Håkan Rodhe

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Preventive Environmental Strategies in Eastern European Industry

An analysis of donor support for cleaner production

Doctoral Dissertation

the international institute for industrial environmental economics
Lund University, Sweden

IIIEE DISSERTATIONS 2000:7

Preventive environmental strategies in Eastern European industry

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Doctoral Dissertation, September 2000

Håkan

RODHE

The International Institute for Industrial Environmental Economics
Internationella miljöinstitutet

The painting on the cover is a seriegraph by Jörgen Fogelquist called
"Sensommarskuggor vid kusten" [Late summer shadows by the coast]

vaksamhet – varsamhet där land möter hav

Jörgen Fogelquist, Lund, May 2000

Published in 2000 by IIIEE, Lund University, P.O. Box 196, S-221 00 LUND, Sweden,
Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: iiiee@iiiee.lu.se.
Printed by KFS AB, Lund.

ISRN-LUTMDN/THME-00/1006-SE
ISSN 1402-3016
ISBN 91-88902-18-8

Acknowledgements

I enjoy writing dissertations. At least partly. What used to feel like an insurmountable task gradually turned into something pretty reasonable once I started to work on it seriously. My ability to work hard and think clearly was put to test, while at the same time my need for help proved the strength of the organisation I work in and the quality of the relations to the people that I am surrounded by. I feel like a lucky guy…

Thanks to all the dedicated cleaner production practitioners and other professionals who have willingly shared their experiences and thereby made this research possible. I am particularly grateful for all the great Eastern European people that I have had the opportunity to meet and work with during these years; it has been most rewarding.

I am grateful for the financial support that this research has received, and would particularly like to mention the WWF Sweden, the OECD, the Danish EPA, the Swedish Institute, the UNEP Industry and Environment Office in Paris, and the IIIEE for supporting various elements of the research, and the Foundation J. Gust. Richert for supporting the final writing period.

I want to thank my supervisors Dr. Lars Hansson and Dr. Thomas Lindhqvist for their kind and relevant support, and Prof. Karl Lidgren for his advice as well as for making this journey possible. Thomas deserves a very special recognition for sharing with me the mysterious box of Eastern Europe, the intellectually challenging discussions, and the most memorable trips to Eastern Europe.

For taking their time to read and provide valuable comments on my drafts I want to express my sincere gratitude to Zina, Peter, Åke, Andrius, Vladimir, Chris, Allan, Harri, Valdas, Dima, Henrik, Martin, Don, Henning & a couple more.

More thanks:

- To my dear Camilla for joining in making this a manageable journey and for all the constructive comments.
- Alva & Noel for making me smile and keeping me and my mind off work a couple of hours every day!

- My mother and my mother-in-law for helping out with the practical life at home, and them and many more for caring.
- Jörgen Fogelquist: I am proud to have one of your paintings on the cover.
- Lyn, for your extraordinarily supportive language support:
- To the clever and charming MSc students that have provided me with useful information in their theses writing: Thank you all!
- Without the benefit of a functioning computer, library support, a clean room, money in the bank, somebody to handle the bureaucracy, smiles in the morning, etc, this dissertation would obviously not have existed today; Thanks all institute administrative staff!
- And all my other dear friends at the institute who make it fun to go to work in my little institute world…

All in all, it's been a privilege.

One is enough, though.

Tegnérsplatsen in Lund, June 2000

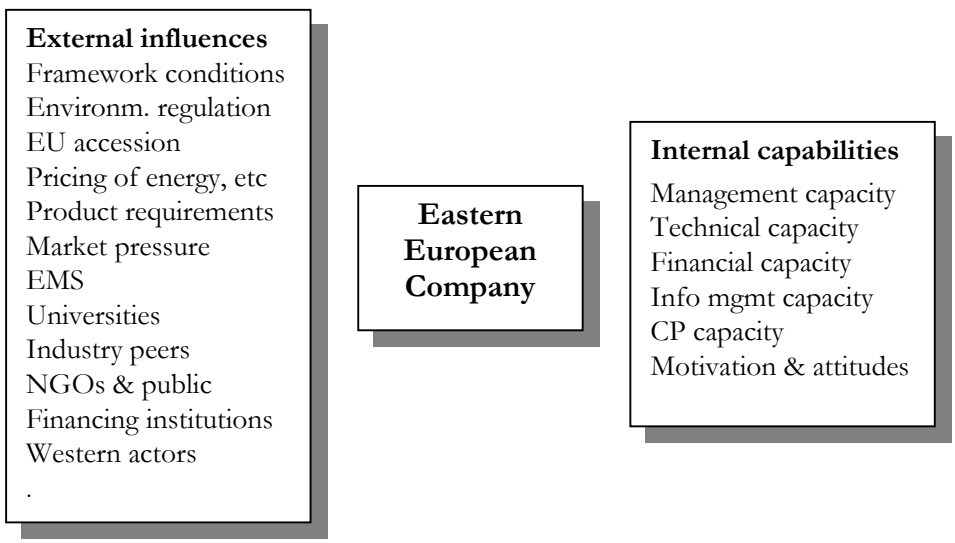
Håkan Rodhe

Executive summary

The donor-funded cleaner production programmes in Eastern Europe have been pursued since 1991, with the aim of supporting the industry in restructuring as well as reducing environmental impact. The double benefits make the approach unique in the sense that it is an environmental strategy that can be justified and pursued in a business climate with severe financial constraints – which is the case in Eastern Europe. The great political and practical interest in cleaner production, but also lately a stagnant donor support, forms the background to this research: if cleaner production is desirable by the actors involved, then why is it not more widely pursued by the donor community? Why has interest lately been stagnant? What can be done to improve the dissemination of cleaner production in industry in the region?

The research has had a multi-disciplinary approach and the quest to understand the mechanisms involved in the donor support for cleaner production has involved applied projects in Eastern European industry, reviews of other work, student projects and desk top work.

The study has unveiled a broad range of factors that influence the promotion of cleaner production in the Eastern European enterprise, both external to the company and internally as illustrated in the following figure:



The way the Eastern European company relates to these factors varies largely with the circumstances and it is in this respect found to be useful to distinguish among the following types of companies:

- State owned enterprises.
- Privatised large and medium-sized enterprises.
- New small enterprises, which constitute a growing part of the economies in the region.
- Joint ventures and various other forms of foreign involvement.

The last two represent the dynamic firms that normally have some of the incentives needed to undertake cleaner production, whereas the state-owned firms may lack the most essential incentives. The privatised firms are somewhat unpredictable in this respect.

The donor efforts in cleaner production have been focused on demonstrating the effectiveness of the preventive strategy, training individuals to perform cleaner production assessments, and setting up cleaner production centres in the Eastern European countries. The efforts have been successful, but they have been small compared to other environment-related expenditure by the donors: the total donor funding for cleaner production in Eastern Europe over the last ten years is estimated to be in the order of 50 million US dollars.

The main conclusion of this dissertation is that donor priorities in the environmental support to Eastern Europe are clearly unjustified. The conclusion is based on:

- That there are significant benefits from the cleaner production efforts in the Eastern European industry.
- The very small share of the cleaner production efforts compared to the total environmental support.
- The problems observed in making the other forms of environmental support function properly, for example wastewater treatment.

What are the justifications for undertaking cleaner production in Eastern European industry? The reasons include the following:

- It is an approach to environmental improvements that is feasible to undertake in the financially constrained situation that exists in Eastern European industry.
- It contributes to restructuring and improved business performance of industry.
- It enables Eastern European industry to leapfrog in the sense that over-investments in resource-intensive end-of-pipe equipment is avoided.
- It contributes to individual learning and improvement processes.

The reasons why cleaner production is not more widely pursued by the donor community include the following:

- There is no readily accessible capacity to perform the work. The knowledge is there but currently not in a form that is useful for the donor agencies.
- The donors are occupied with supporting the environmental part of the acquis (EU law), which largely is defined in terms of end-of-pipe treatment.
- The preventive approach demands a greater involvement from the side of the recipients compared to transfer of end-of-pipe equipment.

It is observed that there has been a stagnant interest in cleaner production among donors, despite the benefits gained. The stagnant interest apparently stems from exaggerated expectations on the dissemination of cleaner production practices due to the great potential for improvement and the over-stating of results that has occurred.

The process of dissemination should not be expected to be quick, and there are several factors contributing to the slow process:

- Dissemination of innovations is an inherently slow process.
- Preventive innovations are particularly slow.
- The financial instability of industry in the region effectively hinders medium- and long-term planning, and thereby preventing businesses from investing.

The further support for cleaner production in the Eastern European industry has the potential to improve in several ways. On the programme

strategic level, the following findings would support a wider implementation and dissemination of cleaner production.

- In general, a broader effort is needed that uses more channels and involves more actors. The objective is to create a fostering climate for the preventive approach, corresponding to the observed wide range of both external influences and internal capabilities that all affect the cleaner production performance of the company.
- The efforts need a longer time perspective and have to be better merged into the long-term course of events. Ad hoc activities that have failed to create on-going processes in the Eastern European industry constitute a clear indication of the potential for improvement.
- It is necessary to create clear incentives for the preventive approach. It is imperative to use models where the preventive approach is actively pursued, such as the model for connecting prevention and wastewater treatment proposed in Chapter 8.
- Building core cleaner production capacities in the region is crucial for a strong local ownership of the process, and therefore for a sustained effort. In parallel to training efforts it is imperative to create structures that can make use of the capacity that is created, or there is an obvious risk that the capacity built by the training efforts will be lost.

Donors in general have a formidable task in transferring the accumulated knowledge necessary for the promotion of the preventive approach in Eastern European industry, particularly in a way that ensures that information reaches the relevant actors and contributes to a continuous and systematic build-up of capacity in the countries. The varying – and increasing – ability to manage cleaner production-related activities in the recipient countries suggests the need for a diversity in practical projects and an increase in demand for local ownership, both practically and financially.

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CHAPTER

ONE

1. Introduction

1.1 Background

Industry in Eastern Europe[1] is predominantly characterised by poor environmental performance, resulting in high emissions to air and water, and large quantities of solid waste. The environmental burden on society is further manifested in the large consumption of energy, water and raw materials per unit of production. The latter not only has environmental implications, but also serious effects on the economic efficiency of the industry. The environmental impacts caused by Eastern European industry have therefore come to be a major concern on the international agenda in the region, with shared waterways, seas, and trans-boundary pollution as areas of prime concern.

The environmental problems, however, will not be solved without economic and social stability in the countries in question. Foreign support, even if crucially important today, will only be able to contribute a lesser part of the environmental efforts in the region, by helping to solve some extremely urgent problems, and transferring know-how. The major part of the concrete measures has to be covered by national resources. The future availability of such resources will depend on the creation of a stable economy that includes competitive and profitable industries.

It is therefore of great concern to observe the general situation in Eastern European industry. The last decade, with systemic changes and new relations with the outside world, has involved dramatic changes in the operating conditions for companies in the region. The development has revealed local industry with great difficulties in competing with Western companies on the market, despite the low cost for salaries. Reasons for the

[1] "Eastern Europe" is used in this dissertation to denote all the countries that are formally called Central and Eastern Europe and the New Independent States of the former Soviet Union. This is elaborated in section 1.4.2.

inability to compete are commonly found in product quality and design, and marketing functions of the companies, but it is not uncommon that production costs in itself is reason enough for the poor competitiveness.

In response to the challenges facing Eastern Europe, Western donors have been involved in activities in the region; a small part of those activities are the cleaner production efforts supporting an environmentally sound restructuring of the Eastern European industry that are focused on in this research. The term cleaner production is used in this dissertation as an expression for the efforts to address environmental problems in industry at their source. These efforts not only address the environmental issues, but also, by focusing on material and energy efficiency, address the economic hardships in the Eastern European industry.

Donor financed cleaner production efforts in Eastern European industry were initiated in 1990. This was done in Poland by Norway, and was followed by the United States, Denmark, and other donors. The relatively limited efforts presented impressive results, and political interest has increased. The ministerial conference in Lucerne,[2] 1993, placed preventive environmental strategies high on the agenda for dealing with environmental issues in industry in the region. The following conference in Sofia, 1995, set up challenging goals of reaching certain levels of cleaner production capacity in each of the countries in the region, to be met by 1998.

However, the practical cleaner production efforts in the field have not matched the ambitions articulated at the political level. Cleaner production efforts still play only a marginal role in the total efforts of environmental support in the region. This is surprising given the fact that nobody has claimed to dislike the efforts or proved their failure. Additionally, as it is generally recognised to be difficult to find effective ways to work with Eastern European industry from the donor side, cleaner production can be seen as a way to alleviate this. This leads to a fundamental and intriguing issue: if cleaner production is desirable by the actors involved, then why is it not more widely pursued by the donor community? Why has interest lately been stagnant? And, consequently, if the assumption of the desirability of

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[2] The environmental ministers from Western Europe, US, Eastern European countries (as defined in this dissertation), and a few more OECD countries met in the framework of the Environment for Europe process, in order to lay out priorities for the restoration of the environment in Eastern Europe.

the cleaner production efforts hold true, what can be done to improve dissemination of cleaner production in industry in the region?

1.2 Objectives

The objectives of this research are to

- Clarify the factors influencing the process of implementing cleaner production in Eastern European industry.
- Examine the role of the donors, and to develop strategies for the further promotion of cleaner production in the Eastern European industry.

1.3 Scope and limitations

This dissertation is a broad analysis of the cleaner production efforts in the region. For the research, it was assumed that cleaner production has the potential to contribute positively to the restructuring of Eastern European industry, and that it is therefore justified to attempt to develop a model for the further promotion of cleaner production in the region.

The main aim has not been to evaluate individual programmes or projects, although elements of these are analysed in some detail. The most carefully evaluated programme is the Danish programme during the period of 1991–95, which is covered by the review in Appendix 3.

As the focus of this research is industry in Eastern Europe, it is primarily the companies who have been on the receiving end of the donor financed cleaner production efforts that define industry in this dissertation. In practice, this includes a large variety of companies ranging from medium sized to very large, along with a few smaller companies. The bulk of the companies are found in the manufacturing industry, but there are also examples of utilities among them.

There exists a considerable span in the bases of the research for this dissertation, from hands-on work in Eastern (and Western) European companies, to development at the policy level. Input comes from both levels, and the analyses, which covered both levels, had an emphasis on the policy level. The understanding of basic issues in technology, training, and

implementation will hopefully strengthen the policy discussion and reduce the risk of an overly theoretical policy discussion.

The perspectives used in this dissertation vary between that of Eastern European and Western, including that of the main actors involved in the process of promoting preventive environmental strategies in Eastern European industry.

The field of cleaner production is strongly related to the field of energy efficiency. The latter forms an integral part in the former, and often contributes substantially to the economic savings revealed in cleaner production assessments. Differences exist, for example the energy area has fewer actors involved in the process, at the technical level more generic solutions exist, and established structures exist within energy service companies, where suppliers have incentives to minimise consumption. This research does not address pure energy efficiency initiatives per se, but experiences from this area have been used to support the analysis.

There are activities in the region that in one way or the other contribute to the promotion of the preventive environmental agenda, without stating any explicit goals in the environmental field. Included in such activities are general management training and strengthening of production efficiency. However, the focus of this research is on efforts where the procedure for cleaner production assessment (see Figure 2-3) plays a central role and the efforts thereby display a clear and articulated cleaner production focus.

Companies are complex systems, with a multitude of factors affecting their development. Economically rational behaviour is mixed with less rational, and actions are not always predictable. Consequently, studying a process whose purpose is to influence a change in the above-mentioned system has obvious limitations; it is only useful to try to understand the influence on the system to a certain degree, beyond that the uncertainties are so large that the ability to make predictions of system behaviour is lost due to the influence from other factors.

1.4 Terminology

1.4.1 Topical terminology

The focus of this research is on preventive environmental strategies for industry. The preventive approach is defined in section 2.2. Cleaner production is the principal term used throughout this dissertation, however some sections – particularly cases – involve other terms such as pollution prevention, waste minimisation, and cleaner technologies. During the process of the research, there has been a need to explain what the preventive strategy entails, and there has been a gradual development of terminology. The variations in the use of terminology also reflect the way the preventive environmental strategy is referred to in the various countries that are involved in the promotion of preventive strategies in Eastern European industry. Where used in this dissertation, they do not imply variations in definitions; they are basically reflections of the language use in the different countries. Other terms with similar meaning also exist.

The term "good housekeeping" is used to denote a subset of the measures that a company can undertake: the simple measures that are easy to implement, possible to undertake with no or minimal investments, and do not require any thorough evaluation. The other terms discussed in the paragraph above include the entire spectrum of no-, low-, and higher cost measures.

The issue of terminology is somewhat problematic, both with respect to the variation of terms, but also with the limited recognition of the concept of preventive strategies. The latter is illustrated by the fact that a country like Sweden – being involved in the support for Eastern European industry – lacks an effective term for cleaner production.

1.4.2 Geographical terminology

The term Eastern Europe is used in this dissertation to denote an area including the Central and Eastern European countries (CEEC), as well as the New Independent States (NIS) of the former Soviet Union. This does not mean that the different parts of the region should be viewed as identical: differences exist and are substantial. There are many common issues but there are also large variations as to the extent to which they apply in a local situation. However, considering the many commonalities, and also

for practical reasons, a single term may be justified. The chosen term does not interfere with specifications made in the dissertation.

Figure 1-1 Map of the region[3]

[3] [Online] Available at http://www.maps.com/atlas/Europe.html 9/6 2000

1.5 Methodology

This section explains the methodology used in obtaining information. The research has been performed in several steps, starting in 1992. Activities have involved desktop research, literature studies, organisation and participation in seminars, field projects in industry, evaluation of efforts in the region, participation in workshops and conferences, and supervision of theses; all with the ambition to better understand the introduction and promotion of cleaner production. These activities are described in the following sections.

1.5.1 Information sources

The research was initiated in 1992 when the former Department of Industrial Environmental Economics was commissioned by the World Wide Fund for Nature to look into the industry policy within the Helsinki Commission (HELCOM) activities to reduce environmental load to the Baltic Sea.[4] At that time, a strong recognition emerged by the author of the potential for preventive environmental approaches in Eastern European industry. This was paralleled with the observation that little was actually being done at the time in the region.[5]

A central aim of this initial research was to understand the cleaner production activities in Western countries, primarily the US and Europe. The preventive industrial environmental agenda was relatively new in Western Europe and could be characterised as explorative. As a part of the efforts to learn about the developments in the area, a seminar was arranged in Lund in 1992.[6]

During the period of 1993–95 an industrial project was undertaken in Lithuania, involving training of industry representatives and Ph.D. candidates, and company case studies. The many trips to Kaunas, with on-site work at the participating companies, analysis of the findings, and

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4 The Department of Industrial Environmental Economics at Lund University was the predecessor of the IIIEE.

5 Rodhe, Håkan & Lindhqvist, Thomas. (1993). *Towards a Preventive Environmental Strategy for the Baltic Sea*. Report prepared for the World Wide Fund for Nature, Sweden.

6 The Systematic Pollution Prevention Approach: Successes and Failures, International seminar, Lund, 8-9 March 1992.

reporting, provided a firm and fundamental insight into the realities of industrial cleaner production work in a country in transition.[7]

In early 1994 an evaluation was performed on behalf of the OECD Secretariat for the Task Force for the Implementation of the Environmental Action Programme for Europe. The objective was to gather experiences from the various cleaner production initiatives underway in the region. The work involved tracking down the various activities, and gathering experience through project documentation and telephone interviews with people involved with the programmes – both at a ministerial and at an operational level. A study trip was undertaken to view some of the Norwegian activities in Poland, involving site visits and interviews with representatives from the programme as well as with participants in the training courses. The outcome could be characterised as a systematic overview of the activities, and a thorough understanding of the common issues involved in the promotion of cleaner production in the region.[8]

In September 1994 a seminar was arranged in Kaunas, Lithuania, under the auspices of the UNEP IE working group on Policies, Strategies, and Instruments to promote Cleaner Production. The participants represented the major cleaner production efforts identified in the previous evaluation. The seminar enabled sharing of experiences, and a broader and more in-depth understanding of the knowledge acquired during the evaluation.[9]

Further studies during the autumn of 1994 – an exploration into the social science field – resulted in a conference paper, which was subsequently selected for publication.[10]

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7 Rodhe, H., Grigauskas, R., Pamakstys, D., Rutkauskas, D., & Sileika, A. (1995). *Waste minimisation opportunity audits to introduce cleaner technology in Lithuanian industry – company reports*. Report for the Danish EPA.

8 Lindhqvist, Thomas, & Rodhe, Håkan. (1994). Evaluation of Industrial Waste Minimisation Initiatives in Central and Eastern Europe. Report for the OECD.

9 Lindhqvist, Thomas, & Rodhe, Håkan (eds.). (1994). *Introducing Cleaner Production in Eastern Europe*. Report from Expert Seminar in Kaunas 8-9 Sept. 1994 arranged by UNEP IE Working group on Policies, Strategies and Instruments to promote Cleaner Production.

10 Rodhe, Håkan & Strahl, Joseph. (1995). Western Support for Cleaner Production in Central and Eastern European Industry. *Business Strategy and the Environment*.

In 1995 an update of the evaluation for OECD was performed, adding developments during the past year, as well as updating and elaborating the descriptions of the activities in the region. This process involved further information gathering by interviews with involved parties in the region, and collection of documentation. An attempt was made to monitor progress on the Basic Capacity Level[11] to be reached by the region in 1998.[12]

A review of the Danish cleaner production projects in central and Eastern Europe was performed in 1995–96. The investigation covered 20 Danish projects performed during 1991–95. Information was gathered through review of project documentation at the Danish EPA, and interviews with officials at the EPA, Danish consultants performing the projects, and with persons on the receiving end of the projects. Some of these interviews were facilitated through colleagues in Eastern Europe.[13]

Several projects have been performed by colleagues at the IIIEE. These projects have added to the information base, and improved understanding of the mechanisms involved in the promotion of cleaner production in the region. The projects involved surveying cleaner production at universities in the region,[14] industrial training projects in Russia,[15,16] and industry reviews in Tblisi,[17] St Petersburg,[18] and Kiev.[19]

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11 Basic Capacity Level is the name used for the cleaner production capacity targets that the ministerial conference in Sofia 1995 set for the Eastern European countries.

12 Lindhqvist, T., Rodhe, H., & Kisch, P. (1995). Industrial Waste Minimisation Initiatives in Central and Eastern Europe – Progress report autumn 1995. Report for the OECD.

13 Rodhe, Håkan & Lindhqvist, Thomas. (1996). *Danish cleaner production projects in Central and Eastern Europe 1991-1995 – a review*. Environmental review No. 2: Danish EPA.

14 Lindhqvist, Thomas, & Fadeeva, Zina. (1997). Cleaner production in universities in Central and Eastern Europe. Review for the OECD.

15 Fadeeva, Zina, & Lindhqvist, Thomas. (1997). Report for the Danish Environmental Protection Agency on the *Cleaner Technology Programme Conducted in the Smolensk Region* April –September 1997.

16 Mont, O., Plepys, A., & Durkin, M. (1998). *Transferring cleaner production to Eastern Europe: experiences from Cleaner Production Training Programme in Roslavl, Russia, 1998*.

17 Thidell, Åke & Chelstowski, Boguslaw. (1995). *Reports from industrial site visits in Tblisi, Georgia*.

18 Thidell, Åke & Chelstowski, Boguslaw. (1996). *Galvano- och ytbehandlingsindustri i St Petersburg – en reserapport*. [Galvanic and metal-finishing industry in St Petersburg – a travel report].

In June 1998 a study trip to Georgia was performed. By invitation of the Georgian Ministry for Environment, site visits to industry and regional environmental authorities were made, and findings were presented and discussed at the ministry.[20] A similar trip was done in to Moscow and Syktyvkar in the Komi Republic in June 1997, involving seminars at universities and industry visits.

In 1999 a survey was performed to identify environmental management related information and education needs in industry in the Baltic States. Respondents included representatives from industries, ministries, universities and other organisations working with industry.[21] The survey has been updated and expanded in scope this year.[22]

From 1996 supervision of masters theses for Eastern European students in the IIIEE masters programme has been a most important source for information and insight.[23] The involvement of persons with the unique combination of qualities of language, culture and knowledge of the local

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19 Lindhqvist, Thomas. (1995). The Kiev Model – Experiences from OECD initiatives to promote waste minimization in Ukraine. In *Promoting Cleaner and Safer Industrial Production in Central and Eastern Europe.*

20 IIIEE. (1998). *IIIEE Georgia mission in June 1998*. Report to the Georgian Ministry of Environment. IIIEE: Lund university

21 Belmane, I., Moora, H., Rodhe, H., & Uselyte, R. (1999) *Environmental Management in the Baltic States´ Industry – a survey of information and education needs.*

22 Plepys, A., Pallo, T., Moora, H., Lepik, I., Uselyte, R., Arbaciauskas, V., Plavinskis, J., Grzibovskis, E., Kielkiewicz-Young, A. & Young A. (2000). *2000: EMS in the Baltic East – a comprehensive survey.*

23 The MSc theses supervised by the author with direct relevance to this dissertation:
Zaporozhsky, Dmitry. (1996). *How to improve the process of dissemination of information generated from the CP project in fish processing industry in Kaliningrad (Russia).*
Caric, Hrvoje. (1996). *Introducing cleaner production to Croatia:: legislation – industry case study – center.*
Durkin, Mikhail. (1997). *Evaluation of Cleaner Production Capacity Building Progress in Russia: Seeking Options for Improvement.*
Belmane, Inga. (1998). *Minimising environmental impact from sanitary sewage in Latvia: the prospects of alternative toilet systems.*
Moora, Harri. (1998). *The implications of the IPPC directive and the BAT concept for the Estonian industry.*
Arbaciauskas, Valdas. (1998). *Cleaner Production Centres in Central and Eastern Europe: Present situation and future directions.*
Minasyan, Gayane. (1999). *Capacity Building for Environmental Management – Case Study: Armenia.*
Lomtadze, Zaal. (1999). *Environmental policy of Georgia – strategies for use of mineral resources.*

system on one hand, and cleaner production expertise on the other, provided possibilities to gather information that otherwise would have been impossible to obtain. The following areas have been researched in this way:

- Institutional structures for dissemination of cleaner production-related information in Kaliningrad.
- Basic conditions for cleaner production in Croatian industry.
- Evaluation of the cleaner production programmes performed in Russia up to 1997.
- Separating toilet systems as an alternative to conventional wastewater treatment in Latvia.
- Cleaner production implications of adapting the Estonian environmental regulatory system to EU requirements.
- The status and development of the cleaner production centres in Eastern Europe.
- National capacity building for environmental management in Armenia.
- Strategies for cleaner production in the Georgian mining industry.

