of improving efficiency, through improved material and energy engineering. One of the best experiences with the CP module was at an enterprise in Bulgaria where the TEST project focused on reducing the water pollution and improving the energy efficiency in an alcohol production unit. There was a strong commitment by the enterprise's management to the TEST project, due in part to the high penalties paid because of the pollutants present in the water this suit's discharge water (The penalties paid and the pollution levels were also limiting the overall production of an otherwise profitable unit).

The initial review showed high CP potential on the water pollution side, the original focus of management concern (different end-of-pipe solutions were being considered by the enterprise before the start-up of its TEST project). Using the CP module clearly widens the scope of possible solutions by focusing on the technological process itself (asking questions about how the preceding technology steps and quality of input materials influenced the amount and quality of the pollution generated). However, the initial review also showed that there was a need to redefine the problem, because another important issue was identified: the quality of the product was poor and inconsistent. The local market traditionally accepted this lower quality due to the lower price. However, this status quo was questioned from the perspective of the broader business strategy of the enterprise.

The most labour intensive step of the CP assessment was, as expected, the detailed analysis of the material and energy flows in the process. There was a general lack of data and information, for example, the first walk-through of the process revealed a lack of information on the flow of the raw material (molasses) and water in the process. There were also obvious energy losses related to the discharge of the cooling water, which had not been quantified before. The first balances showed large gaps in the overall water balance and revealed the need for measurements to be taken. Costs were assigned to material and energy flows, which provided a good justification for the needed measurements.

The enterprise highlighted, as the main value added by the CPA module:

** The detailed analysis of the process, including the energy audit, enabled the management to accurately map the material and energy flows and identify sources and causes of losses and expand the scope of possible solutions*
** Faced with the resulting multitude of CP options, the methodology enabled management to more efficiently priorities actions and select priority CP measures for implementation*

The CP options the enterprise chose to implement helped it comply with environmental legislation by bringing about significant reductions in water pollution. At the same time, the enterprise obtained significant economic gains from the improved efficiency of the processes targeted. In addition, with the improvement of the quality of the final product (which went hand-in-hand with the reduced pollution levels), there was an increase in the overall competitiveness of the whole business.

Enterprise management and staff also gained detailed insights into the CP strategic approach, and they will continue to use it in addressing other problems of the enterprise in their follow-up activities. Based on the experience gained, they understand that CP is a natural approach for continuously increasing overall quality and productivity, while reducing environmental risks.

The full case study illustrating the results of the CPA at the Bulgarian enterprise can be found in Annex III.

C. Environmental Management Systems

1. Overview

Environmental management systems (EMS) have predecessors in quality management systems. Total Quality Management is 'a structured system for satisfying internal and external customers and suppliers by integrating the business environment, continuous improvement, and breakthroughs with development, improvement, and maintenance cycles while changing organizational culture'[35].

Systematic activities are driven by a strong sense of responsibility and leadership on the part of top management, leading to the establishment of a clear medium- to long-term vision of the business and to the development of appropriate quality strategies and policies. This definition illustrates the role of management systems within the management pyramid: their role is to link the goals developed within an enterprise's policy and strategy, with the enterprise's operational system. The Total Quality Management Systems have the objective of guaranteeing specified quality parameters and/or continuous improvement of quality. Similarly, the Environmental Management Systems have the objective of ensuring that the enterprise generates/produces pollution/waste outputs of a quality that is satisfactory to the stakeholders, at the right time and at the right place.

The EMS module is structured on the 'Deming scheme' of 'Plan, Do, Check, Act' (PDCA), which was derived from learning cycles (similar to the implementation of an enterprise strategy). With an EMS, an enterprise uses the PDCA scheme to manage its environmental aspects[36] in such a manner as to obtain continuous improvement in its environmental performance. The EMS also allows the enterprise to document, evaluate and communicate its environmental performance.

An EMS is defined as 'that part of the overall management system that includes the organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implement-

35 http://www.iqd.com/hoshin_def.htm

36 An environmental aspect is the element of an organization's activities, products or services that can interact with the environment - ISO 14001

37 ISO 14001

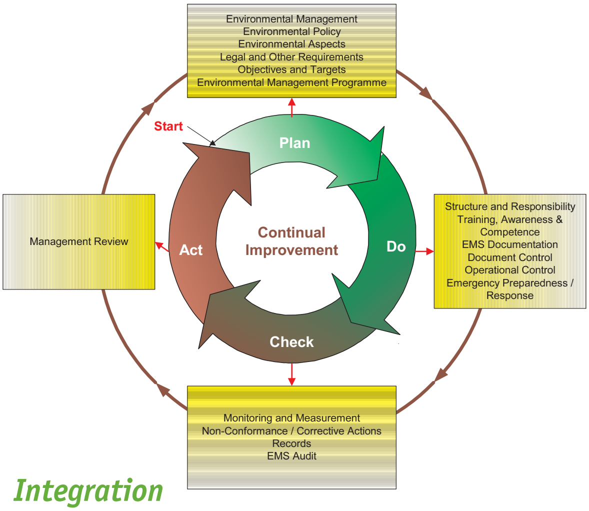
ing, achieving, reviewing and maintaining the environmental policy'[37]. Thus, an EMS should be an integral part of the existing management system, meaning for instance that it should be harmonized with a quality management system if the enterprise already has one in place. It should be noted that an important aspect of the TEST approach was to introduce an EMS only in cases where a quality management system was already in place, because the introduction of an EMS is very much facilitated in this case. Much more work is required if such systems do not already exist at the enterprise.

While recognizing the importance of other EMS standards (like EMAS), the TEST approach promotes the introduction of an EMS consistent with the ISO 14000 standards, since these are the most widely used EMS standards in the developed and developing countries. The main elements of an ISO 14001 EMS are presented in figure 13 (following the Deming scheme).

The effective implementation of an EMS within the TEST approach is reinforced by the use of the CP module. There are a number of aspects in each EMS element that can make the CP module work more effectively and continue to be used over time, while the CP module in turn can become the heart of the EMS's continuous improvement strategy. If properly coordinated, the EMS and CPA tools together can produce more benefits for the overall environmental performance of the company than if each of the tools is applied independently.

Within the Deming scheme, integration of EMS and CPA can take place mainly in the planning and implementation (Plan and Do) phases. The other two phases of the Deming scheme are more important for integration of the CP approach into the enterprise's operations. Figure 13 shows in more detail those areas were EMS and CPA can complement each other.

Figure 13. Continual Improvement Cycle



2. EMS & CPA Integration

2.1. Environmental policy

An environmental policy is defined as 'a statement by an enterprise of its intentions and principles in relation to its overall environmental performance, which provides a framework for action and for the setting of its environmental objectives and targets '.[38] The environmental policy provides the framework for action and for the setting of the enterprise's environmental objectives and targets.

The TEST approach can be integrated into the enterprise's strategy through the environmental policy. The company can use CPA as a tool to help achieve the goals of its environmental policy and for the continuous improvement of its environmental performance in an eco-efficient way.

Amongst EMS practitioners there are often discussions regarding at which stage an environmental policy should be developed. The environmental policy should reflect the enterprise's values, vision and core strategies in the field of environmental management. Therefore, many practitioners place its development at the beginning of the process of establishing an EMS (following the ISO 14000 standard), even before the initial review has been completed. This approach is justified by the need to have some guidance for the initial review and for the identification of significant environmental aspects.

[38] ISO 14001

This is feasible in enterprises that already know their position, have a vision and operate under stable and transparent conditions. However, if there is no need for developing environmental policy at the beginning (to strengthen and communicate commitment of enterprise management in this area), it could be more effective to develop the policy after the initial review, i.e., once the environmental situation of the enterprise is better known. Regardless, the policy can always be improved upon through the learning experience during the running of an EMS.

2.2. Identification of significant environmental aspects

One of the first steps of the EMS planning phase is the identification of the environmental aspects of the company. Environmental aspects are elements of an enterprise's activities, products and services that can have an environmental impact. According to ISO 14001, an environmental impact is any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products or services, which is caused by an aspect.

The purpose of EMS is to manage the enterprise's environmental aspects to prevent adverse environmental impacts from occurring. This is done through the identification of mitigation measures within the EMP (Environmental Management Programme) and/or by setting appropriate operational control procedures. Environmental aspects are therefore central to the practical implementation of EMS.

First, the company should prepare a procedure for the identification and prioritization of the environmental aspects of its activities, and then it should implement the procedure. It should be noted that the way of describing environmental aspects could pre-determine the primary strategic approach that the management will use. For example, if an environmental aspect is described only from the perspective of an emission standard that is media-specific (e.g., the discharge of cyanide in wastewaters from an electroplater), this could well encourage the enterprise to focus on end-of-pipe solutions without exploring the potential for CP. Therefore, care should be taken to describe the environmental aspects in such a way that allows the preventive approach its maximum scope.

According to EMS, the aspects are evaluated and prioritized according to certain criteria in order to identify those aspects that have (or could have) significant impacts, thus providing the baseline for setting the objectives and targets of the EMP. These criteria can include: legal compliance, magnitude of the environmental impact, difficulty in changing the impact, cost of changing the impact and concerns of interested parties (as indicated in the ISO 14004).

Within the integrated introduction of CPA and EMS, as foreseen in the TEST approach, an enterprise can use the same tool of input-output analysis to identify the CPA's focus areas and sources of pollution and the EMS's environmental aspects. However there are some differences concerning the use of input-output analysis within CPA and EMS:

- Scope - In the initial stage of the CPA, the input-output analysis aims at identifying priority focus areas, which include significant environmental aspects. In EMS, on the other hand, it is used to identify all environmental aspects of the enterprise, with priorities being set in a second stage. During the second step of the CPA (the detailed analysis), the input-output analysis is now used in the focus area to identify the causes of pollution
- Quantification - In an EMS, the enterprise identifies its significant aspects using relatively qualitative criteria. The criteria can include quantified data on material and energy flows, but even in this case an enterprise will not need to use as detailed data as it would in the CPA. Conversely, when the enterprise is selecting the focus area(s) of its CPA, later when it undertakes the detailed analysis, the significant aspects are only quantified in material and monetary terms. The potential to improve both environmental and financial performance, only through the efficient use of input materials, is the main criteria for selection of focus area(s) for CPA.

From these considerations, even though the EMS includes a method for the systematic identification of a company's environmental aspects, it acts more at a macro level; there is no systematic approach or tool in the EMS that helps enterprises investigate deeper and identify the root causes of the pollution or waste associated with each environmental aspect. Yet, it is only when management knows the root causes that it can properly direct its efforts exploring potentially available preventive potential. This is where the detailed CPA can be useful in providing inputs to, and increasing the accuracy of, the process by which environmental aspects are prioritized, leading to a more refined selection of significant aspects than is required by EMS.

Therefore, CPA, and more specifically its step of detailed analysis, can provide the necessary systematic approach for identifying the causes of pollution and for exploring a broader range of pollution prevention measures that can then be implemented within the EMP of the EMS. Note that this is valid to the extent that environmental aspects are related to materials or energy flows (i.e., environmental aspects related to noise or vibrations, for instance, could not be analyzed in more detail through a CPA).

2.3. Setting up objectives and targets

Both EMS and CPA involve setting goals and targets, however there are significant differences between these sets of goals and targets, both in when they are set and what is their focus. In the EMS, goals and targets are set after the significant environmental aspects have been identified and they are addressed in specific environmental programmes. In CPA, goals, targets and indicators are set at an earlier stage, during the selection of the focus areas and try to:

- Keep the focus of the work on a detailed CPA
- Encourage the commitment of the enterprise to achieve significant improvements of selected indicators using all feasible preventive measures

Note that setting targets at the start of a CPA is not easy and cannot be very accurate. Therefore, very few CPA practitioners do this. However, it is considered a ‘good marketing’ approach to raise the interest of the company and persuade it to implement a CPA. Targets of a CPA may change over time with an increasing understanding of the problems. If the targets are not achieved, this is simply a challenge for further continuous improvement.

In terms of focus, generally the goals and targets set in an EMS derive from some environmental pressure (for example, from gaps in compliance). Compliance alone is sufficient to be set as the target. Targets that are more ambitious are usually not tackled with the first round of an EMS implementation, as an enterprise could question its ability to achieve such targets or think it does not have the appropriate tools for setting them. It is also a matter of priorities: depending on the nature of compliance requirements, achievement of compliance can represent a vital necessity if the authorities are to allow the operations to continue, so spreading efforts to less critical goals may leave a facility open to legal challenges and a large business risk.

In a CPA, on the other hand, targets have generally an eco-efficient orientation, which could also reflect compliance goals (but do not necessarily have to). Conversely, some compliance related objectives, which can only be achieved through end-of-pipe solutions, do not necessarily imply potential savings, thus do not represent a CP target.

Following the TEST principles, one integrated approach should be used to set the objectives and targets needed to meet the specific needs of the enterprise for both EMS and CPA. These two types of objectives and targets can go hand in hand:

1. Compliance objectives and targets that meet the challenge of coping with environmental legislation (both existing and future).
2. Eco-efficiency objectives and targets that meet the challenge to use the preventive potential of win-win solutions (going beyond compliance).

The main contribution of CPA to EMS, at this planning level, is ensure eco-efficient objectives and targets are included in the EMP (along with those for traditional compliance).

It must be stressed that EMS works at the macro level, while CPA acts at the micro level of the enterprise. Therefore, the eco-efficiency goals of a CP assessment are usually the specific targets assigned to reach a more general EMP objective.

2.4. Environmental programmes

CPA is ‘the’ tool for the elaboration and implementation of specific EMS programmes that focus on eco-efficiency objectives and targets.

CPA identifies sources of pollution and causes for its generation on a deeper level than EMS usually can do (as CPA has to work with environmental aspects on a more detailed level). Here, the main value added by CPA is the ability it gives the enterprise to analyze particular environmental aspects from the point of view of understanding the sources of pollution giving rise to the aspect and linking them to the specific causes (including if necessary, performing a very detailed balancing of important flows).

Feasible options identified within the CPA that address significant sources of pollution (environmental aspects) could help the company reach the eco-efficiency and/or compliance objectives and targets of the EMS. CPA measures could represent the core technical inputs for the preparation of the EMP action plans.

2.5. System for implementation

The ‘vehicle’ of EMS is the system of resources, structures and responsibilities, communication and documentation (i.e. the written procedures and working instructions) used to achieve the goals in the environmental policy and the objectives and targets set within the EMP. As part of any CP project, this ‘vehicle’ must also be created, but on a more basic level to make it possible, to implement the feasible CP options identified.

Therefore, a CPA can benefit substantially from the EMS module, which can provide a very effective vehicle for the implementation of the CPA results. EMS can also ensure a more long-term commitment to CP by an enterprise, by giving it a vehicle through which to continue the use of CPAs. The transfer of information does not happen automatically and it should start by linking CP to the objectives and values far down in the management pyramid, as already described. The other crucial precondition for the successful adoption of CP is appropriate training, awareness and competence in this area developed, across the entire enterprise.

2.6. Conclusions

EMS is an important tool for the implementation of the whole TEST project at a facility level since it provides the framework for the coordination and implementation of all other modules, particularly CPA. It is highly recommended that CPA and EMS be introduced as one integrated tool[39]. However, CPA and EMS should not start simultaneously, to take better advantage of the synergies and avoid duplication of efforts and confusion between the teams As seen with the experience from the TEST programme in the Danube (see Text Box 7), it should be possible to start either with CPA or with EMS.

In summary, the coordination of the CPA and EMS tools should focus on:

- Integrating the CP approach into the enterprise's environmental policy
- Using the results of the CPA to provide input for the planning of the EMS: assist in the identification of significant environmental aspects and their quantification and the setting of eco-efficient objectives and targets which go beyond just compliance goals (this is possible only if CPA is initiated before planning of EMS)
- Using CPA to implement particular environmental programme(s) of EMS and its action plans
- Using EMS as a 'vehicle' to implement CP measures and sustain CPA within an enterprise

The utilization of CPA for the implementation of particular EMPs is a key aspect of the integration with EMS and can be done either when the EMS is initiated before the CPA or when CPA is initiated before EMS. When the EMS is initiated first, CPA can be used after the planning phase of EMS is completed: Here, CPA will be a useful tool for the systematic identification of solutions to reach specific objectives and targets of the EMP.

If the CPA and/or cleaner production strategy becomes part of the enterprise culture, mastering of the CP tools will become part of enterprise skills and CP will be integrated into both the enterprise strategy and operations. This one of the core means TEST uses: merge the improvement of environmental performance with improved competitiveness.

[39] This requires mastering of CPA by those providing technical assistance within EMS implementation and vice-versa. Strong coordination between the teams is crucial.

Text Box 7. Experience from the Start-up of the TEST Approach and the EMS and CP Modules in the Danube River basin

Start-up

Eleven of the seventeen enterprises that took part in the TEST programme in the Danube River basin were motivated by the opportunity to receive technical assistance and consultancy to design their EMS, rather than to explore their potential savings from CP. This was the case especially in Hungary, Slovakia and Romania, where the existing economic drivers in the business environment are pushing enterprises (exporting to EU markets or willing to export), towards the introduction of EMS and obtaining ISO14001 certification. Furthermore, to have a certified EMS in place was perceived by managers as a good instrument to improve their image with national authorities and local communities.

An important factor that influenced and contributed to the successful implementation of EMS in those eleven enterprises was that a quality management system existed (or was under development). The top management of these companies often perceived CP as a highly time and human resources-consuming activity, which would not necessarily bring immediate benefit to the company. With these considerations in mind, presenting the EMS and CPA tools as parts of the integrated TEST approach was a very successful idea. Companies that were initially interested in just receiving technical support for the design of an EMS were later convinced to undertake a CPA as well. Later, most of the managers recognized the usefulness of the CPA itself for the identification of pollution prevention options.

The remaining TEST companies were interested primarily in CP and were not focused on EMS. These companies did not have a quality management system in place, had relatively complex technological processes (chemical and pulp and paper sectors) and did not have a detailed knowledge of the operation and monitoring of their processes. Managers of this type of company immediately understood the benefit of undertaking a detailed CPA to get a better understanding (mapping) and control of their processes. The CP potential made these projects very attractive as it represented the possibility to iden-

tify large sets of measures for reducing pollution and production costs at the same time. In this case, the EMS was presented as the necessary tool to maintain and improve operational control in the long-term and only the EMS elements relevant to achieve this were implemented.

Results of the EMS Component

EMS elements were introduced in all participating enterprises, but the full EMS was introduced in only 11 enterprises, of which 4 obtained ISO 14001 certification by the end of the project[40]*. Of the remaining companies, 4 have the full documentation in place (pre-audit stage, certification expected by the first half of 2004) and 3 enterprises have adopted the main system procedures. The impact of the EMS module is represented in Figures 14 and 15. In 9 of the 11 enterprises that introduced the full EMS, the system was fully integrated with the existing quality management systems.*

Furthermore, as a direct result of the EMS component of the TEST projects, several organizational changes occurred in the environmental function. All the enterprises where the full EMS was introduced showed an increased commitment to managing their environmental aspects, although to a different degree depending on the size of the company and on the previously existing situation. In some cases, the change was moderate, reflected simply in the appointment of an environmental manager. In most of the cases, however, the changes were significant and involved the creation of an environmental department or the increase of its staff. In some of these cases, the environmental function was recognized as a horizontal function under the direct supervision of top management (and not under the production departments, as it had been previously in many cases).

More human resources were appointed to existing environmental functions and an average of 30 percent of the employees had environmental tasks included in their job descriptions.

[40] In March 2003 Rulmentul (Romania) was certified ISO 14001, in June 2003 Nitrokémia (Hungary), in April 2003 Guntner (Hungary) and in October 2003 ZOS (Slovakia).

Figure 14. Introduction of EMS at the TEST Enterprises

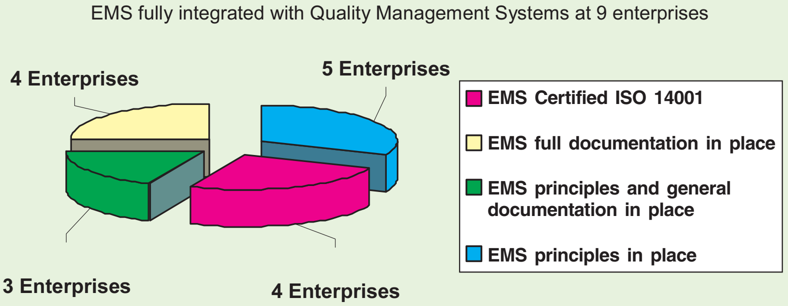
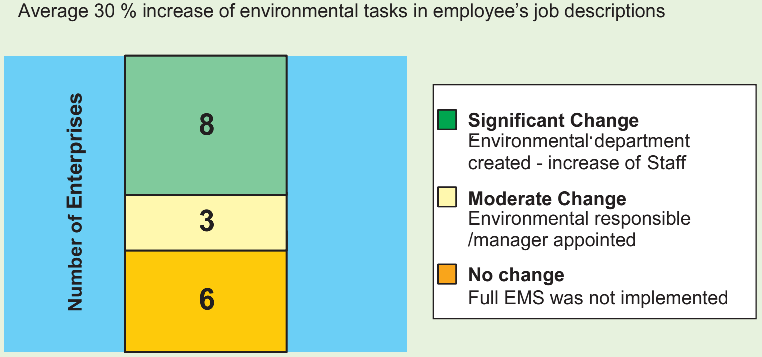


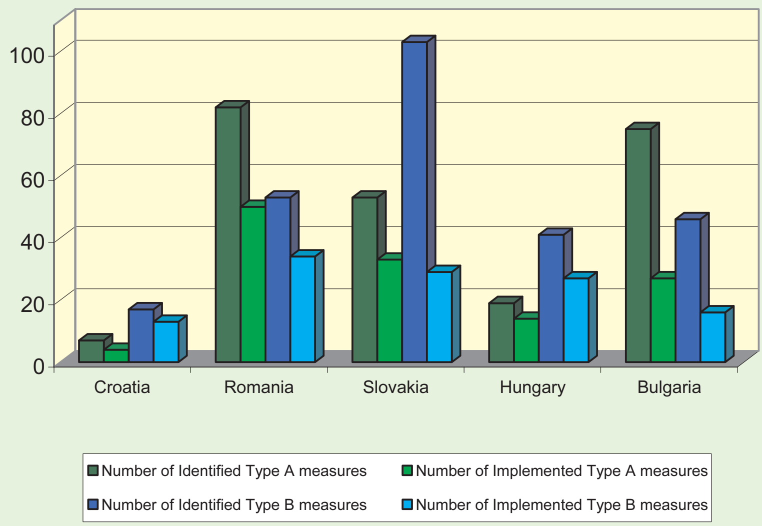
Figure 15. EMS implentation: Organizational Changes



Results of the CPA Component

The implementation of CPA brought significant benefits to the 17 enterprises participating in the TEST project, both in terms of financial savings and in terms of environmental benefits. A total number of 224 good housekeeping measures (Type A) and a total number of 260 CP measures requiring relatively small investments (Type B - having short payback periods) were identified. Out of the total CP measures identified, 128 Type A and 109 Type B measures were approved and implemented by the end of 2003, using the companies' own financial resources. Figure 16 shows the total number of identified measures vs. the number of implemented measures, broken down by country.