Within the framework of the IIIEE MSc Programme, cleaner production audit exercises have been performed in Eastern Europe involving municipalities, service and manufacturing industry. Each of these exercises involved a week on-site with an audit team consisting of approximately 50 students and staff from the IIIEE. The information gathering process involved numerous interviews, visual investigations and review of existing information. The following objects have been examined:

- GCR Hospital in Tarnowskie Gory, Poland (1997),
- Albena Tourist Resort on the coast of the Black Sea in Bulgaria (1998),
- Opava Municipality including eight selected manufacturing industries, Czech Republic (1999)
- Baltijsk Municipality and seven selected manufacturing industries in Kaliningrad, Russia (2000).

Over the years, discussions with colleagues outside the IIIEE, both from Eastern and Western countries, have contributed knowledge and experience to this research. The frequent Eastern European guests to the IIIEE, as well as conferences and meetings, have been most useful in this respect, not

least with regard to the attempts to understand how things actually work in Eastern European industry.[24]

Literature reviews have provided insight into related disciplines that could support the understanding of the wider context in which cleaner production efforts should be viewed.

To summarise, the methodology used in the research involved formal interviews, discussions, on-site observation, review of project documentation and other written sources, in order to cover the various actors involved in the process of introducing cleaner production in the region. The information could be divided in five basic categories:

- Literature, e.g. technical information for on-site work, general experience from work with preventive strategies, papers on the preventive efforts in Eastern Europe and exploring related academic fields.
- Specific industry case studies, concerning the introduction of cleaner production practices in Eastern European industry.
- Reviews, which bring together information from a large number of cleaner production efforts.
- Networking with colleagues, involving sharing of experiences and testing of ideas.
- Contextual knowledge, to reflect upon the successes and challenges of the cleaner production efforts from cultural, institutional and systems perspectives.

1.5.2 Some comments to the method

The approach is by necessity qualitative rather than quantitative, although quantitative analysis forms an important part, especially at the level of the individual case or project.

A key challenge has been to access reliable primary data relating to the cleaner production efforts in the region. Information that is useful for the

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[24] E.g. Roundtables on cleaner production 1996 (as rapporteur), & 1997 (as key note speaker), Helcom Seminar on LCA in Riga, 1997 (as invited speaker), Cleaner Production Conference in Rydzyna 1996, OECD Workshop on CP in NIS 1999.

advancement of the understanding of the mechanisms in cleaner production projects was rarely available in documented and accessible sources.

The barriers to gaining information are also language problems. Further, cultural issues and knowledge of the local system play an important role. Working with Eastern European students in their thesis undertakings, and with colleagues in projects has been a most important way to access primary data. This has provided an insight far beyond what otherwise would have been possible.

Due to the lack of adequate information, the value of primary data was found to be high. Furthermore, the nature of the topic is such that it is not always obvious how to interpret information obtained; it could be wrong, incomplete, or simply hard to understand. Therefore the gathering of primary information from the different actors involved in the projects was an essential element in reducing uncertainty. The picture that eventually emerges is to a large extent the result of a combination of various sources, and it is often difficult to pinpoint one specific source as decisive.

1.5.3 Analytical perspective

This dissertation deals with a broad range of factors that have influence on the promotion of cleaner production in Eastern European industry. To help structure the discussion a model is used (see Figure 1-2). This model utilises the individual Eastern European enterprise as focal point, while dividing the influencing factors into two basic dimensions: the internal cleaner production-related capabilities in the firm, and the external factors influencing the firm. The details of these dimensions are explored in more detail throughout the dissertation.

Figure 1-2 Model for analysing the factors influencing the cleaner production performance

1.6 Outline

Chapter two describes the essentials of preventive environmental strategies in industry. The dissertation is founded on the preventive strategy, and this chapter provides an introduction to the field. Both policy level and company level issues are introduced in order to give the reader an understanding of the strategy, and also of crucial elements of success.

Chapter three provides the necessary background to understand the situation in Eastern European industry. Characteristics are given for the industrial system under the centrally planned economy, covering both the dimensions of the analytical perspective (see Figure 1-2). The general restructuring needs in industry in the region are discussed.

Chapter four holds a general examination of the external factors influencing the promotion of cleaner production in an Eastern European enterprise.

Chapter five describes the major donor-supported cleaner production efforts that have been undertaken in the region, the methods that have been used, and presents illustrative results from the various projects. Observations from the implementation of projects are presented and the company's internal perspective to cleaner production is examined. It is concluded by an analysis of the issues brought up in the chapter.

Chapter six elaborates on the topic of how to evaluate the success in the cleaner production efforts performed in the region. This includes examining the reasons for doing cleaner production, cases from cleaner production efforts in the region, experiences from the United States, as well as use of existing, generic, models for evaluation. The chapter is concluded with an analysis.

Chapter seven looks into issues concerning the dissemination of cleaner production practices in the region. Emphasis is placed on the human dimension of the promotion of cleaner production with input from the disciplines of innovation-diffusion and technology transfer. Once again, US experiences are brought in, as well as Eastern European cases. The chapter is concluded with an analysis.

Chapter eight examines the connections between preventive measures in industry and wastewater treatment. Moreover a model is suggested for the inclusion of preventive measures when setting up wastewater treatment facilities.

The concluding Chapter nine takes the observations and the analyses made in the research as a basis to conclusions and policy implications for the donors.

The appendices include four articles by the author:

- A paper based on a review of cleaner production activities in Eastern Europe performed for the OECD in 1994.
- A paper discussing some of the policy implications for donor support to Eastern European industry of the 1994 review.
- A review of the Danish cleaner production efforts during the period 1991–95.
- A paper addressing the general status of donor-supported cleaner production efforts in Eastern European industry as of 1998.

The papers cover the main areas in this research and provide in-depth material on several areas to complement the body of the dissertation. They are referred to in the main text at numerous occasions.

CHAPTER
TWO

2. The preventive approach

This chapter describes the preventive approach to environmental management in industry. A description of the evolution of environmental protection strategies in industry is followed by a definition of the preventive approach. Thereafter, there is an examination of essential elements in the practical implementation of the preventive strategy, including the waste minimisation assessment procedure. The chapter is concluded with a description and discussion on some of the key measures to further the preventive agenda in an enterprise.

2.1 The history of environmental protection strategies

The strategies that deal with industrial pollution have undergone considerable development over the last couple of decades. This is readily illustrated by looking at the environmental protection efforts at industrial production sites.

The first response to polluting industries was the **dilution strategy**. Here the harm caused by pollution was approached by spreading it over a larger area/volume, thereby reducing the concentration of pollutants in the receiving media. In practice this meant higher chimneys and longer effluent pipes on the industrial production facilities; *the solution to pollution is dilution.*

When dilution was deemed insufficient another strategy became the principal one: capturing the pollutants at the end of the pipe before leaving the industrial site. This is known as the **filter strategy** or the end-of-pipe strategy, and involves the separation and subsequent treatment and disposal of the problematic substances. This became the principal strategy for managing industrial pollution, and it is the strategy that most people think of today when considering the reduction of impacts from industrial operations.

Common for these two strategies is that emissions are treated independently of their origin. The problems are shifted in space and time but the causes for the pollution are not approached. Another commonality lies in the fact that these strategies are non-productive and are associated with added costs for the industrial operations, and hence the perception that environmental protection is costly.

A recycling approach – which could be viewed as a part of the filter strategy – has also been used. Here waste is seen as a resource and effort is put into turning the wastes into a desirable raw material.

Stepping back and raising the question of why pollution actually occurs in the first place gave rise to the **preventive strategy**. In this case, pollutants are viewed as a result of inefficiencies in the production process: the pollutants are originally raw materials bought to contribute to the making of a product rather than to the creation environmental problems. Why buy raw materials to produce pollution?

This gives a direct economic incentive for environmental protection. Improved material and energy efficiency contribute to the increased productivity of the operations. The causes for the inefficiencies are several, including technical and managerial.

The preventive strategy is – contrary to the other strategies – process-integrated and less confined in space and time. Asking the question of why a problem occurs shifts the focus from the end of the pipe to the production process itself, and will eventually bring the focus all the way to questioning consumption patterns and lifestyles. Where the other environmental protection strategies deal with symptoms (waste and emissions), the preventive strategy is directed towards the source of the problem.

The three strategies should not be seen as mutually exclusive. On the contrary, most operations will use them all to a varying degree. The challenge lies in the priorities: the rational enterprise will first do what it can to prevent pollution, and thereby minimise the use of dilution and end-of-pipe strategies.

The preventive strategy has another important consequence. Environmental protection is, for the dilution and filter strategies, an issue in the hands of a few ecologists and engineers dealing with end-of-pipe equipment. In the preventive strategy, the variety of causes for inefficiencies involves both

technical and organisational skills and knowledge of the entire organisation. The preventive strategy has a distinct human dimension, which is a clear difference compared to the other two strategies.

2.2 The preventive approach

Cleaner Production is a concept that has its roots in the early 1970s. At that time, the United Nations and other international as well as national organisations started to speak about the need for minimising the wastes and emissions from industrial production at the source and not only by recycling the already generated waste. At this early time the preventive strategy was called Low- and Non-waste Technologies by some of the organisations, while others called it Cleaner Technologies or Waste Minimisation. Most of the international and national initiatives started at that time developed fairly poorly and gradually most of them faded away.

A few major multinational companies, notably 3M, started a second wave of preventive environmental work as early as the 1970s. They adopted the approach of preventing pollution and wastes at the source as a means of making the environmental protection efforts more efficient. These pioneer companies also stressed the links between environmental efficiency and economic efficiency, illustrated by 3M coining the expression "pollution prevention pays" and naming its internal programme after this expression (abbreviated as 3P). This second wave was taken up in the first half of the 1980s by some of the states and some of the industries in the USA that used the term "pollution prevention", later to become P2. The former focus on adopting the newest and most advanced technologies gave way to a more comprehensive view on ways of improving the environmental performance in a company, which also included the improvement and adaptation of existing technologies, and technology and management improvements.

The second wave of preventive environmental work gradually spread throughout Western Europe during the second half of the 1980s, which led to new projects and programmes, as well as influenced the old existing programmes. The influence came from the United States and the entry point in Europe was the Landskrona project in southern Sweden, where six medium-sized companies formed a convincing case for the preventive approach.[25] An important step for the further international dissemination of

[25] Backman, M., Huisingh, D., Persson, E. & Siljebratt, L. (1989). *Preventative environmental protection strategy: First results of an experiment in Landskrona, Sweden.*, and Siljebratt, Lars.

the preventive approach was when the Industry and Environment Office of the United Nations Environment Programme (UNEP IE) in 1989 launched its Cleaner Production Programme.

Cleaner production is defined by UNEP in the following way:

> *Cleaner Production (CP) is the continuous application of an integrated preventive environmental strategy applied to processes, products and services to increase eco-efficiency and reduce the risks to humans and the environment. For processes, CP includes conserving raw materials and energy, eliminating toxic raw materials and reducing the quantity and toxicity of all emissions and wastes. For products, CP involves reducing the negative impacts along the life cycle of a product, from raw materials extraction to its ultimate disposal. For services, the strategy focuses on incorporating environmental concerns into designing and delivering services.*[26]

A central theme in the preventive approach is the increased responsibility among all the actors involved in the process of reducing environmental impact. These actors are primarily industry, government, and consumers.

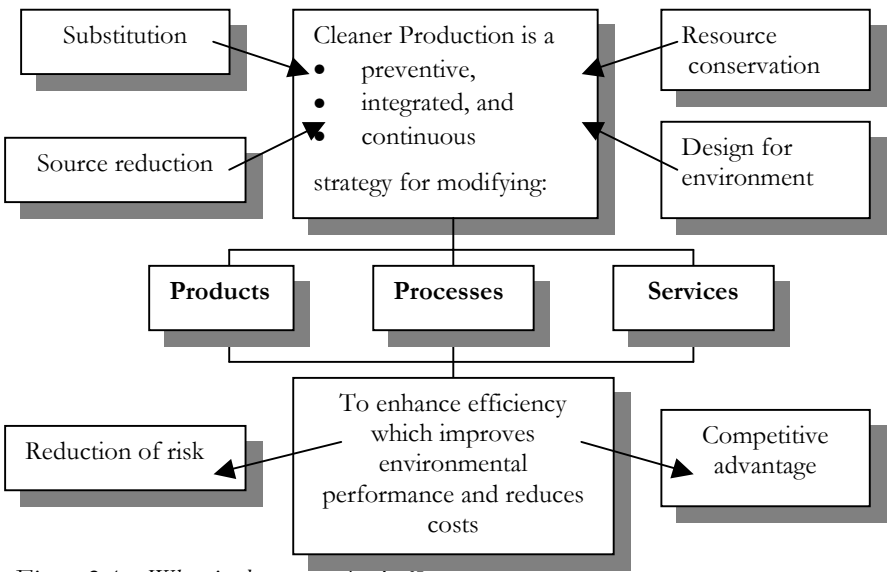

Figure 2-1 What is cleaner production[27]

(1991). *Förebyggande miljöskydd: en lönsam investering* [Pollution prevention: a profitable investment].

26 Available online at http://www.unepie.org/Cp2/what_is/general_info.html.

27 Strahl, Joseph. (1996). *What is cleaner production?*

The techniques involved in cleaner production can be classified as:

- Source reduction by changes in input materials and process technology, and changes in operating practices
- Internal recycling

Source reduction is the most desirable from an environmental point of view, with internal recycling as second best. External recycling, on the other hand, is by many practitioners not viewed as a cleaner production measure since it is not process-integrated, and by focusing on external recycling the more beneficial source reduction measures may be overseen.[28]

The preventive approach has many parallels with quality management, including the idea of doing things right from start, the need for employee participation, the need for integration in company-internal processes, and continuous improvement using the plan-do-check-act cycle.[29]

2.3 Improving on industrial production processes

2.3.1 Basics of industrial environmental management

Environmental issues are diverse by nature, and additionally, their prime causes within industrial processes are manifold and found in all parts of the organisation. Virtually all functions of an industrial organisation affect the environmental performance in one way or the other. Managing environmental issues, among other things, involves dealing with issues of varying size and composition. Consequently, environmental management is not necessarily an easy task.

The key to success lies in being systematic and process integrated. Acting preventively by searching process-integrated measures adds complexity to the process of environmental management, since this involves more actors, processes, and functions within the company compared to an end-of-pipe approach where wastes are managed irrespective of their sources. On the

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[28] See e.g. de Hoo, Sybren et al. (1992). *The PRISMA project as a model for use in other countries: background methodology, results and some follow-up projects.*

[29] For an example where models for quality work has been used for cleaner production see Gallagher, P et al. (1999). New Mexico's Green Zia Environmental Excellence Program: Using a quality model for a statewide P2 program.

other hand, despite being somewhat more challenging, going to the cause of pollution is more rewarding. By preventing problems at the source, the associated savings will reduce overall costs and contribute to increased profitability of the organisation. In particular, in contrast to end-of-pipe solutions, preventive solutions reduce overall resource consumption, and in this way contribute to sustainable development.

2.3.2 Characterising preventive measures in industry

Preventive measures cover a broad area in several practical aspects, as illustrated in Figure 2-2. Since these practical aspects to large extent will affect the possibilities of the implementation of the measures, it may be useful to try to clarify the issue. In principle, all types of changes to production processes will have cleaner production implications; whether or not a certain measure should be regarded as a cleaner production measure is not always self evident.

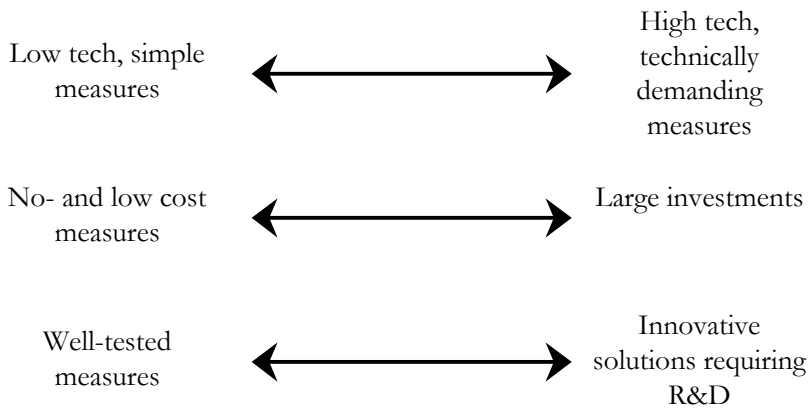

Figure 2-2 Characterisation of cleaner production measures

Technical complexity. The measures will range from simple organisational measures with little technical complexity, for example accurate dosing of chemicals to a process bath, to measures that are technically demanding, for example installing equipment to allow for the application of chemicals by foaming technology instead of using water baths.

Investment cost. Cleaner production measures come in the entire span from virtually no cost up to major investments, for example new production facilities allowing for dry painting instead of wet painting. This is complicated by the fact that investment cost is only a part of the costs associated with process changes, although often an important part.

Adaptation and development. Linked to the issue of technical complexity is the issue of the need to adapt an existing solution to fit the specific purpose, or to develop a new solution. Classic cleaner production measures come in the entire range, from well-tested measures to innovative solutions requiring R&D.

The appropriateness of technology to the specific circumstances is a factor that is related to the complexity and availability of a technology. This is an important dimension concerning the transfer of technology, particularly to countries with a limited assimilative capability, such as many developing countries.

The large variety in the measures that are sought after implies a wide range in procedures in the identification and eventual implementation of options. The simple good housekeeping measures need little, if any, calculation and evaluation; spotting them is all that is needed prior to the implementation. Larger investments require more thorough investigation of alternatives and their implications, involving in-depth competence in the fields of technology, environment, and economic evaluation.

Good housekeeping is for several reasons the most interesting category among the cleaner production measures. These reasons include the following:

- Investments needed are close to zero making these measures feasible for any organisation, regardless of the financial situation.
- The small size of the investment results in short pay back periods making this category the generally most cost-effective among the cleaner production measures.
- The technical competence required is moderate making these measures feasible for most anybody.

2.4 Cleaner production assessment

This section is an examination of the core methodology of the cleaner production work. It starts out by describing the basic procedure for cleaner production assessments, followed by a closer look at the analysis phase of the procedure. Two important tools to support the cleaner production assessment – benchmarking and total cost assessment – are introduced.

2.4.1 The cleaner production assessment procedure

The cleaner production assessment, or waste minimisation opportunity assessment, is the central tool in the cleaner production effort. The basic reference is the US EPA Waste Minimization Opportunity Assessment Manual from 1988[30], which describes the waste minimization opportunity assessment procedure. Most developments of procedures and consequent manuals for process-integrated assessments in Europe have in one way or the other used this manual as a starting point. In the cleaner production efforts in Eastern Europe, the US EPA manual is often directly influential, since the two most widespread programmes both have been using direct translations of the manual in their training courses.

The assessment procedure, as shown in Figure 2-3, describes the steps undertaken at the company level, in order to move from recognition of the need to improve the environmental performance, to the implementation of cleaner production measures. The procedure shares the basic elements with other improvement methodologies, for example in the quality field: planning, analysis, evaluation and implementation.

[30] US EPA, (1988). *Waste Minimization Opportunity Assessment Manual.*

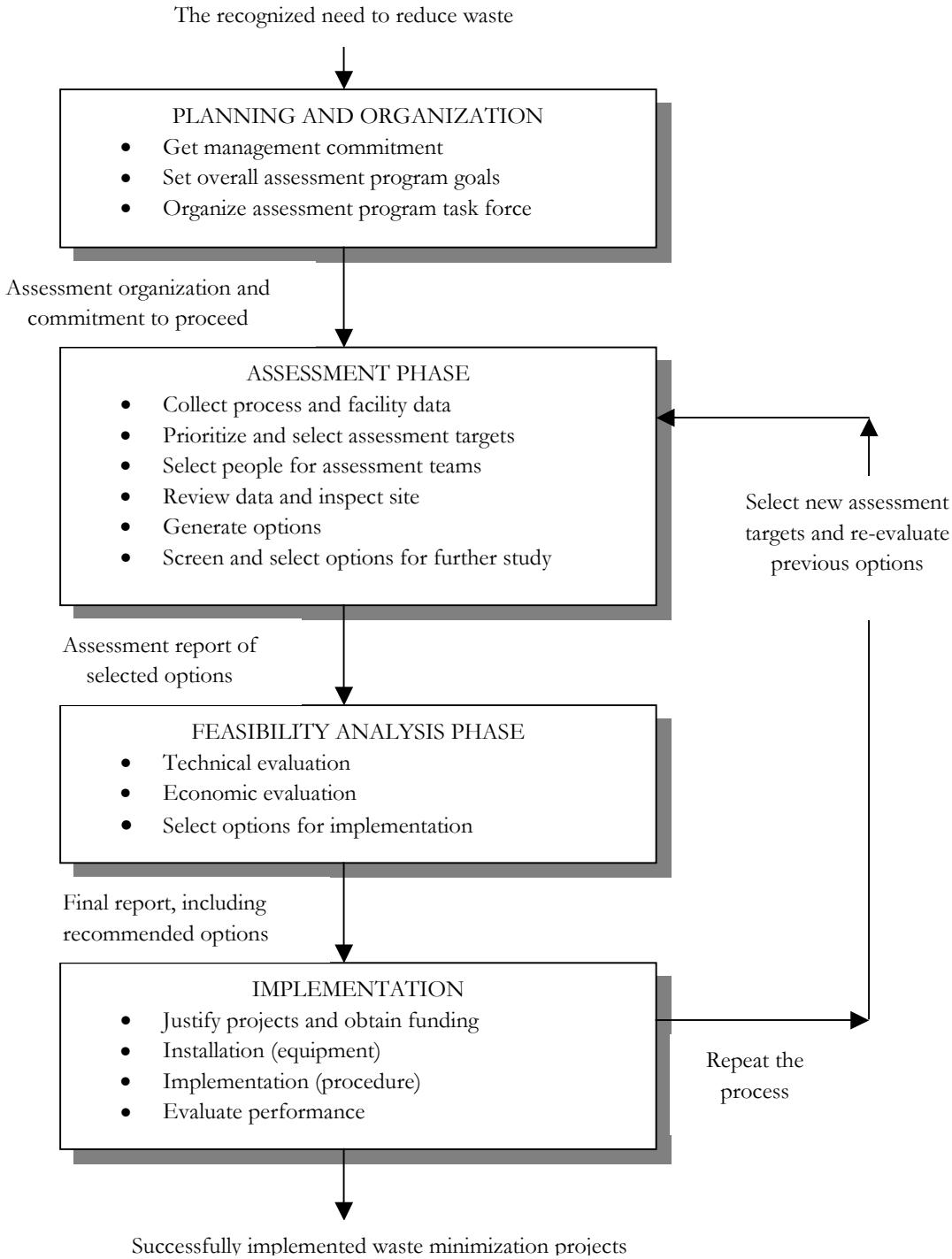

Figure 2-3 The Cleaner Production Assessment Procedure (source: US EPA, 1988)

2.4.2 Analysing the process

The essential part of the cleaner production assessment procedure lies in the analysis of the process; a good analysis of the inefficiencies and their root causes renders many improvement options visible and obvious. The analysis involves several key elements:

- Characterising the process steps by using, for example, flow diagrams. The idea is to obtain a systematic map of the process that allows you to see how the various parts interrelate and also to isolate sub-parts for closer investigation. To create a map of the process requires a thorough understanding of the processes, including the various flows of energy and materials.
- Material and energy balances are used to gain a quantitative picture of the sub-process that is selected for closer investigation. The level of detail needed varies with the improvements sought for and is adjusted iteratively. The use of balances gives control of the operations and provides the evident link between inputs and outputs that is characteristic of preventive measures.
- A root cause analysis is an illustrative technique to identify and structure the causes of a problem. The basic diagram used is found in Figure 2-4. The four root causes (methods, machines, people and materials) are generic and sufficient for most cases. This technique is useful, among other things, to illustrate that causes are not only technical: there typically exists a variety of causes for a problem.
- The generation of options for improvement is the overall objective of the analysis. This step is relatively easy if the previous steps have been performed even though the methodology varies with the type of improvements (see the Figure 2-2). More substantial changes in the processes may require a closer analysis of the operations in question.

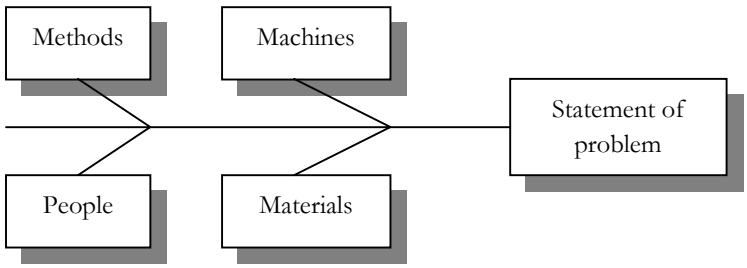

Figure 2-4 Cause-effect diagram to structure the causes of a certain problem[31]

Following the analysis, a prioritisation and evaluation process is performed to select the improvement options that are most beneficial for the company. The nature of this process varies greatly depending on the option in question (see the variations illustrated in Figure 2-2). The simple good housekeeping measures require little evaluation since there are few costs associated with these measures and the environmental benefits are obvious. More substantial changes in the processes require balancing the financial, environmental and technical dimensions in question. Among other things, this requires effective communication among actors within the organisation.

2.4.3 Benchmarking

In the cleaner production assessment benchmarking plays an important role. General consumption figures for energy, raw materials and water are valuable to indicate the overall potential for preventive measures in an industrial operation. More specific figures help to prioritise the parts of the operations to focus attention on.

In the generation of options for improvement, it is common to seek input from sources external to the company. This involves investigating procedures and technical solutions in similar industrial processes and searching relevant documentation such as manuals and demonstration projects.

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[31] Pojasek, Robert B. (1996). Practical pollution prevention: Using cause and effect diagrams in your P2 program.

The benchmarking used is either quantitative, for example figures for raw material use in a certain type of production process, or qualitative, such as checklists to identify the use of certain toxic substances or production techniques. The use of quantitative benchmarks is constrained by the large variations found in industrial operations and the general unavailability of information of this sort.

2.4.4 Total cost assessment

Cost allocation in industrial operations is crucial for the organisation to have correct incentives to minimise wastes, since the key factor affecting the implementation rate of identified cleaner production options is most often the economic evaluation. The situation to be avoided is for example when costs for waste management are covered by central overhead accounts instead of by the department or activity that generates the cost.