Figure 16. TEST Project in the Danube River Basin: Number of Identified vs. Implemented CP Type A and B Measures (by country).



It can be seen that the total number of identified measured varied significantly from one country to another. For instance the Romanian, Bulgarian and Slovak companies had the highest number of identified Type A and Type B measures. This quite high CP potential can be explained by the fact that the pilot TEST companies in these three countries used very outdated technology (compared with the pilot companies in the remaining two countries), thus many more measures could be identified to optimize the existing process.

In general, the ratio between the identified and the implemented measures was quite high, with the exception of a few companies in Slovakia, Bulgaria and Romania. The reason for this is that large sets of the measures that were initially identified as Type B measures were replaced by major EST measures (Type C) requiring significant investment for changes in the technological process

Table 6 provides a summary of the total investments undertaken by each company to implement the 109 Type B measures, the related financial benefits (savings) achieved and the range of payback period (PBP).

Table 6. Financial Figures of the Implemented Type B CP Measures

Financial Figures of the Implemented CP Measures (Type B)				
Country	Enterprise	Total Investments [USD]	Total Savings [USD per year]	Range of PBP
Croatia	Agroproteinka	13,500	23,000	7 months
	Gavrilovic d.o.o.	23,000	113,345	2-6 months
	Herbos	14375	26,615	6 months
	IPK Tvornica Secera Osijek	12,466	179,710	8 days
Romania	Astra Romana	36,000	60,000	0.3 - 1.1 yrs.
	Rulmentul	29,300	11,300	0.6 - 3.2 yrs.
	Chimcomplex	40,100	209000	1 - 6 months
	Somes	42,800	130,000	0.01 - 3.7 yrs.
Slovakia	AssiDoman Sturov	1,098,000	313,000	1-3.5 yrs.
	Zos Trnava	22,500	130,000	0.1-1 yrs.
Hungary	Gunter – Tata Kft.	81,751	95,420	3 weeks - 2.17yrs.
	Indukcios es Vedogazos	36,710	32,100	0.62 - 9.3 yrs.
	VIDEOTON Audio Company	2,577	3,880	0.26-0.63 yrs.
	Nitrokemia 2000	-	-	
Bulgaria	Yuta JSC	230,000	150,000	1 - 2.3 yrs.
	Slavianka JSC	-	-	-
	Zaharni Zavodi AD	18,000	9,200	0.5 yrs.
	TOTAL	**1,686,704**	**1,277,570**	

Integration of CPA and EMS

CPA and EMS were not introduced simultaneously in the TEST approach. Two different approaches were used in the selected enterprises:

- *A CPA driven approach*
- *An EMS driven approach*

The selection of one or other approach was done during the initial review step of the TEST approach, depending on the specific situation at the enterprises (e.g. type of production processes and level of interest level on the part *of management). Efforts to integrate the steps of the CPA and the EMS generally followed the two approaches described above.*

Some of the TEST enterprises in the Danube River basin programme used the first approach, starting with the CPA in the focus area chosen during the initial review. In these cases, the planning phase of the EMS started only after the detailed analysis of material and energy flows was completed. With quantified data in hand on the waste and pollution flows, the significant environmental aspects (related to production) for the EMS could be identified. At the end of the detailed analysis, the EMS's register of environmental aspects could be finalized and EMP objectives could be set. At this point, the CPA was continued: CP measures were identified and the CP implementation action plan was included as part of the overall EMP action plan. Then, the implementation of the EMS's documentation requirements was started. The entire identified CP good housekeeping measures, including maintenance and control of the process were formalized into EMS procedures and working instructions and included within the system documentation.

The TEST enterprises using the second approach started with the planning of the EMS before the CPA. The preliminary environmental review was deepened during the initial review; the environmental policy was drafted and environmental aspects identified. Once priority environmental aspects were identified and the EMS objectives and targets prepared, the CPA focus area was selected, and the CPA started[41]*. CPA was used as a tool for the identification and implementation of specific EMS programmes to explore measures to increase the efficiency of the process and produce potential economic benefits.*

In addition to these practical considerations regarding the implementation and coordination arrangements of CPA and EMS, a conceptual difference should be highlighted with respect to the selection of the significant environmental aspects. As suggested by ISO 14001, the criteria to be used for screening the environmental aspects should be selected by the company. However, two different approaches were used at this point. The first approach, used by some enterprises, focused mainly on the traditional environmental impact criteria mentioned in ISO 14004 for assessing the magnitude of specific environmental aspects. The other enterprises included the CP criteria of

[41] For these companies selection of CPA focus area was not done in the initial review.

increased efficiency and reduction of production costs (potential for economic savings) with the traditional criteria.

Practical experience has shown that in the majority of the cases the use of CP criterion (potential savings) for the identification of significant environmental aspects leads to setting the same priorities as would be the case using only the traditional criteria, which focus on legal compliance and the magnitude of impact. However, this was not always the case. For instance, the use of relatively inexpensive toxic raw materials (e.g. ammonia in the chemical sector), which end up being emitted mostly in the waste streams, combined with the inadequate fines and penalties regime in some of the CEE countries, could significantly reduce the importance of such environmental aspects when the CP criterion is brought into play. In these cases, the use of a potential savings criterion led to a different set of priorities from that arrived at with the traditional environmental criteria focusing on compliance.

Favourable conditions which led to a successful implementation of EMS-CP were:

- *Competency and high technical skills (e.g. as a result of good training, apprentice programmes, experience or formal education) of both the enterprises' employees and of the national consultants. Partnerships created between the project coordination unit, local enterprises and sector-specific institutions or individual consultants revealed themselves to be effective*
- *Existence of a certified quality system in the majority of the companies participating in the project made it easier to build on employees' experience of working with a quality system and incorporate the environmental components into the existing quality documentation*
- *The presence of some employees who had been trained and/or who had gained some previous experience in environmental management*
- *Existence of earlier attempts to identify and evaluate environmental aspects and in some cases existence of pre-existing documented environmental procedures*
- *A strong commitment of the top management for EMS implemen-*

tation, rather than the traditional sceptical response of some middle level managers at the initial level of implementation of the EMS

- *On-going privatization process (for state-owned companies) that, by increasing the external pressures to implement EMS in the companies, became an incentive for active participation in the programme, especially where foreign partners were involved in the privatization*

The following Barriers were faced during the implementation of the EMS and CP:

Practical difficulties in production e.g. lack of the raw materials, downtime due to a lack of orders, personnel restructuring and management changes, caused delays in project activities and required additional efforts. This was a major barrier in some enterprises not only in the implementation of EMS/CPA but throughout the whole of their TEST project. Additionally, the following barriers to implementation of CPA-EMS were identified:

- *Lack of environmentally-related knowledge on the part of EMS team members: most of the employees involved in the design and implementation of the Mess were working in the quality assurance departments and lacked the necessary background and experience in environmental protection. However, where the involvement of personnel experienced in quality management was limited, implementation of EMS progressed even slower*
- *Resistance to change or an acceptance of process inefficiencies as inevitable*
- *A hidden expectation that the project will provide technologies and/or cheap investment financing.*

Companies participating in the TEST project in the Danube River basin had very little monitoring and measurement equipment. This was the main reason that the data on raw material losses and mapping of pollution sources *were found to be very poor in many companies. The figures they had were mainly based on calculations and assumptions and there were limited data with respect to air, soil and ground water pollution. This was a major barrier in the implementation of detailed CPA analyses of pollution factors, which is the basis for the identification and quantification of the real effects and the real benefits of any CP proposed.*

The bargaining power of the environmental managers within most companies is weak and the idea of proposing investments in CP measures to shareholders generally made them very anxious.

D. Environmental Management Accounting

1. Introduction

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.' [42] 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.

2. 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 emitted, as 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 minimized 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.

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 abil-

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

ity 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 prioritizing 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.

2.1. Product/process related decision-making

Correct costing of products is a precondition 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 recalculated costs
- Re-evaluation of the profit margins of products
- Phasing-out certain products when the change is dramatic

- Redesigning processes or products in order to reduce environmental costs
- Improved housekeeping and monitoring of environmental performance.

Table 7 summarizes the main environmental cost categories[43] found in business.

Table 7. Environmental Cost Categories

Environmental Cost / Expenditure Categories									
1		2		3		4		5	
Waste and Emission Treatment		Prevention and Environmental Management		Material Purchase Value of Non-Product Output		Processing Costs of Non-Product Output		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								

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[44]. Savings associated with this category of environmental costs into project evaluations will make a larger number of cleaner production projects more profitable.

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

[44] 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.

2.2. Investment project 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[45]. These environmental costs have been grouped into five categories[46] as follows:

1. 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.
2. Administrative costs buried in the overhead costs and hidden. Examples include monitoring, reporting or training costs.
3. 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.
4. Image benefits and costs, often called intangible or 'good-will' benefits and costs, arise from the improved or impaired perception of

[45] In annex IV of this manual, the results from a Slovak enterprise -KAPPA STUROVO participating in the TEST project in the Danube River basin are summarized. The case study illustrates how profitability of a large EST investment is influenced by contingency environmental costs.

[46] An introduction to Environmental Accounting As A Business Management Tool: Key Concepts And Terms, pg. 8-11, EPA, June 1995

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.

5. 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 generates standards strictly regulating SO_2 emissions, which would be internalized, 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.

3. 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.

3.1. EMS

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.'[47] 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'[48].

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

[47] ISO 14004: 1996 Environmental management systems - general guidelines on principles, systems and supporting techniques, normative references page 2

[48] ISO 14001: 1996 Environmental management systems specification with guidance for use, Section 4.3.3

priorities, targets and objectives within an EMS. Thus, having an EMA system in place will help managers to effectively implement the EMS.

However, within the TEST approach, the EMA is completed when the EMS is in the 'check' stage. Thus, the results of the EMA could only be used in the management review stage of the EMS to revise its priorities (the significant environmental aspects).

3.2. 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.

4. 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[49] financial costs and benefits are a sub-group of

[49] International Organization for Standardization: Environmental Performance Evaluation

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.

5. The methodology

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[50]. 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[51] and the P2Finance (developed by the Tellus Institute[52]) software tools. Cost categories were defined following the existing workbook published by United Nations Division for Sustainable Development (UNDSD)[53].

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

In the following section, the steps of the EMA implementation process are described.

50 Stefan Shaltegger and Roger Buritt: Contemporary Environmental Accounting, Issues, Concepts and Practice, 2000

51 COMFAR is computer software that permits the user to simulate the short- and long-term financial and economic impacts of investment projects. The software permits the analysis of industrial as well as non-industrial projects, new investments, reconstructions, expansions, joint ventures or privatization projects. Demonstration versions of the COMFAR tool can be downloaded from the following web page: http://www.unido.org/en/doc/3470

52 www.tellus.org

53 UNDSD: Environmental Management Accounting: Procedures and Principles, United Nations New York, 2001

6. 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[54] 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 interrelated 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 information that is more accurate 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.

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

[54] 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.

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 percent 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 percent of production costs was too low as criteria and the level could be increased to 3 percent 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.

Defining the scope of the EMA is part of the Initial review of the TEST approach. An ad hoc questionnaire has been designed to support local teams in this process. This is possible because most of the information required for identification of the system boundaries and for the preliminary selection of environmental cost items is gathered through the preliminary environmental review.

7. Calculation of environmental costs

The next step is to choose a schedule (quarterly for example) where 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 analyzed 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 reallocated 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 another cost 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 - B), 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, crosschecking of data should be done using different sources of information such as balance sheets, profit and loss accounts, inventories and material balances.

8. 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[55] 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

[55] This definition is used by UNDSD and by Shaltegger

feel that this approach is too penalizing. To better help managers plan 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.

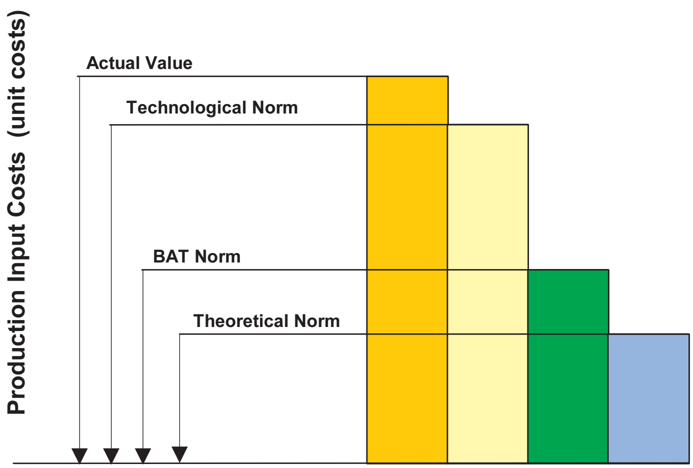
The next, and usually more stringent benchmark is the Best Available Techniques (BAT) level. These will be technologies considered the most efficient and/or protective of the environment, currently available on the international market for particular sectors and/or products. By using this benchmark to calculate non-product output costs, a company is signalling that it recognizes that it could switch to the best available techniques (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 lowering 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 percent 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 flow charts 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 17, where the technological norm is higher than BAT and BAT is higher than the theoretical norm.

Figure 17. 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, 100percent 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 percent waste. For example, catalysts are needed in chemical reactions, but 100 percent 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 8 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 calculation method for non-product output costs will depend on the specifics of the company.

Table 8. 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

9. Allocation of environmental costs

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

- Analyze 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[56]. 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[57]. 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[58]:

- 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

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

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

[58] Stefan Shaltegger and Roger Buritt, Contemporary Environmental Accounting, Issues, concepts and practice, Greenleaf Publishing 2000, p. 136

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.

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[59], such as 'activity based costing (ABC)[60]', 'full cost accounting', 'process costing' and 'material flow costing'.

10. 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

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

[60] 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.

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 costs, then these costs may remain in general overheads, depending also on existing accounting regulation[61]. Regardless, companies can choose to make environmental overheads visible within the general overheads.

Existing information related to environmental costs can also be reorganized 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.

11. 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.

12. 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

[61] 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.

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 US 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. Text Box 8 discusses the implementation strategies used in four companies in the Danube River basin and how EMA was customized to meet their individual conditions and goals. 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.

Text Box 8. Introducing EMA: Experience from the TEST Project in the Danube River Basin

EMA systems were introduced in four companies, namely at Herbos (a herbicide producer - Croatia), KAPPA (pulp and paper sector - Slovakia), Nitrokémia 2000 (chemical sector - Hungary) and SOMES (pulp and paper sector - Romania)[62].

The scope of the EMA was customized at each of these companies to meet their individual needs and circumstances. In two companies (Herbos and KAPPA), the scope was limited to calculating the total environmental cost of the enterprise. At SOMES, the scope was to allocate environmental costs to products for product pricing, whereas Nitrokémia 2000 chose to allocate the costs for comparing different products.

62 Roberta De Palma and Maria Csutora 'Introducing Environmental Management Accounting at Enterprise Level - Methodology and case studies from Central and Eastern Europe', 2003

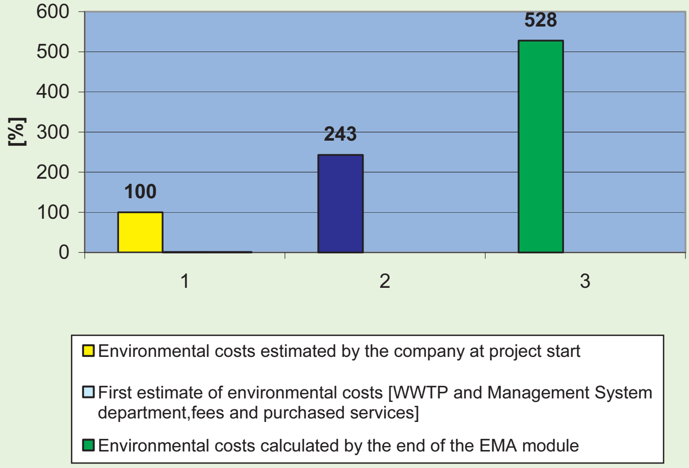
A comparison of the four case studies shows that the factors that may influence the scope of an EMA include:

- *The type of processes (industrial branch)*
- *The willingness of the management*
- *The existing management accounting practices*
- *The skills of the accounting department*
- *The communication between the environmental department and the accounting department*
- *The position of the environmental function in the company hierarchy and its recognition by the top management*

In general, the calculation of environmental costs 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 was not considered in any of the four case studies). The studies revealed that raw material costs associated with non-product outputs are on average 3 times higher than the waste and emission treatment costs.

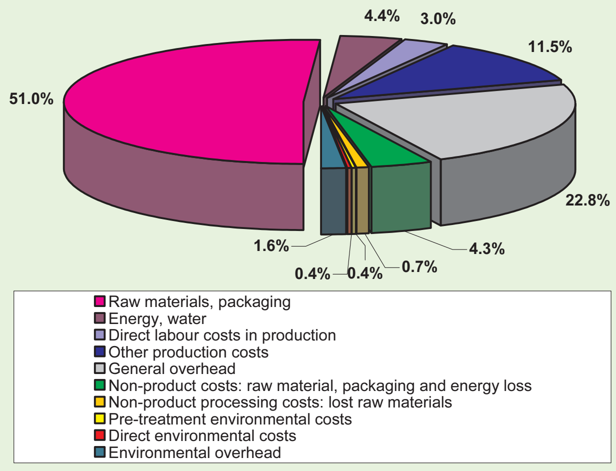
In the pilot enterprises, the actual environmental costs (calculated after implementation of the EMA system) were much higher than had been originally estimated by the enterprise at the start of the project, by a factor of 2 to 10 times higher. Figure 18 shows the difference at KAPPA between the initial estimate of environmental costs, the costs as calculated after the initial steps in EMA implementation and those calculated after the EMA module was fully implemented. It should be mentioned that this estimate is still conservative, since not all possible environmental cost categories were considered during the pilot introduction of EMA in the four companies.

Figure 18. KAPPA-Environmental Costs Chart-Beginning vs. End of Project



Overall, the environmental costs in the four companies were shown to be significant if related to the total production costs, being equivalent to between 5 and 10 percent of total variable production costs, a surprise for the management of these companies. Figure 19 shows the breakdown of production costs of the Atrazine plant in Herbos, Croatia.

Figure 19. Breakdown of Atrazine Product Costs (in percent)-HERBOS

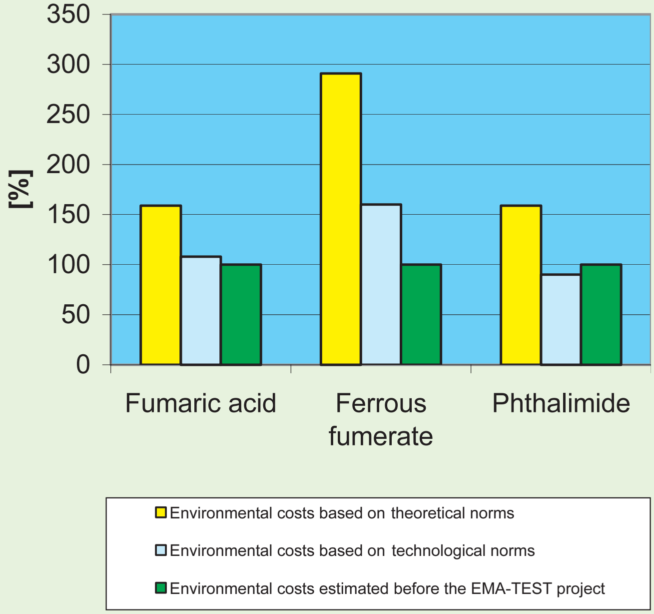


As it is showed in Fig. 19, the direct raw material costs at Herbos represents more then 50 percent of the total direct production costs. This is the reason why non-product output costs represent approximately 7 percent of the total production costs.

Environmental managers found it very useful to have an EMA in place. They recognized that it was a very good tool for justifying environmental projects. The bargaining power of the environmental managers increased significantly, as they were able to demonstrate to managers the economic significance of environmental costs with respect to total production costs. The calculation of non-product output costs and their subsequent allocation to the production steps (where they originated), revealed unexpected figures to the companies. This allocation made it possible to show which portion of the environmental costs implementing CP solutions could reduce and which portion of environmental costs could be avoided by full adoption of BAT.

Figure 20 shows the results of the EMA project at Nitrokémia, Hungary. The study provided a comparison between the originally estimated environmental costs and the calculated environmental costs of the company based on theoretical and technological norms. The calculation of non-product output costs, based on technological norms is much lower compared to the value based on theoretical norms. This shows that there are limited opportunities for cost reduction through the implementation of good housekeeping measures (this was also confirmed during the implementation of the CPA, where a relatively low potential for CP measures of Types A and B was detected). Significant savings on environmental costs could only be achieved in the long-term with major technological change (EST investment, implying major technology change, were in fact identified during the TEST project).

Figure 20. Nitrokémia 2000 Product Enviromental Costs-Before EMA and after EMA (%)



By the end of the TEST project, three out of the four companies where the full EMA module was implemented had established an EMA system. Several environmental costs were pulled out of the overheads accounts, new environmental accounts were created within the accounting department for environmental expenditures and internal procedures were put in place to monitor the environmental costs of the company on a periodic basis and to calculate product costs. The EMA systems were fully integrated into the existing management accounting systems at the companies.