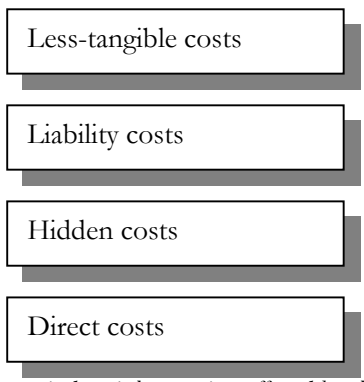

Figure 2-5 Costs in an industrial operation affected by cleaner production

It is common that the business unit that makes a decision on an investment only sees a lesser part of these savings and thereby makes a less informed choice. Cleaner production measures imply savings at several levels of abstraction seen from the production process, as illustrated by Figure 2-5.[32]

- The direct costs are those traditionally reflected in investment decisions and include capital costs, operation and maintenance, labour, raw materials and energy, waste disposal. In cases when these costs are not

[32] Magnell, Mats. (1993). *Miljörelaterad investerings- & lönsamhetsanalys* [Environment related investment and profitability analysis].

allocated to the operational units of the organisation and instead covered by overhead costs, the direct incentives for cleaner production are eliminated.

- Hidden costs include administrative costs for permits, monitoring, and record keeping, as well as internal company costs for cleaning and waste sorting.
- Liability costs entails penalties and fines, presently and in the future.
- The less-tangible costs include improved company image, greater flexibility in the production levels without conflicting with current environmental permits and improved workers' health.

Cleaner production measures do not have to generate savings per se to be considered as beneficial: the factors deciding the profitability may be found in the alternative costs that are avoided. This is part of what the total cost assessment tries to capture.

2.5 Institutionalising cleaner production

To go beyond ad hoc cleaner production assessments and move to a systematic and continuous exploration of preventive environmental opportunities in the enterprise, an institutionalising of the preventive approach is needed.[33] This is preferably done in the context of an overall environmental management system for the enterprise. The following steps constitute key elements in attaining a systematic and continuous process in the enterprise:

- Formulating goals for cleaner production efforts, for example reducing water use by 50% or eliminating the use of formaldehyde. These goals should be specified at appropriate levels in the company in order to be made operational.
- Setting up programmes to reach these goals. A programme will involve issues such as involving the personnel, assigning responsibilities, forming teams, action-plans, routines, training, purchasing of monitoring equipment and follow-up.
- Systematic monitoring, information processing and documentation of achievements constitute important parts of the progress towards the

[33] Pojasek, Robert B. (1999). P2 programs, plans, and projects: Some thoughts on making them work.

ambitions set out by the company. The visibility of progress and feedback on action taken constitute key success factors.

- Cleaner production teams and circles can be useful ways to stimulate an effective communication, both within the organisation and between organisations, and this could also help to support the individuals to implement the changes in their workplaces.[34]
- Top management commitment is crucial for a sustained effort in an enterprise.
- Cleaner production assessments when appropriate. The assessments form the backbone of the improvement process in the company since that is where the analysis of the processes is made (see section 2.4.2). It is, however, not possible to rely on them to form a continuous process due to their project character. They primarily serve the role of exploring new parts of the companies' operations and of vitalising areas that have been analysed previously.

To do cleaner production assessments when business is run as usual is the most common thing to do. However, the key opportunities to make more substantial cleaner production changes in production systems are when more substantial changes are made anyway. This could for example be major over-hauls, break-downs, new personnel, change of management, and planning for new process lines or cleaning facilities. Once larger investments have been made it normally becomes more difficult to justify additional resources for process improvements, and particularly if the new investments are to replace the existing systems.

2.6 Cleaner products and services

As the environmental problems associated with the production facilities have been reduced, and as consumption has increased, the focus of the environmental debate has shifted towards the impacts from the products *per se*. Prevention is a most viable option also in the case of products. The key phase for affecting the environmental impact from a product is the design phase, and managing the environmental impacts from products involves taking into account environmental aspects through out the product life cycle: from raw material extraction to final disposal of the product.

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[34] Hennicke, P., et al. (1998). *Interdisciplinary Analysis of Successful Implementation of Energy Efficiency in the industrial, commercial, and service sector; Final Report*

To reduce environmental impact from products is a little less straightforward compared to the case of processes that is focused in this dissertation. Reasons for this include the large number of actors involved in the life of a product, the need to estimate and balance different types of environmental impacts over the life cycle, and the site dependency of impacts.

The rapid growth of the service sector – in Western economies it is currently the dominating sector counted by output – gives emphasis to the need to address environmental issues outside the traditional manufacturing industry. Although rarely considered to be problematic from an environmental point of view, the mere size of the service sector makes even small impacts large when added up. Introducing preventive environmental approaches in the service sector is not fundamentally different to how it is done in traditional industry, although the smaller size of the individual operations and the greater number of people involved necessitate slight changes in the methodology. The potential for improvement through preventive measures is found to be larger than that in the traditional sectors, partly due to that fact that this industry never was as a major contributor to environmental problems.[35]

2.7 Some common barriers to the preventive approach

Cleaner production is often sold to industry as a way to make money; it is thought that it would be irrational not to exploit the opportunities for cleaner production-related cost savings that are discovered in virtually any company. This may be correct in many cases but what such reasoning fails to take into account is the alternative opportunities that exist for the company to make money. An industry will normally face alternatives that are all profitable, and it is not obvious that cleaner production is the most interesting in that respect. The consequence is that although the implementation of preventive environmental measures often will entail cost savings, they will not necessarily be marketed successfully to industry solely on the basis of the economic outcome.

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[35] For further information on this issue see Kisch, Peter. (2000). *Preventive environmental strategies in the service sector*.

Industry environmental problems are to large extent a matter of scale; what is acceptable – from an environmental point of view – pursued at the scale of a household, quickly becomes problematic on an industrial scale. Preventive actions are often relatively small in size, being on the demand side of the system, and therefore face the challenge of scaling up to make an impact in the overall figures.

New technologies and practices affect the organisational structures in a workplace, favouring some groups and others being on the losing end in the internal shift of power. If the (perceived) costs of adoption for workers exceed the benefits then they will aim to keep things as they used to be.[36]

An argument against the preventive strategy in general is its potential complexity. As is discussed in section 7.2.1 in this dissertation, perceived complexity is a barrier to dissemination. Cleaner production will, to some extent, increase the complexity of the environmental protection efforts by attempting to invoke changes that involve parts of or the entire production processes and workforce.

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[36] Canton, E.J.F., de Groot, H.L.F. & Nahuis, R. (1999). *Vested interests and resistance to technology adoption.*

CHAPTER

THREE

3. The Eastern European context

This chapter is not about cleaner production *per se*. Instead it aims to provide the reader with an understanding of the particularities of Eastern European industry that affect the promotion of a preventive environmental strategy in companies, in order to understand the context in which the cleaner production efforts are undertaken.

The chapter furthermore looks into the changes that are needed for an Eastern European enterprise to survive and become competitive. The understanding of the nature of these changes could provide a useful perspective for the cleaner production efforts.

The differences within the region. Significant differences exist within the region, making it difficult to address the region as a whole in this chapter. A useful distinction can be made between the Central and Eastern European countries (CEECs), and the New Independent States (NIS). Within the CEECs, the differences are substantial, with countries like Albania and Macedonia at one end in a transition towards a market economy, and Hungary, Slovenia, the Baltic States, Poland, the Czech Republic, etc., at the other end. The important distinction in the context of this dissertation is that it is, generally speaking, more difficult to work with industry in the NIS compared to the CEECs (see section 3.1). The characteristics of industry discussed in this chapter generally apply to both geographical areas, but are far more pronounced in the NIS. These differences will also be illustrated in the cases presented in the dissertation.

3.1 Characteristics of the industrial system

Industry in Eastern Europe is inefficient in its use of resources, and shows many irrational features as outlined below. [37] The observation could be seen

[37] That is, irrational from the present Western perspective. The performance by industry within the planned economy could be seen as highly rational from the perspective of that

as an indication of the potential efficiency gains that could be made, while the mind-setting and systems leading to the irrationality also serves as a barrier to such improvements. A preventive environmental strategy is to a large extent dependent on a rational system, an observation that also is valid for the Western societies where lack of rationality hinders the systematic implementation of preventive environmental strategies. The following section points to some of the key irrational characteristics of the Eastern European industrial system that have direct implications for the cleaner production agenda.

3.1.1 Key characteristics of the industry

The central planning and management obviously failed to create a system that promoted economic efficiency the way it is viewed today from a market economy perspective, and a rational use of natural resources, whichever way it is viewed. The characteristics outlined below apply to the main part of the region, although some countries such as Hungary, Poland, and the Czech Republic had another tradition to start with (e.g. the Czech republic was one of Europe's leading industrial economies prior to the second world war). These countries, therefore, became less profoundly affected by the centrally planned economy. In the countries that have come furthest in the transition from a centrally planned to a market economy, the discussed characteristics are gradually losing their value as a description of present reality, but may still help to provide an understanding of the past.

The characteristics included are primarily derived from interactions with the actors of the industrial system in the region, complemented with literature sources. The selection criterion has been the relevance to the promotion of cleaner production in the region, both on a project implementation level in the companies, and/or for policy advice in order to influence industry to undertake cleaner production.[38] The characteristics are written as they are

system, and managers in the industry eventually became very skilled in surviving in their environment. However, with the transition to a market economy, the rules of the game have changed dramatically for industry. The notion of rationality is obviously dependent on the societal structure at hand or the one that will be existing within the planning horizon.

[38] These characteristics are not necessarily unique for Eastern Europe. Several of them would surely be useful to describe the situation in industry in other parts of the world as well.

viewed by the author, including the view of a westerner seeking improvement opportunities for Eastern European industry.

The key characteristics for the internal operations in the industrial enterprises are as follows:

- A focus on technology as the solution to basically all problems, and particularly a focus on major pieces of equipment; small and more uncomplicated machinery is of limited interest.
- There is a significant under-utilisation of the technology in place, illustrated by high specific resource consumption,[39] poor housekeeping and lack of general and preventive maintenance.[40]
- The technology used is typically old and there is often a lack of automation and process control within processes. Breakdowns are common due to the worn out equipment and lack of preventive maintenance. Monitoring of energy and raw material flows are typically done on a plant level but rarely for individual operations or departments.
- The level of sub-contracting is low: many industries produce most basic components themselves in small workshops instead of buying them from companies specialising in such products.
- The products are generally of questionable quality and poor design. Exceptions existed, such as part of the military industry. The reasons for the low quality include a general indifference to customer preferences and evaluation – the customer should be happy just to obtain the product – and a lack of benchmarking and competition. The production system is supply driven instead of driven by demand from end-users.
- Lack of strategic planning, primarily due to the generally unstable situation for companies where survival is the main concern. Running at low capacity, hard to find markets for the products, and a general lack

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[39] A large number of the characteristics described in this section contribute to the difficulties to run processes as efficiently as the technology in itself would allow.

[40] A not unusual comment on this from Eastern Europeans, is that managers had/have incentives to purposely run enterprises inefficiently in order to lower the value of the company, in the hope to get an opportunity to purchase it cheaply in the privatisation process. However, the problem with under-utilisation of technology is more widespread than to be explained by this phenomenon. It is perhaps also so that the phenomena had greater effect on the general management practices in the enterprise than on the management of specific equipment.

of sales and marketing functions. This clearly reduces interest to invest in developing the processes.

- Rudimentary systems to manage and control the operations within the enterprises. Absence of efficient financial steering systems within the organisation, including budgeting and control. Lack of systems to assimilate experience in order to avoid mistakes a second time. Systems and incentives to motivate employees are also essentially absent. Hierarchical management structures with centralised decision-making; even small issues are brought to the general manager.
- There is poor information management, making it difficult to understand what is really taking place in an operation. There were no incentives, and certainly no tradition in sharing information, rather an unwillingness. There is also a tendency to monopolise information. Primary information could exist but it would not be processed in a way as to create useful and accessible secondary information. There is a shortage of information in general and difficulties exist in accessing information, both internally and externally.
- There is often a lack of personal initiative and responsibility. Much time could be spent on preparing excuses for why something would not work, instead of just fixing it. Low creativity, and a tendency to report progress even if there is not any, rather than saying it the way it is. Low creativity, when it comes to improving processes, should not, however, be mixed up with the industrious efforts associated with making equipment function despite shortages in supplies and maintenance.
- There exists an eagerness to give a good impression. When visiting a company, they may not expose all parts of the processes, either by closing down certain operations or by simply not showing it.
- There is also a great willingness to accept information that is presented. For instance, people tend not to question data supplied to them by others. This is particularly surprising since there has been a system with at least two sets of data, one to be reported to the authorities and another for internal use. An explanation often given is that people do not usually question data, although they might suspect that the data are wrong. In general, data on production processes and their environmental impacts are unreliable.
- The skills and education of people are, to a varying degree, useful in the current context. However, this is a complex and somewhat ambiguous issue. Some projects report the skills of the people in companies as an asset, while others complain about the low knowledge level. People are

educated – but seldom appropriately. People may also have unrealistic hopes and expectations on, e.g., foreign support. [41] In general, the skills and knowledge among individuals – craftsmanship, technical knowledge, etc – may be fully comparable to those found among Western workers, but the system to use these skills is much less effective, resulting in lower overall performance. Knowledge is poor in planning, steering and control of industrial operations.

- Individual industrial operations are commonly performed on a large scale. Currently the importance of these large companies is diminishing and the previously almost nonexistent SMEs are growing in number. Large companies are typically overstaffed.

Research and development functions were typically detached from the enterprise and could be illustrated by the following characteristics:

- A deficient innovation process: where R&D normally was separated from the company and centralised to, for example, research institutes in Moscow.[42] There existed a conflict in the academic interests from the research institutes and the practical needs from the companies that constrained the innovation process. A bureaucratic and hierarchical organisation of the R&D results in excessive lead-times in projects. There are poor selection processes with a lack of alternatives and competition, poor access to information concerning potential solutions. In general there was a lack of incentives for the company to innovate and undertake changes; on the contrary, any changes undertaken could get them into trouble.[43] Assimilation of Western technology was characterised by an excessively slow and cumbersome process. There was slow or no diffusion of innovations.[44,45]

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41 Sandberg, Mikael. (1999). *Green post-Communism? Environmental aid, Polish innovation and evolutionary political economics*. p. 35., Gomulka, S., Nove, A., & Holliday, G. (1984). *East-west technology transfer*. p. 80

42 Some large companies actually had a rather substantial in-house organisation – KB (constructor/designer bureau) – that co-ordinated and worked together with the R&D institutions external to the company. Interview with Konstantin Mont, former head of KB institute at Kharkov Machine Tool Plant, 10/5 2000.

43 Gomulka, S., Nove, A., & Holliday, G. (1984). *East-west technology transfer*. p. 35, Sandberg, Mikael. (1999). *Green post-Communism? Environmental aid, Polish innovation and evolutionary political economics*. p. 33

44 For an insightful discussion on innovation processes in the Soviet industrial system see Sandberg, Mikael. (1999). *Green post-Communism? Environmental aid, Polish innovation and evolutionary political economics*.

> *Soviet innovation projects, guided by state-owned monopolies rather than firms, had very little to do with variety and competitive selection.*
>
> *Diffusion was more or less absent, except in cases where military and other high-priority sectors were interested in imitation, which means that innovations seldom produced second generations, hardly ever mutated, and thus failed to create even a microevolution of innovations.*
>
> *The adopted technology was generally not incorporated to create competition, but to be used as a new monopoly.* [46]

The key characteristics of the interactions between the enterprise and the external system influencing the enterprise include the following:

- The prices for raw material and energy were very low compared to world market prices, thereby giving few incentives for energy and material efficiency. The merging into world markets has led to substantial price increases during the last decade. On the other hand, the companies do not necessarily pay the bills, and consequently the effective prices are lower than the nominal values.
- The production system did not promote efficiency, resulting in high production costs. Production governed by plans, and indicators for success of the plans would be based on quantity or weight of products, capital turnover, etc., but not related to profits or quality.
- Old managers in these countries have spent most of their lives trying to meet state imposed production plans, often involving complicated battles to obtain resources and materials. The struggle today is more oriented to financial problems and accordingly the response is to approach the government for credits, rather than to address inefficiencies within their own companies.
- The challenges for the company lay in obtaining resources, not in meeting various kinds of demands from a market such as cost efficiency and product quality. Innovations were consequently primarily motivated by the need to overcome supply difficulties.
- State-owned companies will often not be able to make use of the profits that have been made from, for example, lowered operating costs.

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45 Sandberg, Mikael. (1999). *Green post-Communism? Environmental aid, Polish innovation and evolutionary political economics*., p. 43, Gomulka, S., Nove, A., & Holliday, G. (1984). *East-west technology transfer*. p. 77.

46 Sandberg, Mikael. (1999). *Green post-Communism? Environmental aid, Polish innovation and evolutionary political economics*. p. 22, 23, 38.

Savings made will often not be available for investments or for any other in-company use at all. This might provide an explanation for cases when companies cannot find money for profitable investments in production efficiency, but still buy new rubber boots for the workers and a new car for the general manager.[47] Money for investments will usually come directly from the government and the return on investment will not necessarily be made available for internal use and hence of little interest to the company. There is also often a lack of capital, low costs for labour, corruption at various levels, and taxation on turnover rather than on profits.

- Companies have few contacts with universities mainly due to the theoretical focus of the work performed within the universities. The industrial internships for students that often existed were normally not effective in contributing to the development of the production system.
- Environmental regulation of industry involves a complex set of legal requirements, often with demanding targets, coupled with a flexible approach to enforcement. Regulating bodies are often dependent on fines and taxes as income for their own organisations. Environmental fees may in reality be based on production rather than on actual effluents.

A comparative advantage found in many companies in the part of the region that has come furthest in the transition process is a will and interest to develop, undertake changes and adopt new technologies and practices. The conservatism to change that is not uncommon in the workplace in Western industry is much less of a problem here.[48]

3.1.2 Enterprise structure

The enterprises in the centrally planned system were large. They were typically designed by the associated ministry and intended to be of regional and national importance. Today, a greater variety in the organisation of the enterprises exists. From a cleaner production perspective it is useful to consider the variations in prerequisites for restructuring that exist in industry. These variations typical have a substantial effect on the efficiency

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47 This example was taken from a tannery in Lithuania that we worked with in 1993–95.

48 Henrik Aulin, Aulin Business Development, Estonia. personal communication 25 May 2000.

of the management of energy and raw material resources. In this respect, the following classification has emerged during the research for this dissertation.[49]

- State owned. These enterprises can have among the most misguided incentives for the restructuring of their operations, with, among other things, overlapping of the company finances with those of the state. Conservation of resources does not necessarily constitute a driving force for cleaner production in this case.
- Privatised large and medium-sized enterprises, and part of larger enterprises. Interests in development of the production processes vary considerably, but short term planning is predominant.
- New small enterprises. These constitute a growing part of the economies in the region, and are less burdened by historical facts. It is also a part of industry that is notoriously difficult to deal with from an environmental perspective; the time and capacity for such issues are limited. On the other hand, if information reaches the decision-makers in these companies they are more likely to respond to the incentives for change compared to the old companies.
- Joint ventures and various other forms of foreign involvement. Enterprises with foreign involvement stand out among the others in the overall restructuring process: the process is more rapid, with the foreign contributions covering the entire spectre of business operations.[50] Resource efficiency is brought up to world market levels more rapidly than for those companies that do not have foreign involvement.

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[49] The classification is a result of practical experiences coupled with literature input from disciplines dealing with the restructuring of industry in CEE, including those described in ACE Quarterly Phare.

[50] Myant, M., Fleischer, F., Hornschild, K., Vintrov, R., & Zeman, K. (1997). The restucturing of production and the changing nature of the enterprise in Central and Eastern Europe. Research results. In ACE Quarterly Phare, Issue no 9, Autumn 1997. + for example the cases presented in Case 3-1 in this dissertation.

There exist several other characterisations of the enterprises in Eastern Europe. One such is the division into:[51]

- Dynamic firms that will respond well to incentives and information. This would correspond to the new enterprises, the joint ventures and to some extent to the privatised firms.
- Static firms that are shielded from competition or otherwise not responsive to incentives, including the state-owned firms and to some extent the privatised firms.

3.2 The changes needed for a firm to become competitive

Obviously large parts of Eastern European industry need to change in order to become competitive. The previous listing of problematic characteristics clearly illustrates the pressing need for change in basically all parts of a firm's operation. The changes necessary will no doubt vary largely from firm to firm, but it is obviously a question of restructuring the industry as such, and often of restructuring operations for the individual firm.

At the micro- (firm) level it could be observed that the improvements in process efficiency that come with the implementation of cleaner production measures constitute a useful element contributing to the restructuring process in the enterprise. It could therefore be concluded that cleaner production contributes to the restructuring process, and consequently it could be useful to try to assess the extent and dimensions of change in order to understand the context and the role of the cleaner production efforts performed in the region.

Firms that are clearly competitive certainly do exist, and many of these are found in those countries that were least touched by the centrally planned economy such as Poland, Hungary, the Czech Republic, and Slovenia. The changes needed for these firms would not be different from those facing any firm in the West, and are therefore significantly smaller compared to what most Eastern European companies are facing.

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51 OECD. (1998), *Policy statement on environmental management in enterprises in CEEC/NIS*

The following section examines the development of eight companies in Lithuania, the experience from the last decade in former East Germany, and attempts some general conclusions on the issue.

3.2.1 Evolution of eight companies in Kaunas

This section constitutes a case of general development in industry, which involved a pilot cleaner production project in Kaunas, Lithuania, in which eight companies participated. The project was initiated with pre-project fact-finding in 1992, and concluded in 1995. An in-depth understanding of the situation in these companies was developed at that time. After the project, colleagues in Lithuania accessed additional information on the situation by, among other things, participating in various cleaner production related activities in the companies. Case 3.1 documents the general developments in these companies. The main objective is to provide an illustrative example of the development of companies in the region, but a few short comments on the cleaner production activity have also been included.

The following set of indicators was used as the basis for the inquiry of change in the companies. They were developed empirically, adding new parameters as needed.[52]

- Product development, change in design, quality, etc
- Market for products
- Level of production
- Production equipment
- Production management & procedures
- General management, including
  - training of employees
  - new managers (Western?)
  - organisation of activities (formalised systems,)
- Raw material & energy supply
- Sub-contractors
- Logistics in procurement and distribution

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[52] At first, a basic model was used to conceptualise the process of change: hardware (equipment) on one hand, and software (knowledge, attitudes, information, etc.) on the other. It soon became evident that more precise classification was needed.

Case 3-1 General development in eight firms in Kaunas, Lithuania, during the period 1992–99. Brief cleaner production comments are included.[53]

	Banga Electronics
Situation in 1992	The largest enterprise in Lithuania (8 000 employees) as well as the largest producer in its product category in the entire Soviet Union. Products were TV tuners and TV sets and the market was the former Soviet Union. The product quality was good by Soviet standards; the products were considered to be among the best in the former Soviet Union. The company was a typical Soviet enterprise in the sense that it managed all process steps from raw materials to final product; the printed circuit board production line was neighboured by a small shop producing screws and nuts.
Evolution	The enterprise went bankrupt in late 1995. The obvious reasons were the loss of market for their products and heavy competition from world market goods. The price of a TV set was approximately the same as world market product but quality was inferior. Production of tuners was 650 000 per month in early 1992 and by mid-1994 the production had ended. The product itself did not change. The company had no chance to survive.
Cleaner production	The company was actively involved in the project but there was no possibility for undertaking the investment required for the main improvement possibility identified.
	Kaunas Sweets Factory
Situation in 1992	Producer of sweets and chocolate candies with a good reputation (the sweets were tasty) on the domestic market. It had 750 employees and was therefore one of the smallest companies in the project. Production capacity was 22 000 tons per year. Important raw materials were both of domestic (sugar) and international (cacao) origin.
Evolution	Production first dipped to 30% of capacity due to loss of markets and increased production costs. By the end of 1993 production was up to 45% and by the end of 1994 to 70%. Bought by Krafts Jacob Suchard in 1994 and has thereafter undergone substantial changes in many areas. Production equipment has been gradually improved. Changes include entirely new production lines. The company today gives a totally different impression compared to the situation in 1993. The

[53] Primarily based on information from Rodhe, H., Grigauskas, R., Pamakstys, D., Rutkauskas, D., & Sileika, A. (1995). *Waste minimisation opportunity audits to introduce cleaner technology in Lithuanian industry – company reports*., and interview with Darius Pamakstys, APINI, Kaunas University of Technology in November 1999.

	new owners have supplied the installed equipment. Products have improved in quality and there is a greater assortment. Potato chips is the latest product. The current markets are Lithuania and the rest of the former Soviet Union. More clear responsibilities in the workplace, training to change behaviour (especially among the shop floor workers) and selection of personnel have been key measures to improve the company's performance. Influence by the new owners has been substantial in this respect. Overall there has been a transformation from a Soviet style management to a world market like structure. The managers have, during the entire restructuring process, been Lithuanian. Certified according to ISO 9 001 in early 1998. ISO 14 001 certification is underway. Both are requirements from the owners. Kraft Jacobs own consultants run the process of certifying.
Cleaner production	The technical director took a large interest in the introduction of cleaner production measures in the company. From a cleaner production perspective the company is judged to have improved significantly during this period. Changes include the more efficient use of water and heat in the cleaning operations, and reduced raw material losses in the production processes. Soviet companies typically lack monitoring making it difficult to evaluate actions and find areas for improvements but in this case the monitoring of material and energy flows has improved greatly. The company hired an engineer trained in the cleaner production project for further environmental engineering duties.
	Silkas Textiles
Situation in 1992	A state owned company with 2 300 employees producing silk textiles (for clothes, curtains, etc) and heavy textiles (e.g. seats in cars). The production capacity was 20–30 million metres per year. Relatively new production equipment with Soviet origin from late 1980.
Evolution	Privatised in 1993. Ownership and top management changed twice during the initial project. The company was almost bankrupt in 1996 and as a result lost a significant number of employees. Since then the situation has improved somewhat. However, the situation today is rather unstable, and planning is still done for the short term. The products are competitive on both Eastern and Western markets. No major changes in product quality have been made. The market for the products has shifted to also include Western Europe. A minor part of the production is for the domestic market. Production equipment is, in principal, the same as in 1992. The company had old Soviet chemicals that were stocked up in large amounts and had to be used before alternatives were

	considered. Today these stocks are used up and in order to export to the EU, more expensive, but less polluting (e.g. high fixation dyes), chemicals from western suppliers are used.
Cleaner production	The interest in CP activities has been rather low from the company despite several opportunities for savings. Some improvements have been undertaken in the field of chemical substitution, forced by EU requirements on chemicals choices.
	Vilkas Tannery
Situation in 1992	The main part of the operations consisted of the tanning of sheep hides. Some other hides were also processed in smaller quantities, including mink and fox. Sewing operations on site used part of the production to produce coats, hats, gloves, scarves, etc. The main part of the raw material was bought from Kazakhstan.
Evolution	The company is perceived to be in a relatively stable situation but has lately been hit by the Autumn 98 Russian crisis. Today, some of the sheepskins come from Australia. The product quality has been improved following process improvements including better chrome-fixation and improved process control. Design and material choice has improved greatly in order to compete in the market.
Cleaner production	The company was judged to have made real improvements within the initial project, and was later involved in other projects as well. Specific measures include chemical substitutes. The largest investments have, however, been made in end-of-pipe treatment.
	Pienas Dairy
Situation in 1992	Dairy with 900 employees producing milk and milk products such as cream and kefir. They had problems with product quality and logistics. Russia was an important market. Whey was sent out with the wastewater (causing problems with the effluent load) since pig farmers could not afford to come and pick it up.
Evolution	The company is currently operating under relatively stable conditions after a troublesome situation 2–3 years ago. Product quality and assortment have developed significantly during the period in order to compete on a domestic market where competition is rather tough. Employment was down to 550 in 1995. The market for the products is primarily domestic. The quality of the incoming milk is still a large problem as are milk shortages during wintertime.
Cleaner production	Did implement some good housekeeping measures.

	Maistas Meat processing
Situation in 1992	2 000 employees producing meat and meat products such as sausage. The production level was approximately 500 cows, 1 000 pigs per day, and some poultry. State owned. Normally some 40% of the meat produced was sold in Russia. Production facilities and equipment were in need of replacement (except some equipment in the sausage department). Buildings from 1930–50s, equipment from 1960–80s.
Evolution	Bankrupt in 1996 due to declining business in Russia and general inability to adapt to new market circumstances. Employment down to 1 500 in early 1994. Production in the slaughterhouse fell to 15% of capacity in early 1995. Pig slaughtering almost disappeared and pork carcasses for sausage production were bought on the international market at a cost not exceeding domestic prices. Products did not undergo any changes. Production equipment did not change. Production management and procedures did not change. In general, management was slow to react to the new market situation. There has been tough competition from newly established small-scale businesses that managed to gear production to the raw material available, and also had lesser overhead costs and production time. Raw material became a problem when the large pig farms disappeared. There were problems in organising collection of pigs and cattle.
Cleaner production	The interest in CP measures was rather small in the company. They did not believe in undertaking what they perceived to be small measures. There were good potential for savings related to energy (cooling), raw materials (blood and fat), and water (cleaning).
	Poperius Paper
Situation in 1992	1 000 employees producing paper (consumer goods, newsprint, packaging and technical grades) from bleached pulp imported from Russia. Product quality was significantly lower than that of Western competitors. One paper machine (5 000 ton/year) could use waste paper as a raw material but the final product was of low quality. Production capacity was approximately 70 000 tons per year.
Evolution	Production has been very low and it has been difficult to compete in terms of quality. In 1993 paper production was 5 000 tons and in 1994 2 000 tons. The company has tried to initiate the production of other products.
Cleaner production	Good potential for good housekeeping measures was discovered but little motivation to implement.

	Inkaras Rubber
Situation in 1992	The main business was rubber glue, shoes, medical products, and various rubber products. Raw material suppliers as well as markets for the products were found in the former Soviet Union. More than 2 000 employees.
Evolution	Business has varied but overall declined during the period. However, production was never down to zero, the company maintaining an acceptable business level with contracts to e.g. Italian rubber shoe producers. Today the trend is upwards. A large long-term contract has been signed with Adidas, which has led to increased production and hiring of new personnel. The latter becoming a problem regarding meeting quality requirements. The former Soviet market was greatly reduced due to custom fees and difficulties in settling deals. In addition, raw material costs increased to levels equal to Western suppliers. Hence, the company has shifted its focus westward regarding both raw material procurement and sales. Products have changed, rubber soles production has reduced substantially. The Adidas contract involves sewing top parts for sport shoes. Adidas supplies all materials, and Inkaras cut and sew. Medical products have increased slightly but not as significantly as had been expected by the company. Competition from Western suppliers was found to be tough. Some new products are being tested. Production equipment has not undergone any larger changes, except the recent expansion of the sewing department with Adidas machines. Organisation of the company has changed only to a lesser extent. The managers are still the same as before.
Cleaner production	The company has been involved in all possible CP activities and is perceived as an interested and constructive partner in this respect. Made real improvements within the initial CP project.

The latest developments in these companies are reported to be that Banga – the electronics company that went bankrupt in 1994 – might be starting up a smaller production again, and that Inkaras – one of the more successful companies in the case – went bankrupt in early 2000, owing up to one year's wages to the workers. These developments serve as an illustration of the instability and the unpredictability of industrial operations in the region. The process of gathering information for the cases illustrates another characteristic of the situation in general concerning industrial operations in Eastern Europe: information is rare and various rumours exist of what

might actually be going on, making it difficult to get a correct picture of the situation.

3.2.2 Some experiences with restructuring in former East Germany

Former East Germany potentially provides an interesting lesson. Prior to the integration with the former West Germany, industry was in a situation comparable to that in the other Central and Eastern European countries. With the assistance from the rest of Germany, industry has now largely adapted to a level that allows for survival in the market. What changes have been made in the firms? What could be kept intact? How much new equipment was brought in?

A study performed in 1995–96 concluded that the extent of transformation was substantial in the former East German industry.[54] The changes were determined by the West German economy, with the broad introduction of managerial expertise, skills and contacts.

- The enterprise structure had undergone massive changes, including a virtual elimination of large enterprises.
- Growth was strongly dependent on subsidisation from West Germany, which gave strong developments in the fields of construction and the production of consumer goods. Sustained or export oriented growth had only a limited base.
- The R&D policies from West Germany could not be directly transformed into the East German context, where large companies were less able to take advantage of the policy package.

A literature search performed in 1999 resulted in several findings from the development in former East Germany.[55]

- The focus of the efforts to restructure industry in the former East Germany has shifted from an initial, often unsuccessful, intention to increase presence of foreign companies, to a focus on supporting local

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[54] Myant, M., Fleischer, F., Hornschild, K., Vintrov, R., & Zeman, K. (1997). The restucturing of production and the changing nature of the enterprise in Central and Eastern Europe. Research results reported in ACE Quarterly Phare, Issue no 9, Autumn 1997.

[55] The literature study was performed for the author by Helga Vanthournout.

companies to enhance their competitiveness and build domestic capacity. The emphasis is on small and medium sized companies.

- Productivity is lower compared to the former West Germany, mainly due to old equipment and the human factor. The cost to produce an item is 1/3 higher in the new Länder compared to the old Länder.
- Most of the successful companies are active on local and regional markets, and few have been able to take and keep market shares on the West German or foreign markets.
- The managerial level in companies from the former East Germany is a major bottleneck in the improvement process.
- Low product quality and slow development of new products are common barriers to the development of industry, as well as an insufficient market orientation.
- Companies from the former East Germany are hampered by the difficulties in establishing business networks. Such aspects, together with managerial skills, have been found to be major contributions from the managers that have come from former West Germany.
- Financing is a general problem and the money available for investments has declined considerably after the first years of government subsidies and chances for taking new markets.

The situation is not fully comparable, since no other country could hope for the same financial backing as the one received by the former East Germany. The process of restructuring could therefore be expected to take a longer time elsewhere. An important difference between the former East Germany and the Eastern European countries is the higher costs for workforce, etc, which deprives the former East Germany from a comparative advantage in the marketplace.

3.2.3 Which companies will survive?

The question of survival of a company is central to the design of the cleaner production efforts. Investing resources into a company that might close down shortly is one of the greater risks in the donor efforts.

Survival as such becomes a matter of definition when production levels approach zero, when the company's finances are closely interlinked with those of the state, and in the lack of effective legislation in the area of bankruptcy.

Most large enterprises risk disappearing, as seen for example from the East German experiences; at least from the size they once had if judged on the number of employees.

It could be observed that some branches are under heavy competition from the world market, for example electronics and household appliances. Coupled with weaknesses in the innovation process, they have a small chance of survival. Other branches, such as the food industry, continue to have a basic market for their products and therefore they have a better chance of survival.

In terms of management, it is not surprising to find that those who are actively attempting to learn and adapt to new circumstances have better chances of survival compared to those who carry on as usual. This was indicated in the case of the Kaunas companies in Case 3.1, and broadly supported by other observations in the field.

The age of the managers has on several occasions been found to be of profound importance for the openness of the company to new influences, and, in a general sense, the adaptiveness to change. The younger generation is often much easier to deal with.[56]

The single most important factor in the process of restructuring is likely to be foreign involvement in the firm.

3.2.4 General comments

In general, a great need for change can be observed, both in industry and in society in general. The changes involve apparent attitudinal dimensions, including care for people and resources, knowledge of the new rules of the game, and technological enhancement.

The picture that arises is complex: the survival of companies appears to be a function of a large array of factors, and the changes they undertake vary considerably and do not lead to consistent results. It is difficult to predict which companies will survive and what changes will be required.

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[56] Henrik Aulin, Aulin Business Development, Estonia. personal communication 25 May 2000, and Weiss, Michael. (1999). P2 in the Polish nonferrous industry: case studies from WEC.

Trying to understand the changes needed in an Eastern European firm in order to become competitive is not easy, partly because it is an on-going process, and therefore there is no clear end-perspective to use.[57]

The eight cases from Lithuania presented in Case 3.1 are obviously a limited base for observation, and therefore must be seen as indicative at most. However, it should be noted that they do not conflict with general observations from industrial restructuring, including drastic reductions in production levels, substantial reductions in the number of employees, shift from markets in former Soviet Union westwards, foreign involvement implies more rapid restructuring, and the need to improve quality of products due to competition. However, the cases in Case 3.1 do not reflect the heavy and energy intensive industry that makes up a significant component of industry in the region.

It is clear that there is an ongoing restructuring process, although it is significantly hampered by lack of capital, information, and knowledge of how to proceed. The process of restructuring has so far, as noted earlier, proceeded unevenly in the region, and it is therefore evident that the needs of the companies also vary. The changes in the environment-related business climate are swift, at least in some areas.[58]

There are indications that investments in new technology do not appear to be a necessary requirement for competitiveness, at least not in the short term.

> *…the growth of the new enterprise sector is not based on new technologies, but rather on small, flexible organisations, focused strategies, adaptive human resource practices and low fixed costs, i.e. a very small capital stock.*[59]

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[57] When firms cease to go out of business may seem as natural borderline; that should indicate that they are competitive. However, in a competitive market firms will always come and go so the borderline is perhaps better thought of as when the rate of bankruptcies is the same as elsewhere in the world (provided that the relevant legislation is comparable and likewise enforced).

[58] See e.g. Belmane, I., Moora, H., Rodhe, H., & Uselyte, R. (1999) *Environmental Management in the Baltic States´ Industry – a survey of information and education needs.* Attitudes and needs related to environmental management were found to be changing rapidly, with the EU accession process, and western markets, as important drivers.

[59] The citation refers to the situation in Poland. It is found in Sandberg (1999 p. 56, and refers to work done by Johnson, S. and Loveman, G.W.(1995). *Starting over in Eastern Europe. Entrepreneurship and economic renewal.*

The growth seen in the Baltic States – particularly in large-scale industry plants that have had low production levels – has been to seek better utilisation of existing production capacities, pushing investments in new technology in the years to come.[60]

[60] Belmane, I., Moora, H., Rodhe, H., & Uselyte, R. (1999) *Environmental Management in the Baltic States´ Industry – a survey of information and education needs*. pp 11-12.

CHAPTER
FOUR

4. External cleaner production-related influences on the Eastern European enterprise

This chapter provides an examination of the external factors that are relevant in influencing the preventive agenda in Eastern European enterprises. The donor efforts, which are discussed in more detail in the coming chapters, focus on cleaner production and constitute only one of many factors that influence core cleaner production issues in industry, such as raw materials and energy efficiency, and a toxics use reduction. This chapter is not intended to provide an exhaustive analysis of these factors, but rather as an introduction to the policy context in which the cleaner production efforts are pursued.

4.1 Introduction

The external factors that can influence cleaner production behaviour in a company are manifold, and the influencing factors vary considerably in importance depending on the phase of cleaner production activity that the company is in, and also among companies. The variations among companies are dependent on the circumstances in which the company is operating, and these can vary greatly in Eastern Europe. The characterisation of Eastern European companies described in section 3.1.2 reflects the various ways in which companies respond to influences.

The relatively well-performing Estonian manufacturing company AS Norma illustrates the variety of factors that can be important for the successive implementation of cleaner production measures in a company (see Case 4-1).

Case 4-1 AS Norma

AS Norma is a large Estonian enterprise producing parts primarily for the automobile industry. The company was among the first to take part in the World Environment Center (WEC) programme for Estonia in 1994, and it stands out in that programme as a successful case when it comes to activity beyond the donor-financed cleaner production programme.

The demonstration project performed by WEC made the company realise the potential of the preventive strategy; a programme was set up and a working group was formed to pursue the cleaner production agenda further. The efforts were at that time largely driven by the interest among certain individuals in middle management and the challenges in trying to comply with the effluent limits for the operations in the galvanic department. Costs gradually became a more important driving force for improvements as prices for raw materials and energy increased. The operations in the galvanic department were, over a couple of years, gradually brought up to a level in line with the Helcom requirements for this type of operations. The improvement process involved organisational changes, no- and low-cost, as well as medium-sized investments.

When the EU legislation on Integrated Pollution Prevention and Control (IPPC) was introduced in Estonia in 1998, the company volunteered as a pilot company. The company already fulfilled the requirements on Best Available Techniques (BAT) that come with the directive. The interests of the company were instead to initiate a dialogue with the regulating authorities, merge the various permits for their operations into a single one, and try to get a longer permit period in order to apply less often.

During the last decade, some of their Western customers have taken part in creating incentives for the company to improve their environmental performance. A recent change in ownership has resulted in the top management also being aware of the necessity to work seriously with environmental issues. Interest in reducing environmental impacts per se has not constituted a driving force.

At present the company is under pressure from customers to implement ISO 14 000, and the company has also agreed with the Ministry of Environment to do the same. As a part of this agreement, the company is allowed to partake in the drafting of new legislation, and also gets access to a new funding line. Environmentally related product development has not

been on the company agenda so far, but there is an interest to initiate activity in the field.

As illustrated by Case 4-1, the support for the preventive agenda in the company can involve a range of actors and measures as it develops over time, including donor-funded change agents, complying with regulation, pricing of raw materials and energy, dialogue with environmental authorities, simplification of permitting procedures, customer demands, ownership changes, and access to funding. The following sections outline the factors that may influence the progression of cleaner production.

4.2 Factors influencing the Eastern European enterprise

4.2.1 Environmental authorities

The authorities involved in the legislative process and the supervision of industry traditionally influence the way environmental issues are managed in the companies. From a cleaner production perspective, key issues are found among the following:

- Permitting, involving issues such as requirements for certain equipment and time for adaptation to new requirements.
- Enforcement, where both lack of supervision and arbitrariness in the enforcement provide disincentives.

There exists a considerable gap between the official regulatory model and the realities from this regulatory model that confronts the enterprise. Unclear and unenforced environmental standards constitute a major disincentive for cleaner production practices in industry. Another disincentive is that even if the companies reduce their emissions they still expect to pay approximately the same amount in environmental fees and fines. The reason is that the fees paid by companies in many cases provide an important part of the income for the regulating body. [61]

[61] This does not refer to bribes. That was not the intention; funding for environmental agencies is often based on fees and fines from the companies, as was observed in e.g. Georgia: IIIEE. (1998). *IIIEE Georgia mission in June 1998*. However, several trips also have given the opportunity to observe the occurrence of unofficial payments to government officials.

Officials from regulating and enforcing agencies normally do not have knowledge of the preventive strategy and its possibilities and requirements. This situation is a missed opportunity to influence companies, but could result in clear disincentives for preventive measures such as requirements for specific end-of-pipe equipment instead of defining targets based on effluent amounts and concentrations. Concentration-based limits can create barriers to the efficient use of water resources (see Case 4-2).

Permits are the main instruments to regulate companies and this is therefore important in the cleaner production context. Wastewater permitting can be a decisive driving force, as illustrated by the Norma (see Case 4-1) and Koh-I-Noor (see Case 8-3) cases. This is supported by evidence from the United States where the actors operating municipal treatment facilities have helped to promote preventive measures in industry.[62]

Case 4-2 Wastewater charges based on concentrations

When working in the Polish textile industry, the Danish consultants in the Poltex programme (Case 7-4) often were confronted with the claims that water savings will force them to pay more for their discharges of wastewater. The reason for this controversy was that the costs for the discharges were based on the concentration of the effluents. By saving water, the effluent concentrations went up, as did the costs. The system for fines was constructed so that the company pays a certain cost for discharges up to the allowed levels, and then a much higher price for discharges exceeding the standards. This system is common in Eastern Europe. The system clearly gave a disincentive for the company to save water.

In this context it was also found to be problematic that standards are somewhat randomly set, with variations among companies and the inclusion of less important parameters in the standards. The actual calculations were based on a few samples, which contributed to the arbitrary character of the fines.

Involving local authorities seems to be an interesting way to secure continuous effort in the field of cleaner production. While companies may disappear, the local authorities provide a more stable platform for action.

62 Lindsey, Timothy C. (2000). Key Factors for Promoting P2 Technology Adoption.

The involvement of local authorities has also spurred creative interaction and dialogue between authorities and companies.[63]

The local authorities may have several reasons to promote preventive environmental measures in the local industry, of which the following are examples.

- Industry typically has a large influence on the quantity and quality of waste to be managed, wastewater to be treated, energy to be supplied, and transportation flows. These areas constitute key areas for local policy, and typically constitute the main part of the environmental impact within a town or region.
- Local environmental authorities and companies in Eastern Europe have little of the collaborative working climate that exists between industry and authorities in, for example, Scandinavia. Here cleaner production has proven to be a concept around which a large variety of actors can convene, including industry and the regulatory bodies.

4.2.2 EU accession process

The process of making the environmental regulation comply with the environmental acquis[64] has become the major driving force in the restructuring of the environmental regulatory system in Eastern Europe, with subsequent effects on industry in the region. Central in this respect is the EU directive on Integrated Pollution Prevention and Control, the IPPC directive, which covers large-scale industry.[65]

The prime objective of the IPPC directive is to integrate the various environmental aspects – water, air, soil, waste, noise, and radiation – so that permitting and control of these aspects are handled simultaneously, allowing for a single permit instead of several. This constitutes a significant rationalisation of the process for the involved actors, and also minimises the risk for shifting environmental burden from one medium to another.

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63 See e.g. Chelstowski, Boguslaw. (1994). Cleaner production in Tarnowskie Gory, and Kowalczyk, Jan. (1994). Cleaner production and local authorities. Both in Lindhqvist & Rodhe (eds) *Introducing Cleaner Production in Eastern Europe.*

64 Acquis is the common term used for European Union law in this context

65 The IPPC directive – EU directive 96/61/EC – was adopted in 1996, and constitutes a framework directive within the EU industrial pollution abatement policy.

Some of the requirements of the directive are that the permits should be integrated, they should contain pollution standards based on BAT, there should be a large degree of self-monitoring by the companies, and the permitting process and the permit itself is to be made available to the public. All of these requirements require significant changes in the Eastern European countries.[66]

The IPPC directive has some key features that may help to promote a preventive environmental approach to environmental management in Eastern European industry.

- The mere introduction of the new approach constitutes a major improvement of enforcement and transparency, which in itself is beneficial.
- Avoiding the shift of problems from one medium to another favours tackling problems at the source.
- Basing the environmental standards on BAT is a clear improvement *provided that* the specific BAT definition is based on a cleaner production approach and not on end-of-pipe technology.
- The greater degree of negotiation and dialogue between companies and regulators could be valuable *provided that* the people working with the companies are trained in the preventive approach. That is not the case today.

A general concern is that the IPPC process is implemented in the countries in order for them to quickly become eligible for the European Union, not because they want to reduce the burden on the environment.

4.2.3 Pricing

The cost for resources and wastes is the most fundamental factor in the promotion of cleaner production practices. As shown in Chapter 5, the key condition for implementation of the identified improvement options is the economic evaluation performed. The savings possible are obviously directly correlated to the costs associated with the material and energy flows. Price increases, for example, for energy during the last decade, have been an incentive for firms to improve energy efficiency. However, due to the lack

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66 Moora, Harri. (1998). *The implications of the IPPC directive and the BAT concept for the Estonian industry.*

of hard budget constraints that exist for many companies in Eastern Europe, pricing is presently not able to influence the behaviour of the entire industry.

Of direct importance for the evaluation of the options generated in the cleaner production assessments is the pricing of raw materials, energy, solid and hazardous waste, raw water and wastewater discharges. Support for industry to better allocate the overhead costs will further add to the importance of the pricing factor in the process of implementing preventive measures (see the discussion on total cost assessment in section 2.4.4).

4.2.4 Ministry of industry

In comparison with the development of industries in the Western countries, it is clear that the ministry of industry – or the corresponding organisation(s) – has a central role. Support programmes to stimulate progress among companies are one of the tools that are used in this respect. The cleaner production efforts in Eastern Europe have not involved the industrial ministries substantially. Energy ministries are another important actor in this respect in the Western countries with their activities in the field of energy efficiency.

4.2.5 Foreign investors and partners

Foreign investors have a significant influence on company operations with improvements in resource efficiency, which contributes to the preventive agenda. This is illustrated by the Lithuanian companies in Case 3.1. However, direct foreign investment will only affect part of the industry in Eastern Europe (see Appendix 3). The experiences from the former East Germany, as discussed in section 3.2.2, show that the external involvement, even in the extraordinary circumstances of East Germany, cannot replace the development of indigenous industry (see also Appendix 3).

It is imperative to show that the company is efficient in the use of existing resources potential investors and partners are not scared away. The Eastern European industry's common hopes for investments in new technology seem far from reality considering the poor utilisation of existing technology. Making a good impression, and at the same time helping themselves, by efficient resource management should be a cornerstone in the strategy for any company in the region.

4.2.6 Market requirements

Product requirements have influenced change at several occasions, for example, when the Eastern European company seeks to market its products in the Western market. Examples involve avoiding formaldehyde in textile processing, and substituting PVC soles in shoes.[67]

4.2.7 Formalised management systems

Formalised management systems, notably ISO 14 001 and EMAS, have received much attention lately, both from industry and other actors. The formalised environmental management systems are primarily of interest to industry in Eastern Europe in the quest for new markets in the Western countries. An ISO 14 001 certificate contributes to a positive image as seen by potential business partners. Several cleaner production practitioners in Eastern Europe have moved from trying to sell cleaner production services to providing EMS services to companies, as a way to survive after the withdrawal of donor support for cleaner production centres.

The cleaner production implications of the environmental management systems are unclear. The systems require, among other things, a functioning management system that is a prerequisite for an effective work to minimise environmental impact. On the other hand, these systems contain no real requirements on environmental improvements per se*,* and the primary motivation for the undertaking is non-environmental. Evidence from the implementation of ISO 14 001 in the Baltic States suggests that the process normally leads to some real improvement in the companies, based on the fact that environmental issues are prioritised within the company agenda and that one feels pride in doing a good job with the business.[68]

4.2.8 Universities/research

Cleaner production is an area where industry, universities and their students can find direct benefits from co-operation. However, universities in Eastern Europe have traditionally had limited contacts with industry. Central research institutes typically performed the industry-related R&D. Students

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67 Rodhe, H., Grigauskas, R., Pamakstys, D., Rutkauskas, D., & Sileika, A. (1995). *Waste minimisation opportunity audits to introduce cleaner technology in Lithuanian industry – company reports.*

68 Audrius Sileika, EMS Auditor in Lithuania. Personal communication 9 May 2000.

in higher education have limited access to companies for project work and other activities enabling mutual learning. The bakery case from Kaliningrad provides an illustration of the benefits that may arise from courses with industry case studies (see Case 4-3).

Companies generally benefit in several different ways, from:

- Environmental issues placed upon on the agenda of the workers, enabling change
- Reflection of their performance in this respect
- Networking and contacts with potential employees
- Documentation of environmental aspects and improvement options

In view of the involvement of higher education in the preventive work performed in industry in the United States (see section 7.4), as well as the need for trained people in general in Eastern Europe, the universities in the region appear to be significantly under utilised.

4.2.9 Peers

Industry peers are frequently the most important factor in affecting the introduction of an innovation in an enterprise (discussed further in section 7.2.1). This is also likely to be an influential factor in the case of cleaner production in Eastern Europe.[69] Case 7-4, with findings from the Danish efforts in Polish textile industry, illustrates the importance for industry to see the innovations implemented before they really trust that it will work.

Industrial trade organisations have two important fundamental roles in this context: first, a generally influential role, among other things, involving dissemination of information, and, second, providing or guiding branch-oriented, more specific informational and technical consultancy services to the companies.

4.2.10 NGOs and public

NGOs and the general public have little influence on company behaviour in Eastern Europe today. Public participation in the environmental issue is

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[69] E.g. supported in OECD. (1998). *Policy statement on environmental management in enterprises in CEEC/NIS*.

low, partly due the hardships facing the citizen, but also due to a lack of general environmental education.[70] This point is further illustrated by the lack of public interest found in the environmental performance of Georgian mining industry.[71]

4.2.11 Financing institutions

A lack of financial means for implementation is recognised to be a major barrier to the actual achievement of the improved efficiency in the companies. It has been widely experienced that implementing more than no-cost measures is troublesome, since it is difficult for the companies to raise the money needed. It is also difficult to find financial institutions that are willing to provide loans of the relatively small size that is commonly needed. The challenge with the small size of the loans lies in finding structures that bring down the administrative costs to a reasonable level, and the inclusion of environmental criteria in the process adds to this challenge.

Providing subsidised (soft) loans as in the case of NEFCO (see section 5.1.5) has developed as an important driver for the implementation of cleaner production measures in the affected countries. Key issues in this case, besides the subsidy, lie in finding the local capacity to manage the process and to find structures that make companies do the no- and low-cost measures first.

4.2.12 Western actors

Western actors have a fundamental role in demonstrating desirable techniques. People in societies with transition economies typically have a great interest in Western products and their ways of doing things. The bottom line is that if it is not done in Western societies then it is not likely to be done in Eastern Europe either. For the promotion of the preventive approach, it is therefore an issue of great concern to view the limited explicit knowledge and recognition of preventive environmental strategies in the Western communities. This is also true for donor agencies and project performers of various kinds. The resulting message perceived by the

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[70] Belmane, I., Moora, H., Rodhe, H., & Uselyte, R. (1999) *Environmental Management in the Baltic States´ Industry – a survey of information and education needs.*

[71] Lomtadze, Zaal. (1999). *Environmental policy of Georgia. Strategies for use of mineral resources.*

Eastern counterparts is therefore mixed and without the clear support for preventive strategies that could be justified and needed.

The consulting firms involved in the cleaner production efforts in Eastern Europe are not the large firms, but rather small and more specialised actors (see Appendix 4). In general, the large firms have not succeeded in establishing successful businesses in the area. This could have several explanations, including the limited funding available in the field making it of limited value strategically for the firms, and the inherent difficulties with the preventive approach in the case-specificity, which limits the possibilities to standardise procedures. The inability to involve the large firms is probably a factor in the slow process of dissemination of cleaner production in the region.