E. Environmentally Sound Technology Assessment

1. Introduction

In many if not most cases, the introduction of good management practices alone is insufficient to completely solve a company's environmental problems. Investment in technological change or end-of-pipe solutions, are usually necessary to achieve significant improvements and to comply with environmental regulations. In the context of the TEST programme and in line with the definition provided by Agenda 21, UNIDO has adopted a definition of EST that includes both cleaner technology and end-of-pipe solutions. The concept of EST builds also on the concept of Best Available Techniques (BAT), where 'best' refers to best environmental performance while 'available' refers to economic feasibility as well as availability of the technology on the market.

Many businesses in developing countries and countries with economies in transition have already recognized the benefits of investing in EST. However, the EST market is constantly changing, and entrepreneurs as well as business experts need access to information on the latest technological solutions and financing opportunities.

Experience from the TEST programme in the Danube River basin showed that even when financial resources are available within a company, difficulties exist which may lead management to take the wrong (sub-optimal) decision for new investments. These include:

- Difficulty in accessing information on new technologies
- Difficulty in accessing information on environmental legal requirements
- Difficulty in accessing information on trends
- Language barriers
- Time constraints
- Insufficient skilled internal human resources
- Insufficient skills or expertise of the external local consultants

The common practice in many enterprises is to make investment decisions without performing a deep investigation or analysis of the market opportunities and the best technological solutions available. In some cases, investments are analyzed without using the traditional financial indicators (NPV, IRR, etc.) or without the proper sensitivity factors; for example, the environmental costs arising from future changes in the regulatory regime are often neglected. Another problem may be technology adaptation to the local needs and conditions.

An additional barrier is created by the fact that banks and other financial institutions are hesitant to approve investment proposals without performing a sound feasibility and risk analysis. Access to cheap capital also means access to information on existing opportunities. In some countries, the existing environmental funds from governments or other sources to assist companies with environmental initiatives are not fully used each year because managers are not informed or because they are not familiar with the application requirements.

The ESTA module of the integrated TEST approach aims to help entrepreneurs overcome these barriers and:

- Generate ideas
- Reduce uncertainty
- Conduct pre-feasibility studies following a standardized format
- Incorporate environmental criteria (considerations) into the decision-making process
- Bring an investment decision in EST to the implementation stage

2. Scope and implementation of the ESTA tool

The basic purpose of the ESTA tool is to allow managers to perform more detailed techno-economic evaluations on those EST options identified in previous steps of the TEST project that require a large investment in cleaner technologies and/or end-of-pipe solutions.

The ESTA tool can be considered a natural extension of the CPA tool. The problems to be addressed and the preliminary focus of the ESTA have already been highlighted in the initial review. The final selection of what the ESTA should focus on should coincide with the medium-long term investment plans of the enterprise and should be based on the company's strategy. The ESTA should also focus on those technologies that will enhance the competitive advantage of the enterprise (revealed during the market and financial viability assessment).

A preliminary identification of the Type C CP options (those requiring large investment) will already have taken place in the CPA module. However, the final selection of the options (Type C and end-of-pipe) to be analyzed will be done at the start of the ESTA module i.e. options will be screened from the technical point of view using sector guidelines and sector-specific expert judgment, and a detailed economic evaluation of the technically viable options will be conducted. A pre-feasibility study needs to be prepared and profitability indicators of the investment need to be calculated. This is the basis of the work undertaken in the ESTA module. Practical experience from separately implementing CP options and EST options in two steps is very positive and shows the importance of:

- Optimizing existing processes prior to the identification of specific technical needs that require significant investment
- Devoting enough resources to the financial appraisal of measures requiring large investments prior to their being implemented
- Using appropriate computational tools for financial appraisals, such as COMFAR[63], which allow for a detailed sensitivity analysis as well as an evaluation of long-term environmental costs and benefits
- Presenting a set of feasible measures requiring investment in one package so that a comprehensive strategy for their implementation (which may have to be done in several stages) can be prepared

The ESTA tool has the following basic steps:

- Final selection of potential cleaner technologies and end-of-pipe solutions, involving a technical evaluation of the options and

[63] (http://www.unido.org/doc/3470),

preparation of technical specifications for the identified technologies, including the preliminary identification of possible suppliers

- Conduction of a pre-feasibility study, including environmental accounting analysis (the COMFAR software tool developed by UNIDO can be used for the calculation of profitability indicators and for performing detailed sensitivity analyses)
- Understanding the related benefits and risks
- Identification of possible sources of funding

The selection of ESTs should be done using existing sector guidelines[64], which are a good source of benchmarking information, as well as expert judgment. In cases where such guidelines are not available, then sector experts could follow the following steps during the identification of ESTs:

1. Creation of a table with all relevant factors for each group of ESTs.
2. Identification of the key environmental indicators (consumption or emission per unit of production) for each such group.
3. Qualitative ratings of other factors (cross-media effects, technical applicability and economic aspects) for each group, where quantitative data are not available.
4. Ranking the groups of ESTs by their environmental performance, in terms of reduction of the key indicators (related to specific emissions or to consumption).
5. Assessment of the environmental cross-media effects caused.
6. Assessment of the technical applicability.
7. Assessment of the costs (investment and operational).
8. Identification of the EST.

Assessment of the environmental performance of possible ESTs can be expressed as an absolute or relative reduction against a reference/existing technology. Assessment of technical applicability should reflect the com-

[64] There are several sector guidelines like the BREFs (Best Available Technique Reference Documents), http://eippcb.jrc.es/pages/FActivities.htm

plexity of the technology as well as effects on product quality. Assessment of costs should be expressed in:

- Environmental terms (for example, expressed in USD per unit of abated emission)
- Economic terms, including the evaluation of any benefits (such as product quality, safety, or the reduction of raw materials and utilities/resource consumption).

In order to assess the economic viability of an EST, the existence of national or international financial incentives needs to be investigated. The investment and annual operating costs of an EST could be compared with the income level of the company/sector.

After the selection of the technology is completed and the first level of technical specifications is prepared, the financial appraisal can be finalized.

UNIDO has developed a computational tool named 'COMFAR' that can be used at this stage of the ESTA module for the preparation of data for the financial appraisal. The software is user-friendly and can support local experts in the calculation of discounted financial indicators for stand-alone investment projects, including impact on the balance sheet. It will make it easier to do sensitivity analyses as well as to compare different project alternatives. It should be noted that many financing institutions and banks all over the world accept the COMFAR software.

If the pre-feasibility study and the related sensitivity analysis show that the investment is profitable and is affordable, a full feasibility study and business plan can be prepared. A business plan will be needed to justify the specific EST investment to banks and/or to shareholders of the company. It usually contains 7-8 chapters plus annexes:

1. Company presentation
2. Products and services
3. Process(es)
4. Markets and competition
5. Management team

6. Project (including drawings)
7. Financing and key risks
8. Annexes:
   Annex 1 - Actual financial statements for the past three years: income statements (to determine the operating and net profitability), balance sheets (effects on the company assets, liabilities and equity), and cash flow statements.
   Annex 2 - Financial forecast: operations (products and sales), income statements, balance sheets, and cash flow statements.
   Annex 3 - Project appraisal (including environmental costs as a result of EMA) Annex 4 - Key assumptions in developing the business plan (markets, inflation, etc.)

The start-up of the full feasibility/business plan and tendering phase of an EST investment requires the full commitment of top management for the specific investment and the availability of financial resources or bank guarantees.

Depending on the financial resources available and the size of the investment, there could be technical assistance provided within the framework of a TEST project, for example in the design or evaluation of a tender document. However, full feasibility studies and tendering, including bargaining with potential suppliers, should be the sole responsibility of the enterprise, especially if large investments are being considered. This was the case in the majority of the companies during the implementation of the TEST programme in the Danube River basin.

Relevant links also exist between the ESTA tool and SES. The objective of the former is to provide substantive inputs on major technology changes needed as part of sound strategic decisions on new investments. The identified investments in EST have to be in line with the business strategy and should therefore support/enhance the enterprise's competitiveness in the medium- to long-term. On the other hand, the internalization of the environmental concerns as one of the criteria for the selection of EST/new investment might in turn have an important effect on the business strategy.

Once the ESTA is completed, a business plan should usually be developed for the new investments. Where relevant, the business plan should include a schedule of changes to be implemented to bring the facility into compliance. In addition, in such cases a negotiated environmental compliance schedule should be developed or updated and (re) negotiated with the relevant environmental authorities. The purpose of this agreement is to obtain assurances from the authorities that they will not take enforcement actions against the facility as long as it stays on the proposed schedule of improvements[65]. In cases where the proposed EST investment will result in lost jobs, the business plan should also include a social action plan. The social plan should be discussed and agreed upon with the trade unions and should reflect the existing national and local policy in this area.

Text Box 9. The IPPC-EU Directive and the TEST Project in the Danube River basin: An Example on How Regulation Can Drive the EST Transfer Process.

The introduction of the EU's Integrated Pollution Prevention and Control (IPPC) Directive (96/61/EC) was the first time the concept of Best Available Techniques (BATs[66]) was brought into most of the EU member states[67] and EU pre-accession countries in CEE. These pre-accession EU countries have all already adopted this piece of legislation, thus providing an important legal framework. This legal framework helped to obtain the necessary commitment from the managers for investing in EST within the framework of their individual TEST projects.

The IPPC Directive promotes the adoption of a more integrated approach to preventing and controlling pollution from industrial sources. The main aim of the Directive is to achieve a high degree of protection of the environment as a whole, by preventing, or, where that is not practicable, reducing emis-

65 This could be done within the framework of the project advisory board.

66 'Best available techniques' (BAT) means the most effective and advanced stage in the development of activities and their methods of operation. BAT indicates the practical suitability of particular techniques for providing, in principle, the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole:

- 'Techniques' include both the technologies that are installed and the way in which the installation is designed, built, maintained, operated and decommissioned,
- 'Available' techniques mean those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, regardless of whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator,
- 'Best' means the most effective in achieving a high general level of protection of the environment as a whole.

67 Some European countries like Sweden, UK and Ireland have had some kind of BAT concept in place since the early 90's and this provided the blueprint for the Directive.

sions into the air, water and land. The IPPC Directive applies to a broad range of industrial sectors, covering both existing and new installations.

Regulators must in turn set permit conditions to meet the Directive's objectives and provide a high level of protection for the environment as a whole. These conditions are based on the use of the 'Best Available Techniques' (BAT), which balances the costs to the operator against the benefits to the environment.

Ten of the seventeen enterprises participating in the TEST project were already included on their national authorities list of industrial installations that would be obliged to comply with the IPPC Directive. Therefore, the implementation of the ESTA module within the TEST programme in the Danube River basin was tailored to assist these industrial installations in the preparation of techno-economic studies for the introduction of BATs in accordance with the specific requirements of the IPPC Directive.

The BREFs (Best Available Techniques Reference Documents) elaborated by the EU Joint Research Centre in Seville were the main reference during the identification of ESTs, along with sector guidelines. The BREFs provide general indications of the emission and consumption levels that could be considered appropriate for a BAT. For this reason, they contain relevant technical information concerning BAT for a range of industrial sectors. EU governments are requested to use these emission and consumption levels as a basis for setting environmental quality objectives standards.

Operators of installations covered by the IPPC Directive have to apply for a permit from their regulator (the Environment Agency or Local Authority) before operation. The applicant must consider all the environmental impacts associated with the installation when preparing a permit application. Applications for permits for operators of existing installations will have to negotiate are subject to public consultation requirements under the IPPC-EU Directive, therefore implementation will be on a case by case basis

Text Box 10. Coming into Compliance with the IPPC Directive in a Romanian Company Through the Implementation of the ESTA Module

Through the TEST programme, installations covered by the IPPC Directive have acquired a clear indication of the type of investments needed and the related costs for complying with the IPPC Directive. The TEST project has been very beneficial to these companies as well as to the local authorities for the preparation of the requirements for the integrated permit.

In Romania in particular, TEST meshed with existing national priorities: all companies have been requested to produce estimates of the time and funds necessary to comply with the IPPC Directive. It was very beneficial to the Romanian company, ASTRA, to have a methodology and an example at hand for its HRFU-Hydro refining unit (the subject of the company's TEST project) to generate these estimates.

The full case study on the implementation of EST at ASTRA's Hydro Refining unit is included in this document in Annex IV. Two EST options were identified: revamping the HRF Chemical Reactor and upgrading the Gas Scrubber Column. The estimated outcomes from implementing these two EST options will be to reduce a number of the environmental impacts associated with the unit; specifically, reduce environmental taxes, contingency costs and spending for waste treatments. Fresh water, an important resource environmentally, will be saved by virtually eliminating its consumption for the gas wash, while optimal operation of the reactor will contribute to reduced power, utilities, and catalyst consumption.

The economic analysis does not include the possible replacement of the catalyst, which could further improve the environmental record of the unit (by hopefully eliminating heavy metals from the catalyst). As research is still underway, the outcome for the catalyst replacement has not yet been estimated.

All environmental taxes and fees in this unit are expected to be lower because less water will be sent to the wastewater treatment facility. This will result in fewer chemicals and labour being needed and less energy, utilities and cat-

alyst used per tonne of product, etc. This will result in savings on the operational costs of the WWTP.

Lower consumptions are expected for specific materials (power, raw materials, chemicals, energy). However, these reductions will need to be confirmed over several months of continued operation (at nominal plant capacity or as near as possible to it). Implementing the two EST options are preliminary steps in complying with the stricter regulations that will be operative once Romania applies the current EU norms for best available techniques.

Text Box 11. Implementing the ESTA Module: Experience From Slovakia Enterprise

The implementation of the ESTA module within individual TEST projects showed that it was possible to overcome the traditional barriers to the transfer of ESTs requiring large investments in several cases. Experience from implementation of the ESTA module is illustrated at a Slovakian enterprise (KAPPA) (full case study is reported in Annex V).

The situation at the company was one where the water costs and water pollution fees were consistently increasing, with higher costs expected in the future. In addition, there was significant pressure on the company to improve its environmental performance, especially from future EU-compatible regulations and implied liabilities (especially the IPPC Directive). Therefore, the company was very interested in benchmarking its environmental performance in preparation of its response to these pressures.

The company strategy for the future focused on expansion, thus a proposed major investment project target was set for increased profitability, increased production output, improved environmental performance and compliance with EU regulations. KAPPA had already defined its investment plans for the next five years in three areas before its TEST project:

- *Change in the main process in the pulp mill, to simplify it and increase the efficiency of the chemical recovery plant by switching to non-sulphur pulping.*
- *Increase in the capacity of the paper mill and in the degree of recycled paper used (as one of the main raw materials).*
- *Expansion of the WWTP by installing a biological treatment system.*

The main goal of the TEST project was to review the company's vision of its future and to help integrate the environmental issues with the investment considerations. The assistance given, within the framework of the project, focused on providing advice in setting specific targets and limits in such a way that they would be in compliance with BAT specifications while being technically achievable and 'typical' for BAT levels.

Two new EST investments were identified within the TEST project, focusing on the minimization of water consumption, reduction of pollution loads and optimization of production. The idea of focusing on preventive measures before building the new addition to the WWTP sounded very attractive to the management of the company.

These EST investments will improve the company's environmental performance and increase its productivity. Both investments were analyzed using COMFAR. During the preparation of the pre-feasibility study, a sensitivity analysis was performed taking into consideration contingency environmental costs, such as future liabilities, expected future increase of pollution fees and future fines (based on lower levels of possible intervals) and expected increases in the costs of raw materials. The sensitivity analysis revealed significant changes in the financial indicators of the proposed project: by considering contingency environmental costs the proposed EST, investment became more profitable.

F. Evaluation of Implemented Measures

At this final stage of the TEST approach, several identified measures will have been already implemented after the ESTA module. Before proceeding to the final SES module, it is important to measure the results of each project tool, compare, and evaluate the environmental and economic performance of the company before and after implementing the TEST approach. The overview generated from this analysis will reflect the positive changes, which occurred after implementing the identified measures, and provide the information needed to convince the management to reflect and incorporate (as applicable) the TEST approach at the strategic level of the enterprise.

The evaluation process consists mainly of three steps:

1. Selecting indicators
2. Measuring indicators
3. Reporting

Appropriate indicators should be identified first. At the enterprise level, indicators can be grouped into two categories:

1. Management Performance Indicators (MPIs)
2. Operational Performance Indicators (OPIs)

MPIs should provide information on the organization's capabilities and efforts in managing matters such as training, legal requirements, efficient resource allocation and use, environmental cost management, purchasing, product development and documentation or corrective actions which have, or can have, an influence on the organization's environmental performance[68]. MPIs can be further divided into the following categories: implementation of policies and programmes, conformance (with the standard and procedures), financial performance, and community relations.

[68] ISO 140031 - Environmental performance evaluation

Within the context of the TEST project indicators, MPIs could be set with reference to each project tool. Examples of MPIs used within the various enterprise-level TEST projects are given in table 9.

OPIs should provide management with information on the environmental performance of the organization's operations. OPIs relate to: production inputs and their supply, production outputs (products, waste/pollution) and the delivery of outputs[69]. Key operational performance indicators (KPI's) should have been selected and measured by the end of the initial review to provide a baseline for comparison of environmental performance. OPIs will provide an eco-efficiency measurement of the CP and EST measures implemented and are therefore reported in relation to a production unit (or added value). Some examples of OPIs are:

- Water consumption per unit of production
- Energy consumption per unit of production
- Waste generation per unit of production
- Waste recycling rate
- Material usage per unit of production
- Pollution loads per unit of production
- Emissions per unit of production

Traditional environmental indicators can also be used to complement the information provided by the OPIs, giving an indication of the magnitude of the reduction achieved through the implemented CP/EST measures. Examples of such indicators are: total water intake (m^3/year), total wastewater discharged (m^3/year), contaminant levels in discharged wastewater (for example tonnes of BOD/year in effluent), total waste generated (tonnes/year), or total CO2 emissions (tonnes/year).

The measurement of MPIs and OPIs occurs after the implementation of each of the TEST tools (CPA, EMS, ESTA and EMA) and should be completed before the last TEST project module, SES, starts.

[69] ISO 14031

Table 9. Management Performance Indicators and TEST Project Tools

TEST Project Module	Management Performance Indicators	Comments
CP ESTA	Number of pollution prevention measures implemented/under implementation/to be implemented versus the total number of feasible measures identified	It may be a good idea to differentiate between Type A, B and C options
CP ESTA	Minimum and maximum (range) of the PBP, IRR or NPV related to investment-needing-measures implemented/ under implementation/to be implemented	For Type B and Type C options
CP ESTA	Minimum and maximum (range) of investment for the measures implemented/under implementation/to be implemented	For Type B and Type C options
CP ESTA	Total investment for the measures implemented/under implementation/to be implemented	For Type B and Type C options
CP ESTA	Total savings achieved through the implementation of cleaner production measures - reduction of production costs	For Type B and Type C options
EMS	Completion of EMS elements according to the ISO 14000 standard	
EMS	Organisational changes (creation of the environmental manager/environmental department)	
CPA EMS EMA ESTA SES	Number of employees trained in TEST tools	
CPA EMS EMA ESTA SES	Number of man-days of training given during the TEST project	
Overall Project	Participation of the employees in the project, in man-days, vs. the total working days of the Team over the duration of the project	
Overall Project	Number of employees with environmental requirements in their job description vs. the baseline situation (prior to the project start)	
Overall Project	Top management participation in TEST training or meetings, in man-days	
CP ESTA EMS	Number of regulatory non-compliance issues resolved	
CP ESTA	Economic savings from preventing penalties and/or fines due to the implementation of selected measures	
ESTA	Total investment in end-of-pipe projects planned prior to the project start vs. total investment in end-of-pipe planned to be implemented after implementation of TEST project tools	

G. Sustainable Enterprise Strategy

1. Introduction

From the point of view of sustainable development, it has been argued that there is no such thing as a sustainable enterprise. This is because its sustainability is an integral part of larger systems. Recognizing this, it is still possible to assess the sustainability of an enterprise, where the entire chain of production and consumption related to that particular enterprise is the minimum 'sustainability unit' that should be considered. In this sense, a sustainable enterprise is understood in this guide to be an enterprise that is able to sustain its competitive advantage while properly reflecting the environmental and social concerns of its stakeholders.

The starting point of the TEST approach is the integration of the relevant environmental and social concerns into the business' operations. In this way, these environmental and social challenges can be transformed into business opportunities. The drivers for this process are the expectations of stakeholders: the base of the management pyramid. These expectations should be reflected at each level of the management pyramid, from the enterprise's vision and mission statement, through the operational strategies and procedures, to its processes and products.

The practical implementation of the TEST approach and its tools (CPA, EMS, EMA and ESTA) at the operational and managerial levels of the management pyramid has proved that exploring the links between an enterprise's operations and its environmental and social aspects can lead to increased competitiveness in the medium-long term. ANNEX V illustrates the results of the full application of the TEST approach at one company participating in the TEST project in the Danube River basin

However, to sustain the positive results achieved during the implementation of each TEST tool in the long-term, the TEST approach and its principles have to be reflected at the strategic level of the enterprise[70]. This can be achieved through the formalization and translation of the core strategic environmental/social success factors that have been identified, into an

[70] The strategic level includes vision, mission, core values and strategy.

enterprise's business strategy objectives (a system to measure and track the performance of the company against the objectives set should also be put in place).

Tracking and reporting the successes achieved with the TEST tools (as discussed in Part III - F, Evaluation of Implemented Measures) is very important to secure the sufficient confidence from management before they will permit any changes to be incorporated in the company's strategies.

At this final stage of the TEST project, a significant amount of trust should have been built-up between the outside consultants, management and shareholders. Only if this trust exists will they discuss the details of their business and operations, which are often proprietary or confidential, with someone from outside the company and allow them to have an influence on its strategies.

The SES module of the TEST approach has been designed to address the strategic level of the enterprise. However, it must be remembered that SES is not a tool for building an enterprise strategy, but rather a tool to integrate environmental and social considerations into an existing strategy. Therefore, the existence of a clear business strategy is a pre-condition for introducing SES. Depending on the specific situation at an enterprise, they may require differing types and degrees of assistance in the field of strategic management and planning.

The TEST Team may face a number of barriers during the implementation of the SES project module, such as:

- A relative lack of commitment to the use of this tool, demonstrated notably by management's unavailability for interviews and an unwillingness to invest the necessary amount of time
- The existence of a non-formalized 'intuitive strategy', which lacks a structure or empirical basis
- An excessive attachment to the existing strategy, resulting in a resistance to change it
- A lack of commitment to environmental issues
- An unwillingness to share confidential information about the business strategy, because it is thought that this will threaten any com-

petitive advantage (real or perceived) the company has over other companies in the same field

NOTE: For a better understanding of the terminology used in this section it is recommended that the reader refer to Annex I, 'The General Principles of Enterprise Strategies and its Development'.