A central element in the donor-supported efforts is to ensure a continuous building of capacity among actors in the Eastern European countries. This involves training efforts and documentation when carrying out projects in the region.

4.2.13 General framework conditions

The lack of a stable system with regard to general factors influencing industry behaviour is often a disincentive for cleaner production. Issues include a functioning legal system with established property rights, bankruptcy legislation, and, in general, enforcement, transparency and democracy in decision-making.

Many of the above factors serve as disincentives to long-term planning and willingness to invest, and therefore constitute a barrier to the implementation of cleaner production measures in industry.

4.3 Concluding the influences

The external factors observed to be influencing the introduction of cleaner production measures into Eastern European companies are brought together in the model in Figure 4-1.

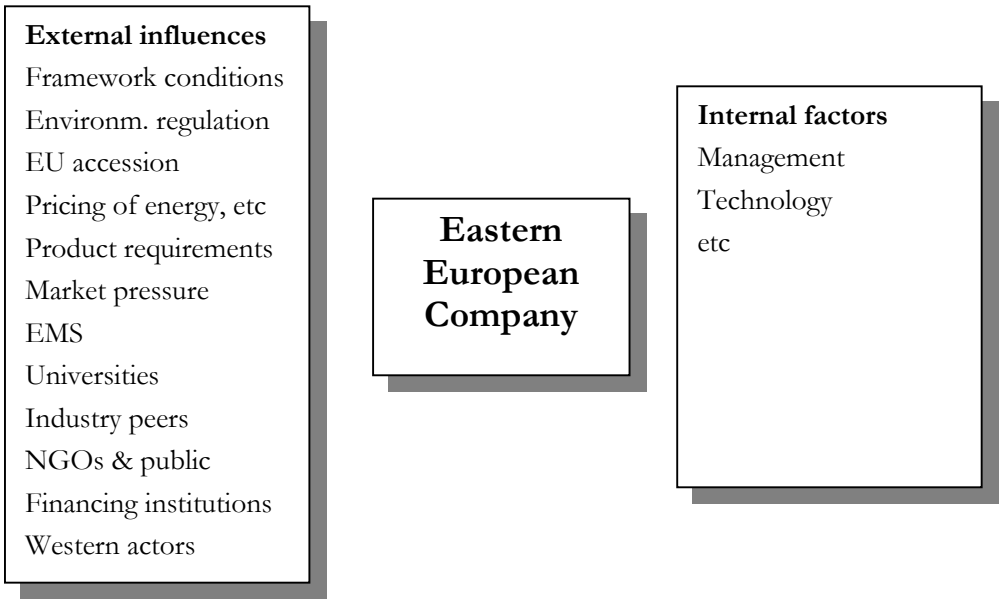

Figure 4-1 Factors affecting the preventive agenda in an Eastern European firm

It is now relevant to ask: Which factors are more important than others? Which factors are conditional? These questions, however, are difficult to answer. What makes things happen on one occasion may not affect the situation at all in another, although having to pay for the consumption of energy and raw materials (which is not always the case in the region) probably could be viewed as a condition.

The case of the bakery in Kaliningrad provides an example that a relatively minor influence can provoke the implementation of cleaner production measures in an enterprise (see Case 4-3). Notably, it is a small enterprise, and therefore belongs to a group of enterprises that are known to be difficult to deal with from a cleaner production perspective.[72]

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[72] Hennicke, P., et al. (1998). *Interdisciplinary Analysis of Successful Implementation of Energy Efficiency in the industrial, commercial, and service sector; Final Report.*

Case 4-3 The Kaliningrad bakery case

Svedar is small-scale bakery in Kaliningrad. It is a new company set up in premises previously occupied by a canteen. The directors of the company participated in a five-credit course in cleaner production in 1998, offered by Kaliningrad State University. The course was an introduction to cleaner production, and involved lectures, classroom exercises and company work.

Inspired by the course, several improvements were undertaken in the bakery, resulting in monthly savings of USD 500–550, and overall reductions in the use of energy and water of approximately 10%.

The major energy-consuming equipment – two baking ovens of 47 kW each – was not sufficiently insulated, heating up the workplace significantly. A number of relatively minor improvements in the insulation of the ovens allowed the company to reduce the energy consumption for the ovens from 12 000–12 500 kWh to 8 500–9 000 kWh on a monthly basis; a saving of 25–32%. The working environment was improved as well.

The kneading equipment was not used to capacity because not all batches of bread were large enough. A smaller kneader was rented, which allowed for the reduction of the water needed for cleaning by 15–20% and the amount of flour stuck on the inside by 3–4%. It also improved the quality of the bread.

The use of purified water was confined to where it was necessary, in the dough preparation, while other operations use normal tap water. Signs promoting the turning off of taps when not in use gave water savings of 5%.

The premises covered 305 m^2. A rationalisation of the production area confined the area used by the company to 160 m^2. The other space is vacant, requiring no cleaning or heating, and can potentially generate income from renting.

The threshold (or transaction costs) of the implementation of cleaner production measures varies greatly among companies. A model for dissemination of cleaner production practices could partly rely on finding those companies with the lowest threshold. This is probably not the case in most efforts today, since most companies have rather vague ideas on what

the outcomes of the cleaner production activities will be and the selection of companies is not only done on an interest basis (see the discussion in 6.1).

Targeting low-threshold companies could probably be done by identifying individuals within those companies who are capable and willing to perform as innovation champions. Much of the cleaner production progress that has been made in the region can be attributed to individuals who have seen opportunities in the preventive approach – both for personal reasons and/or for the organisation. This observation fits well with the general structure of Eastern European industry where the individual may be skilled but the system influencing the individual is poorly functioning (as discussed in section 3.1).

Other elements in a strategy to involve the low-threshold companies could be the creation of a variety of opportunities, training, and broad access to information.

CHAPTER

FIVE

5. Donor supported cleaner production efforts in Eastern Europe

This chapter primarily provides an overview of the initiatives that have provided input for the research behind this dissertation, with the focus on larger programmes. The description intends to give an understanding of how the efforts are performed, their scope, and geographical spread, along with typical results reported from the efforts. This is followed by a short analysis in order to pinpoint the key features of the programmes, and a collection of observations from the project implementation in practice. The chapter is finalised by a discussion on a key issue: the cleaner production efforts in the context of the end-of-pipe support, primarily the construction of wastewater treatment plants.

5.1 Overview of cleaner production programmes

5.1.1 The Norwegian programme

The Norwegian programmes are training programmes. The participants are mostly company representatives such as engineers and environmental personnel, but also consultants, academics, and others. The essence of the training programmes is by on-job training to learn to perform cleaner production assessments and basic economic analyses of the projects. The Norwegian programme was first organised by the Norwegian Society for Chartered Engineers, and later taken over by the World Cleaner Production Society in Norway.

The training programmes are organised in so-called schools. Thirty to forty participants would typically attend a school, and the overall duration will be 4 to 8 months. The actual training takes place during a few intensive gatherings of approximately one week each. Between the classroom sessions, the participants are requested to perform cleaner production assessments in their companies. This work is performed in small groups,

and is supported by advisors who visit the companies. The results from the cleaner production assessments are reported orally and in written form at the final session of the school. See the schematic presentation of a programme in Figure 5-1.

The methodology used first requires an analysis of the processes chosen before looking for the possibilities to improve. The options generated at the company are then evaluated and prioritised. Those considered useful are grouped according to no and low, medium, or high investment needed. It is assumed that implementation is done of the no- and low-cost options during the course of the programme. After completion of the cleaner production assessments and subsequent reporting, the participants are awarded a certificate by the course organisers.

The classroom training sessions devote ample time to cleaner production principles and methodologies, but also deal with the basic economic evaluation of identified options. While the first programmes in a country are led by Norwegian trainers and performed in English with translation when needed, the idea has been to transfer the programme as quickly as possible into the hands of local experts trained in the first schools. In Poland, the Czech Republic, and the Slovak Republic this occurred after the first couple of schools, while the progress has been much slower in Russia. No funds are available for implementation in the enterprises.

The Norwegians started their first programme in Poland in 1991 and since then more than 1 000 Cleaner Production experts have graduated from the training programmes. Hundreds of opportunities for profitable measures preventing pollution have been identified and described by the participants, and most considerable environmental and economic savings have been reported from the implementation in the companies involved in the programme. After some five years of Norwegian support the programme was financially taken over by the Polish Ecological Fund. Also in the other countries, the Norwegian initiated programmes are reporting considerable successes.

Within the efforts in north-western Russia the Norwegian programme started performing in-company training schools in large companies. At least three companies where involved in these activities, situated in Arkhangelsk, Murmansk and St. Petersburg.

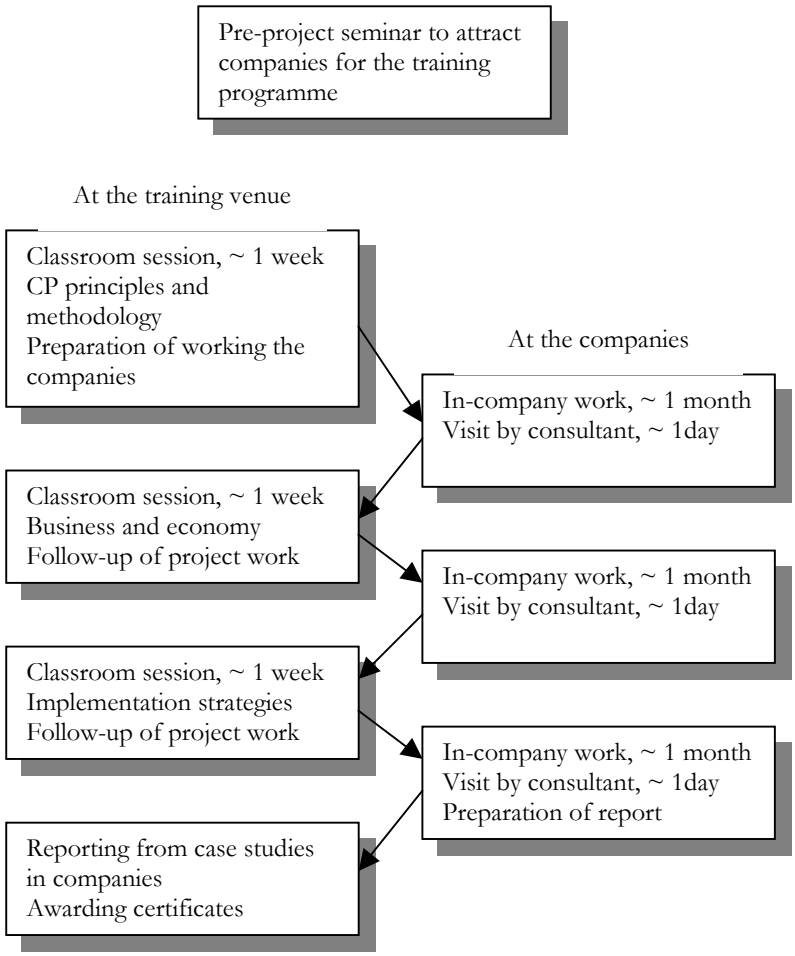

Figure 5-1 Typical organisation of a training school in the Norwegian programme of 4–8 months duration [73]

[73] Primarily based on OECD (1995). *Best Practice Guide for Cleaner Production Programmes in Central and Eastern Europe*, p. 19; complemented by several other sources.

Table 5-1 Statistics from the Norwegian programme[74]

Country	# of schools	# of trained persons	Time of involvement	# of case studies	Centres established
Poland	>25	>1000	1991[75]–	>400	1
Czech Republic	4	122	1992–1995	34	1
Slovak Republic	4	>150	1993–98	73	1
Russia	>14	> 300	1994–	–	1
Russia-Kaliningrad	2	57	1997–1998	–	–
Lithuania	4+1[76]	117	1996–1999	187	–

A feature in the Norwegian programme that should be recognised is the ability to finance local consultants, normally participants of earlier schools, for teaching in the training schools. This has a benefit in the greater amount of work performed within the project budgets due to the lower costs for these persons compared to Western consultants, but of more fundamental importance is the improved learning process that is made possible. Placing the responsibility of the activities into the hands of the local partners has showed to be an effective means of building local cleaner production capacity.

5.1.2 World Environment Center

The World Environment Center (WEC) activities also focus on the use of assessments to identify opportunities for pollution prevention measures.

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74 Durkin, Mikhail. (1997). *Evaluation of Cleaner Production Capacity Building Progress in Russia: Seeking Options for Improvement*. Kjaerheim, Gudolf. (1999). *Final report from Kaliningrad phase 2, May 1998 – December 1998, of the Russian-Norwegian capacity building program in cleaner production.,* Dobes, Vladimir. (1995). *Czech/Norwegian cleaner production project 1992-1995: Final report*.

75 The first school was started in early 1991 in Katowice, with some related activities already in the fall of 1990. Nedenes, Olav. (1991). *Experiences from waste minimisation programs in Poland*.

76 Four schools supported by the Norwegian programme and one fully locally funded.

WEC is based in New York and the main sponsor has been US aid funding. There is less emphasis on training compared to the Norwegian programme, and American experts are more directly involved in the work at the industries. The results are demonstration projects that will serve as examples for other companies. To secure implementation, the Americans are also supplying financial support for limited investments. This support is typically in the order of 10 000 USD for each plant. The American projects are reporting similar achievements to the other programmes with considerable environmental and economic savings at low investment costs.

The WEC activities on industrial waste minimisation have a typical life span of two to three years in each of the Eastern European countries, with considerable exemption is some cases. The programme started its activities in Poland in 1992, and has gradually spread eastwards. The programme divides the work in the respective countries in two phases: demonstration projects, and impact projects.

The demonstration projects are an up-to-one-year effort in a company resulting in one or a few demonstrations. Each demonstration involves investments of 5 000–20 000 USD into US equipment, sponsored by the programme. The co-financing from the company ranges from zero to several tens of percent of the investment, on average slightly less than 20%.[77] During this period, the company is visited several times by US experts from the industry in question and WEC personnel. US companies frequently provide the industry experts at no cost. The Americans work together with the company representatives in the development of demonstration projects, thereby providing a demonstration of how to deal with these kinds of problems. The practical work involves forming a steering committee for management involvement, and, at the operational level, working together in teams to solve the tasks.

The second phase of the programme is made up of so-called impact projects. These projects are similar in focus and also include some presence by industry experts at the companies. The big difference is the lesser involvement from the WEC, both physically and financially. The investments in this phase are on average slightly larger, and the share contributed by the WEC is less than 10%. The training of company

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[77] Michalek, Romuald. (1996). *Experiences in establishing cleaner production activities in Central and Eastern Europe.*

representatives in cleaner production methodology is included also in this programme phase.

The establishment of pollution prevention centres in the various countries has been a major undertaking in the WEC programme.

Table 5-2 Statistics from the WEC programme[78]

Country	**# of plants involved**	**Centres set up**	**WEC involvement/ time**
Poland	20	3?	1992[79]–
Lithuania	7	1	1994–96/98[80]
Latvia	13	1	1994–96
Estonia	8	1	1993–96
Hungary	9	1	
Czech Republic	8	1	
Slovak Republic	8	1	1995–99
Bulgaria	8	1	
Romania	9	1	
Kazakhstan	2	-	1997
Uzbekistan	2	-	1997

The WEC programme reports impressive savings from the investments that are made in the waste minimisation projects (see Table 5-3).

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78 Michalek, Romuald. (1996). *Experiences in establishing cleaner production activities in Central and Eastern Europe*, World Environment Center. (1995). *Economic and environmental benefits of industrial waste minimization in Poland.* World Environment Center. (1995). *Economic and environmental benefits of industrial waste minimization in Estonia, Latvia and Lithuania.* World Environment Center. (1997). *Economic and environmental benefits of WEC waste minimization program in Kazakhstan and Uzbekistan*.

79 World Environment Center. (1995). *Economic and environmental benefits of industrial waste minimization in Poland.* p. i.

80 The programme went on until 1996 but WEC was still involved in the activities of the pollution prevention centre until 1998.

Table 5-3 Savings reported from the WEC programme up to 1996 [81]

Country	# of projects[82]	Investments/USD (000)			Savings USD (000)/year
		WEC	Plants	Total	
Poland	52	203.4	1345.2	1548.6	7984.3
Lithuania	13	92.5	75.0	167.5	473.1
Latvia	18	108.6	97.8	206.4	1021.1
Estonia	20	57.4	40.7	98.1	553.0
Hungary	13	55.9	424.4	480.3	747.0
Czech Rep.	19	45.5	1132.4	1177.9	3015.0
Slovakia	17	34.8	176.5	211.3	1204.0
Bulgaria	8	130.9	18.0	148.9	597.0
Romania	27	64.7	282.9	347.6	3255.0
Kazakhstan	6	–	–	94.4	1321.2
Uzbekistan	3	–	–	44.7	1052.8
Total	196			4525.6	21223.5
Average investment per project: 23 000 USD					
Average saving per project: 108 000 USD					

5.1.3 The Danish Programme

The Danish programme, which in size is of the same order as the Norwegian and the WEC, is not focused on one type of project and not channelled through one organisation in the different receiving countries. As a consequence, it is less visible. Compared to cleaner production efforts supported by Norway and the United States, the Danish efforts are somewhat more difficult to grasp and describe at a general level. The most important reason is that the Danish programme, unlike the programmes from these two donor countries, comprises some 30 projects of different

81 Michalek, Romuald. (1996). *Experiences in establishing cleaner production activities in Central and Eastern Europe.*

82 Each plant taking part in the WEC programme normally develops 1-3 waste minimisation projects together with the WEC personnel, which explains the difference in the labelling of the columns plant and project in Table 5-2 and Table 5-3.

size (as of early 1996), which are run by about 15 actors who are not using a common methodology. The programme is largely based on technical demonstration.

The content of the Danish support for cleaner production in Eastern Europe emanates from the experiences made with the Danish Cleaner Technology Programme and has adopted a similar branch-oriented structure, even using the same consultants to a large extent. The Danish projects are also much more focused on technical implementation than the Norwegian and US efforts, including support for medium-size investments. The results achieved are similar to those reported from the other cleaner production efforts in the region, with payback periods ranging from weeks to a few years. The Danish ambitions to also implement medium-size investments reveal troubles with long-term planning in industry.

The Danish efforts are described in more detail in Appendix 4. Examples of Danish supported projects can also be found in Appendix 4.

5.1.4 Other bilateral donors

Austria has supported the development of the cleaner production centres in the Czech and Slovak Republics (see section 5.2), and the establishment of the National Cleaner Production Centre in Hungary, through the National Cleaner Production Centre Programme, which is a joint UNIDO and UNEP programme. Austria has also supported other projects in these countries and in Slovenia. The Austrian efforts use, for example, the methodology developed for the Ekoprofit project in Graz, which in principle does not substantially differ from the methodology used by the other donors.

Canada, Finland, the Netherlands, Sweden, Switzerland, and the United Kingdom are examples of other countries that have supported cleaner production projects in Eastern Europe.

The Czech Republic also acts as a donor country in the field of cleaner production. In 1997 they started activities in Croatia, Uzbekistan, and Macedonia. These efforts are modelled on the experiences that Czech experts have attained by working domestically with cleaner production programmes from Norway, Austria, the Netherlands, the United States, and the United Kingdom.

Within the framework of Western MSc programmes, several cleaner production site assessments have been undertaken in the region.[83] These assessments have been broader in scope but have generally reinforced the findings from the other undertakings in the region (for an example see Case 5-1). More importantly, these programmes have made significant contributions to the cleaner production capacity building in the region. The IIIEE MSc programme had 24 Eastern European graduates by the end of 1999.

Case 5-1 Gornoslaskie Centrum Rehabilitacji (GCR)

The Upper Siliesian Rehabilitation Centre – Gornoslaskie Centrum Rehabilitacji (GCR) – is a large rehabilitation centre in southern Poland, constructed in the late 1960s. In April 1997 the participants of the IIIEE 96/97 MSc programme performed a cleaner production audit of the facility. The audit team comprised 30 MSc students, Polish students to support with translation, staff from the IIIEE, Polish supervisors: in all approximately 60 persons. The exercise lasted one week and included on-site investigation, analysis and reporting to the management.

A large number of areas for improvement were discovered and among them; the thermal energy system provided a particularly interesting case. Heat was supplied to the facility 24 hours per day by 135° water from two coal-fired boilers situated 1 km away. The boilers were from the late 1950s, poorly maintained and apparently operating at low efficiency: the combustion chamber was not completely encapsulated, the possibilities to regulate the combustion process were rudimentary, and there were sooty emissions from the smoke stacks. The coal consumption was 7 000 tons per year, corresponding to two trucks each day. The primary, 1 km heat transfer loop was poorly insulated with consequent heat losses.

However, the largest saving potential was found at a later stage in the auditing process. After heat-exchanging the in-coming water to the hospital, heat was directed to various end-users including pools, hot water, space

[83] See the Dutch experiences in e.g. de Almeida, A., Basilia, I., Chodak, M., Dobes, V., Kalinina, I., Kazmierczyk, P., & Hajnal, K. (1993). *Pollution prevention in metal finishing industry: Prisma study for VD Kovocas, Czechia*, and the cleaner production audits perfomed within the IIIEE MSc programme during the years 1997–2000 involving both service and manufacturing industry in Eastern Europe. The service sector audits are described in Kisch, Peter. (2000). *Preventive environmental strategies in the service sector.*

heating and cooking. The high temperature of the water leaving the boilers was set in order to produce steam for 8 steam kettles in the kitchen. These kettles were in use a few hours per day and consumed roughly 3% of the primary energy produced in the boilers. By replacing the steam kettles with electric kettles the temperature of the water leaving the boilers could be lowered to 60–70°, resulting in a saving estimated to almost half of the energy consumed, or, in other words, potentially avoiding one of the two daily truckloads of coal.

To arrive at this conclusion was not trivial, primarily due to the problems in obtaining information on the system. The monitoring of the energy flows was inadequate, record keeping of varying quality, and nobody at GCR felt responsible for the overall performance of the thermal energy system. Therefore, the assimilation of material to arrive at this conclusion took several days.

5.1.5 International organisations

OECD is acting as the secretariat for the Task Force for the Implementation of the Environmental Action Programme for Central and Eastern Europe and has in this capacity promoted the spread of cleaner production in the whole region. Since 1998 the responsibility for co-ordination has been divided geographically: The Task Force secretariat at the OECD focuses on the NIS, and the CEE region is now managed by the Regional Environmental Center for Central and Eastern Europe (REC) in Hungary.

As a target for cleaner production capacity building in Eastern Europe, the concept of Basic Capacity Level (BCL) was launched at the ministerial conference in Sofia in October 1995. The ambition was to reach a basic level of cleaner production capacity in all Central and Eastern European countries by 1998. The OECD Task Force co-ordinates these efforts. The BCL is further discussed in Appendix 5.

UNIDO has supported industrial projects in the Volzhsky region in Russia in 1996, and in Uzbekistan in 1997–98. The Volzhsky project involved the auditing of four companies, but involved little training and was not part of any long-term effort.[84] In Uzbekistan, eight companies were engaged in a

[84] Durkin, Mikhail. (1997). *Evaluation of Cleaner Production Capacity Building Progress in Russia: Seeking Options for Improvement.*

training programme, more like the Norwegian programmes. The results from the company representative's case studies are presented in Table 5-4. Two of the options were implemented during the project.

The main UNIDO undertaking is the programme for National Cleaner Production Centres (NCPCs) in which three Eastern European centres are involved (see Table 5-5).

Table 5-4 Results reported from UNIDO project in Uzbekistan[85]

Company	**Type of option**	**Invest-ments/ UKS**	**Pay-back period/ years**
Mubarek Gas Processing Plant	Savings in chemicals and raw materials	5 027 745	2.51
Mubarek Gas Processing Plant	Reduction of anhydride sulphide emissions	18 800 000	1.33
GPU "MubarekGas"	Utilisation of torch gases; water management	700 000	< 0.1
GPU "ShurtanGas"	Reductions of air emissions from the sulphur unit	468 000	0.44
Tashkent Paint Varnishing Plant	Water management and product recovery in the production of yellow ferrous oxide*	893 200	0.078
Tashkent Dairy	Reduced emissions of NH_3 and salt	3 195 000	3.92
Tashkent Traktor Plant	Elimination of Zn effluents by closed loop system for Zn^{2+}-containing waste water in the galvanic dept*	210 000	0.52
UzKTZM, Chirchik	Wastewater reductions	1 053 000	0.73

*Implemented during the project

The World Bank commissioned environmental and energy audits of ten large industrial enterprises in Ukraine in 1993. The enterprises in question belonged to the chemicals, metallurgy, and mining sectors. The findings

[85] Slesinger, Josef & Mont, Oksana. (1998*). Introduction of cleaner production and development of a sustainable cleaner production programme for Uzbekistan.*

from the audits put no-cost and good housekeeping measures as the highest priority in the short, and the medium to long term.

> *Paradoxically all the audited companies understand the benefits to be gained . . . However, at the same time both management and workers seem not to be bothered by small improvements, not realising the large efficiency improvements to be gained and the positive effect on the willingness to invest with external investors. Foreign investors are unlikely to finance the more expensive medium- and long-term improvements, unless cheaper short-term solutions have been properly evaluated and implemented.* [86]

The Nordic Environment Finance Corporation (NEFCO) has made available funding for medium-sized investments for companies that have participated in cleaner production programmes. The company must, apart from normal credit control, also show that it is an investment in cleaner production practices. The money is a regular loan, but the low interest rate makes it attractive for the companies to apply.[87]

- The NEFCO funding was set up in early 1998 and has to date been made available for companies in the Baltic States, primarily Lithuania, and Russia. There are plans to expand the scheme.
- The funds are primarily intended for companies that have taken part in the donor-financed cleaner production training programmes. The 21 projects awarded by May 2000 have almost exclusively gone to companies that have participated in one of the Norwegian cleaner production training schools.
- The funding is 50 000 to 200 000 USD per project and the NEFCO share is max. 90% of the project cost. Payback periods on the investments of up to 3 years are accepted.
- Cleaner production centres are used as intermediaries to assist in project preparation and to evaluate the cleaner production aspects of the proposed investments.
- The fund is revolving and repaid loans are channelled to new loans. The interest levels are set to cover the costs for managing the loans; interest rates are today 3% in the Baltic States and 6% in Russia. The basic input to the fund is 30 MDKK and 2 MNOK.

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86 Claasen, Robert. (1994). Energy and environmental audits of industrial enterprises in Ukraine. Tebodin Consultants and Engineers.

87 Nordic Environment Finance Corporation (1999). *Revolving facility for cleaner production investments*, and personal communication with Gunnhild Utkvitne, Senior manager of environmental affairs at NEFCO 22/5 & 7/6 2000.

- The companies receiving funding are observed to be relatively stable and capable of long-term planning.[88]

5.2 Cleaner production centres

An essential part of the strategy to promote cleaner production by the donors has been the establishment of cleaner production centres. Both the Americans and the Norwegians have initiated the creation of cleaner production centres in the countries where they have been active. In several countries, centres have been started by both organisations, and in Poland today there are at least five centres that have their origin from one of these two programmes.

The intention of the centres was to create a node for cleaner production activities in the country, providing companies, as well as governments, with technical and methodological expertise and information. The centres have typically been involved as local counterparts in the industrial projects described previously in this chapter. The practical functions include training, demonstration, information transfer, policy advice, and support for financial mechanisms. The centres are typically small organisations with 1–10 employed persons, with annual budgets up to 160 000 USD. The host institutions for the centres include a variety of industry-related actors (see Table 5-5), and notably no government structures. Donor financing of the centres activities has been reduced over time.[89]

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88 Staniškis, J., Kliopova, I., Stasiškienė, Z. & Kildišas, V. (1999). *Capacity building program in cleaner production in Lithunia (1995–1999).*

89 Arbaciauskas, Valdas. (1998). *Cleaner Production Centres in Central and Eastern Europe: Present situation and future directions.*

Table 5-5 Cleaner Production Centres in Eastern Europe. Source: Arbaciauskas (1998)

CP Centre	CP Programme	Date of establish-ment	Host institution
Clean Industry Center, Bulgaria	WEC	1995	Bulgarian Industrial Association
Czech Cleaner Production Centre, Czech Republic	Norwegian, UNIDO/ UNEP	1994	The Centre is an independent organisation
Pollution Prevention Center, Czech Republic	WEC	1995	Czech Environment Management Center
Pollution Prevention Center, Hungary	WEC	1995	University of Veszprem
Hungarian Cleaner Production Centre, Hungary	UNIDO/ UNEP	1997	Dept. of Env. Economics and Technology, Budapest Univ of Economic Sciences
Technical Assistance Centre for Pollution Prevention and Waste Min., Estonia	WEC	1994	Estonian Management Institute
Pollution Prevention Center, Latvia	WEC	1994	The Centre is an independent organisation
Kaunas Pollution Prevention Centre, Lithuania	WEC	1994	Institute of Environmental Engineering, Kaunas University of Technology
Polish Cleaner Production Centre NIF-NOT, Poland	Norwegian	1991	Polish Federation of Engineering Societies (NOT)
Pollution Prevention Center, Lodz, Poland	WEC	1994	at Lodz Technical University

CP Centre	CP Programme	Date of establish-ment	Host institution
Pollution Prevention Center, Katowice, Poland	WEC	1995	Faculty of Materials Science, Metallurgy and Transport, Silesian University of Technology
Pollution Prevention Center at Atmoterm Ltd., Poland	WEC	1995	Atmoterm Ltd.
Pollution Prevention Center, Romania	WEC	1995	The Centre is an independent organisation
Russian-Norwegian Cleaner Production Centre, Russian Fed.	Norwegian	1996	International Centre of Social and Labor Problems
Slovak Cleaner Production Centre, Slovakia	Norwegian, UNIDO/ UNEP	1995	Slovak Technical University
Pollution Prevention Center, Slovakia*	WEC	1995	Mech. Engineering Faculty, Slovak Technical University

* has recently been integrated with the Slovak CPC

The centres have primarily been established within the framework of the Norwegian and the WEC programmes. Notably, these programmes do not co-operate and each programme sets up their own centre, with one exception. In the latter part of the 1990s, several centres in the region were brought into the UNIDO/UNEP national cleaner production centre scheme. The centres are almost exclusively relying on donor support, in the forms of basic support for centre functions and direct project funding. A compilation of results from projects in a country has been done by the Czech cleaner production centre (see Table 5-6).

Table 5-6 Results reported from cleaner production projects in the Czech Republic[90]

Year	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
Number of long-term projects	1	1	2	4	1	4
Number of participating firms	7	6	10	23	7	21
Number of people trained	27	31	64	74	21	71
Environmental effects						
VOC emission reduced (Ton per year)	0	1982	151	335	10	237
Wastewater reduced (Thousand m^3 per year)	0	5	7	907	3438	77
Non-hazardous waste reduced (Ton per year)	51	9216	6481	413	30	630
Hazardous waste reduced (Ton per year)	8172	110	1335	595	198	574
Financial savings at firms (Million CZK per year)	9.7	30.5	43.9	103.9	20.5	39.1

The main benefit from the centres has been the platform they create for cleaner production activities in the country. Technical assistance to companies is a service performed to some extent by all centres, whereas the dissemination of information is poorly functioning. The success of the centres appears to be closely linked to the persons involved in the centre and their abilities to establish co-operation with a broader range of actors. The centres that rely solely on a single donor are more vulnerable when the donor support ceases, which is already the case for many centres. The survival of the centres has consequently become an issue of finding other incomes and one popular source is the assistance needed from industry to set up environmental management systems.

[90] Dobes, Vladimir. (2000). *Approaches to cleaner production in economies in transition – the results and perspectives of the cleaner production centres.*

5.3 Cleaner production at Eastern European universities

Cleaner production training and education at Eastern European universities is a marginal occurrence. There are few activities related to cleaner production going on at universities in Eastern Europe. Even in Poland and the Czech Republic, where the most activities are taking place, the activity is modest:[91]

- At most, 10–15 universities in these countries have courses where cleaner production is part of the curricula.
- A minor part of those courses is entirely devoted to cleaner production. In these cases, the courses are normally in the order of 30–40 hours, with 10–20 students per year, and not part of any compulsory curriculum.
- At the University of Technology in Brno a two-semester course – involving diploma work in industry – has been set up in co-operation with the Czech CPC.

Other countries where some cleaner production education exists include Slovakia, Lithuania, Russia (Kaliningrad), and Bulgaria.

The area appears, surprisingly enough, to be truly unexploited.

- The courses appear to be developed by enthusiasts without financial or informational backing. The support from the universities is close to non-existent, as is the funding from international co-operation programmes.
- Educational material is hard to find. The main text available is translations of the US EPA manual on waste minimisation assessments.[92] Cases that are elaborated enough to provide educational value are rare.
- Information sharing regarding, for example, available literature is underdeveloped.

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[91] This section is based on a survey done in 1997 and reported in Lindhqvist, Thomas, & Fadeeva, Zina. (1997). *Cleaner production in universities in Central and Eastern Europe.*

[92] Audun Amundsen, a Norwegian researcher had his book on cleaner production translated into Czech, but this book is too expensive to be used in the courses, according to Alena Labodova at Ostrava Technical University.

- There is little tradition of company involvement in education, why the reliance on classroom lecturing is high.
- There is an interest to develop more courses.

5.4 Some concluding remarks on the cleaner production programmes

The cleaner production efforts performed in Eastern Europe by the various donors are largely based on the same programme elements, with some differences in their application giving the programmes their distinct characteristics.

5.4.1 Key elements of the efforts

What is the core of the cleaner production efforts? In the case of the transfer of a technology, the central elements include the hardware, the dimensioning and adaptation to the process in question, and the knowledge needed to operate it.

There are several important elements in the training efforts. The essential part lies in teaching a rational, and in this case environmentally oriented, innovation process at the process level. As discussed in Chapter 3, the innovation process was a significant weakness in the typical Eastern European company, with, among other things, the R&D function being separate from the company, no competition in the selection, no economic evaluation, and it was a generally slow process.

The research for this dissertation has identified the following key features of the innovation process taught in the programmes:

- Competitive selection. It is important not to settle for the first possible solution, but to develop alternatives and evaluate these in order to make an as good a choice as possible.
- Economic evaluation. The evaluation taught also involves environmental and technical evaluation, but these are normally not new for the participants. It is the economic evaluation that is troublesome, and one can end up discussing payback calculations for many hours.
- Involvement of workers. The people working in a certain department often know the process best, and they often can come up with good

suggestions for improvements. They will be involved anyway when it comes to implementation.

- Analysis prior to the discussion on solutions. Avoid jumping to solutions straight away; the process of identifying the problems is valuable.
- When dealing with a specific environmental problem it is important to ask why the problem occurs, and direct the attention to the source of the problem. Hence, avoid treating symptoms of inefficient processes such as wastes and emissions.
- Systematic process mapping and problem identification. You cannot solve everything at once: *Prioritisation* is essential, and it is imperative to have a systematic information basis for this process.
- Mass and energy balances as a tool to establish control of the process being investigated. What goes in must come out somewhere. Many options for improvements become obvious once a good understanding of the process is established.
- Practical and group-oriented problem-solving techniques, including e.g. brainstorming and prioritisation techniques.
- Technical support is made up of either common and generic cleaner technologies,[93] or, when the consultant has in-depth knowledge of the particular process, branch/process specific cleaner technologies.
- The procedure for Cleaner Production Assessment, see Figure 2-3, constitutes the core element in the methodology taught in the programmes. Programme practices range from following this procedure stepwise with considerable rigour, to a more flexible approach using the procedure as principal guidance.
- Demonstration of the preventive approach in country. To observe the feasibility and the actual results is an important eye-opener, and is often a turning point from scepticism to interest.

5.4.2 Some comments on the programmes

The two most visible programmes, the Norwegian and the American, focus the resources on comprehensive model programmes. There are some differences in the implementation of the projects, but the similarities are

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[93] See e.g. Johansson, A., Kumra, S., Peck, P. & Rodhe H. (2000). *Cleaner technology principles and approaches for energy, water and resource conservation.*

obvious. Both programmes are using cleaner production assessments as a central tool, and the methodology of the programmes is taken from the waste minimisation opportunity manuals prepared by the US EPA. Although they have somewhat different impacts, both programmes appear to have been successful. The appreciation of the people who have taken part in the respective programmes is generally high, and the reported environmental results are most encouraging.

The success of the Norwegian programme is primarily associated with the contributions in capacity building in industry, and particularly the part of the trained persons that develop both capabilities and high interest in the preventive approach. The high involvement of local people in the process is a significant contributing factor in this respect. The case studies performed by the companies during the programme also contribute to the success, but the large variations in implementation, estimations of savings, and reporting significantly reduces the value of this element.

The success of the WEC programme is primarily associated with demonstration of the preventive approach. The high involvement of external consultants in developing and documenting the cases make these generally more useful compared to those from the Norwegian programme, although the level of documentation falls short of allowing to see how savings have been calculated and the understanding of technical details of the solutions. The latter clearly limits the value of the cases for general training purposes. The involvement of local actors is less pronounced compared to the Norwegian programme.

The role of the consultant varies among the programmes. The Norwegian programme stresses the importance of leaving the responsibility for the process in the hands of the company.

The cleaner production measures introduced by the WEC programme often involve the introduction of measuring equipment in order to make it possible to run the processes more efficiently. Equipment includes conductivity meters for process baths, combustion gas analysers, and solvent leak detection units.

Profitability of the investments is often impressive in the various efforts, illustrated by the short payback periods reported. It should be noted that the costs for identifying and processing these options is not normally included in these calculations, and this is why the overall financial outcome

from an effort should not be judged on par with the payback on investments. The process of reporting is discussed further in Chapter 6.

The initiative to fund cleaner production investments through soft loans by NEFCO supports the creation of interest among companies and gives incentives for a continuous process in the companies. Challenges here include securing the implementation of good housekeeping prior to the larger investments, finding local capacity to facilitate the process with the applicant companies, and finding ways to involve companies after finalising the support for industry training programmes. This instrument typically reaches the best performing and most stable part of the industry in the region.

The cleaner production efforts could be classified on a scale between the extremes of technology and methodology transfer respectively (see Figure 5-2). Technology denotes a solution to a specific problem, which in practice almost always involves some type of equipment. Methodology denotes a procedure that enables the company to come up with a solution themselves.

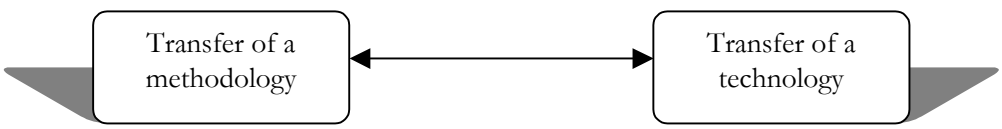

Figure 5-2 Objectives of cleaner production efforts in a company[94]

In the case of clear-cut technology transfer efforts, it is relatively straightforward to assess the outcome in terms of environmental load reduction and economic improvement. The project typically includes actual implementation and the results are, if not monitored, then at least possible to estimate without too much trouble.

Transfer of methodology, or training, is on the other hand inherently problematic when it comes to measuring success. The causal chain to results that stem from actual implementation in industry is hard to follow, and there is a considerable dependence on other parameters.

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[94] This distinction was suggested by the author at the pre-conference to the roundtable on cleaner production held in Denmark 1996.

In practice, most efforts could be seen as being a mix of the two approaches, but many efforts will be rather distinctly oriented towards one of the two. The outcome differs between the two approaches, and therefore also the way to evaluate them (see further Chapter 6).

5.5 Observations made from project implementation

The following section is a synthesis of practical project-level observations made from cleaner production efforts in Eastern European companies. The observations are, unless otherwise stated, based on material from the evaluations performed in 1994 and 1995 presented in the articles in Appendices 2 and 4. This section predominately deals with problems.

5.5.1 General project management

An overall observation is that large variations exist among the problems encountered in the implementation of cleaner production projects. The problems that may arise cover a broad spectrum, where local circumstances and considerations and, most significantly, the persons involved will dictate the outcome.

Programmes are, not surprisingly, found to be easier to implement in the Central European countries that have come furthest in the transition to market economies. Programme implementation is, consequently, increasingly problematic as the degree of irrationality in the industrial system increases (see section 3.1), which generally coincides with moving eastwards.

A widespread scepticism exists among Eastern European companies of Western consultants conducting investigations in their companies, resulting in reports but not practical measures. This scepticism does not primarily arise from specifically cleaner production activities, but emanates from contacts on all types of issues: technical, economic and environmental.

For CEE, it is difficult to find English-speaking personnel at the companies and this is especially true for smaller companies. In many cases, English is not known at all. In the NIS, the working language is Russian. Translations, however, can cause distortion of the message, even when done

professionally. Knowledge of the local language among the project staff is a distinct success criterion, not least in training efforts.

Training programmes are more likely to be successful when developed and carried through in-country, and closely linked to real issues within the companies, rather than training abroad. A risk encountered with training abroad is that when coming back home the actual working conditions prevents the implementation of the acquired skills and knowledge.

5.5.2 Local co-ordination and set-up of projects

Working with national authorities and organisations in the region can be time and resource consuming. Institutions on the receiving end are often poorly functioning, and action in direct self-interest occurs. A solution can be to work directly with regional counterparts, provided formal requirements allow it.

The local co-ordinator is crucial for the success of the initiative with a large number of practical issues that have to be managed, including the following:

- Identifying companies that are willing to actively participate in a project and carry it through is an area where contributions by local co-ordinators have proved to be important. Finding and motivating companies can take considerable effort, and this has been a limiting factor in some occasions.
- Communication is a general barrier and language is commonly recognised as only being one part of this problem. Cultural differences often create problems in different situations. The use of local partners greatly improves the possibilities of managing and solving these problems.
- However, finding suitable local partners and to establish fruitful relations is a difficult task.

Selecting suitable representatives from the companies for a training programme has proved to be an important issue. Company ecologists are usually interested in the issues discussed but often possess a somewhat peripheral position in the companies; their primary responsibilities lie in environmental monitoring, and they are rarely involved in the production. They are often not in the best position to carry out the changes in management and production that are looked for. Mid-level management,

such as production engineers and preferably the production managers, should be the ones to be involved in the training programme.

In general, it is imperative to pay close attention to the selection of partners, companies, and other actors in order to reduce risk and support continuous work.

5.5.3 Company involvement

Ensuring top management interest and commitment is emphasised by all programmes. There have been various ways to ensure such commitment, including the following.

- Offer support for investments.
- Make study trips to the West a part of the training.
- Hold seminars for management.
- Elevate the status of the programme, e.g. by involving ministries.

In order to ensure that the company representatives have confidence in the methodology, and feel a general ownership of the issue, it has proved valuable to have them take an active part and have responsibility for practical work in the companies. This includes issues such as suggestions for improvement in the processes, and reporting from case studies. Working this way has several benefits, including a potentially better learning process, and it also lowers the needs for support if the company can manage more issues themselves. The drawbacks lie in a generally lower control of the process, including fewer possibilities to demonstrate a working process, and fewer possibilities to verify results.

A specific problem is encountered in training programmes where participants perform case studies in their own companies: the trainees pick up a previously developed technical project that they never have been successful in pursuing, hoping for the double benefits of maybe having it implemented and also satisfying the course requirements in a convenient way. This is not necessarily a bad thing since this may highlight measures that are useful in the cleaner production context, but often this is not the case, and, moreover the process of developing an understanding of the problem, and generating and choosing among options, is essentially left out.

The level of activity among the Eastern European actors involved in the programmes has at times had a tendency to go up and down: up when

partners are present, and down when work is to be pursued by, for example, the companies themselves. To complement on-site visits, telephone calls have been a useful element in keeping up the level of activity.

5.5.4 Identifying improvement opportunities in the companies

Mapping a process can be troublesome. The figure given for a certain material or energy flow will often vary, depending on whom you ask. In addition, the companies will often have inadequate measuring devices. It is therefore not easy to develop an understanding of the on-site operations.

There exists at various levels an unwillingness to report on the actual situation both within companies and to authorities, out of fear for the consequences. Identified problems may be followed by sanctions. In general, there are few incentives to share information within the companies, either vertically or horizontally.

In the process of generating opportunities for improvements it could be observed that:

- companies in general have little access to relevant information, on for example possible solutions to a certain problem;
- people are not accustomed to bringing forward and evaluating alternative solutions to a specific problem; and
- there is little experience with involving people working with the process in question in the generation of improvement opportunities.

People like to be presented with a methodology to follow step-by-step. The comparatively strict application of the procedure for cleaner production assessment (see Figure 2-3) in the Norwegian programme is likely to be a part of the success in that programme. People seem to be more secure when they follow a pre-set methodology, rather than being creative and thereby standing the risk of having to justify their actions.

It is a general observation that, compared to the West, people often are less ready to use their own initiative. This results in the need for more supervision during practical work.[95]

There is a significant emphasis on trying to find strictly technical solutions to problems and people are largely sceptical of non-technical solutions. Housekeeping solutions are not regarded as real solutions and there are often problems in convincing top management that this is a good way to work. It is genuinely difficult to make people understand that step-by-step improvements in efficiency, involving both technical and managerial issues, are the way to work. The company representatives often perceive that they know the solution to their problems but that they just lack the financial resources to implement it (i.e. to buy the piece of equipment they perceive as the solution). The doubts are reduced when economic and environmental results are compiled and brought forward, but the doubts nevertheless constitute a significant barrier to a serious and continuous involvement in the issue from the company.

5.5.5 Implementation of the identified options

All companies can do good housekeeping, but only a part of the companies are stable enough to do any long-term planning and are thereby able to undertake more substantial investments.

Only part of the improvement opportunities that are identified become implemented.[96] Implementation is hard to achieve in the short run, and reasons for this are found in the many barriers that are noted elsewhere in this chapter. Also, implementation is often dependent on the existence of a dedicated person who follows up and implements changes.

The savings from improvements in the efficiency of the production process (saving energy, raw materials, etc.) are normally larger than the savings on waste management and wastewater treatment. However, if efficiency gains

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[95] Appendix 2; and e.g. Chodak, Miroslav. (1994). *Major constraints to successful implementation of cleaner production in the transitional economies of Central and Eastern Europe*

[96] Appendix 2; and e.g. Randmer, Anne. (1997). *Disseminating of Cleaner Production in Estonia – How slow it is?.*

can reduce the size needed for end-of-pipe treatment then this can be a major financial driving force.[97]

Financing investments, even small (less than USD 10 000), is a difficult task for the companies, and is commonly recognised as the major obstacle to a wider implementation of options that emerges from the waste minimisation assessments.

It is interesting to note that companies may pursue the entire application process for a loan from the NEFCO cleaner production fund, be granted a soft loan, and then finally turn the offer down.

Savings that are made as a result of cleaner production measures implemented in Eastern European companies can be of two types: real money, or a sort of virtual money that arises from the barter agreements that are frequently settled between companies in the region.[98] In the barter transactions, money never changes hands, the deal is negotiated and it is consequently difficult to assign a monetary value to the savings. The savings may also be purely imaginary if they are based on production levels that are no longer upheld.

5.5.6 Follow-up and dissemination

Dissemination of cleaner production practices and general sustainability of activities is problematic and limited; initiatives have a tendency to die out after the donor intervention. The cleaner production approach is normally not institutionalised after the completion of the donor-funded programmes.[99]

The cleaner production assessments performed typically involve only a smaller part of the company, for example, the assessment could address a specific issue such as water use in a particular department. When approaching a company that has been part of one of the programmes it is not likely that impact will be detected from the cleaner production efforts. In fact, few persons might know of the cleaner production effort at all.

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97 Dobes, Vladimir. (1995). *Czech/Norwegian cleaner production project 1992-1995: Final report*.

98 Personal communication with Andrius Plepys, research associate, IIIEE, 10 May 2000.

99 See e.g. Appendix 4; and Staniškis, Jurgis, & Stasiškienė, Zaneta. (1999). *CP Follow-up System in Lithuania*.

Companies seldom document implemented measures and their results in a way that is useful for external follow-up – they have no tradition and perceive few incentives to prepare documentation for actors external to the company.

If companies are unable to fulfil their obligations within the projects, it could be useful to have softer elements incorporated into the programmes. This could include elements such as training and the production of written materials.

A substantial part of the monitoring of progress from the programmes is done by counting the activities that have taken place, for example, the number of training programmes and number of trained persons. Results in terms of reduced emissions and resource use are more difficult to access.

The cleaner production centres have generally had difficulties to live up to the expectations placed on them. Information sharing turns out to be a challenge in a region where the tradition for such activities is weak.

5.6 Company internal factors affecting the preventive agenda

The model presented in Figure 1-2 divides the factors influencing cleaner production in industry into internal and external. This section analyses the internal factors identified during the cleaner production efforts undertaken.

The internal, cleaner production determining capabilities of the enterprise are suggested to be classified in the following six areas:

- Management capacity, which would include general management capacity to prioritise, plan, implement, and follow-up changes in the organisation. The ability to evaluate and manage the economic dimensions of operations is a key area. Capacity to implement a strategy of continuous improvements in many small steps. A large part of the barriers observed from the cleaner production efforts are related to management issues.
- Technical capacity, involving issues such as capacity to utilise the equipment in place, and capacity to identify and assimilate appropriate new equipment. The technical capacity per se is probably less of a problem, but the projects illustrate the challenges associated with

competitive selection and linking economic considerations with the technical.

- Financial capacity, for a rational exploitation of the funding opportunities available, both internally and externally. Appropriate project preparation to be able to apply for funding from financial institutions is an element in this respect.
- Information management capacity. This area could well be defined as a part of the overall management capacity. The reason to give specific attention to the issue is the key role of the area in the cleaner production context in an Eastern European enterprise; it is observed to be a significant weakness and therefore has a substantial potential for improvement. The area includes monitoring of the processes, information availability internally and externally, data quality, and follow-up and feedback.
- Cleaner production knowledge and interest. A general understanding of the preventive strategy, coupled with relevant skills and knowledge to undertake cleaner production assessments. It is observed in the cleaner production efforts in the region that people spontaneously think about end-of-pipe treatment when environmental issues are brought up. Challenges in this respect are illustrated in, for example, Case 7-4.
- Motivation and attitudes among staff. Without support and commitment from employees, it is hard to manage the good housekeeping issues in everyday operations.

Figure 5-3 Internal capabilities of the firm affecting cleaner production implementation

5.7 Concluding discussion

5.7.1 The question of success of the cleaner production efforts in the region

The basic conclusion is that the cleaner production efforts have been successful. Additionally, nobody has seriously questioned the strategy and it has in no way been proven to be ineffective.

The cleaner production efforts in the entire region have, during the last ten years, totalled USD 50 million.[100] This is a very small part of the total donor funding for environmental issues in Eastern Europe.[101]

At the project level, improvement potentials, with no or low investments, in the range of 10–25% usually exist within companies. The variations are substantial reflecting the individual character of industrial operations, but the level of savings possible is in any case substantial enough to be attractive both for companies themselves and actors pursuing environmental objectives. The efforts needed to identify the cleaner production opportunities vary both with the capacity of the company and the types of measures in question.

However, the approach is not such a big success that the service is saleable for consultants on the local market. There is still a need for subsidies, or at least other ways to support industry in this respect. This is the case elsewhere in the world (see e.g. section 7.4) and has proven to be the case also in Eastern Europe, illustrated by the cleaner production centres moving to environmental management systems in order to make a living when donor support is ended.

The individual effort is typically small and it has been difficult to scale up the process. There are benefits with the small size of the individual projects

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[100] This estimation was made by Valdas Arbaciauskas, Thomas Lindhqvist and the author in June 2000. It is based on the reported progress on Basic Capacity Level as presented in OECD. (1999). *Environment in the transition to a market economy: progress in Central and Eastern Europe and the New Independent States*, and several available cost figures.

[101] It is difficult to obtain a figure for the total environmental support from the various donors. As a comparison: only the Danish expenditure for environment in Eastern Europe is several times larger than the total support from all donors for cleaner production.

in the possibilities to control costs, and the lower risk of attracting local actors who want an unsubstantiated share of the money.

Achieving a critical mass of cleaner production capacity in the relevant receiving entity appears to be crucial in sustaining and multiplying efforts. Recognising the common objectives of capacity building and continuous processes, not achieving the critical mass needed for sustained activity is a waste of resources.

The preventive strategy is often set against the end-of-pipe strategy when discussing the prioritisation of support for Eastern European industry. This is questionable at a regional programme level since in most of the companies in the region, end-of-pipe investments do not constitute a financially viable option; the discussion should probably more correctly be addressing prevention versus not doing anything at all. At the company level, the debate of prevention versus end-of-pipe is largely unavoidable due to the existing notion that end-of-pipe equipment is the solution to environmental problems; the lack of financial viability of end-of-pipe solutions is often unrecognised by the technical personnel who will engage in the discussions on solutions. However, for the lesser part of industry that can afford end-of-pipe investments the discussion on prevention versus end-of-pipe is highly appropriate.

5.7.2 The necessity of cleaner production assessments

Cleaner production assessments have had a central role in cleaner production efforts to date, both as a tool to identify opportunities for improvement and as an educational exercise. But the performance of one or a few assessments is not enough to create an on-going process in industry. A broader institutionalisation of the preventive environmental approach also requires a systematic application of other operational tools and practices. This includes measures such as the development of systems for systematic monitoring of resource use, target setting and planning for reductions, and mechanisms for feedback and follow-up. A cleaner production assessment is an isolated event that has to be placed into a systematic and longer-term context. The Norwegian programme, among others, attempts to create an on-going process, but that is evidently not an easy thing to do (see Chapters 5 and 7).