2. Objective and scope of the SES

Defining the scope of the SES tool involves analyzing the enterprise's vision, mission and strategic process. To some extent, this is done during the market and financial viability assessment performed in the initial review[71]. However, usually additional information has to be gathered. This can be done at the initial step of the SES, by a guided interview with the management (the structure of figure 28 in Annex I could be used for asking the relevant questions).

The scope that will be given to the SES tool and the implementation scheme that will be adopted will depend greatly on the situation found in each enterprise and on the availability of financial resources: any technical assistance has to be evaluated from this point of view in order to achieve realistic results. In general, the preliminary scope of the SES is set during the initial review and it is further defined at the start-up of the SES module.

Practical implementation of the TEST programme in the Danube River basin showed three possible scenarios could occur, each requiring either different types of technical assistance or different ways to proceed when implementing the SES:

1. If an enterprise already has a formalized set of strategies and a performance measurement system in place (i.e., it already has strategic management), the SES tool can be introduced with limited resources. In such cases, the main benefit of the SES tool would be in reviewing the existing strategic objectives and if necessary, including recognition of the contribution that environmental and social aspects make to the competitive advantage of the business.

[71] See also section A in PART III

This should be reflected both at the business strategy level and at the functional strategies level (marketing, operational, financial).

2. Where an enterprise does not have formalized strategies, i.e. where it operates based on an intuitive strategy; basic strategic management principles should be introduced first to help the enterprise formalize its existing strategy (including environmental and social considerations). This is the most common situation in developing and transitional countries. Assistance in strategic management is not the primary focus of TEST, but if financial resources are available, a way should be found to work on formalizing the strategic level. This could be done, for example, by using the SBSC method, (described in Text Box 12), which can be used to help formalize the existing verbal (intuitive) business strategy into a written version while incorporating the social/environmental dimensions at the same time (this could be done at least at the level of an SBU[72], as a demonstration case).
3. Some enterprises do not have any form of business strategy. This will be revealed in the initial review during the market and financial viability assessment. In this case, the first question that comes to mind is ‘should such an enterprise undertake a TEST project at all?’ The answer to this question is a value judgment best made by a financial expert. However, even if the TEST approach is introduced under such circumstances, the SES module cannot really be applied. In this type of enterprise, an in-depth analysis of the company and its business environment will show an overall need for strategic restructuring and positioning of the enterprise (but outside the scope of a TEST project).

3. Stakeholder participation and social aspects within the SES framework

Stakeholders should be used as a key resource for identifying the sustainability concerns that should be integrated into the operations of a company. Likewise, the process of developing a strategy will also, by definition, help identify these concerns.

[72] SBU - Strategic Business Unit

To identify the strategically relevant social aspects a comprehensive group of potentially relevant stakeholders can be consulted. These relevant stakeholder groups can then be divided into internal stakeholders, stakeholders along the product-value supply chain, stakeholders in the local community and societal stakeholders. Once the key stakeholders for the specific business are identified from these groups, the core social strategic issues relevant to reaching the business financial objectives can be formalized by performing a social audit following the SA 8000 standard[73] or the GRI guidelines[74].

The question of when and how to involve particular stakeholders ultimately resides with the enterprise. The TEST programme offers some mechanisms on how to do this, such as using the national project Advisory Board. However, there has to be some basic level of trust and positive motivation developed first.

Sometimes it is better to involve some of the stakeholders after the enterprise has completed its first experiences with the TEST approach and has evaluated the results. However, this should not be a one-way process. Dialogue stimulates learning and can improve relationships. Thus, it is easier to facilitate this dialogue if the people are invited to participate to some degree in, or at least informed about, the project from the very beginning.

If stakeholders are not involved until the end, they can be informed about the project through meetings and from reports, describing what was learned. This allows them to participate in the conceptual step of reflection/use of the experience gained. Typical questions that may be posed by stakeholders include:

- How does this experience affect our values and visions?
- What does it mean for our relationship and further cooperation?

4. Links between SES and other TEST project modules

The SES module has links with all levels of the management pyramid, therefore aspects of the business and functional strategies are addressed within

[73] Social Accountability International Standard - http://www.cepaa.org/
[74] GRI - www.globalreporting.org/

each of the TEST tools. In particular, the initial review is the tool where the business environment and the business functions are analyzed to provide the correct direction to the implementation of the enterprise-level TEST project. After the initial review, most elements of the business strategy are acquired and will be used setting the scope of the SES implementation (to take place at the end of the project).

Another important link is between the EMS and the SES. One of the first steps of the EMS implementation is the formalization of an environmental policy, through which environmental management will be linked to the core concerns and vision. This can be seen as the first step toward the implementation of the SES[75].

5. Implementing the SES

5.1. General principles

The purpose of the SES is to help the management of the company turn the core strategic environmental/social success factors, identified during the implementation of the TEST approach, into formalized performance objectives aligned with the objectives of the company's business strategies (financial, marketing and operational). This means that the environmental and social objectives are not stand-alone objectives, but are connected to the other objectives of the company and ultimately contribute to achieving the financial goals of the business[76].

For instance, an environmental/social objective could be 'to promote the environmentally and socially responsible image of the business'. This objective contributes to the achievement of another objective of many businesses, 'to increase the market share', which ultimately contributes to reaching a defined turnover, growth, or financial goal.

Environmental success factors are central to implementing SES and should be identified first. From those factors, the environmental/social performance

75 The environmental policy is usually an independent document, and it reflects the more specific vision of the company with respect to environmental concerns.

76 Typical strategic objectives of a business, seen from the financial perspective, can be grouped together under the following categories: revenue growth, productivity growth, and asset utilization.

objectives for each perspective of the company (marketing, operational and financial) can be derived and integrated into the functional strategies. Examples of objectives that reflect the environmental and social dimensions linked, for instance, to the marketing function of the company are:

- Design of environmentally friendly products (R&D function)
- Social and environmental marketing
- Adding an environmental premium to the price (advertisement/ promotion/direct sales)

More environmentally friendly products and better product awareness (resulting from emphasizing environmental issues in advertising) can ultimately results in more sales, exports, higher profit margins, government support at home, etc.

At the level of operational strategy, cost reduction objectives are important to achieve higher productivity and finally higher returns on sales. Environmental/social considerations can positively contribute to these goals as well as through:

- Better management of environmental aspects (within the EMS module), leading to savings in fines and penalties
- Elimination of environmental capacity bottlenecks (optimal use of assets)
- Using the cleaner production strategy (within the CPA module) to obtain savings from optimizing energy, material flows and end-of-pipe operations
- Creating better quality products by reducing/eliminating toxic residues in the final product (within the CPA module), thus increasing the volume sold and/or price
- Improved labour productivity achieved through better working conditions (health and safety). This implies a reduction/elimination of medical and damage payments to workers as a result of inadequate working conditions

Environmental considerations can also be reflected in the financial strategies of the company. This can be done by searching for and applying for 'cheap' capital (e.g., environmental grants and subsidized loans), cost transparency by allocation of environmental costs to cost and profit centres (as promoted within the EMA module) and by considering contingency environmental and social costs when making new investments (the EST module).

Table 10 provides some examples of environmental and social performance objectives derived from the TEST tools that can be set in relation to the key elements of the main functional strategies.

Table 10. Enviromental and Social Performance Objectives Related to the Key Elements of Main Functional Strategies of a Business

Functional Strategy	Key Elements	Performance Objectives
Marketing Strategy	• R&D • Products • Price • Distribution	• Design of environmentally- friendly products (R&D function) • Social / environmental marketing (advertisement/promotion /direct sales)
Operation Strategy	• Processes • Location • Layout • Procurement • Quality • Human Resources • Environment	• Cost reduction by better resource use and management of environmental aspects (saving of energy, materials) • Better labour productivity achieved through better working conditions (health and safety) • Quality control purchasing • Better quality achieved through the reduction/elimination of toxic residuals in products • Elimination of environmental capacity bottlenecks
Financial Strategy	• Leverage and investment • Credit policy • Cash management • Access to capital	• Access to inexpensive capital (environmental grants & subsidised loans), • Cost transparency by allocation of environmental costs to cost and profit centres (EMA), • Consideration of contingency environmental costs in new investment selections

5.2. Translating SES into action: performance measurement and the Sustainability Balanced Score Card

Modern approaches to strategy development stress the fact that the more detailed and fixed the formal formulation of strategies, the lower the probability that it will be actually implemented. An effective enterprise strategy is dynamic and evolves over time (through learning); hence, the initially formulated strategy is only a starting point for action. The results of this action are evaluated and the experiences gained are reflected back at the strategic level. This should affect further strategy development and implementation of subsequent actions.

Feedback on the actual effects of the strategy is crucial for its further development. Performance measurement includes the means of monitoring and maintaining organizational control, which is how management ensures that the organization is pursuing strategies that will lead to the achievement of its overall business goals and objectives.

A popular management framework for measuring organizational performance is the Balanced Scorecard (BSC)[77]. BSC translates organizational vision into clear measurable outcomes that define success and that are shared throughout the organization. It has been developed to better address the intangible, non-financial assets/values necessary for an organization's success.

As a strategic management tool (see figure 21), the BSC describes and depicts the causal contribution of major, strategically relevant issues to a successful achievement of a firm's strategy (Kaplan & Norton)[78]. Thus, it appears promising to use the BSC methodology as a starting point to integrate the environmental and social management into the general management of a firm.

As an instrument for performance measurement, the BSC can be used to coordinate the translation of the business strategy and to communicate it. The gap between strategic and operative planning can be bridged by breaking down the previously formulated business strategy into the four perspectives of the BSC[79]:

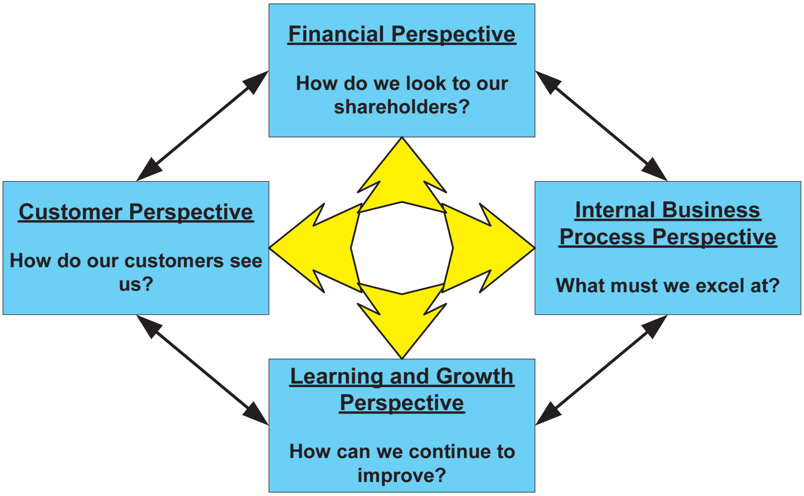
1. Financial perspective - How do we look to our shareholders?
2. Customer perspective - How do our customers and other stakeholders see us?
3. Internal business process perspective - What must we excel at?
4. Innovation and learning perspective - How can we continue to improve?

[77] Kaplan Robert S, Norton David, 1996

[78] Ibid

[79] Kaplan & Norton, 2001, pp 65

Figure 21. The Balanced Scorecard (Amaratunga 2001[80])



The purpose of the BSC is to generate a system hierarchy of strategic objectives in the three perspectives, and align them with the financial perspective. Based on such a causal system of objectives, corresponding measures are formulated in all four perspectives.

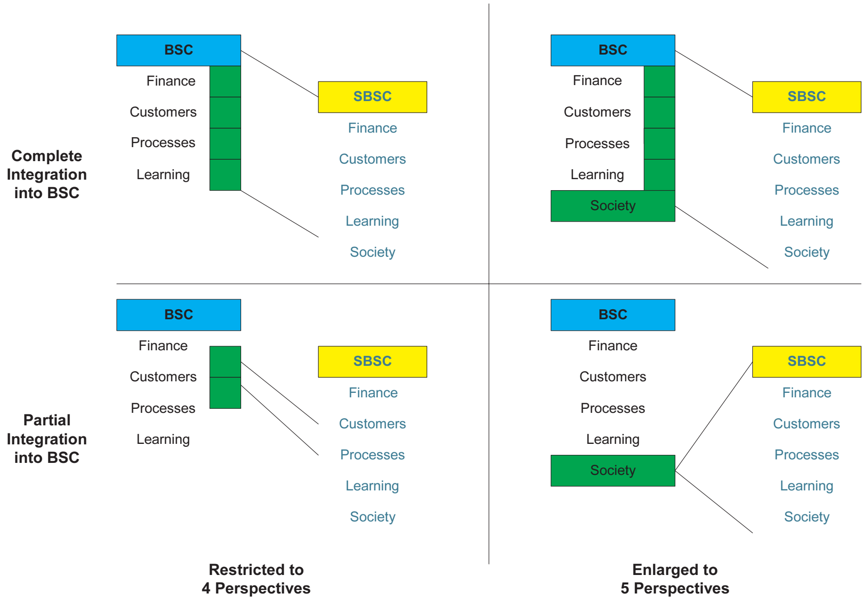
The BSC is a good tool to assist management internalize those environmental and social aspects that contribute to the financial business goals. In the most recent evolution of the BSC, the Sustainability Balanced Score Card (SBSC), this can be done in three different ways. First, environmental and social aspects can be integrated in all, or in some of the four standard perspectives (partial or total SBSC). Second, environmental and social aspects can be taken into account (additive SBSC). Third, a specific environmental and or social scorecard can be created (transversal SBSC, extension of the two variants)[81]. In addition to these approaches, a firm may also resort to a 'Shared Services SBSC' involving only some parts of the organization.

80 Process improvement through performance measurement: the balanced scorecard methodology, Dilanthi Amaratunga, Baldry David and Sarshar Marjan, http://www.mcbup.com/research_registers
Work Study, Volume 50. Number 5. 2001. pp. 179±188, MCB University Press.

81 (Deegen 2001, pg. 50; Episten 1996, pg.73; Figge et al. 2001 and 2002; Sturm 2000, pg. 374)

Figure 22 shows the different ways the environmental and social consideration can be integrated in the traditional four perspectives of the BSC.

Figure 22. Approaches for integrating sustainability considerations in the BSC



The decision on which approach is more appropriate for a specific business unit depends on the business' organization and on the nature of the relevant environmental and social aspects (of the strategies) identified in the process of formulating a SBSC. The choice of how environmental and social aspects are integrated occurs during this process, rather than at the beginning.

Depending on the type and the size of the organization, a SBSC should be prepared for the corporate level, looking at the vision and mission and setting the financial goals. However, social and environmental strategies identified in the corporate SBSC should flow down to the strategic business units (SBUs) of the organization.
The process of formulating a SBSC at the business level can be divided into three major steps:

1. First, the strategic business unit has to be chosen.

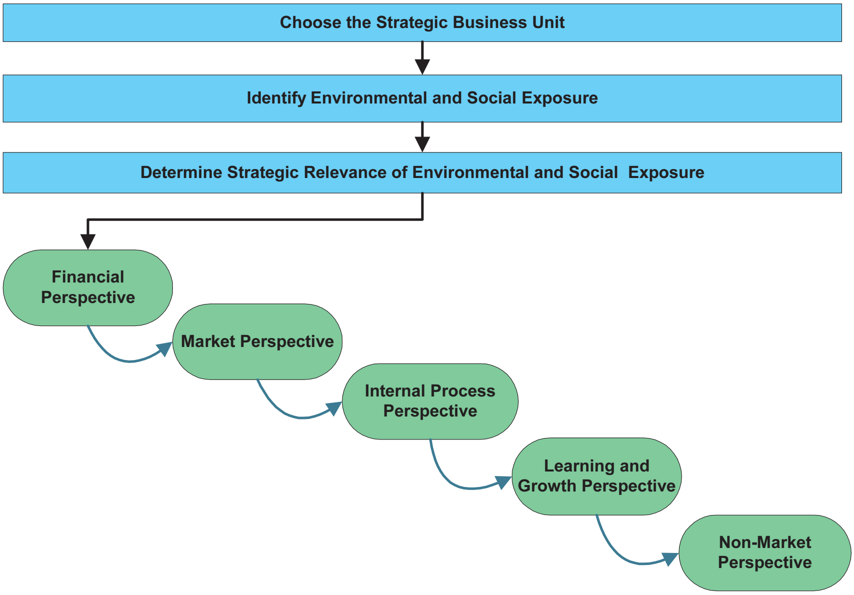
2. Second, the environmental and social aspects of concern have to be identified.
3. Third, the relevance of those aspects, for the specific business unit's strategy, has to be determined.

Determining the strategic relevance of environmental and social aspects is at the core the SBSC. By going through the perspectives in a cascade-like process, starting from the financial perspective (as indicated in figure 23), guarantees the causal linkage of the strategically relevant aspects. This serves to align relevant aspects of a business unit toward the successful conversion of the strategy and thus toward long-term economic success.

At the next stage, appropriate objectives are set for each perspective of the SBSC, including those related to environmental/social issues. Then, a set of leading and lagging indicators[82] will be identified for each objective. After identification of the appropriate measures to address each of these objectives, an action plan is prepared for implementation of the strategy.

[82] Lagging indicators measure whether the strategic core aspect in the perspective has been achieved, as compared to the performance of the company in the past, leading indicators show how the results in each perspective, compared to the lagging indicators, are to be achieved in the future. Additionally risk factors also exist: those factors have to be managed sufficiently to guarantee business operations, however addressing them does not lead to any competitive advantage.

Figure 23. Process of Formulating a SBSC (Figure et al 2002)[83]



The formulation of a SBSC can be successfully conducted using the information generated by the TEST tools at the level(s) where environmental and social exposures are identified. The strategic relevance of the environmental and social aspects is then defined and objectives are identified. TEST offers the opportunity to implement the SBSC within the SES component with a top-to-bottom and a bottom-up approach: the measures identified within the TEST tools are important inputs for building the action plan to implement the SBSC. Practical experience from implementing the SBSC within the SES component of the TEST project is reported in Text Box 12.

[83] Process improvement through performance measurement: the balanced scorecard methodology, Dilanthi Amaratunga, Baldry David and Sarshar Marjan, http://www.mcbup.com/research_registers
Work Study, Volume 50 . Number 5. 2001. Pp. 179±188, MCB University Press.

TEST BOX 12. Practical Experience From Implementation of the SES in the Danube River basin

Overview

The turbulent framework conditions in the Danube River basin countries' with economies-in-transition made it very challenging to work on their strategy level. As a result, the SES tool could be introduced only in few enterprises. However, this does not diminish the importance of the questions SES raises for successful practical implementation of the TEST approach.

The experience from implementing the TEST module showed that one of the main barriers in introducing the SES is the difficulty of explaining to the managers and shareholders the benefits of this aspect of the project, especially if strategic management is not in place. The majority of the enterprises involved in the pilot implementation of the TEST project in the Danube River basin were lacking formalized business strategies: operating mostly on the basis of intuitive strategies. A need for strategic management was revealed during the application of the SES tool in almost all the enterprises, and represented a major barrier.

Furthermore, it was difficult to approach the shareholders of a company during a consulting assignment if the consultancy was not their initiative. Either they are multi-nationals or they do not have the time or desire to cooperate on this initiative. One possible way to overcome these barriers (and implement the SES) is through the idea that the consultants may be able to influence shareholder strategies indirectly, through top management.

Most of the TEST enterprises were not part of a larger corporation, therefore an all- encompassing corporate strategy was not an issue and key strategic decisions were taken at the level of business strategy. As such, the companies themselves had to make the decisions, at all levels of the hierarchy, including positioning of an enterprise in its global, economic, political and social framework conditions at the first level of the corporate strategy. Only two TEST companies were part of larger multi-national corporations. In these companies is was practically impossible to address key issues of corporate strategy, thus SES was implemented at the level of business strategies only.

Building the SES at a Romanian enterprise: experience from the implementation of the SBSC

ASTRA Romana is the oldest and the most profitable oil refinery in Romania and one of the four Romanian companies that participated in the implementation of the TEST project. After successful completion of the previous TEST tools, and in particular after the positive financial benefits achieved with the CPA/ESTA (for the results of the ESTA at ASTRA, please refer to Annex III), the management was convinced and committed to start the SES module. Enough trust was already built during the project implementation to start addressing the strategic level of the enterprise.

The SWOT (strengths, weaknesses, opportunities and threats) analysis conducted already during the initial review revealed that although the company is viable, it operates in an unstable business environment and major threats and opportunities that are likely to influence the business operation in the medium-long term were identified. However, at the start up of the SES there was a need to gather additional information on the existing strategic process at ASTRA, before defining the scope of the SES module. This initial gathering stage was done utilizing various tools like:

- *Interviews with the top managers*
- *Social performance questionnaires (following the SA 8000)*
- *Baldrige self-assessment checklists*

The initial assessment revealed that the company operates on the basis of an intuitive strategy with lack of strategic process, mainly due to:

a. *50 years under the previous political climate resulted in a style of management that discouraged any intent to improve things and often disqualified any innovations. A top-down approach was the rule during the former regime. A reactive mentality, characterized by being precautious with what could affect one's personal status, led to extremely high barriers for open and honest communication.*
b. *Employees are diffident, reticent, reserved in any direct approach, but*

have many valuable ideas when their identity is respected and strict confidentiality observed.

c. *The Polytechnic education (most of the ASTRA specialists are engineers) does not include a solid economic training. Employees and managers are very good technicians, but they are not familiar with the business environment and do have a holistic view of the market in which the organization operates.*

Having acquired all the necessary inputs, the scope of the SES was set and the work was organized. An internal team was appointed at ASTRA, comprising of several top managers and unit directors (including the team leaders who participated in the implementation of previous TEST tools) and a strategy local expert, hired to provide training, on-site consultancy and assistance during the development of the SES.

The scope of the SES at ASTRA contained two main objectives:

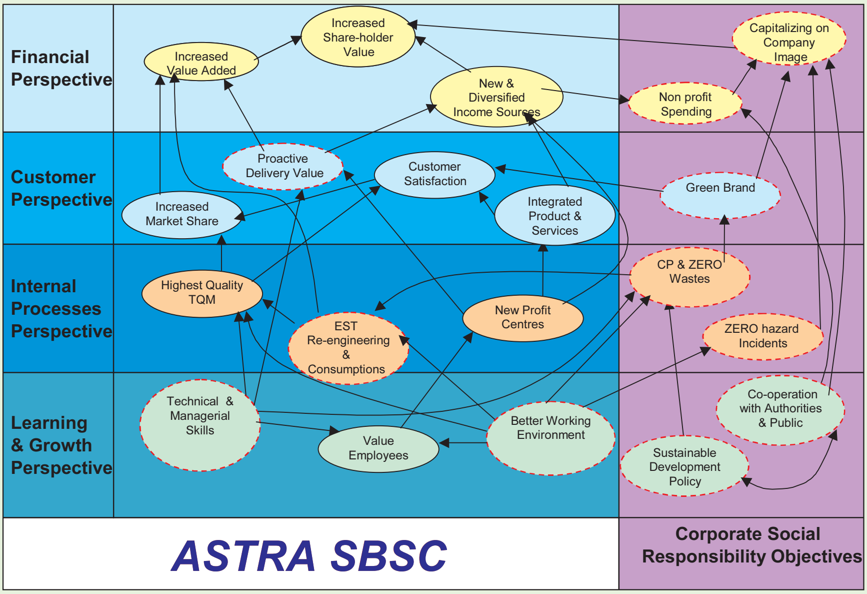
1. *Review and renormalizing ASTRA strategy (including developing a strategic planning capacity).*
2. *Start to set-up a Sustainability Balanced Score Card (SBSC) as the strategic management system of the company.*

Given the very favourable conditions at ASTRA it was decided to provide assistance and basic training to their employees in the field of strategic management, which was needed to successfully apply the SES. The existing vision, mission, core values and strategy of the business were reviewed to make sure that valuable sustainability elements were included.

After this initial stage, there were discussions about what kind of SBSC would be more appropriate for a company like ASTRA. Given the high environmental/social exposure (type of production, size of the plant), a transversal SBSC (with the environmental and social aspects integrated in the traditional four perspectives) with an additional fifth sustainability perspective should be utilized. However, due to the complexity of this SBSC approach and giving the existing start-up situation at ASTRA, it was decided to use a complete integration into the traditional 4 perspectives of the BSC (see also figure 22).

The SBSC at ASTRA was initially developed at the corporate level: performance objectives were identified for each perspective of the business, including the objectives related to the environmental and social exposure. Figure 24 reflects the cause and effect diagram of the SBSC developed at ASTRA: it shows the relationship between the different objectives set for each of the four perspectives.

Figure 24. Corporate SBSC at ASTRA: Cause and Effect Diagram



The implementation of the previous TEST tools (CP, EMS, ESTA) was very effective when developing the SBSC, since they contributed in clearly identify the environmental/social objectives to be incorporated into the SES.

Defining the objectives provided the grounding to then define a core set of the key performance indicators (KPI), both lagging and leading, that would allow the performance of the company to be measured against the objectives set. Table 11 summarizes the KPI categories identified for each perspective. Each KPI category corresponds to a set of diagnostic and analytical indicators to be measured.

Table 11. SBSC at ASTRA: Key Performance Indicators (KPI)

The Five Perspectives				
• Financial Perspective	• Customer (stakeholder) perspective	• Internal Processes Perspective	• Learning & Growth Perspective	• Corporate Social Responsibility Perspective)
Lagging KPI (Outcomes)				
• Revenue Growth • Productivity Growth • Share Value • ROCE • Asset Utilization	• Market share • Customer acquisition • Customer retention • Customer satisfaction	• Innovation Process • Specific Consumptions	• Employee satisfaction • Employee retention • Employee productivity	• Freedom of action • Legality and conformity
Leading KPI (Enablers, Performance Drivers)				
• Capitalizing on Company good TBL record	• Product attributes • Consumer (stakeholder) relationship • Green Brand Customer profitability	• Product quality • Product cycle • BAT alignment	• Employee skills • Technical infrastructure & equipment • Climate for action	• Lobbying • Environmental reconstruction

The SBSC defined for the corporate level of ASTRA cascades to each strategic business unit of the company: each unit will extract objectives from the corporate SBSC and adapt the KPI to its own situation. In this way, the alignment of the corporate sustainability objectives will be achieved by replicating the SBSC at the lower management levels.

In conclusion the following outcomes were achieved through the implementation of the SES TEST module at ASTRA:

a. *A more comprehensive strategy was developed that integrates all existing valuable company strategy components, as well as the TEST modules results in a sustainability-vision approach.*

b. *The Sustainability Balanced Scorecard implementation was started as a strategic management system and measurement tool, at the company level as well as at operational levels.*

c. A strategic planning capacity was created that will result in the future establishment of a strategic planning department within the organizational structure of the company.

The SES module of the TEST approach was developed in 2 ways:

1. *Top-down: ASTRA top managers reviewed and complemented the company strategy with elements added by the TEST approach and its tools.*
2. *Bottom-up: most of the new sustainability components added to the strategy (like CP, waste minimization, EST, EMS) have already been implemented at the company through the previous TEST tools, starting from the plant level and were already well understood and practiced by lower managers before being inserted in the strategy.*

The positive results achieved at ASTRA showed that the approach used was effective: the TEST tool should be a pre-requisite for a direct SES implementation. Once lower managers have the SBSC Cause & Effect Diagram they will easily recognize modules and activities to which they had a direct contribution and they have been practiced for sometimes (CP, ESTA, EMS).

H. TEST project cycle

The introduction of the TEST approach follows the cyclic pattern of continuous improvement of environmental, economic and social performance, which is based on the learning cycle. The learning cycle describes the general process of obtaining new skills and insights and it is composed of the following four steps (introduced already as the Deming scheme in the chapter on EMS, Part II -C):

1. PLAN - existing concepts and strategies are used as starting points for planning
2. DO - implement the plan
3. EVALUATE - evaluate the activity
4. ACT - act on the experience: the experience gained from the practical implementation is reflected and used to further develop strategy, eventually resulting in the revision of its starting points (strategic objectives or even vision and mission)

The learning cycle is a perpetual engine of desired changes. It does not turn just once per project as it may appear from the 1-4 sequence above or from the development cycle of the EMS within the project. It is completed every time people learn: through evaluating, reflecting, acting and implementing new planning based on what they've learned. This means that the cycle is (or should be) repeated at the individual, group and enterprise levels in small day-by-day cycles. These small cycles can be done within larger cycle periods as part of the whole project, or have no fixed end time i.e. can continue after the project is over or be overlapped with the Deming scheme (within implementation of EMS or any other advanced management system).

A failure to complete the learning cycle is a common source of problems. For example, if the reflective part of the cycle (evaluation and acting) is missing, people lack feedback for improvement and continue to repeat old routines and follow old strategies. Or, if people only implement activities and evaluate their results without reflecting on the experience gained when planning in the future, then they are just learning new skills, not gaining any new insights on why things work as they do. To overcome these problems, adequate emphasis should be put on the development of good conditions for learning, including good feedback systems. This is one of the core requirements that must exist for the continuous improvement of environmental performance, and which is the basic goal of the TEST approach.

With preventive environmental management projects in industry, experience has shown that the weak point of the learning cycle is usually with a lack of reflection (acting). Consequently, there is a lack of integration of new approaches into enterprise operations. This is why SES is placed at the end of the project cycle where the most amount of information is available to reflect upon: information obtained from the project. This integrates the TEST approach into the enterprise strategy and consequently sustains the use of the TEST tools to meet enterprise needs. However, the process of gaining insight into the benefits of the TEST approach should have started at the beginning, during the initial part of the project and should be driven by reflecting on the specific project steps and results.

The sustaining and reflection process is done within the individual modules. However, the overall evaluation and reflection of the project is done at the very end using the SES module to complement their analysis and integrate the evaluation of each tool into assessing how they work as a whole.

All TEST modules and tools fit into the learning cycle. ANNEX VI shows a table describing the contribution of each TEST tool to the general outputs of the TEST project learning cycle (plan, do, evaluate and reflect). It highlights links to show how the outputs of a single step of a specific tool can be used to assist another tool more effectively reach its outputs and demonstrate the synergy of this approach to produce better results more efficiently. Please note however, the table in ANNEX VI does not reflect either a real-time duration or a temporal sequence of the project activities.

The recorded time lines, sequencing and duration of the activities of each project tool will depend to a great extend on the situation in the company when initiating the project, as well as on the number of tools chosen for implementation at the end of the initial review. Text Box 13 provides a comparison of these time-related elements of TEST project activities in two companies participating in the TEST project in the Danube River basin.

Text Box 13. TEST Approach: Temporal Sequence and Duration of Activities of Each Project Tool

Figures (25 and 26) provide an example of the duration and scheduling for implementing the TEST tools in two comparably sized large industries in the Danube basin. The comparison shows that because it is needs driven, the TEST approach does not need to follow a rigid implementation structure: the duration of each module and actual sequence of activities related to each module, can vary significantly from one company to another.

The first figure (25) refers to a chemical company in Hungary, while the second (figure 26) refers to a pulp and paper company in Romania: the first company started with the CPA, while the second with the EMS. Regardless of how each started, in both cases the EMA was introduced after the CPA's detailed analysis had been completed. The duration of EMS implementation was very different, comparatively, due to the different initial starting points: the Hungarian company had already implemented some basic elements of EMS prior the TEST project. EST assessment had a longer duration in the Hungarian company than in the Romanian company, due to how extensive its focus area was and the technological implications. The SES module could not be introduced in the Romanian company due to an ongoing redefinition of the plant's business strategy at a corporate level.

Figure 25. TEST Work Plan for a Chemical Company in Hungary

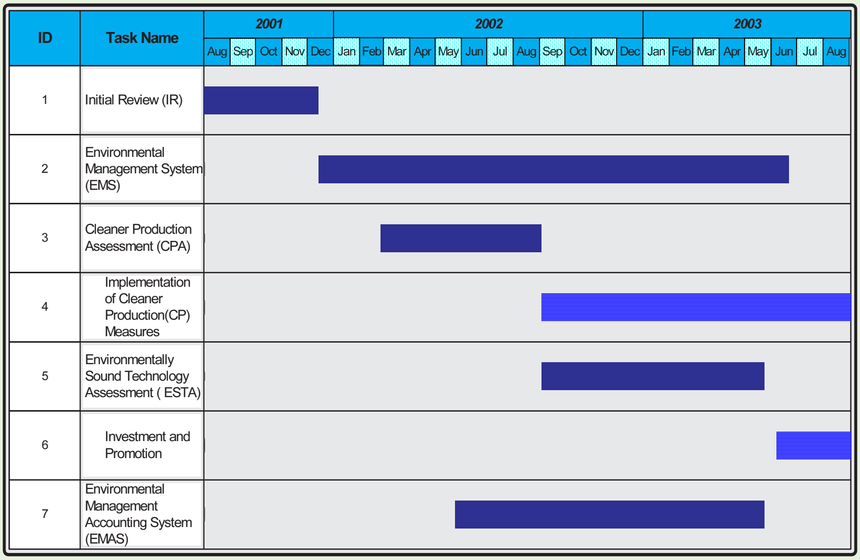
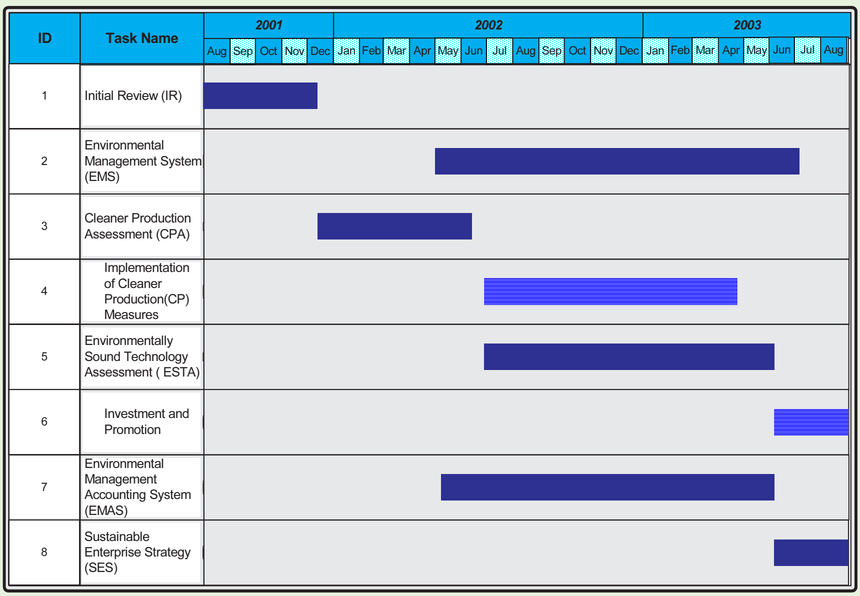


Figure 26. TEST Work Plan for a Pulp and Paper Enterprise in Romania



I. CONCLUSIONS

TEST aims at providing a systematic approach to integrating the concepts of industrial competitiveness and environmental/social responsibility to allow the company to attain corporate sustainability. Enterprises using the TEST approach become more productive and competitive through the better management of their existing processes and by integrating environmental considerations into the decision-making process for new investments.

The TEST integrated approach is implemented through the introduction of different tools. Each of the TEST tools promotes and contributes to the overall competitiveness of the company:

- Initial market viability assessment (within the initial review) - reveals existing opportunities and threats in the business environment and is beneficial to strengthen the position of the company in the market
- CPA - provides the methodology to identify production cost reduction measures, resulting also in environmental benefits
- EMS - contributes to improving the company's image to the stakeholders (clients, customers, authorities) while increasing the awareness of existing environmental aspects
- EMA - reveals the financial implications of the environmental aspects of the company, bringing a competitive advantage in terms of better control of production costs and particularly environmental costs
- ESTA - enables optimal decision-making (management) for investment solutions in new technologies
- SES - helps the managers integrate the core environmental and social aspects into business strategic objectives

Implementation of the TEST integrated approach at the enterprise level follows a specific step-by step process. First, improve the existing situation by better management of the processes, then consider the introduction of new technology or use end-of-pipe solutions (as a last resort), reflecting on and considering the lessons learned at a strategic level and use the gained insight for the planning follow-up activities. The TEST enterprises, which underwent these steps with the pilot project implementation in the Danube River basin, have continued this process, understanding that this road will lead them towards a continuous improvement of their economic and environmental performance.

The design of the TEST programme as it was developed for the Danube River basin, is uniquely different from its earlier design. Currently there are on-going technical cooperation projects, addressing industrial pollution in three aspects.

1. Continued participation of the facilities in the TEST programme is contingent upon improving while assessing. This means that enterprises must implement at least some of the improvement measures identified by each assessment before/while they proceed to the next assessment in the TEST approach. For example, they must implement the no and low cost cleaner production options identified during the audit while proceeding to the EST assessment.
2. The TEST project is not the typical diagnostic study usually undertaken by outside international and national experts. Rather it is an integrated assessment and improvement project conducted by enterprise teams under the guidance and supervision of outside international and national experts. The integrated TEST approach results in more improvement options being generated and the quality of measures implemented and maintained improves. Active participation of enterprise members at both operational and managerial level has shown itself to be its second important benefit. These are built into the internal capacities within the enterprise and within the country so that they can continue with the TEST approach on its own on the both levels. It should be noted that by using internal employees, the company and its workers take an ownership for the project and results that having the work performed solely by external personnel can never attain. Inclusion leads to a pride in seeing their work succeed.
3. The TEST approach should not be seen as the traditional step-by-step methodology focusing only on selected levels of the management pyramid. TEST is designed to be used as a viable integrated approach driven by enterprise needs. The advantage of the TEST

approach is that the embedded tools used to implement it address not only the operational level but also other levels of the management pyramid e.g., the managerial and strategic levels as well. The environmental performance of the enterprise is analyzed in connection with its economic and financial performance.

The TEST programme and its integrated approach is based not only on the mastering of particular tools and tailoring them to the specific situation but, what is crucial and unique about this process, is using all the synergies possible between the particular tools and modules to support each other. This means that TEST implementation, in practice, does not have to rigidly follow the simplified TEST programme implementation scheme (in the TEST approach) presented in figure 3, which can give the impression of being more structured and linear. This feature should be used to organize the project into manageable and logical units and teams. The communication between these groups is crucial, particularly at specific steps of their implementation, where there is an ability to go back to completed steps for more inputs. For these reasons it is important that particular tools will not be implemented as a self-standing and isolated projects. The different tools should not only build on each other, but they should be implemented within one logical strategy, leading to the integration of the particular tools (for example EMA or CP assessment) or approaches (for example CP strategy) into the enterprise operation.

Focusing on important advantage points, using all the possible synergies from the particular modules and the possibility to sustain the results through the ongoing improvement provided by the SES tool, will make the implementation of TEST easier and more effective. Experience shows that this is the way to prevent difficulties, which could rise from the complexity of the TEST. It also ensures that particular tools and approaches will continue to be used long after the specific module is formally terminated. The EMS and SES are the crucial crosscutting modules, which should guide this integrated approach through the whole of TEST and sustain its benefits in the long term. Only with such an arrangement can the desired continuous improvement of the enterprise's environmental performance and competitiveness occur.

Enterprises undertaking the TEST approach will be enabled, by the end of the project, to formalize their own sustainability strategy, which best fits with management's desires and the existing business environment (although where basic strategic management skills are already in place this process is smoother). There can be different corporate sustainability strategies and they can be distinguished from each other by the four types of environmental competition strategies[84]:

1. Clean: environmental market buffering strategies - in order to defend existing markets
2. Efficient: environmental cost strategies in order to be cost and environmentally efficient
3. Innovative: environmental differentiation strategies in order to differentiate by environmental product
4. Progressive: environmental market development strategies in order to develop markets environmentally

Each higher level of strategy includes the previous ones, which become active after they are explored.

Due to the existing business environment and drivers in CEE, the TEST tools and the overall implementation strategies were tailored during the first application of the TEST approach in the Danube River basin to support the adoption of an 'efficient' type of corporate sustainability strategy at the company level.

By focusing on setting a scope for an efficient type of strategy, the TEST pilot implementation did not specifically include the products and services, which are placed at the upper level of the management pyramid and their links to the baseline of the pyramid (stakeholders): product and services were addressed only in an indirect way through CPA and EST.

The innovative and progressive types of sustainability strategies were considered too advanced to apply at the time, considering the realities of the situation in the CEE at the time of the project start. In fact, all the companies that participated in the first application of the TEST project in the Danube River basin were without a corporate sustainability strategy, and

[84] Adopted from Dyllick/Belz and Schneidewind (1997:076-1776)

90 percent did not have a strategic management structure in place either. The transitional economic situation which characterizes CEE countries, and the challenges faced by local enterprises from the EU accession were considered the main drivers and criteria for the selection of the most suitable type of corporate sustainability strategy for the local companies. The focus on the efficient strategy proved to be a very good choice (and the right choice at the time) in the pilot implementation of TEST: the existing framework in CEE countries enabled the implementation of this strategy, with demonstrable benefits compared with the traditional and reactive 'clean' environmental strategies. This created a market to further spread the TEST approach in CEE countries.

However, future applications of the TEST approach can be done differently and even more proactively. Strategies toward corporate sustainability could be promoted to further develop the environmentally friendly products 'niche' just beginning in the business environment (the 'innovative' strategy) or eventually aim at stimulating the creation of new environmental markets (the 'progressive' strategy). The decision on which corporate strategy type to focus on will depend on the framework conditions (appropriate drivers in the business environment like customer demands, supply chain mechanisms, economic incentives, etc.) and on the willingness and capacities of the target companies.

Therefore a second generation of the TEST approach might include other tools such as 'Design for Environment' to address products and services as well as stakeholders in a more systemic way. In this case, the overall TEST implementation strategy might be revised accordingly, but it is still reasonable to imagine that tools like CPA and EST, which focus on process optimization, as well as EMS, EMA and SES will be needed in most cases and will have to be applied within an integrated framework to achieve the best results.

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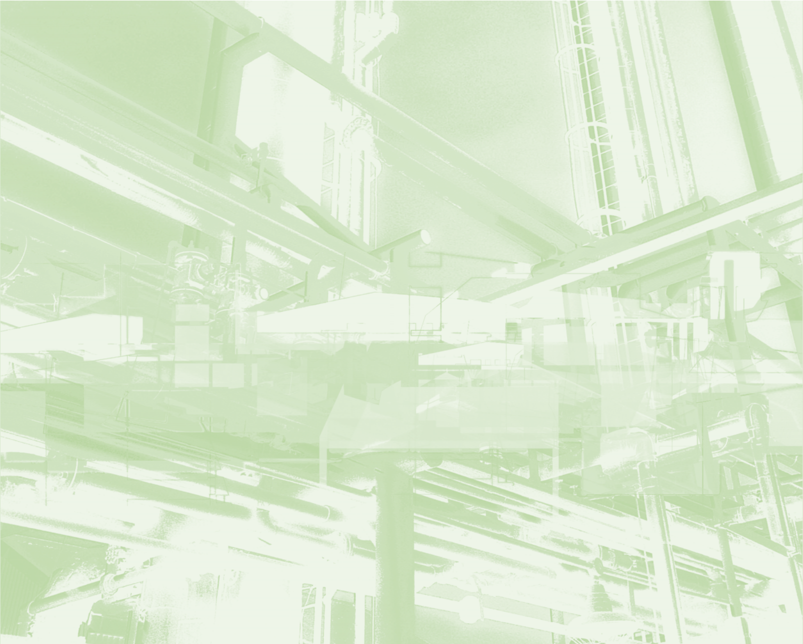
PART IV



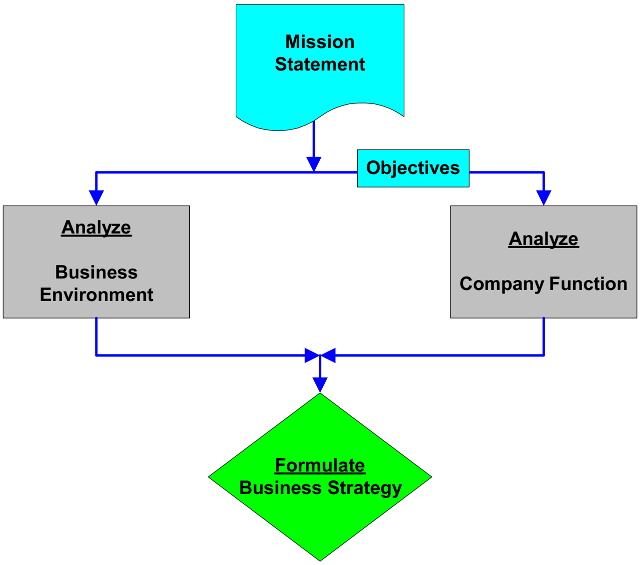
ANNEXES

ANNEX I - Enterprise Strategy and its Development Process

General Principles

To have a strategy means to have a consistent set of approaches and priorities, as well as a general understanding that guides management in making decisions on how to achieve the enterprise's mission statement and objectives. The development of an enterprise strategy is shown in figure 27.