The use of cleaner production assessments continues to be a cornerstone of the preventive agenda. They are not only needed as initiator for the first

activities in the companies, but also to start up preventive work in new parts of the processes and to update the information basis in a section where an assessment has been undertaken at an earlier stage. Experience from the efforts in Eastern Europe, as well as from elsewhere in the world, clearly points to the difficulties in getting cleaner production assessments to become a routine measure in industry. Without external support, companies rarely perform assessments.

Mechanisms that support the performance of cleaner production assessments should therefore be a central element in a preventive environmental strategy for industry. This involves various types of assistance to industry, often with a significant technical component. The challenge is to make such mechanisms financially viable over a longer period of time, a challenge that, for example, has led to the systematic involvement of university students and retired engineers, who are less expensive, in the United States.

5.7.3 Donor capacity

Donor capacity in the field of cleaner production turns out to be a limiting factor. This issue is a bit strange; the limiting factor for countries like Sweden is by no means skill, knowledge, or equipment that can support cleaner production efforts in Eastern European industry. On the contrary, there is much experience to transfer in the field of cleaner production. Still, transfer capacity is lacking.

The donor efforts made are typically closely linked to donor country expertise in the field. These experiences are built domestically and then later brought into the aid programmes. For consultants, this provides an extra market for their acquired skills. Countries lacking programmes focusing on preventive environmental strategies also typically lack the easily accessible capacity to carry out cleaner production projects. For Sweden the knowledge exists but not in a form that is easily accessible for use in donor projects.

To this end, any significant efforts to raise the capacity in the donor countries have not been undertaken, even though it would not be an overly complicated task.

The environmentally sound restructuring of Eastern European industry is an issue that is increasingly owned and dealt with by local actors. The role

of donor countries is consequently being shifted from the transfer of basic knowledge into more focused issues and networking.

The tendency among Eastern European actors to monopolise information is a clear barrier to dissemination. This is an issue primarily to think about for the local actors involved; it does contain a large potential for improvement. From a donor perspective, it points out the need for diversifying the channels for dissemination, for example, by involving more actors in the process. Thus, networking has become a key issue.

The central role of the change agents in the process of the promotion of cleaner production in the region creates a significant risk from the donor perspective, particularly with regard to the tendency among actors to monopolise information (see section 5.5). If the local counterpart selected therefore turns out to be performing poorly, the donors face a difficult situation due to the investments made, capacity building and the difficulties in changing counterpart.

Eastern European industry is a moving target, largely due to the extra-ordinary process of restructuring that is taking place. The needs for support are also consequently changing, both in size and content. The donor support for cleaner production in Eastern Europe has not, with a few exceptions, had adaptation as its prime characteristic.

5.7.4 The human dimension of cleaner production

The process of promoting the preventive approach has a strong human dimension, although it is not always articulated very clearly in discussions that are held in the West. The promotion of cleaner production in Eastern Europe differs from the West in the greater importance of the human dimension to the implementation of cleaner production measures. This involves attitudes among the individuals who take part in the process, as well as motivational factors in the surrounding organisational system.

The motivational issues are central in the promotion and sustainment of the preventive approach in the enterprises, and this is an area where the tradition based in the centrally planned economy constitutes a particular problem.

5.7.5 Why does the preventive approach not gain larger popularity?

Companies in general lack the internal management capacity to systematically benefit from the cleaner production potential in their operations. In the words of a cleaner production practitioner "the information and knowledge needed to implement cleaner production practices is often there, but it is scattered among different departments and managers and therefore nothing happens".[102] There is no system capable of bringing the various elements needed together in a continuous development process. In this respect, the promotion of cleaner production is dependent on the strengthening of internal management capacity in general and of environmental management systems in particular.

There is little tradition in working together to solve problems; the typical approach is that one is assigned a task to solve, and you stay within your area of work. In group-work, it is common that people start to argue, instead of being constructive. As a cleaner production practitioner put it "if it has something to do with rubles, then it is for the economist; if it is something to do with kWh, then it is for the engineer; and if it is something with biological oxygen demand (BOD), then it is for the ecologist".[103] Since cleaner production assessments not only involve the three dimensions of technology, environment, and economy, but also require weighing them against one another when the identified options for improvements are to be prioritised, then there is a clash with traditional ways of working.

The profitable investments uncovered by the cleaner production assessments performed in the Eastern European industry are, or at least should be, attractive per se. However, the efforts in performing the assessments are normally not included in the evaluation of the profitability of the investment, and this will affect the overall evaluation to some extent. On the other hand, this is no excuse for doing the good housekeeping measures where the analysis is negligible, and it is also hard to see this as a real argument when skilled workforce is abundant and capital is scarce as is the case in large parts of Eastern European industry.

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[102] Harri Moora, SEI Tallinn, personal communication, 20 May 2000.

[103] Andrius Plepys, research associate, IIIEE, personal communication 9 May 2000.

5.7.6 Donor implications

There are many implications for donors from the findings in this chapter, and their significance will vary among the donors and the situation. Below are listed some of the more important.

- Continued efforts are needed.
- More channels should be used and more actors involved on the recipient side.
- Continuous support for cleaner production assessments is needed.
- Ad-hoc activities should be avoided and ensure that projects are linked into a long-term structure.
- There should be a contribution to systematically build local capacity.
- Donor capacity in cleaner production needs to be created.
- A larger variety is needed in the efforts to reflect the varying needs.
- Make documentation readily available from the projects.

CHAPTER

SIX

6. To measure success

As identified previously in this dissertation, one of the key challenging areas lies in measuring the real outcomes from the efforts undertaken. The cleaner production efforts involve and affect a number of actors, all with different agendas, and the outcomes are not always straightforward to measure. This chapter addresses the issue of measuring the success of the cleaner production efforts that are undertaken in the region. It does so by:

- Discussing the various benefits from the programmes, and the motivational factors for the actors involved.
- Analysing the general methods for evaluation of training programmes in order to better understand the possibilities and limitations of such evaluation. What is realistic to expect from such evaluations?
- Bringing in experiences from measuring pollution prevention progress in the US. They have a head start by at least a decade and useful experiences can supposedly be brought into the Eastern European context.
- Discussing proxies for future reductions in environmental load as a complement or alternative to other measures. When it is not possible to quantitatively estimate in a reasonable way the size of the future savings, should we perhaps look into indicators that could say something about the probability of such savings.
- Examining the issue of monitoring progress at the company level. The actual monitoring of progress at the enterprise is problematic in general, and this problem is accentuated in the Eastern European context. What could you expect to know from improvements in the company?
- Concluding and bringing the raised issues together in a reflection of how we can understand the outcomes of the cleaner production efforts in the region.

6.1 Why perform cleaner production programmes

It may seem self-evident that there is good reason to promote cleaner production in Eastern Europe. However, the reasons to undertake an initiative are several and the many actors involved in the process all have varying motivational factors for their action. The justification for devoting attention to this issue is the need for perspective when evaluating the outcomes of the efforts.

An analysis of the reasons reveals the following points:

- Reducing pollution on the international level, which refers to the self-interest among donors to reduce trans-boundary pollution.
- Reducing pollution locally.
- Transfer of modern environmental strategy, as help to self-help and support for a sustainable development.
- Transfer of methodology for problem-solving, and to support communication among actors in the region.
- Minimising end-of-pipe investment in industry.
- Minimising end-of-pipe and infrastructure investment in society, including wastewater treatment, waste treatment, and energy production.
- Improving business performance. Principally monitored in the financial evaluation of the efforts, in practice mostly done by payback, where the key factor, besides the size of the savings, is the length of the payback period for the investments made.
- Improving workers' health.
- Opportunities for individual learning.
- Promoting cleaner technologies from suppliers in the donor country in question.
- Networking, both professionally and in a broader sense, including between the East and West and among actors in Eastern Europe.

There are also other benefits of the cleaner production efforts that are worth noting. They include democratisation and empowerment, both at the level of the individual, of the company, and in a national context. Table 6-1 refers to success criteria developed for a similar type of programme. These criteria illustrate, among other things, the central role of the human dimension in the promotion of preventive approaches.

Table 6-1 Criteria for successful energy efficiency activities and related programmes[104]

Quantitative indicators of success

- Reduction of energy consumption and CO_2 emissions
- Cost-effectiveness of measures

Qualitative indicators of success

- (Intrinsic) motivation of company actors and decision-makers has been improved
- Supportive infrastructure for actors within the firm has been established
- Motivation on the level of the firms or institutions has been created or increased
- Interaction of the firm with external agents has been improved
- Supportive external surroundings for the firm have been created or improved

In many cases cleaner production projects, as part of their objectives, serve as demonstration objects for further dissemination in the region. This makes the potential benefits from the effort larger, but also more difficult to grasp. On the other hand, from a practical standpoint, it could be argued that such dissemination does not take place by itself, and therefore a pure technology transfer effort is not likely to lead to any further implementation. The last observation obviously makes evaluation less problematic, restricting the scope of evaluation to the primary demonstration effort (see further the discussion on dissemination in Chapter 7).

A preventive approach to environmental management is mainly about doing things right from the start. The introduction of a preventive approach at an early stage in the restructuring process facing Eastern European industry will increase chances for cost-efficient solutions to environmental problems. Restructuring gives an opportunity to introduce changes in general, and changes related to cleaner production in particular.

The criterion that will be the most important varies among actors and projects. There are several actors involved in the undertaking of cleaner production efforts in the region, all with different interests, objectives and degree of involvement. The major actors are the donors, the consultant firms implementing the projects, the companies on the receiving end, local

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[104] Hennicke, P., et al. (1998). *Interdisciplinary Analysis of Successful Implementation of Energy Efficiency in the industrial, commercial, and service sector; Final Report.*

counterparts who organise and carry through the efforts, and environmental authorities who support the projects.

Donors can have rather complex agendas. Objectives to assist development in the receiving country, as well as furthering the environmental agenda, could be coupled to requirements to support domestic consultants and equipment suppliers.

The typical consultant firm involved in the process of implementing cleaner production in Eastern European industry as a performing agent, would seek to utilise the existing knowledge within their organisation, deliver at the desired quality, and find opportunities for further work.

The companies receiving practical cleaner production support have a variety of interests for entering the process. They may also be forced to join the project by the local environmental authorities (see Case 6-1). Apart from reducing environmental impact, successful cleaner production projects typically result in several other benefits to the company, such as:

- Improved economy by reducing costs for raw materials, energy, waste management, discharge fees, avoided pollution control technology, etc.
- Improved productivity and product quality.
- The ability of the company to benchmark themselves with Western firms.
- Direct financing of equipment and evolution of bankable projects.
- Western contacts.
- Transfer of knowledge, Western ways of doing business and positive change of attitudes.

These side-effects may be of less direct importance from the donor's point of view, but are crucial in the sense that they often are the main reasons for Eastern European companies to engage in a cleaner production project. Therefore they pave the way for making this approach to reduce environmental impact attractive, and consequently boost the dissemination of cleaner production in the region. It is important that these side effects are not overlooked when evaluating a project.

Case 6-1 Forcing companies to join the projects

The OECD project in Ukraine in 1994–95 was linked to the regional committees in Dnipropetrovsk and in Kharkiv. The same was the case with the Danish project in Smolensk, Russia, in 1997–98. In both these cases the regional committees used a combination of persuasion and pressure to have companies to initially join the projects.

The local counterparts in the cleaner production efforts, who co-ordinate the programmes, find companies to participate in the programmes, etc., want to survive (make a living), establish themselves in the market for this type of services, network, and learn.

Other Eastern European actors, such as ministries who take part in setting up the projects also have multiple agendas. The improvement of the environmental situation could be part of their agenda, the support for the domestic industry is probably important, but often the most important motivational factor is money. In this respect, however, the cleaner production projects are likely to be less corrupt since they involve smaller amounts of money and therefore more easily pass through the ministries.

6.2 Evaluating training efforts

The cleaner production efforts in the region range from being almost pure training programmes to varying degrees of hardware transfer components. The training component of the donor-supported cleaner production efforts in Eastern Europe is in any case most substantial.

How does one evaluate the effects of a training effort? The indicators used for some of the efforts included in this research, that is the number of participants, and the number of persons awarded with certificates, etc., do not reveal much of the real outcomes of the training. The research for this dissertation has, not surprisingly, showed that a person participating in one of the training programmes eventually may or may not be engaged in cleaner production activities; the outcome may be anything from the enthusiastic process engineer who departs from the training with ambitions to improve the processes, to the certified participant who moves on to a new position with little use for his/her acquired knowledge and skills.

Nevertheless, there should exist a systematic approach to evaluate training efforts. The following section attempts to understand what such an evaluation could entail.

6.2.1 A basic model for evaluating training efforts

Evaluating training efforts is obviously a challenging task. There are typically many steps and influencing factors involved between the training, and the desired outcome. It may therefore be useful to bring in a conceptual model of the issue in order to structure the analysis.

The method selected in this case is a basic model for the evaluation of training efforts, described in Figure 6-1.[105] The method refers to the following four distinct levels of evaluation.

- The reaction of the participants to the training. This is typically evaluated at the end of a course by having the participants fill in a simple evaluation form.
- The actual learning that has taken place in the training. Three basic dimensions of learning are addressed: changes in attitudes, gained knowledge, and improved skills.
- Behavioural change as a consequence of the training. Four basic conditions should be fulfilled in order to obtain the desired changes in behaviour: An individuals desire to change, knowledge of what to do, how to do it, and an appropriate working climate. Relative to change, the working climate could be described as either preventing, discouraging, neutral, encouraging, or requiring. The person is rewarded for changing with intrinsic rewards such as a feeling of pride and self-esteem, and extrinsic rewards such as praise, recognition, and monetary rewards.
- Results that can be attributed to the training.

[105] Kirkpatrick, Donald L. (1998). *Evaluating training programs: the four levels.*

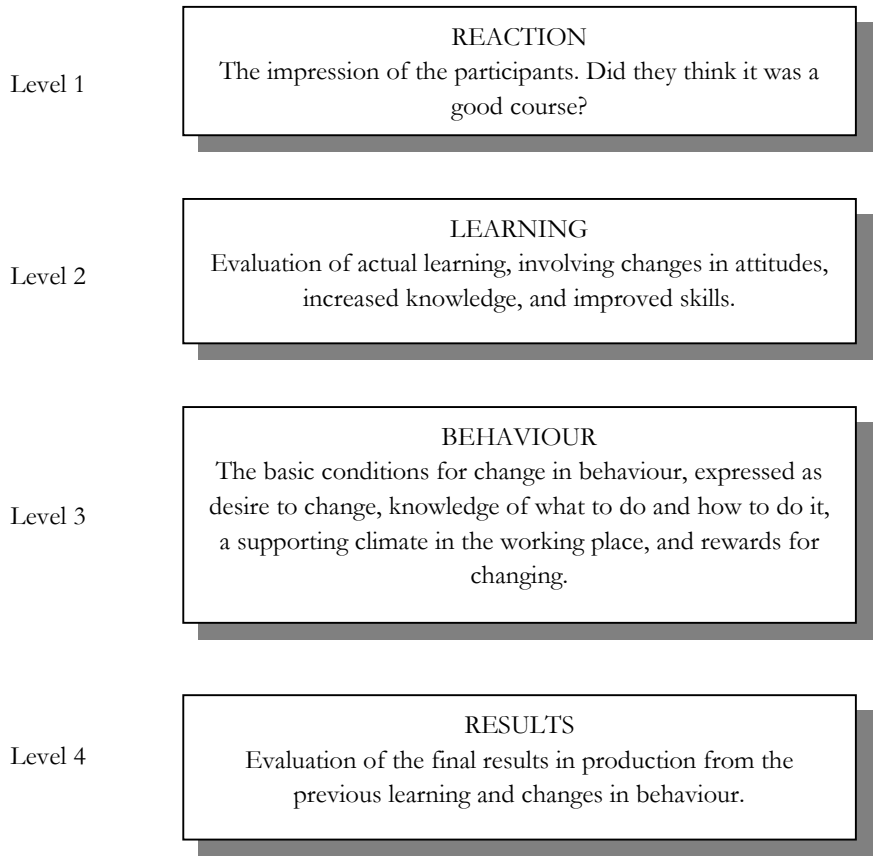

Figure 6-1 Four levels of evaluation in training programmes, from Kirkpatrick (1998).

The four levels suggested for training programme evaluation interlink closely. In order to achieve the desired results, changes in behaviour are necessary. These are reliant on the fulfilment of the four conditions (desire, etc.) for behavioural change (Level 3). The first two conditions, desire to change and knowledge, require previous learning. Finally, the reaction is perhaps not conditional, but it is obvious that if the reaction from the participants is negative, then learning and behavioural change is less likely to take place.

It is possible to affect the working climate in order to make behavioural changes more likely. Examples of how to do this are involving management

in the development of the training programme, or to give a condensed version of the course for the management.

6.2.2 Applying the model to cleaner production in the Eastern European programmes

Most programmes perform some evaluation of the impression of the participants, typically using prefabricated sheets that are distributed at an appropriate time. This would correspond to level one in the model (see Figure 6-1), and thus the lessons that could be learned from such evaluations are limited with regard to the outcome of the training programme. However, a positive evaluation is essential, since a negative impression most probably will hinder further progress.

The second level of evaluation, the learning, is addressed in the programmes where participants do practical casework in their own organisations, and present their findings within the course framework. The participants are eventually awarded a certificate, provided they demonstrate the required skills and knowledge. The certificates could therefore be seen as a measure of the learning that has taken place.

In this respect, it should be noted that the attitudes, knowledge, and skills, of those being rewarded a certificate will vary considerably, due to several reasons. Important reasons for the variations are found in the basic education and working position of the participants. To reflect this, levels of certification have been used (see Case 6-2). There are also few incentives for being strict about the certificates from the organisation delivering the course.

Case 6-2 Two levels of certificates

A Danish-supported cleaner production training programmes was performed in Smolensk in 1997.[106] Twenty-seven participants were given certificates at the end of the final seminar attesting that they had participated in the seminars and had fulfilled the demand to design and report on a cleaner production project in their respective companies. Seven

[106] Fadeeva, Zina, & Lindhqvist, Thomas. (1997). Report for the Danish Environmental Protection Agency on the *Cleaner technology programme conducted in the Smolensk region* April – September 1997.

participants qualified as cleaner production training assistants and they were awarded certificates to this effect. This certification was based on a quality evaluation, which included the projects developed in the various companies, the reports of the participants, and the knowledge and understanding of each individual.

The third level is inherently difficult to evaluate. Changes in behaviour may take place directly after the training, at a later stage, or never. In the context of the examined cleaner production programmes in Eastern Europe, behavioural changes are most likely to occur during the on-the-job training course when there is support for changes and cleaner production is on the agenda. After the courses other issues tend to dominate the agenda. [107]

In the case of unchanged behaviour, the challenge lies in understanding which of the four conditions for behavioural change, desire to change, knowledge and skills, supporting climate, and rewards, are hindering the process. There have been no systematic and comprehensive evaluations within the programmes in Eastern Europe that cover this level. On the other hand, this is the truly interesting level to evaluate when it comes to understanding why some efforts work and other do not.

The evaluation is done at the level of behavioural change by speaking to individuals, as well as through observation, in order to understand the impact of the training. The picture that arises from evaluation of the cleaner production efforts in Eastern Europe in this respect is mixed, which is not surprising considering the broad scope of the conditions for behavioural change. The conditions cover both factors relating to the individual's capacity and attitudes, as well as surrounding factors relating to rewards and the fostering climate. In the Eastern European setting they may all be problematic, but the most important condition is likely the climate for change in the workplace.

At the level of results, in this case referred to as reduced environmental impact and cost savings in the targeted industrial operation, most cleaner production efforts are reported. The figures are, however, not always easily comparable, since the basis for the information varies considerably (see the further discussion on this issue in section 6.5).

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[107] Vladimir Dobes, Czech CPC. Personal communication 10 May 2000.

6.3 Measuring success in US pollution prevention programmes

To understand the outcomes of the cleaner production efforts in Eastern Europe, one ought to be able to compare parallel processes from elsewhere in the world. It is, admittedly, not likely that one will find a similar context to the one in Eastern Europe, but the exercise may still be worthwhile. The situation in the US is of particular interest in this respect since this is where preventive programmes have been in place for the longest time: more than a decade longer than those in Eastern Europe.

6.3.1 Some US experiences

The Federal Pollution Prevention Act of 1990 is the national policy of the US and states that pollution should be prevented at the source wherever feasible. Most states have adopted legislation concerning the implementation of pollution prevention in industry, for example those states that have introduced planning for prevention in industry. Almost every state has a pollution prevention programme with a pollution prevention centre or agency. The centres are publicly funded primarily from the state; federal funding was important initially but has been reduced. The organisation of the centres is mostly separate from the regulatory agency, involving, for example, universities and non-profit organisations. The average budget of a pollution prevention agency, as found in a nation-wide review in 1997, was slightly less than 1 million USD, and the main activities are primarily providing technical assistance and training to small and medium sized businesses.[108] The cost for the pollution prevention programmes is in the order of 1% of the total environmental expenditures of both the state and local level.[109]

A survey on the performance evaluation activities in these pollution prevention agencies was performed in 1997 (see Table 6-2). Findings of relevance to the Eastern European context include the following:

- Data are primarily collected for internal management purposes in the agencies.

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[108] Kelley Manns, Edith, & Varlamoff, Susan M. (1999). Internal performance measurement in state P2 agencies. p. 58-59.

[109] Guillemin, Robert, & Goldberg, Terri. (1999). Assessing Pollution Prevention Progress in the Northeast.

- The agencies collected a diverse array of performance information.
- Roughly half, 53%, collect performance evaluation data on a regular basis.
- The most common measurements were counting the number of activities that had been undertaken, e.g. the number of workshops held, requests for on-site assistance, organisations assisted by the agency, and people trained.
- Figures were also reported for cost savings, percent of waste reduced, and reduction of TRI chemicals. Thus, only around half of the agencies use pollution reduction figures in their performance evaluation.

Table 6-2 Performance information collected in US State P2 agencies.

Type of measurements used	Used by
Number of workshops	89%
Number of requests for on-site assistance	78%
Number of people attending workshops	78%
Number of publications	69%
Number of telephone requests for assistance	67%
Number of organizations assisted	67%
Number of people trained	67%
Total number of clients	64%
Cost savings avoidance	56%
Percent of waste reduced	56%
Reductions of TRI[110] chemicals	53%
Customer satisfaction measures	53%
Number of projects funded by an organisation	53%
Number of collaborations	53%
Matching of leveraged funds	31%
Other	16%

From Manns & Varlamoff (1999).

The picture that arises of the reporting practices in the US pollution prevention agencies from this survey appears somewhat lax. However,

[110] TRI = Toxics Release Inventory which is a government regulation requiring companies to report their emissions of certain high-priority chemicals.

pollution prevention agencies are continuously struggling to improve their monitoring of savings in chemicals, raw materials, and money, but it is not an easy task. The motivation primarily comes from the need to justify the activities in the never-ending fight for funding.[111]

Answering a question on what information the agency would like to collect, one respondent (out of 47) said that in an ideal world he would want to catalogue all the compliance improvements, pollution prevention implementation and pollution reduction, and economic impacts of that pollution reduction.[112] It seems that the "difficult issue of how to best measure and track P2 progress quantitatively has never been satisfactorily resolved".[113]

It is difficult to clearly track savings made at company level in the figures for overall waste generation. "It is interesting to note that source reduction activities reported by facilities do not appear to be significantly affecting waste generation."[114]

6.4 Assessing long-term results from cleaner production initiatives

A major part of the outcome of the cleaner production efforts lies in the future, at least potentially. The long-term, that is, post donor involvement perspective is of great interest to try to evaluate. Long-term results constitute an important part of the outcome expected from the efforts. All cleaner production efforts in the region have more or less clearly stated ambitions to influence future cleaner production-related behaviour in industry. Apart from explicitly stated ambitions in the various efforts, the overall ambition of the efforts is to support progress towards more environmentally efficient industry in the region. The continued cleaner

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111 Neil Kolwey, Pollution prevention technical assistance coordinator, Colorado Dept. of Public Health and Environment P2 Program. Personal communication, 28 April 2000.

112 Kelley Manns, Edith, & Varlamoff, Susan M. (1999). Internal performance measurement in state P2 agencies.

113 Hirschorn, Joel S. (1997). Why the Pollution Prevention Revolution Failed – and Why it Ultimately will Succeed. p. 69.

114 Hirschorn, Joel S. (1997). Why the Pollution Prevention Revolution Failed – and Why it Ultimately will Succeed. p. 70.

production activity in the participating companies constitutes a central part in the realisation of these ambitions.

However, it is obviously difficult to predict what will happen in the future. Assessing long-term results is problematic for several fundamental reasons.

- Time perspective. There is no obvious limit in time for savings made in a company; an improvement will continue to contribute over the years. It is not easy, however, to tell for how long.
- Actual outcome. Future results could be anything from worsening of the situation to fantastic improvements.
- Causality or allocation. Final results – assuming they are known – are influenced by a multitude of factors, making the contribution by a particular effort less obvious.
- Attained knowledge and contacts are used for other purposes than cleaner production.
- Practical issues involved in monitoring (see Chapter 6.5).

6.4.1 Proxies for future results

The difficulties that exist concerning quantitative predictions of future results suggest the need for alternatives. At the company level, proxies[115] indicating the probability of future activities constitute one such alternative.

There exist several conditions that will enhance the probability of continued cleaner production activities in a company following an initial training or demonstration activity. These conditions could be used as proxies for future results.

In his doctoral dissertation on the promotion of cleaner production strategies in companies, van Berkel suggested that long-term success with cleaner production depends on the rate of technical innovation and on the management practices in the company. He further suggested nine system-related proxies for future results (see Table 6-3). As the underlying basis for these suggestions, he argues with some empirical support that the

[115] The term proxy is used in a similar meaning as the more common term indicator, with the difference being that it is not possible to know exactly what a proxy implies. For an indicator this is not a prerequisite.

probability for source reduction activities is higher as companies initiate and develop the nine proxies.[116]

Table 6-3 Environmental management practices conducive to sustaining cleaner production in an organisation

Environmental policy
Environmental goals
Production management
Leadership
Environmental reporting & communication
Employee involvement
Cleaner production assessments
Materials accounting
Cost accounting

Another set of proxies could be derived from what Pojasek proposes as basic elements of a successful pollution prevention programme (see Table 6-4). He stresses the need to adapt the elements to the needs of the specific organisation, possibly also adding other elements.[117]

Table 6-4 Programme elements for company level waste minimisation programmes.

Provide top management support, including goals and incentives supporting P2
Characterize the process, e.g. by process mapping to identify P2 opportunities
Perform periodic P2 assessments in order to keep momentum in the program
Maintain a cost allocation system instead of allocating to the facility overhead costs
Encourage technology transfer, e.g. by using technical universities and government programs
Conduct program evaluations, internally or using third party audits
Source: US EPA 1993 cited in Pojasek (1999)

[116] van Berkel, Cornelius W.M. (1996). *Cleaner production in practice: methodology development for environmental improvement of industrial production and evaluation of practical experiences.* pp. 47, 53.