Figure 27: Developement of Enterprise Strategy

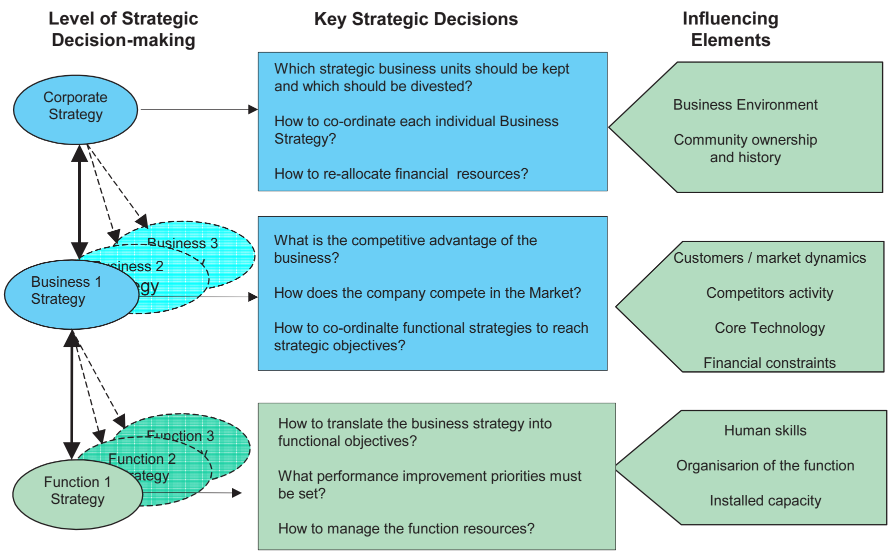


Once the business environment and the company have been analyzed[85] the next logical step is to the enterprise strategy. An enterprise strategy can have three basic levels: corporate, business and functional. These strategies are interdependent; hence, they overlap in practice.

[85] The analysis of the business environment and of the company function is done within the initial review and is complemented during the TEST implementation.

A three-level model of the hierarchy of an enterprise strategy is a convenient way to present how to develop a strategy using these guides, indicating the 'top-down' relationship between particular levels (meaning that the business strategy is devised only within the context of a well-defined corporate strategy, and the functional strategies only within a well-defined business strategy). Each strategy level is characterized by a set of strategic decisions to be taken and by a number of influencing elements that have to be analyzed. The three-level hierarchy model is presented in figure 28. However, strict adherence to this step-by-step scheme is neither ideal nor realistic.

Figure 28. Strategic Decision-Making and Influential Elements



1. Corporate strategy

The corporate strategy can be formulated using the gathered information on the business environment. Many models exist to answer key questions and help build the corporate strategy. The key questions are: which strategic business units should be kept and which should be divested, what is the best way to coordinate the individual business unit strategies to achieve synergies and how to best reallocate financial resources? Those who are interested in the method should refer to the following resources for further details (Boston Consultancy Group, General Electric Grid, Charles Hoffer Matrix).

2. Business strategy: the Porter model

The purpose of a business strategy is to find the 'Competitive Advantage' of the company. According to Porter's model, there are two types of markets (broad and narrow) and two kinds of competitive weapons to acquire these types of markets (cost leadership and differentiation) as indicated in figure 29. Both competitive weapons are mutually exclusive: it is either one or the other.

2.1. Cost Leadership

Low costs enable an enterprise to compete through low pricing and high sales volumes, which lead to increased profits. Use of this strategy is limited by the fact that there is a place for only one true cost leader. (For example to make a price difference significant, it has to be at least 5 percent lower, compared with the competing products.)

Companies which focus on this type of strategy might find it very useful to incorporate the cleaner production strategy of the TEST approach into their operations: this will lead to higher process efficiency and/or lower production costs. Such a situation was very common among the enterprises participating in the first TEST project in the Danube River basin.

3. Differentiation

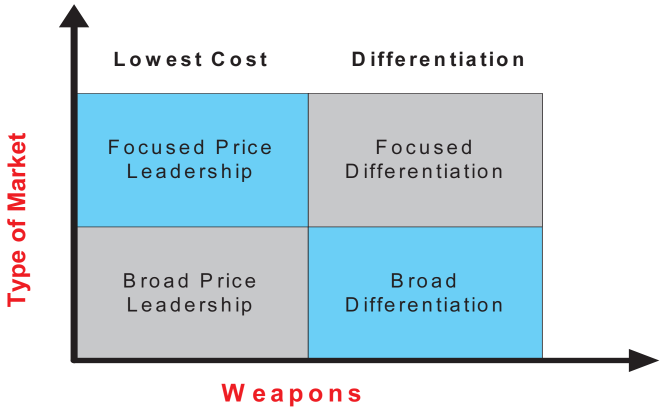
Differentiation can be achieved by a variety of means such as flexibility, specialty, innovation, loyalty and brand. A 'differentiated product' creates, in contrast to the 'low cost product', brand loyalty and a positive reputation that facilitates premium pricing, which can be used as a baseline for increasing profits.

The TEST approach can bring, for example, differentiation within the process through introduction of the ISO 14001 standard.

According to Porter's Model, there are four types of business strategy as indicated in figure 29:

1. Focused price leadership
2. Focused differentiation
3. Broad price leadership
4. Broad differentiation

Figure 29. Porters Model of Business Strategy



The business strategy defines the way the business wishes to compete in its markets and determines how to coordinate the functional strategies to achieve the strategic objectives. Once the competitive advantage of the business is defined, the set of objectives of the functional strategies is determined by it.

4. Functional strategies

Functional strategies are important in defining how to translate the business strategy into functional objectives, what performance improvement priorities to establish and how to manage the available resources to achieve a competitive advantage. Each function of the business needs a strategy to guide its actions.

More detailed, functional objectives are set at this level. There are three main functional strategies for marketing, operations and financial management (plus R&D strategy where applicable).

Elements of the marketing strategy include:

- Research and development
- Products
- Price
- Distribution
- Communication

Elements of the operational strategy include:

- Processes
- Location
- Layout
- Procurement
- Quality
- Human resources
- Environment

The elements of the financial strategy include mainly:

- Leverage
- Investment
- Credit policy

Accounting and legal services are supporting functions for the day-to-day management of the business and the strategic business decision.

5. Strategic planning

The functional strategies are finalized and translated into concrete objectives. The next level of the strategy building process can be to develop the company's long-term strategic plans, spanning 5-10 years, by setting the performance objectives of the functional strategies. For example, in the case of the operational strategy, objectives are related to: production capacity; material utilization, energy utilization, labour productivity and quality.

ANNEX II - Case Study: Implementing CPA at a Bulgarian Enterprise

A. CP and Energy conservation opportunities (ECO's)

Situated in the town of Gorna Oriahovitza near the River Yantra, (flows into the River Danube) ZAHARNI ZAVODI AD is the largest sugar and alcohol production company in Bulgaria. The enterprise was established in 1913 as a sugar-processing factory. In 1922, the Alcohol Production Factory (APF) was built. From 1959-60, the Sugar Production Factory (SPF) was renovated, and the Thermal Power Plant (TPP) was erected and started to supply the different facilities with steam and electricity.

At present ZAHARNI ZAVODI AD is a private enterprise, which has a workforce of 1360 workers and annual turnover of 72,408,000 BGN.

Due to the high degree of complexity of the technological processes and the large number of production units, the TEST project focused its attentions on the CPA module, at the unit with highest environmental problems, the APF.

Analysis of the processes in the APF focused on three areas of interest: material, energy and cooling water flows. These flows are connected and it is very difficult to isolate a single environmental impact, therefore they were addressed as a group. The goals of the CP assessment were defined as follows:

- Reduction of the slop water flow and its pollution loads (high COD load) entering the River Yantra
- Reuse of the wasted heat energy from all waste water flows from APF
- Recuperation and reuse of cooling water

B. Environmental problems

The wastewater flows from the APF are the main source of organic-matter pollution to the River Yantra. The APF flow consists of three independent streams:

- Slop water flow (a liquid distillery residue from the distillation column)
- Water of Luther (a liquid residue from the rectification and fusel columns)
- Wastewater flows from cooling equipment and from washing of single technological components, including wastewater from other sections (fermentation of molasses, production of yeast and yeast culture production of CO_2 etc.)

The energy audit of the section responsible for the production of pure alcohol revealed very high heat energy losses from the wastewater flows. Heat recovery technology was not in place for this source. Not only is the heat energy wasted by not being reused, but also it contributes to the thermal pollution of the Yantra when it is discharged into the river.

It was only reasonable then, given the results of the initial review audit, to perform a detailed water audit of the pure alcohol production section, given the high inefficiencies in the cooling water system. The existing system uses once-through water-cooling, pulling fresh water from either the Yantra or from the company's own water wells. As the name implies, it is used once to cool the heat exchangers then discharged into the wastewater stream of the APF. This is the reason an additional focus area, connected with cooling water flows, was selected.

C. Brief description of CP selected measures

1. Material flows

To achieve the goals of the material flows focus area, and after having completed the detailed mass-balance of the process, several CP measures have been identified and divided into five groups, depending on the technological changes proposed:

1. Amending the process steps and equipment/technology currently in use in the APF
2. End-of-pipe technologies for the removal of organic matter from the wastewater
3. End-of-pipe technologies for producing commodity products from slop water
4. Change of raw material without changing the existing technology
5. Change of raw material in conjunction with a change of the technology

Some of the identified measures were good housekeeping measures (type A). These are:

- Improvement of the fermentation process with small technological changes to increase the alcohol content of the molasses and therefore the input of pure alcohol itself
- Raising qualifications/skills of operational staff by attending a training course connected with CPA
- Revision of the chemical laboratory procedures. Checking the system of process steps and controls and their compatibility with international standards for alcohol production
- Improving scheduling management to avoid leaks from periodic equipment maintenance
- Improving raw material (molasses) storage and performing quality tests in the laboratory to guarantee the necessary quality levels
- Improve the heat exchangers and chemical cleaning process
- Adjust the water consumption used in the heat exchangers installing on-line control devices (without modifying the technology or affecting its efficiency)

These measures were implemented in 2003. The results from their implementation are expected to slightly improve the quality of the final product and have some positive economic effect.

Almost all of the measures from groups (2) - (5) require significant investments and during the assessment were classified as categories type C. Those, identified by the CP team as the most promising options, in conjunction with decrease of organic pollutants from slop water are listed below, and includes some end-of-pipe solutions as well as major investment in new EST technology:

- Conventional activated sludge treatment (biological waste water treatment of the slop) to destroy organic matter followed consecutively by ultrafiltration (UF) and reverse osmosis (RO)
- Reconstruction of the existing cooling water system from a once-through system to a recirculation cooling water system
- Treatment of the slop in a membrane bioreactor (MBR-technology)
- Change of raw material by introducing an appropriate technology of alcohol production able to convert the organic matters of the slop into commodity products

The replacement of molasses from sugar beet (presently used) to molasses from wheat has been suggested as the most promising solution and will be further investigated with the EST module.

D. Energy flow focus area

Measures for achieving the energy goals set for the focus area have been classified in two groups, according to the composition of the following wastewater flows:

a. Hot waste water flows containing detrimental substances
b. Non-polluted hot wastewater flows

The measures for energy conservation of these sources are different. The composition of the flows can be described as follows:

a. Hot waste water flows in the APF that contain detrimental substances are slop water flow and water of Luther; their heat energy capacities being 1,950,000 kcal/hr for the slop water flow and 832,703 kcal/hr for water of Luther. The feasible opportunities for energy conservation within this group are closely connected to the installation of heat exchangers to recover waste heat to use for:

- The supplementary heating of alcohol before entering the distillation column
- Heating water for domestic use
- Heating of the incoming input water for the nearby TPP

b. Non-polluted hot wastewater flows in the APF derived from the cooling water, flows from the reflux condensers of the epuration and rectification columns; their heat energy capacities being 95,552 kcal/hr for the epuration column and 1,710 436 kcal/hr for the rectification column

As both these heated cooling water flows are not polluted, the opportunities for their reuse seem realistic and can be used as follows (see table 12):

- Direct domestic use e.g. toilets (but not to be used in contact with food or for food preparation)
- Re-pumping to the near by thermal power plant to be used to heat raw water in the water softening installation

Table 12. ZAHARNI ZAVODI AD-Heat Recovery Opportunities

No.	Heat Recovery Source	Use		Group
1	Slop Water Flow	a.	Pre-heating of alcohol before distillation	C
		b.	To heat water for domestic use	B
		c.	To heat input water in the TPP	B
2	Water of Luther Flow	a.	Pre-heating of alcohol before distillation	C
		b.	To heat water for domestic use	B
		c.	To heat input water in the TPP	B
3	Cooling water from reflux condensers of rectification and epuration columns	a.	Direct domestic use	B
		b.	Re-pumping to thermal power plant	B

Following the UNIDO methodology, a feasibility study was conducted for the third option described in table 12.

This measure covers the use of slop water waste heat energy, by using a heat exchanger and the necessary supplementary equipment in the APF and nearby TPP to heat raw water at the TPP inlet.

The slop water heat energy concept is closely connected with the erection of a prefabricated plate heat exchanger. This measure will result in a reduction in demand for steam to heat input water, with the total amount corresponding to the amount of non-returned condensate from the APF. Reducing steam consumption will accordingly lead to reduced fuel consumption and consequently a reduction of CO_2, SO_2 emissions and particulates to the environment.

Total investment costs, including equipment, installation, engineering and contingency costs are estimated to be 35,164 BGN. Operational and maintenance costs include expected expenses for equipment maintenance and additional costs for electricity (consumed by the pump), estimated to be 1,586 BGN/year.

Preliminary calculations, done using simulation models (technical and financial), indicate a fuel consumption reduction of 563 tonnes of coal and 36 tonnes of heavy fuel oil respectively where the operational modes of the APF were assumed to be similar to those reported for 2001. Annual savings, at current fuel prices are estimated to be 65,818 BG, which leads to an amazingly quick pay back period of 6 months.

Since the implementation of the measure is connected with reduced fuel consumption, it is not surprising that environmental benefits will also be achieved. The previously mentioned fuel savings are stepping-stones to the annual reduction of atmospheric emissions, reducing them by 1,187 tonnes of CO_2 (equivalent), 29 tonnes of SO_2 and 482 kg particulates annually.

E. Conclusions

Expected results from the implementation of the proposed measures can be summarized as follows:

- Several Type A measures that do not need investment have been identified and implemented. They will ensure improvement in final product quality as well as reduction of specific consumption inputs. Reduced water consumption and improved heat transfer can be achieved through upgrading all cooling water heat exchangers and by introducing sound cleaning procedures of heat exchange surfaces to remove scale

- The change of raw materials and appropriate change of alcohol production technology requires large investments, but at the same time can solve the problems with polluting the Yantra by decreasing the organic load of COD /1000 l alcohol to zero; this will be investigated within the ESTA module
- The energy conservation measure which includes the design, commissioning and implementation of a heat exchanger and corresponding supplementary equipment to recover waste heat energy from slop water involved an investment of 35,164 BGN. Resulting fuel savings from this measure are 563 tonnes of coal and 36 tonnes of heavy fuel oil respectively. Annual savings, estimated using current fuel prices and APF modes of operation, added up to 65,818 BGN annually and an investment capital pay back period of 0.5 years
- For heat exchangers that have a high consumption of cooling water and low outlet temperature, the consumption of cooling water can be decreased by accurate water flow regulation (by installing or improving thermocouple units linked with water flow) without interfering in alcohol production processes
- Replacement of the existing once-through water-cooling system with a new recirculation cooling system requires a high investment, but the expected results would be reduced fresh water losses by 81 percent

ANNEX III - Case Study: Introducing EST in Accordance with the IPPC-EU Directive at a Romanian Company

A. Overview

S.C. ASTRA ROMANA S.A. is one of the leading privately owned oil refineries in Romania. It is listed, along with other 12 companies, in the first category on the Bucharest Stock Exchange.

ASTRA is the only producer of lubricants in Romania and its export share is significant. It was decided the TEST project modules should focus on the Hydro Refining Unit - HRFU, which is one of the most profitable business units.

The implementation of CPA revealed a great potential for cleaner production options and several CP measures were implemented. This led to a reduction of specific raw material consumptions and utilities and resulted in a total financial savings of 60,000 USD during the year 2002. Environmental benefits were achieved in terms of a reduction of wastewater discharge, CO_2 emissions, and the total elimination of oily products in the final effluent through internal recycling.

However, despite the increased efficiency achieved through the numerous CP measures, there were still important differences between the specific consumptions achieved at ASTRA (e.g. raw materials, catalyst, utilities, resources such as methane and water) and the BAT standards mentioned in the BREFs.

The EST module focused on identifying ways of bringing specific consumptions closer to the BAT standards: limiting resource consumption and pollution became the main goals of the EST Module. Two main EST options were identified and investigated from a technical and economical point of view, in order to increase the productivity of the plant and reduce its environmental impact.

- Option I: Revamping the HRF Chemical Reactor - by using an on-line computer system (EVOP) to monitor the operation of the plant. Using the EVOP framework will result in the optimization of the operating parameters and flows of materials and utilities
- Option II: Upgrading the Gas Scrubber Column - redesign the present technology and eliminate fresh water (used for scrubbing exhaust gases) when the catalyst is regenerated and the oven de-coked

B. EST Option I

EST Option 1 groups two types of measures:

A. Optimize the existing installation, to get as near as possible to the BAT parameters:

- Install extra measurement/control devices on the hydro refining reactor
- Install automatic devices for maintaining operation parameters
- Connect all existing measuring and control devices to a process computer
- Proceed with an EVOP modus operandi: in order to reach better efficiency
- Devise optimal techniques for catalyst replacement, regeneration and pre-sulphuring to keep environmental impact to a minimum.

See figure 32 for the adopted technical solution (configuration) versus to the existing configuration.

B. Develop new catalysts with higher sulphur removal efficiencies and higher reactor efficiencies:

- Test new class MCM-41 meso-porous catalyst materials
- Determine the best composition and geometry of the catalyst

- Test the catalyst in the industrial reactor

The technical/economical evaluation of the proposed technology, under the form of a pre-feasibility study, showed the following financial figures for this option:

The total investment is 2.086 Million euro:

- Pay Back Period (PBP): 9 years at a 10 percent Discount Rate, (Dynamic PBP: 10 years)
- NPV: 943 euro
- IRR: 11.09 percent (interest 10 percent)

Expected savings are approximately 2.7 USD per tonne or 450,000 USD per year (at a full capacity of 140,000 tonne per year).

ASTRA has already prepared a detailed project for installing a process computer at the asphalt removal plant, adjacent to the hydro refining plant studied here. ASTRA specialists will try to attach the hydro refining unit to the asphalt removal plant process computer, which will reduce costs considerably. This alternative solution is very straightforward to implement, the only limiting step is modifying the process computer at the de-asphalting plant. At present, banks and funding agencies have been contacted to identify possible sources of financing. ASTRA and ZECASIN-Bucharest (one of the TEST project partners in Romania) have agreed (October 29, 2002) upon a joint-project directed at searching for better, environmentally friendly, catalysts that are more efficient. The experiments have already started, with extremely promising results. An application for a governmental grant for the development of the new catalyst is awaiting the approval of the Romanian Ministry of Research. This funding opportunity was explored also because the problem of low-sulphur oil fractions fits within the priorities of the Romanian R&D objectives.

C. EST Option II

This option focuses on the optimization of the gas scrubber column, aiming to replace the current fresh water supply with the water from the ASTRA wastewater separator. The existing deep-well fresh water system is maintained as a backup system. Additionally the onsite monitoring of wastewater quality from the separator will be enforced.

The prefeasibility technical/economical evaluation study of the proposed technology showed the following financial figures for this option:

The total capital cost of the investment is 1.075 Million euro:

- Pay Back Period (PBP): 9 years at 10 percent Discount Rate; (Dynamic PBP: 10 years);
- NPV: 318 euro
- IRR: 10.42 percent (interest 10 percent)

Savings are expected to be approximately 1 USD per tonne or 100,000 USD per year (at a full capacity of 140,000 tonnes per year).

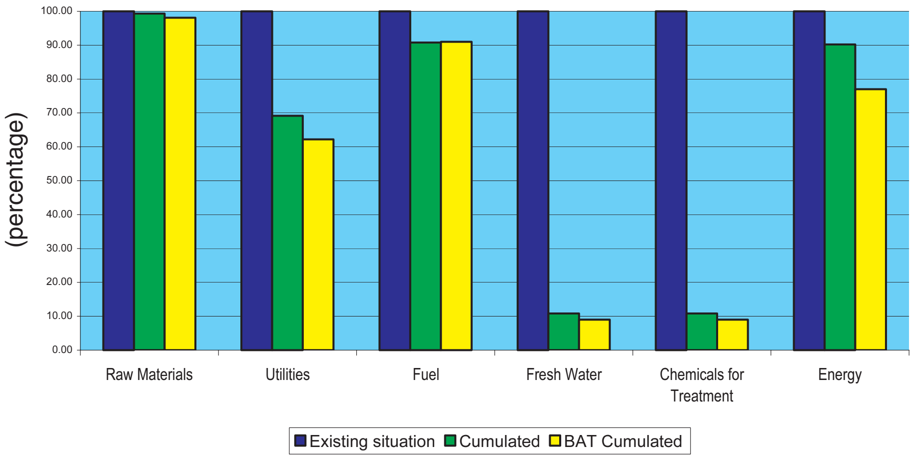
The design for the water recycling system had been completed by early 2003. See figure 33 for the technical solution adopted versus the existing configuration. The commissioning will start at the end of the life of the catalyst (during the temporary shout down of the plant for maintenance). Estimated benefits (technical, economical and environmental) are:

- Fresh water consumption reduced by 90 percent
- Reduce the amount of wastewater produced by ASTRA
- Reduce the environmental expenditures to treat the fresh water
- Minimal technical modifications: no special equipment needed
- Directing efforts toward an integrated water system as recommended by BAT

D. Benefits of the EST Options

Figure 30 compares the exiting situation with the situation after implementation of EST options in comparison and with the BAT average standards (measured in percent).

Figure 30. S.C. ASTRA ROMANA S.A. - Input Material Consumption: Start-up Situation, After ESTA (cumulated Implementation Results of Option One and Two) and BAT Benchmarks



A breakdown of the financial benefits after the implementation of the EST Options is illustrated in figure 31: all cost categories are included and important reductions are emerging from all of them.

Figure 31. ASTRA ROMANA S.A.-Estimated Financial Benefits After Implemention of EST

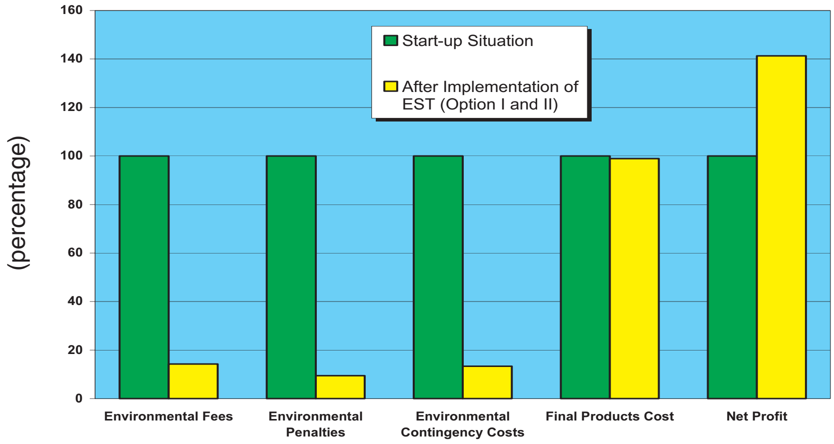


Figure 32. Existing (black) and Adopted EST layout (red) for the Hydro Refinning Reactor Optimization-ASTRA.

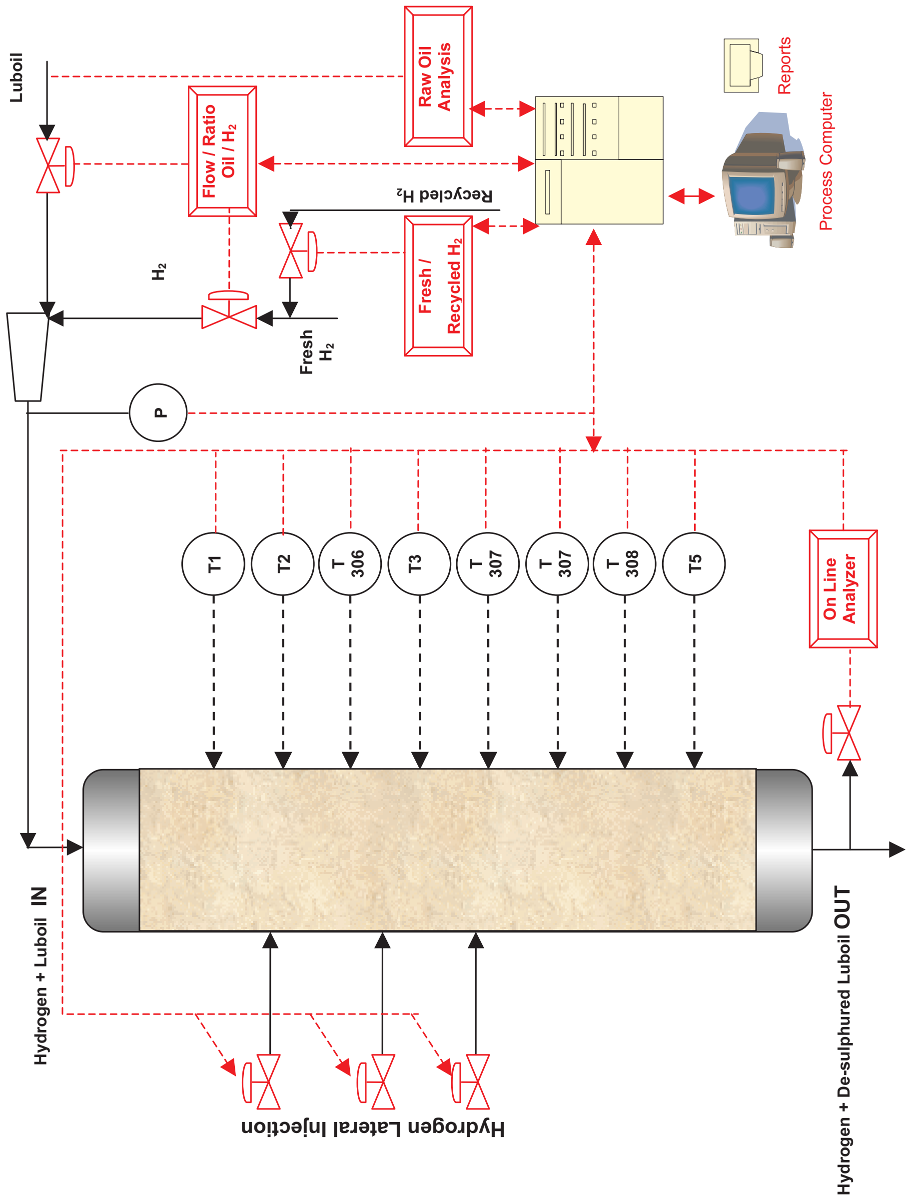
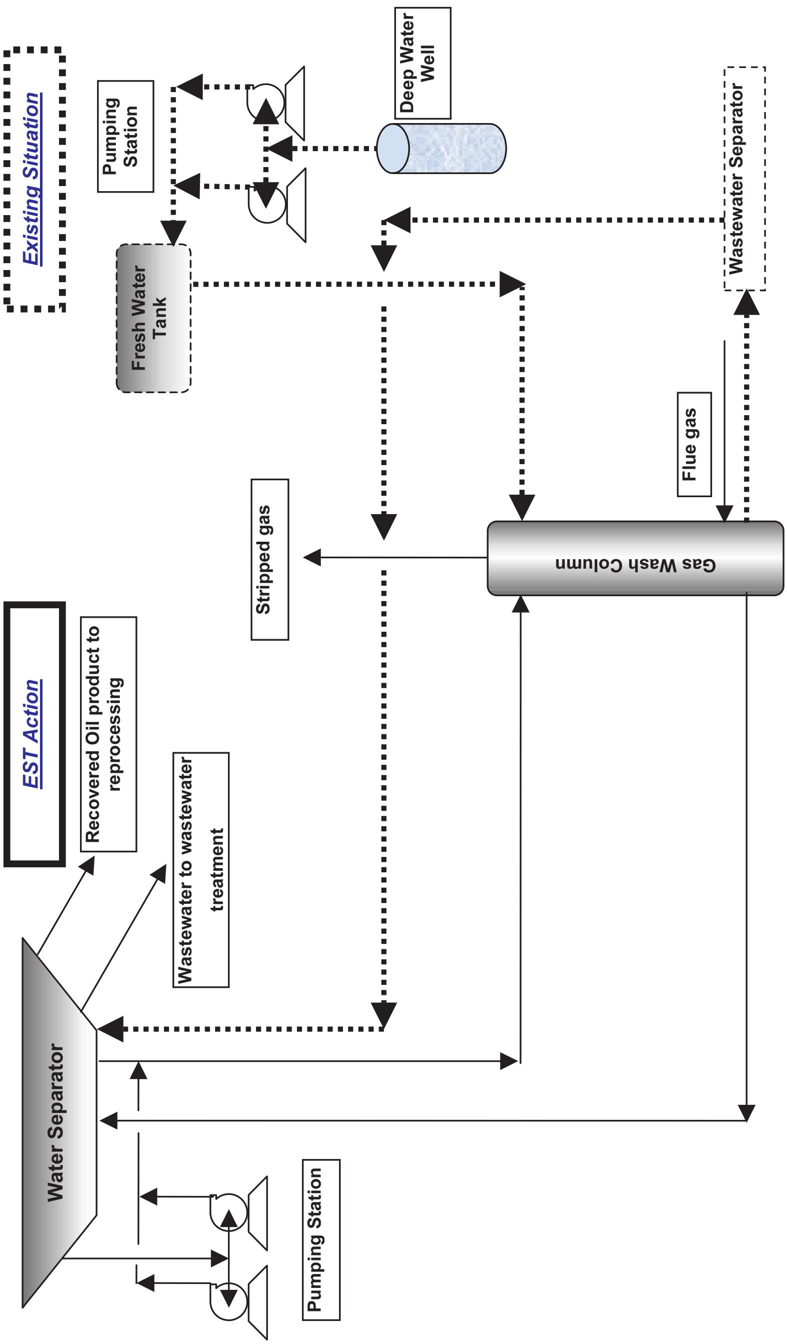


Figure 33. Existing and Adopted EST Layout for the Scrubbing column ASTRA



ANNEX IV - Case Study: Profitability of an EST investment and contingency enviromental costs at a Slovak Enterprise

A. Overview

KAPPA Štúrovo is located at the Slovak-Hungarian border, directly on River Danube. The company uses 120 thousand tonnes of waste paper per year. The main production is fluting, machine board, pasted board and other types of boards, which are exported mainly to countries in southern and Western Europe.

KAPPA Štúrovo belongs to the top ten companies, with the highest profit, in Slovakia. According to the ICPDR, KAPPA is also one of largest Danube polluters in Slovakia.

In June 2001 KAPPA Štúrovo decided to join the TEST project: top management's main environmental concern was the costs related to an investment into a wastewater treatment plant, which had already been accepted as a necessary and unavoidable expenditure. After the initial review, the CP assessment was conducted. More than 25 feasible cleaner production measures were identified and proposed to the management. As a result of the CPA module, water consumption in the cardboard production line decreased from 120 m^3/tonne (May 2001) to 76 m^3/tonne (April 2002). However, it immediately appeared that significant EST investment would be needed to reach BAT sector standards.

Future company strategy focused on expansion, therefore the TEST-EST module focused on major investment projects targeted at increased profitability, increased production output, improved environmental performance and compliance with EU regulations.

Two major technology changes were analyzed within the EST module:

- NSSC Pulp washing (1,960 million euro investment)
- Green liquor sludge disposal (239,300 euro Investment)

The economic evaluation showed that these two investments would 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.

Below is a brief description of the two projects.

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, from the current 300 BDtpd (peak 330 BDtpd) to 350 BDtpd (peak 370 BDtpd) levels
- Improve the quality of the product by improved 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 BOD5). The proposed investment will have a significant influence on reducing BOD5.

Operation is scheduled to start in the first half of 2004. The assumed life span is 8 years. Table 13 summarizes the basic assumptions and savings related to environmental costs.

Table 13. KAPPA-NSSC Pulp Washing Project Assumptions and Projected Annual Savings (in th. euro)

Cost Item	Yearly Savings [th.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 14. KAPPA-NSSC Pulp Washing Project Financial Indicators (in th. 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 [th. euro]		4714.20	3018
NPV ratio		2.47	1.58

The financial benefits of this project strongly depend on an increase in production. In financial terms, the production has to increase from 25 th. euro to 41 th. euro to obtain zero NPV. Moreover, table 14 shows that by considering contingency environmental costs, the proposed EST investment is more profitable.

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 reused in the technology.

Table 15. KAPPA-Green Liquior Project Assumptions and Projected Annual Savings (in th. euro)

Cost Item	Yearly Savings [th. 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	

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

Tables 15 and 16 provide an overview how important the consideration of environmental benefits is in project appraisals, especially in terms of internal rate of return.

Table 16. KAPPA-Green Liquior 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 [in th.euro]		224.03	31.53
NPV ratio		1.03	0.13

ANNEX V - A Full Case Study: Implementing the TEST Approach in a Romanian Pulp and Paper Company

In April 2001, the management of the Romanian pulp and paper company SOMES decided to join the TEST project, recognizing the importance of managing the current environmental aspects of the company and the benefits to future operations and competitiveness.

After the initial environmental review the bleaching unit was identified as the TEST project focus area, as it is responsible for the most significant environmental impacts of the whole plant due to:

- The hazardous pollution generated by the creation of chlorinated organic compounds
- High water consumption compared to BAT levels
- High material losses (chemicals, product and resources: water, energy) not well quantified

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

- A decrease of flow and effluent loading from the mill
- A decrease in consumption of specific chemicals at the bleaching unit (CP project)
- Product quality improvements
- A decrease in maintenance and repair expenditures
- An electric power consumption reduction

As result of the project, a total number of 175 employees were trained (on

CP, EMS, EMA, EST), 20 company departments (out of 34) participated at TEST training sessions and the unit participation in TEST activities amounted to approximately 770 man days.

A real raising of awareness led to organizational changes (a Quality and Environmental Department was created) and the number of employees with environmental skills and tasks doubled vs. the situation at the project start.

A. Cleaner production assessment (CPA)

The initial targets of the CPA assessment were: reduction of raw materials (fibres), chemicals and water as well as the reduction of wastewater flows and pollution loads.

After the detailed analysis was performed, pollution sources were identified and a total number of 32 feasible type A and B options were identified (vs. only three measures already known by the company team). Figure 34 illustrates the section of the production process where CP measures were identified and implemented. The pre-feasibility analysis of the B-type measures was done using the following steps:

- Technical feasibility was assessed against the existence and performance reached through specific devices and pieces of equipment
- The technically feasible measures were assessed from the point of view of economic/financial feasibility: only two proposed measures showed Payback Periods (PBP) longer than one year, most of them had PBP of less than half a year
- The environmental feasibility was assessed using a multi-criteria approach, considering the following aspects in addition to emission quantity & frequency:
  - Present and future penalties for exceeding standards
  - Cross-media contamination of specific pollution sources
  - Intensity of resource consumption
  - Adverse health effects

Type A and B CP options were grouped by how they contribute to the same CP targets. For example, the consumption reduction (of a particular chemical) was the result of four individual measures:

1. Continuous flow measurements of the material that is treated with the respective chemical contributed to approximately 30 percent of the reduction.
2. Continuous concentration measurements of the material that is treated with the respective chemical contributed to approximately 30 percent of the reduction.
3. Continuous measurement of the chemical content in the generated effluent contributed to approximately 20 percent of the reduction.
4. Monitoring chemical-based emission into the atmospheres contributed to approximately 20 percent of the reduction.

Twenty of the 32 feasible CP options were approved by the company's management and included into the CP Action Plan. CP options included process control monitoring consumptions and emissions, local collection of leaked material and its reuse, recycling of alkaline and acid solutions and 'white water'; devices for 'down-time' reduction and devices for pressurized water for washing.

Figure 34. SOMES CP Module Applied to the Pulp Bleaching Plant

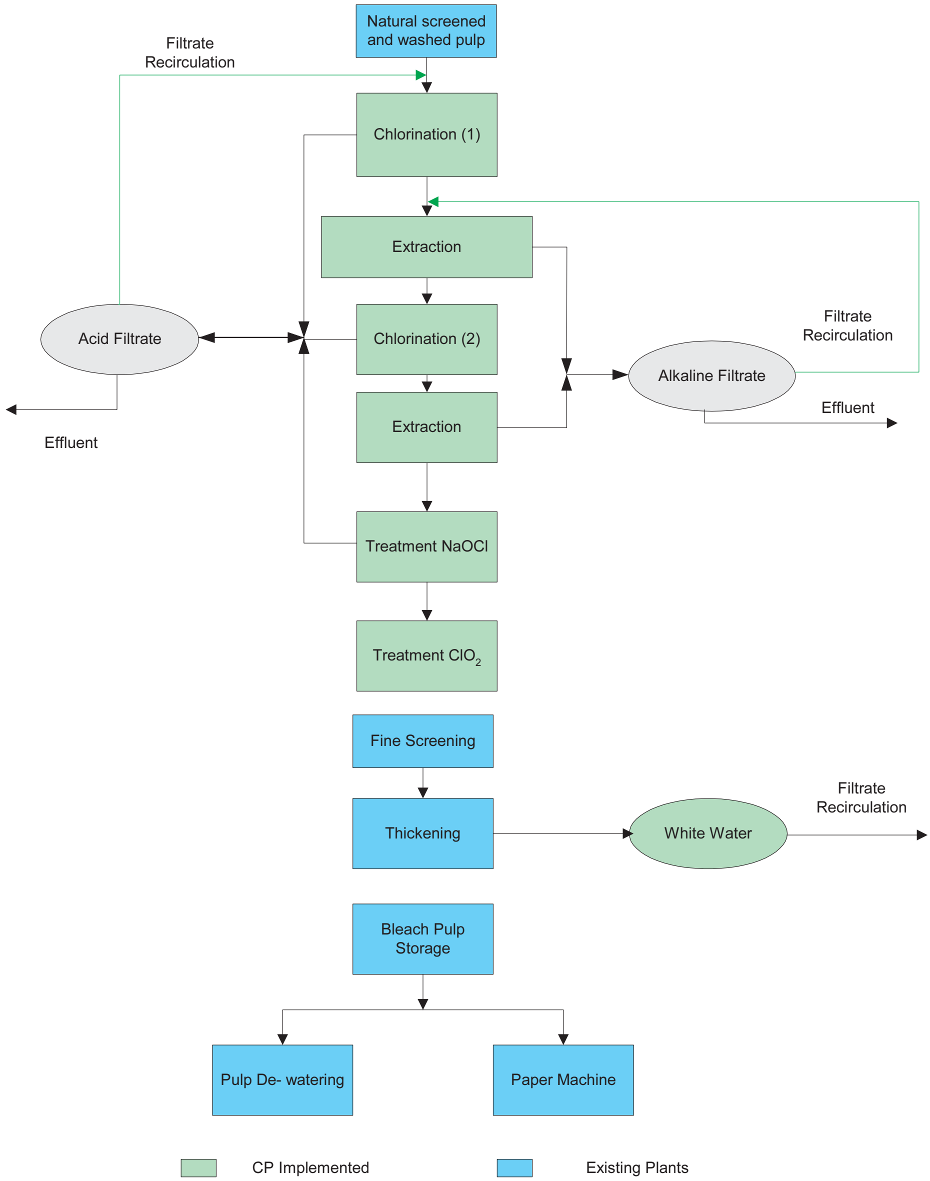
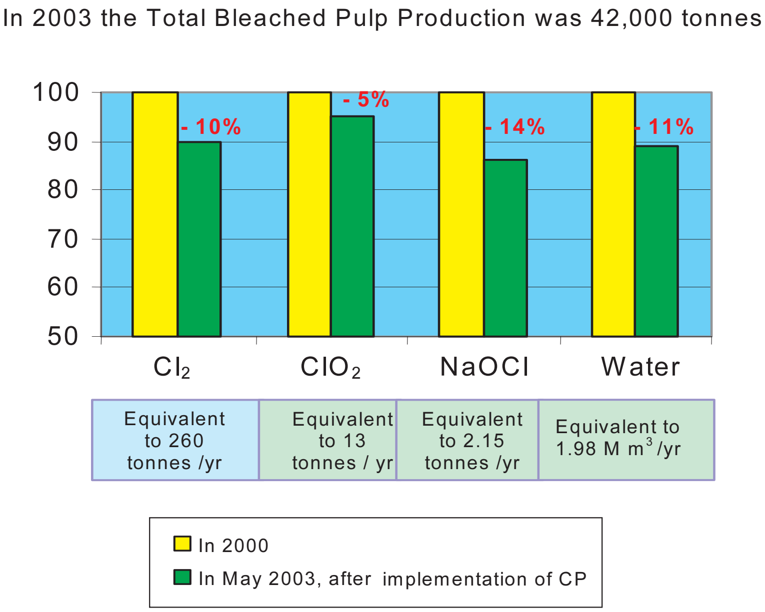


Figure 35. SOMES Effects of Implemented CP Measures: Reduction of Chemicals and Water Specific Consumption



A significant reduction of pollution loads was achieved, i.e. wastewater flow, TSD, TDM and AOX discharged. The graph in figure 35 shows the effects of CP measures on bleached pulp effluent based on year 2000 production levels, before the project started and compared to the BAT standards (BREFs for pulp and paper industry). Through the implementation of the identified measures, a significant amount of water and chemicals were saved and chlorine emissions have been reduced by 92 percent at the bleaching unit, as indicated in figures 36 and 37.

Figure 36. SOMES-CP Effects on Bleached Pulp Effluent

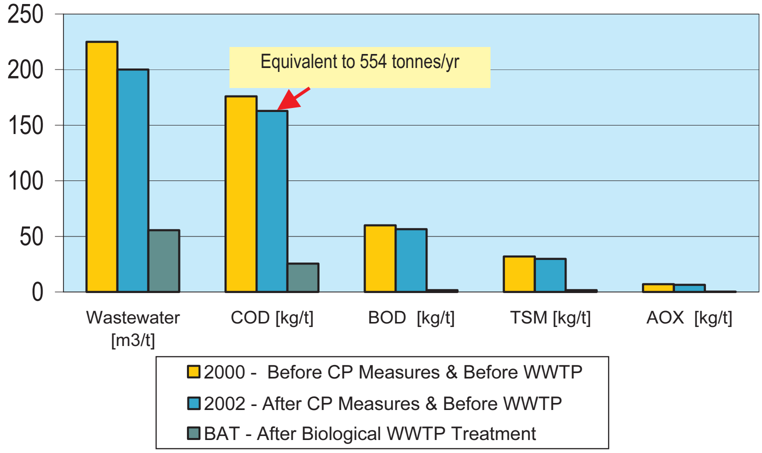
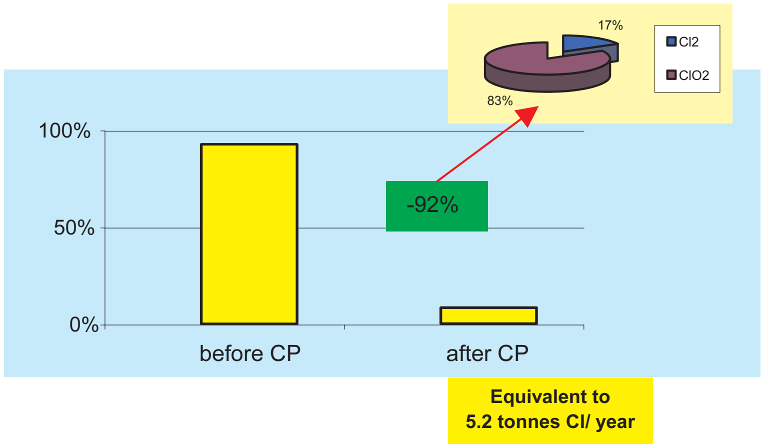


Figure 37. SOMES-Reduction of Chlorine Based Gas Emissions at the Bleaching Unit



The range of investments for type B CP options varied from a minimum of 100 USD to a maximum of 31,500 USD. Economic evaluations showed a pay back period range between one month and 3.7 years. The overall implementation cost of the proposed CP Action Plan was estimated at 100,500 USD, of which 34,000 USD was implemented in 2002 and 66,500 USD will be completed in 2003.

The calculated economic benefits in 2002 for the implemented CP measures were approximately 43,000USD (i.e. the investment of the first year was paid back within a year). These savings resulted in a 9 percent reduction of raw materials consumption and water costs at the bleaching plant, equivalent to 2-3 percent of the overall bleaching production costs, as is illustrated in figure 38. The breakdown of savings in figure 39 also shows the relative contribution of cost categories to the total savings and emphasized that the main saving source was achieved from the reduction of water consumption and effluent discharge (including fees and penalties), corresponding with the reduction of chemicals.

Figure 38. SOMES-Effects of Implemented CP Measures on Bleached Pulp Production Costs

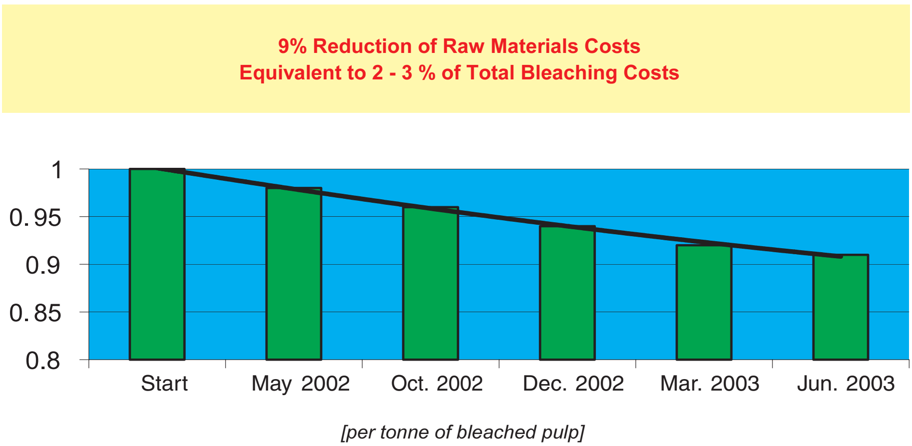
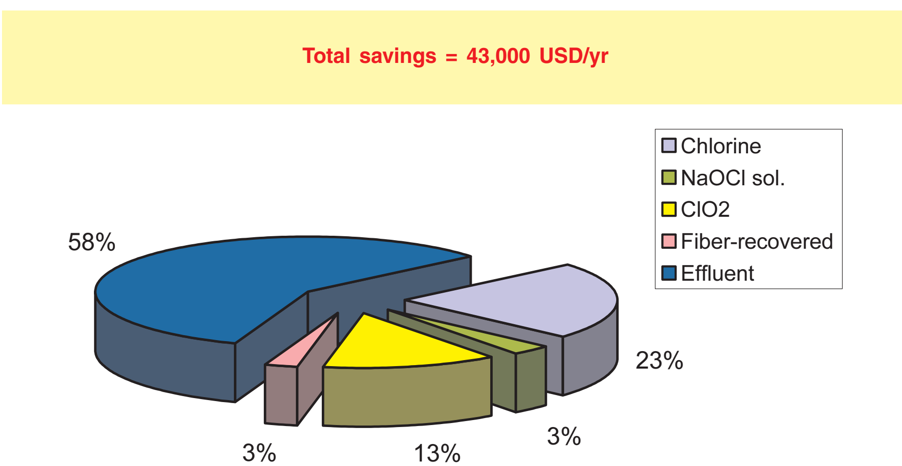


Figure 39. SOMES-Reduction of Production: Breakdown Costs by Cost Categories



The importance of CPA was recognized at all management and operational levels and the detailed analysis was replicated in all operating units (mass balance completed for all processes). Because of the extension and continuous application of CPA to other process units (wood chipping) additional CP measures were implemented.

B. Environmentally Sound technologies Assessment (ESTA)

Despite the significant increase of process efficiency and improved environmental performance resulting from the implemented CP measures, the AOX parameter (Adsorbable Organic halogens) remains very high, about 6.0 kg/BDt, compared to the 0.25 kg/t required and provided by the BAT (Best Available Techniques) for the Pulp and Paper Industry. At the same time, despite the 9 percent reduction of water consumption achieved during CPA, the bleaching department remains the largest water consumer in the mill: about 150-160 m3/BDt, compared to 30-50 m3/ADt (total) provided by using BAT for the bleached kraft pulp production. Although very diluted, the COD load discharged by the mill is still very high compared to BAT standards.

Overall, the technology used is quite obsolete and out of compliance with the national and EU environmental requirements. Besides the growing local market demand for pulp and paper products, the quality of pulp produced is low and some paper customers have started looking for chlorine-free wrapping paper. Elimination of elemental chlorine is a must for the company's future strategic business position.

Given the existing situation and the BAT requirements it was decided to focus the EST - TEST project module on a techno-economical evaluation for a delignification stage before the bleach plant, by extended or modified cooking and additional oxygen stages as well as a new elemental chlorine free (ECF) bleaching unit. Figure 40 illustrates the new process stages as identified for implementing EST at SOMES.

A detailed sensitivity analysis of the investment, taking into consideration long-term environmental benefits and new legislation trends, was performed using the UNIDO COMFAR tool. Despite the overall investment cost being very high (approximately 11.5 Million USD), the financial indicators of the investment proved to be very positive in terms of NPV and showed an average IRR of 16 percent.

Substantial savings of raw material, chemicals, process water as well as utilities (power and steam) will be achieved by implementing BAT for the bleaching unit. Additionally, a significant portion of environmental costs will be reduced, equivalent to approximately 40 percent of the total cost reduction. Based on a preliminary estimate the cost reduction per each cost category has been calculated and reported in table 17.

Table 17. SOMES-Reduction of Production Costs by Category at the Bleach Plant after Implementation of EST/BAT[86]

Reduction of Production Costs by Category, Due to Implementation of EST/BAT for Bleached Pulp and Paper		
Cost Categories	**Sub-Categories**	**USD/ADt[87]**
Raw Materials, Chemicals and Water		4.7
Utilities (power and steam)		7.74
Environmental Costs	Wastewater Treatment Costs	5.4
	Discharge Fees	1.0
	Penalties	4.0
Total savings in pulp production		22.84
Additional cost reduction for utilities consumptions at the paper unit (reduced pulp drying and raw materials costs at the bleached paper production line)		4.7

Data have been calculated based on the nominal pulp and paper production capacity (43,000 tonnes bleached pulp /year)

Data have been calculated based on the nominal pulp and paper production capacity (43,000 tonnes bleached pulp /year)

The process' increased efficiency will enhance the bleached pulp characteristics as follows:

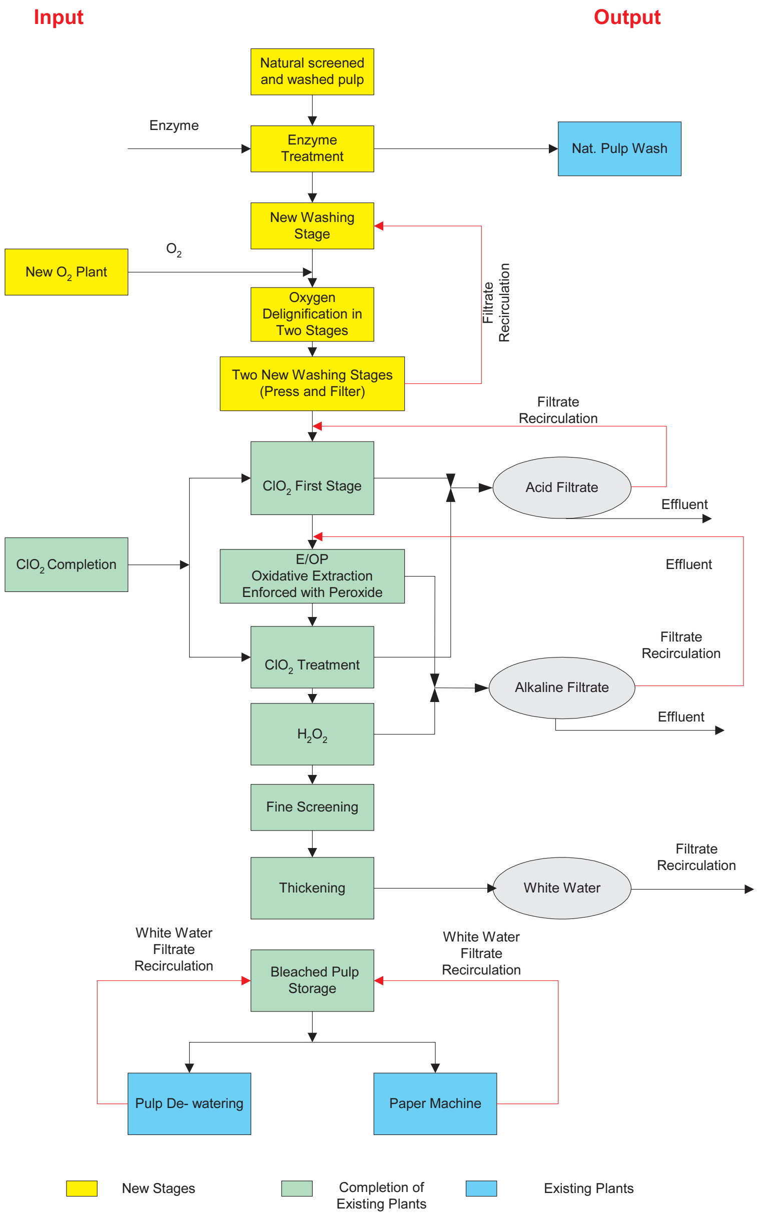
- An increase of the final pulp brightness up to 88 - 89 percent ISO
- An increase of the final breaking length of pulp by 1000 - 1200 m
- An increase of pulp purity degree

Due to the quality increase of the product (including its more environment-friendly performance), it was estimated there would be an increase

86 Adt - Air Dry ton of pulp / BDt - Bone Dry ton of pulp
87 Adt - Air Dry ton of pulp / BDt - Bone Dry ton of pulp

in the market price for bleached pulp of about 20 USD per BDt. More important, of course, is the fact that if chlorine is not eliminated, the SOMES mill would not be sustainable in the long-term as demand for their product will continue to decrease.

Figure 40. SOMES-ESTA module Applied to the Bleaching Unit



Generally speaking, the investment in oxygen delignification and bleach plant revamping significantly enhances the SOMES mill long-term competitiveness. It reduces the production costs of the product by 22.84 USD per tonne of bleached pulp while it closes the gap between pulp quality and pricing by an estimated 20 USD per tonne.

High-cost CP measures (approximately 300,000 USD) for medium consistency pumps, evaluated as a pre-investment for the new chlorine-free bleaching unit (EST module) were installed within the project period. The remaining part of the investment is expected to start in 2004.

C. Environmental management system (EMS)

At TEST project start, the choice was to introduce the EMS at the pilot level of the bleaching unit. A total of 40 employees were trained, representing 20 functions (of the total of 34) and the unit trained people with approximately 135 employees. The top management approved an environmental policy. At the project's end, the basic elements of EMS documentation were in place. The skills built at the enterprise motivated the company to extend the scope of the EMS to the entire plant and the unit management is now focused in acquiring ISO certification for the entire plant by 2004. SOMES has quite recently acquired the QMS certification. It was the SOMES management decision to develop the EMS first at the pilot level, as a model to be transposed and integrated with the QMS at the mill later.

D. Environmental management accounting (EMA)

As part of the TEST project, the management of SOMES decided to introduce an EMA system to have a better and more comprehensive approach to management accounting. SOMES is using a method for costing generally known as Absorption Costing (AC). The company is organized into five main cost centres, 5 main auxiliary sections and 5 minor auxiliary sections as summarized in table 18:

Table 18. Absorption Costing at SOMES

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 only environmental cost category recognized in the management accounting system at SOMES, before the EMA project started, was the waste-water 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 19 the main environmental cost items and their allocation method are reported as they were before the EMA project start.

Table 19. Management Accounting System Allocations (Before Introducing the EMA Tool) at SOMES

Cost Item	Allocation Method
Non-Product Raw Material	Direct Cost As Raw Material
Fines & 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

The following objectives were set at project start:

- 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

- 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

1. 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.

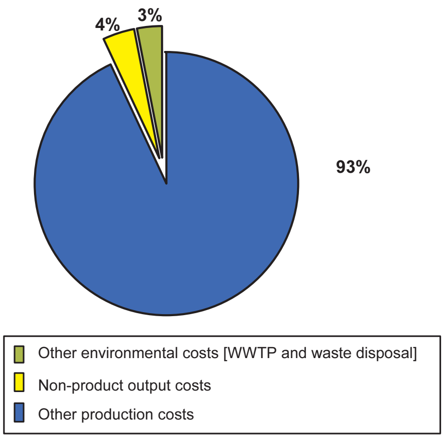
Once environmental costs items were selected, all cost centres, including all process overhead generator centres, were analyzed to collect information on the environmental costs and the existing allocation keys.

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.

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). [88]

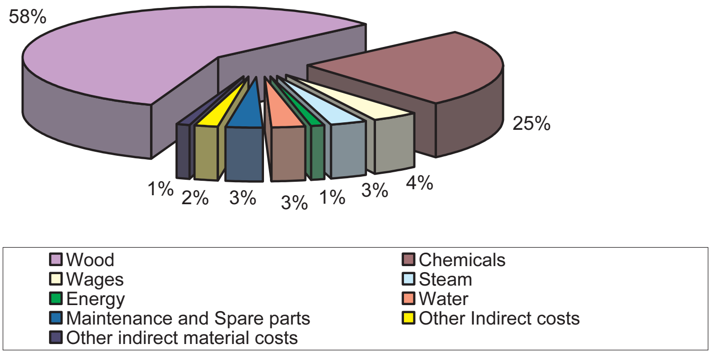
Solid waste disposal costs were calculated and properly allocated to the cost centres that generate them. The environmental costs were first allocated at the cost centre level and then at the product level. Figures 41 and 42 summaries the structure product cost for bleached pulp and provide a breakdown of non-product output costs.

Figure 41. SOMES Production Cost Structure: Bleached Pulp



[88] These costs were analyzed 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

Figure 42. SOMES Non-Product Cost Structure: Bleached Pulp



At it's conclusion, the EMA component of the TEST project achieved the following:

1. 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.
2. Management Accounting and Data Collection System were reorganized and Procedures were prepared to highlight the environmental costs.
3. Continuous application of CPA for reduction of the environmental costs was adopted.
4. CPA was extended to the entire plant to support environmental cost controlling information system (EMA).
5. 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:

1. Existing cost allocation methods and allocation keys were revised to take into account environmental criteria.
2. Total environmental costs were calculated and allocated to the appropriate cost centre and to the products.

3. 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 20 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 percent will generate an average increase in profitability of approximately 3 percent. For a turnover of 31,600,000 euro, the amount of savings will be 948,000 euro.

Table 20. Non-Product Output Costs Compared to Enviromental Treatment Costs (end-of-pipe) For Each Product-SOMES

Products	Total Production Cost	Non-Product Output		Environmental Costs (End-of-pipe)	
	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

ANNEX VI - Integrated Scheme of the TEST Approach and Possible Links Between the Tools within an Implemented System

	General Level of Outputs	Specific Outputs of the Steps of Each Tool and their Links
Initial Review	**1. Overall diagnosis** (Core aspects of the existing situation) **2. Priorities for the TEST project** (Focus of the TEST project and its particular tools)	**Implementation plan and organizational scheme of the TEST project including:** • Cleaner production assessment (CPA): focus area and plans for CPA (including Preliminary identification of Environmentally Sound Techniques (EST)). Decision whether to start CPA before EMS (for example in order to further commit an enterprise and quickly address specific problems and/or to postpone the decision if implementing EMS). • Environmental Management System (EMS): draft environmental policy, environmental impacts, scope and environmental policy. Decision whether to start with EMS before CPA, which can be implemented as a specific program of EMS in this case. • Environmental Management Accounting (EMA): scope and system boundary. Decision at which stage of implementation of the other modules (CPA, EMS) the EMA should be initiated. • EST: preliminary identification of focus area based on the results of the market and financial viability • Sustainable Enterprise Strategy (SES): preliminary set-up of the outputs for the SES module, based on: major weakness and major competitive advantages of the enterprise, most fundamental problems in the functional areas as well as strategic management attitude as well as, existence of a formal or intuitive or non-existent strategies.

	General Level of Outputs	Specific Outputs of the Steps of Each Tool and their Links		
		CPA / ESTA Tool	**EMS Tool**	**EMA Tool**
Plan	**3. Detail Map of the Situation**	**CPA Tool** Detail map of pollution sources for the focus area. (Focus on the operational level). **Relates to and links with:** →EMS: identification of environmental aspects →EMA: Identification of pollution sources can provide input for allocation of internal environmental costs	Identification of all environmental aspects **Relates to and links with:** →CPA: Possible additional criteria for selection of focus area and for priority setting. →EMA: Structure for allocation of environmental costs.	Understanding the production cost flow
	4. Setting Priorities (Decision on what to address immediately)	Detailed analysis (mass balances) of the process **Relates to and links with:** →EMS: Implementation of specific EMP with focus on the operational level	Significant environmental aspects identified and Environmental Management Programs (EMPs) designed. (EMP goals can focus on the operational level (for example to reach an environmental standard) or on the system level (like improved communication)).	Selection and calculation of environmental costs items. **Relates to and links with:** →EMS: Additional criteria for identification of environmental aspects →CPA: Additional criteria for selection of focus area and for setting priorities

General Level of Outputs		Specific Outputs of the Steps of Each Tool and their Links		
		CPA / ESTA Tool	EMS Tool	EMA Tool
Plan	**5. Understanding causes of pollution generation**	Pollution causes (can be identified on both the operational and the system levels) as a result of the detailed analysis **<u>Relates to and links with:</u>** →EMS: Implementation of specific EMP →EMA: definition of cost centres for environmental costs allocation		Allocation of environmental costs to cost centers/products
	6. Improvement Options	Initial set of CP options based on preventive techniques. **<u>Relates to and links with:</u>** →EMS: Implementation of specific EMP	Initial set of measures to address the goals of the EMP including large range of operational and managerial measures as well as end of pipe solutions	-Final selection of environmental cost items to be included in the EMA system on a continuous base - Design of EMA information system (environmental accounts to be created, etc.)

General Level of Outputs		Specific Outputs of the Steps of Each Tool and their Links		
		CPA / ESTA Tool	EMS Tool	EMA Tool
Plan	**7. Feasible Measures**	Set of CP feasible measures based on the results of the pre- feasibility study (technical, economic and environmental) structured following the A, B and C categories of the CP measures. **Relates to and links with:** →EMS: Implementation of specific EMP **ESTA Tool** Final selection of high investment needing EST measures to be further investigated (should be based on input from the initial review and CPA – category type C) and detailed evaluation • Techno-economical evaluation • Pre-feasibility • Financial evaluation This is a self-standing module as it broadens the scope of the CPA to end of pipe solutions. →EMS: Implementation of specific EMP →SES: Reflection on experience gained	Set of measures (both operational and managerial) to implement the EMP (for operational and end of pipe solution feasibility study are conducted))	Environmental costs items to be considered within feasibility study and sensitivity analysis for CP/EST measures

General Level of Outputs		Specific Outputs of the Steps of Each Tool and their Links		
		CPA / ESTA Tool	EMS Tool	EMA Tool
Plan	**8. Decision on feasible measures to be implemented**	Plan for implementation of feasible CP measures. Business plan for measures needing high investment should be also developed from the scope of TEST **Relates to and links with:** →EMS: Implementation of specific EMP	Action plan for measures to be implemented within EMPs	
Do	**9. Measures implemented**	Implementation of CP/EST measures: Execution **Relates to and links with:** →EMS: Achievement of goals of specific EMP →SES: Reflection on experience gained	Implementation of the EMS elements: • Roles and Responsibilities • Training • Procedures • Documentation • Operational control Implementation of action plans identified within the EMPs. **Relates to and links with:** →CPA: Implementing and sustaining CPA and CP measures through EMS elements and procedures	Set-up of the EMA information system. Controlling measurements

	General Level of Outputs	Specific Outputs of the Steps of Each Tool and their Links		
		CPA / ESTA Tool	**EMS Tool**	**EMA Tool**
Evaluate	**10. Evaluation of project impact**	Monitoring and evaluation of effects of the implemented CP measures (Utilizing the TEST indicators) **Relates to and links with:** →EMS: Evaluation of effects of particular EMPs	Systemic evaluation of performance on the management and on the operational levels (Utilizing the TEST indicators • Monitoring and measurements • Non conformance • Records • Audits **Relates to and links with:** →CPA: Evaluation of CP measures	Evaluating EMA system: Review environmental costs items to be calculated and allocated **Relates to and links with:** →EMS, CPA: Evaluation of the economic effects of the implemented measures
Act	**11. Sustain results within each project tool**	Secure sustainability: sustain CP (including selection of new areas for its implementation) **Relates to and links with:** →EMS: Corrective action and management review →SES: Reflection on experience gained	Corrective Actions Management Review **Relates to and links with:** →CPA: Requirement for CPA within the corrective actions →SES: Reflection on experience gained, development of sustainable enterprise strategy	Implement required modification of the EMA system **Relates to and links with:** → EMS: review SEAs →SES: Reflection on strategic objectives of the business
	12 . Adopt SES (Integrate TEST approach in business strategies)	**SES Tool** Reflect the experience gained at the operational and managerial level (trough CPA, EMS, EMA and ESTA tools implementation) within the strategic level: review enterprise business and functional strategies and their performance objectives to incorporate environmental/social considerations.		