[117] Pojasek, Robert B. (1999). P2 programs, plans, and projects: Some thoughts on making them work. pp 97-99.

The list of tentative proxies could be much longer; the above-mentioned proxies constitute illustrative examples developed by two experienced practitioners. The success criteria developed by Hennicke et al. that are displayed in Table 6-1 contain five qualitative indicators of success. These would also be useful as proxies for future results.

Monitoring the progress with these proxies offers a way to judge the probability of future cleaner production activities. Evaluation of the progress within each proxy requires qualitative, and perhaps also expert judgements. The possibilities for quantitative predictions of results – savings and pollution reduction – are in any case limited.

6.5 Monitoring progress in the companies

This section deals with the issue of monitoring what has happened as a result of the cleaner production efforts. In practice, it turns out to be difficult to obtain accurate data on the progress of implementation of cleaner production measures in companies. A fundamental problem is that companies themselves do not necessarily know. This in turn could be due to several reasons, including the following that have been observed in the cleaner production work with Eastern European industry.

- The company does not care to find out.
- It is problematic to measure something that is avoided. [118] You are never really sure about the reference value; the figures for the situation if nothing had been done. Reference figures relate to historical production and not to the present.
- It is not possible to measure cleaner production progress accurately. For example water consumption is commonly monitored at the company level, but rarely at the departmental level, thereby making it difficult to track results from changes performed in a certain department. The savings are not discernible in the overall monitoring. Estimations and/or ad hoc measurements are alternative ways to assess results.

[118] If you by "to measure" mean to derive *the* true figure, then it is of course impossible to measure something that is avoided. On the other hand, to arrive at an adequate approximate figure for your purposes may be perfectly feasible, although slightly problematic.

- Poor documentation. Information management in Eastern European companies does not usually quantify resource use in unit operations or individual departments. Western companies also, in general, do not document resource use and emissions at a detail that allows for a quantitative follow-up of all kinds of cleaner production measures.

In this context it should be noted that information/indicators on cleaner production progress in an industrial operation typically are both quantitative, for example, figures for material efficiency, and qualitative, for example checklists for good housekeeping measures (see section 2.4.3).

As a consequence of the lack of information, there is a significant effort involved in gaining results. Neither companies nor donors have devoted the resources needed to follow up on in-company work.

The conditions for reporting are also an important factor. People involved in training courses report of competitive environments in the classroom where companies do their best to try to be the one that presents the best results.[119] There are in these cases few incentives for the individual company to keep the reported figures down. Case 6-3 is a good illustration of the importance of the conditions for the reporting of results.

Case 6-3 Estimating savings from cleaner production measures in companies

The Czech cleaner production centre introduced a model for the relationship between the company and themselves acting as consultants; the payment for their services are taken in the form of a percentage of the savings that are incurred by the company as a result of the cleaner production assessment performed. According to the manager of the Czech CPC, Vladimir Dobes, this construction markedly changed the attitude from the company representatives when it came to estimating savings from the cleaner production measures; from the normal situation where people had few reasons to keep figures down, to a situation where they were very conservative in their estimations.

Companies taking part in Cleaner Production programmes are not necessarily eager to report all actions they have taken and this is particularly the case for "easier" housekeeping measures. In some cases the companies

[119] Vladimir Dobes, Czech CPC, personal communication May 2000

do not consider them as real actions (they do not involve "real technology") and this is even more likely for an Eastern European company. In other cases, while realising such measures to be rational, they might find it embarrassing not to have taken the appropriate actions earlier. Companies are, naturally, eager to give a good impression and all programmes will also be looked upon as some sort of an evaluation of the company and its management.[120] Even large savings may go unreported, as illustrated by Case 6-4.

Case 6-4 A company that did not want to divulge their large savings

An experienced Eastern European cleaner production practitioner told about a case where his organisation was working together with a large enterprise in the chemicals business. The company had a good reputation in general but was also a well-known polluter. The company was an enthusiastic and constructive working partner in the cleaner production assessment process when suddenly, after the having mapped out process flows and losses, the company withdrew from co-operation in this area. No explanation was given at that time. At a later stage, however, it turned out that the analysis of the process had detected a trivial malfunction of the production process, which resulted in several tons of product per hour being emitted to the surrounding environment. The management had become afraid of the consequences and therefore stopped the project with the external cleaner production agents while still implementing the changes needed. They had thought that the previous level of losses were normal. Being a major success story for the company finances as well as the environment, it is problematic that the cleaner production programme in this case could not get deserved credit. The savings were of a size that would have paid for the programme several times.

Also, there is an allocation problem. Changes may be undertaken for various reasons, including production efficiency, workers' heath, and the risk of accidents, and the changes will most often have pollution prevention components. Quantitatively, the allocation problem lies in assessing the share of costs that could be attributed to the reductions in pollution. The

[120] There is also evidence that companies deny that implementation has taken place, while an on-site inspection shows the opposite (Vladimir Dobes, personal communication). This serves as an indication of the difficulties associated with obtaining an accurate picture of the situation.

problem from a reporting perspective is that changes with significant pollution prevention implications may go unreported because there may be another primary reason for implementing the change.[121] If the change was never seen as environmental in the first place, perhaps rightly so, it therefore may be left out when reporting on cleaner production progress.

The following case – Case 6-5 – is an examination of the reporting process in one of the schools within the Norwegian programme where the circumstances made possible a closer look at the practice.

Case 6-5 Reporting results – a case from the Norwegian programme

The Norwegian programme has performed two traditional training schools in Kaliningrad, Russia.[122] The normal reporting in the Norwegian programme from the company case studies are reports of some ten pages in Russian from each company. These reports are then typically summarised into a one-page summary in English. In the case of the second school in Kaliningrad, the documentation in English was more elaborate, and persons who were involved in the practical work in the companies performed the translation. In this case, therefore, there was an opportunity of more in-depth understanding of the basis for the results presented.

The second school was performed during May to December 1998. The participants attended a pre-project seminar in July 1997, and thereafter 33 agreed to participate, representing 23 companies, Kaliningrad State University, and Kaliningrad State Technical University.

Twenty-five participants received diplomas at the end of the course,[123] after having taken part in classroom training and conducting cleaner production

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[121] See e.g. Williams, Deann R. (1996). Measuring P2 Progress: Washington State's Experience. p. 39.

[122] These two training schools – in 1997 and 1998 – were also followed by a training course in financial engineering in 1999, where companies who participated in the previous schools were invited to learn how to apply for the NEFCO revolving fund for cleaner production. seven companies chose to do so, two of these eventually applied for funding, and one has been accepted to date. Both applications concerned conversion of boiler to natural gas.

[123] The failure rate – only 25 graduated out of 33 – was higher than normal. An important reason being the collapse of the ruble in August 1998, which forced several companies to close their operations.

assessments in the participating companies. Implementation of discovered options is part of the undertaking, and the final report states the following in the report overview.[124]

> *Implemented options amounted to yearly savings of about USD 800 000 with nil or small investments.*

Furthermore:

> *Water consumption is reduced by more than half a million m³, yearly savings in electrical power consumption is about 250 MWh. There are further considerable reduction in solid wastes, raw material consumption, including oil and natural gas, effluents to air (including odour reductions) and in hazardous wastes, especially heavy metals.*

This gives rise to some questions. An energy saving of 250 MWh corresponds to approximately 20 000 USD, and 500 000 m³ water to approximately 80 000 USD, in total 100 000 USD.[125] Evidently a considerable discrepancy.

In Table 6-5 there is an account of 1) the savings reported in the programme, and 2) a revised figure for savings when the reported figures were found to be unsubstantiated. The revised figures do not represent a verification of the savings, as the investigations did not, in most cases, allow for such conclusions. Instead, the revised figures represent the figure that emerges when claims found to be unfounded are deducted from the reported results. The resulting figure could thus still be lower, but there might also have been other improvements performed.

The revision of the figures was performed in two steps.

- Comparison of the summary results presented in the final report with the individual company reports in the appendices of the same report. The writing concerning implementation was often unclear, but at several occasions it was evident that implementation had not taken place. This allowed for the first part of the revisions.
- To further investigate what had actually been implemented, interviews were performed with a local advisor for the project, and with four of

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[124] Kjaerheim, Gudolf. (1999). *Final report from Kaliningrad phase 2, May 1998 – December 1998, of the Russian-Norwegian capacity building program in cleaner production.*

[125] 1 USD = 16 rubles, which was the approximate exchange rate at the time. Prices from Dmitry Zaphorozhsky, May 1999.

the companies.[126] The acquired information revealed the need for further downward revisions of the reported savings.[127]

Table 6-5 Yearly savings from implemented options in company cases. Second Norwegian CP school in Kaliningrad. From final report.[128] Revised figures are added.

Company	Option type[129]	Economic savings reported (USD)	Economic savings, revised figures (USD)
Baltkran*	A	2 008	1 216
	B	8 898	136
Baltik GmbH	A	1 958	1 958
	B	23 507	0
Concrete Construction Plant # 2	A	2 400	600
	B	1 500	1 500
Kaliningrad confectionery	A	1 277	1 277
	B	4 152	2 284
Kaliningrad state sea fishing port	A+B	66 924	0
Kaliningrad-gasavtomatika	A	3 854	3 854
	B	3 083	3 083
Morozhenoje	A+B	1 686	1 686

[126] This is according to Dmitry Zaporozhsky, who was local project advisor in the project, and also translated company reports from Russian into English: interview 23/3/2000. The interviews with company representatives were made 21-24/3/2000 with assistance of Amal Samerkhanova and Natasha Chvyreva who had been part of the CP training and in-company work in question, as students from Kaliningrad State University.

[127] A more in-depth investigation of the implementation would probably change the figures further; in some cases it was not possible to obtain information from the companies. What we attempted to confirm was that the measures had been implemented – not the estimated savings. The interviews also showed that some of the measures had been implemented after the completion of the training school.

[128] Kjaerheim, Gudolf. (1999). *Final report from Kaliningrad phase 2, May 1998 – December 1998, of the Russian-Norwegian capacity building program in cleaner production*. p. 14-16.

[129] Options are classified as A, B and C. A denotes without investment, B minor and C major investments. C options are rarely implemented during the training programmes, but may form basis for funding applications.

Company	Option type[130]	Economic savings reported (USD)	Economic savings, revised figures (USD)
Koenigavto	A	6 650	6 650
Kaliningrad Railways	A	663.5	663.5
	B	14 539	14 539
Kaliningrad Refrigerating Plant	A	1 428	1 428
	B	483	483
Rosvestalko	A	5907	1994
	B	8 251	0
Strojdormash	A	4 639	4 639
	B	4 187.6	1 165.6
Kaliningradteploset*	A	1 000	1 000
	B	147 700	15 700
Tsepruss*	A	7 055	7 055
	B	452 947	**
Vodokanal UVS-1*	A	2 299	2 299
	B	20 411	20 411
	Total	799 000	~96 000

* interviewed; **partly implemented later

- A more realistic figure for yearly economic savings from the company case studies arose after examining the underlying material. Instead of 800 000, a more correct figure of implemented measures during the project would be in the order of 100 000 USD.[131]

[130] Options are classified as A, B and C. A denotes without investment, B minor and C major investments. C options are rarely implemented during the training programmes, but may form basis for funding applications.

[131] The company Tsepruss claimed to have partly implemented their B-options after the completion of the project. This could add approximately 150000 USD to the overall savings according to the figures presented by the company.

The reported overall figure for water savings, 500 000 m^3, is most likely exaggerated.[132] According to the review of the results, a more correct figure should be not higher than 100 000 m^3.

It is hard to say in what way information shared during the final presentations on the case studies could have contributed to the final aggregation of savings. In any case it is clear that the company reports in the final report, and interviews with participating persons, do not support the levels of savings stated in the summary of the final report.

6.6 Concluding remarks on the issue of measuring success

6.6.1 Benefits from cleaner production

The potential benefits from the cleaner production efforts go far beyond the direct savings in for example raw materials and energy from the cases performed, as shown in section 6.1. These benefits include the support for improved business performance, improved innovation processes in the companies, individual learning processes, and leapfrogging in the sense of avoiding over-investing in resource-intensive end-of-pipe treatment. In slightly more elaborate terms:

- Measures to protect the environment in Western industry have changed in character over the last decades, from dilution and treatment towards an increasing focus on process integrated solutions with an emphasis on a more efficient use of energy and raw materials, that is, a preventive approach. Eastern European industries are in a position to use the knowledge that has been brought about and can thereby avoid unfruitful investments, such as over-dimensioned treatment plants (see e.g. the saving potential illustrated in Case 7-5).
- Due to the lack of incentives to minimise the use of energy and raw materials, Eastern European industry in general is less efficient in this respect when compared to Western industry. In other words, there is a

[132] The main part of these water savings – 391 000 m^3 – were supposed to come from the elimination of tap water leakages and spillages at Tsepruss (A-options). These remarkably high figures for such activities could not be confirmed in the interview with the company, and these measures had in any case not been implemented.

large potential for improvement by the implementation of preventive measures.

- The main part of Eastern European industry is in a bad state, and it is therefore difficult to find resources for environmental protection. This makes measures that enhance the efficiency in the use of resources particularly attractive – or even the only feasible alternative – since they, besides reducing environmental impact, also help to raise productivity and save costs for energy and raw materials. A large number of measures can be undertaken at no or low investment costs.
- In a sustainable development perspective the preventive approach is essential, since it reduces the resource intensity of a given operation.

6.6.2 General measuring

There is much interest in measuring the success of the cleaner production efforts and the reasons for doing so could be divided into four categories:

- To make possible quantitative comparisons with alternative ways to reduce the environmental impact caused by industry – i.e. end-of-pipe treatment – in the region.
- To make possible, and give incentives for, innovation, benchmarking and continuous improvement among the various cleaner production actors that are active in the region.
- To make possible company internal benchmarking and progress.
- To obtain absolute figures on the benefits from the cleaner production efforts performed in the region.

Measuring success from cleaner production efforts is a challenging task, and the basis formed for continuous work is crucial but hard to judge. It could therefore be justified to divide the monitoring of success into two dimensions: the direct results from the project – for example savings in resources and money – and the basis formed for continuous work in the company (see Figure 6-2).

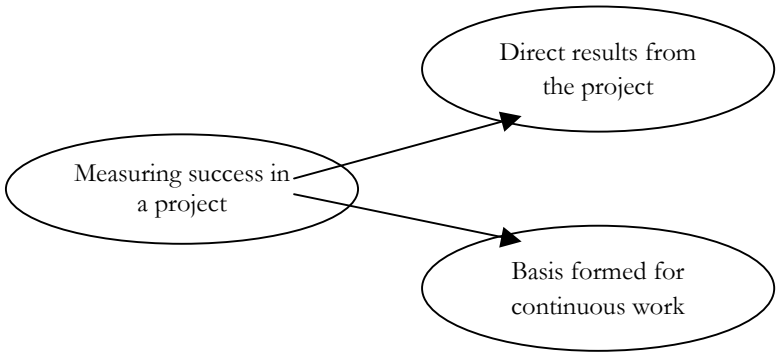

Figure 6-2 The two dimensions of monitoring of success in CP programmes

The examination of proxies for the long-term results in section 6.4.1 gave several suggestions for qualitative proxies. However, to use them as proxies for long-term results seems slightly unrealistic in the context of the efforts that donors have put into reporting so far. Their best use is perhaps in another area within the cleaner production efforts in Eastern Europe: as guidance for the internal capabilities needed to create an operational basis for continuous work in the company (as illustrated in Figure 6-2). In doing so, these qualitative elements of a basis for continuous work are in distinct contrast to the actual situation in Eastern European industry (as presented in Chapter 3) as well as to the hopes expressed in donor efforts of continuous work after the first cleaner production assessment performed in a company. In this perspective, it appears that the donor efforts to date are largely insufficient to create a momentum for cleaner production in Eastern European industry.

The reason for measuring success that involves the comparison of alternatives deserves some reflection. In most situations, the only realistic alternative to the preventive approach for reducing the emissions from industry is to close down operations. Investment in end-of-pipe equipment is a viable option only for a minor part of the companies in Eastern Europe, and when installing such equipment few people would argue about the cost-efficiency of doing the preventive work first (although it is not necessarily done, see Case 8-3). This would make the reason for measuring involving the comparison of alternatives less important, leaving the other reasons as the main drivers: benchmarking within the cleaner production community, internal company monitoring of progress, and knowledge of absolute savings.

6.6.3 Training

The exercise of trying to understand how to evaluate training programmes has, apart from providing insight into how to improve that specific process, also contributed to the understanding of the difficulties of moving from training to actual implementation. Of particular interest in this respect are the conditions for implementation that are suggested in level three of the model displayed in Figure 6-1. These four conditions are listed below.

- Desire to change
- Knowledge of what to do and how to do it
- A supporting climate in the working place
- Rewards for changing

The first two are related to the individual and are therefore possible to affect with, for example, a training programme on cleaner production. The latter two conditions are out of control of the individual and the training programme that he/she participates in. Considering the situation in many enterprises in the region (see section 3.1), this part of the model helps clarify and explain the observed difficulties in implementing identified options.

6.6.4 Reporting

Counting the activities that are involved in the cleaner production efforts, such as companies involved, certificates awarded for training programmes, and demonstration projects constitute an important part of the monitoring of the activities. Attempting a thorough and detailed evaluation of the training efforts is most likely not practicable. Therefore, it should be expected that the counting of activities will continue to constitute an important part of the follow-up. However, the weaknesses and large variations in the current reporting and its information basis, makes improvements in this field crucial to sound decision-making in the donor community.

To find structures that give incentives for a reasonable reporting procedure is a key path to the improvement of the decision-making involved in the cleaner production efforts. The conditions for the reporting obviously affect the figures for savings that are presented at the end of the project (see the discussion in section 6.5 and particularly Case 6-3). This is an area that needs a little creativity; improved monitoring procedures in the companies,

involvement of other actors such as students in the process, and having the companies pay part of the savings could all constitute elements of such an improved incentive structure.

The reporting of savings from cases and demonstrations has few incentives to keep estimations of savings at the lower end of a probability range. Also, the transparency of actual calculations and estimations is low, which makes it difficult to form an opinion on the quality of the figures.

6.6.5 Donor implications

The findings in this chapter render the following implications for donors:

- The need to recognise of the significant additional benefits beside the reductions in environmental impact.
- The need to provide possibilities for a continuous improvement process within programmes and within companies using benchmarking, by ensuring reasonable standards of reporting and making information available.
- The need to create incentives for reasonable reporting of savings from the projects.
- The dependence on counting the number of activities performed will continue to be an important measure, but it is important to regularly collect more detailed information on the outcome of the activity.

CHAPTER

SEVEN

7. Dissemination of cleaner production practices

The following chapter looks into the issue of the dissemination of cleaner production practices in Eastern European industry, and particularly the rate of dissemination.[133] The common perception among practitioners is that progress is slower than expected, and a substantial untapped potential for improvements exist. Once again, both theoretical and practical perspectives are sought to better understand the issue. This chapter provides:

- Some general comments on the issue of dissemination in the perspective of this research.
- An investigation into two major research areas that are highly relevant to cleaner production dissemination and that may contribute to the understanding of the dissemination issue: diffusion of innovation, and technology transfer.
- Practical experiences with dissemination of cleaner production from the US pollution prevention programmes that may add value to the Eastern European issue.
- Concluding comments on the topic.

An important component of the analysis is the selection of information that is included in the chapter, since the areas addressed are diverse in nature. Care has been placed in the selection of material, and the guidance for the selection process has been the perceived relevance to the practical processes involved in the dissemination of cleaner production in the region.

[133] In the context of this dissertation, the term dissemination not only implies the transfer of information, but the adoption of cleaner production measures. Dissemination is considered successful if cleaner production practices are implemented in other industrial operations.

7.1 Some reflections on the issue of dissemination in the Eastern European programmes

As part of the objectives to be reached for the ministerial meeting in 1998, along with the basic capacity level, it was expressed that dissemination to all medium- and large-scale industry in the region should occur. It could be argued that it would be at least as interesting to search for dissemination within the individual company that has been involved in the cleaner production initiatives. The typical cleaner production initiative involves only a small part of the enterprise (see Chapter 5) and there is consequently a large potential for further work within the companies. Also, since the trained persons are company representatives rather than independent consultants, the primary dissemination route to be expected from the efforts undertaken would be within the company. Continued efforts are highly dependent on actions from the trained persons.

It may therefore be useful to divide the routes in the dissemination process into within and between companies, as illustrated in Figure 7-1. Although a simple notion this issue is often overlooked in the policy discussions. The two routes differ in the policy measures that are needed to promote the dissemination: within the company, it is largely an issue of institutionalisation, while the route to other companies normally requires intermediaries.

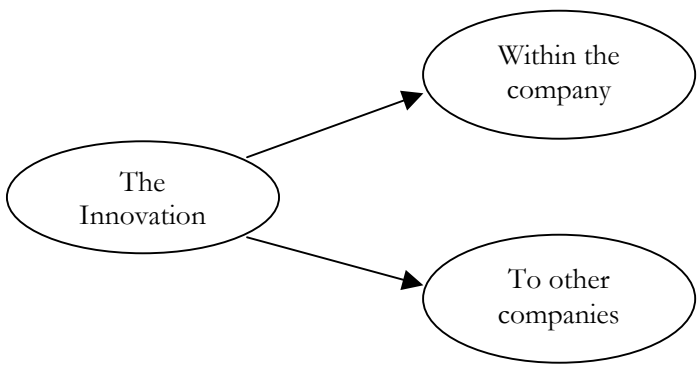

Figure 7-1 Directions of dissemination of cleaner production innovations

Dissemination is largely an issue of creating structures that favour the adoption of cleaner production strategies. Training and education, access to

information, cost structures, and legal structures providing incentives and opportunities, are all integral parts of the broader dissemination of cleaner production strategies in Eastern European industry. These issues are analysed further in Chapter 4.

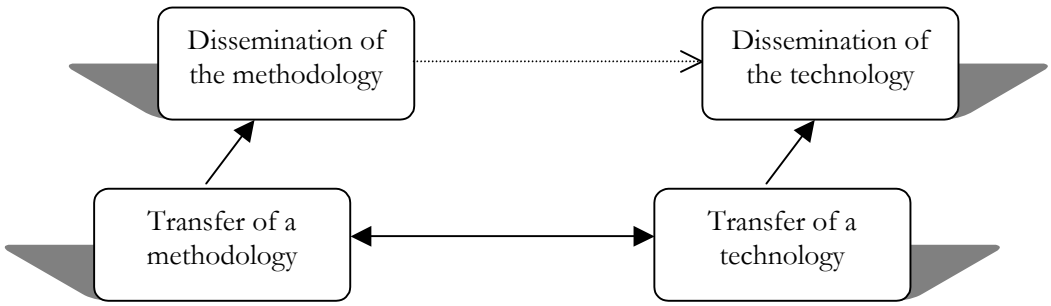

Figure 7-2 Basic dissemination model for the cleaner production efforts

Dissemination in the context of the cleaner production programme could mean either the diffusion of a specific technology that has been demonstrated successfully, or the wider use of a self-contained methodology that enables a company to find a solution, illustrated in Figure 7-2.[134]

- Diffusion in the application of a methodology is probably most likely to occur when it does not involve the transfer of skills and knowledge to other persons, i.e. when the first trained persons apply the methodology in another part of their workplace. This would primarily involve dissemination within the organisation, but also the application of the methodology in other organisations when the first trained persons act as external consultants.
- Diffusion of a technology is the type of dissemination that is most often discussed. A reason for this is greater visibility when it is a piece of equipment, and greater measurability, which makes it easier to keep track of the diffusion process.

[134] In this specific context the term "technology" is used to denote not only equipment, but also organisational changes; the "technology" to disseminate would be found somewhere along the equipment-organisational change scale.

Networks that give continuous inputs and incentives for preventive solutions to environmental problems can be instrumental in the dissemination of preventive measures. Another key determinant for success is the individual learning process where training results in higher confidence and motivation of the staff.[135]

7.1.1 Demonstration

A large part of the cleaner production efforts in Eastern Europe are intended as demonstration projects in one way or the other.

- The efforts by the World Environment Center are performed in two phases, where the objective of the first phase is to set up demonstration projects in industry.
- The Norwegian programme at times denotes the case studies performed in the training programmes as demonstration projects, but the overall programme objective is more to demonstrate a methodology.
- The Danish efforts are focused on more substantial demonstrations of cleaner technologies. These cases include demonstrations in, for example, textile, fish processing, and surface coating, where substantial support is given to investments in hardware.

It is observed that these demonstrations are rarely discussed in terms of how they are to be used, that is, they are not viewed from the dissemination perspective. The demonstrations are typically seen as goals per se, coupled with statements such as "spreading throughout industry is foreseen" or "the consecutive implementation in neighbouring companies is expected to result in substantial environmental improvements in the region".[136] Dissemination through imitation is relatively more common than by invention of new solutions illustrating the need for demonstration.

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[135] Hennicke, P., et al. (1998). *Interdisciplinary Analysis of Successful Implementation of Energy Efficiency in the industrial, commercial, and service sector; Final Report*

[136] Lindhqvist, Thomas, & Rodhe, Håkan. (1994). *Evaluation of Industrial Waste Minimisation Initiatives in Central and Eastern Europe.*

7.2 Diffusion of innovation

The diffusion of cleaner production innovations is a central theme in this research. It therefore appears to be relevant to bring in experiences from the generic discipline diffusion of innovations in the field. The following section is based on Rogers.[137]

An innovation is defined as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption".[138] It is the perceived newness of the idea on behalf of the individual that is of importance, not that the idea is new in itself. Additionally, newness in this context is defined not only as obtaining new knowledge, but also as being persuaded or as making decisions to adopt on the basis of already existing knowledge. The transfer of knowledge and attitudes makes it possible to define the process of diffusion of innovation essentially as a social process.

7.2.1 Factors governing the rate of diffusion

According to Rogers, the rate of adoption of innovations is largely explained by their characteristics, and the following five qualities are found to be the most important in this respect.

- Relative advantage of the innovation compared to the idea it supersedes. The objective relative advantages, such as economic paybacks, are typically not the factors that trigger diffusion. Instead, it is the perceived relative advantage by the individual that is most important, involving factors such as prestige, convenience and satisfaction. "*A preventive innovation has a particularly slow rate of adoption because individuals have difficulties in perceiving its relative advantage.*"[139]
- Compatibility is the perceived consistency with existing values and needs, and past experiences. Lower compatibility gives a lower rate of diffusion.

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[137] Care should be taken when applying the concept of diffusion of innovation in the Eastern European context. The system is/was in many ways different from that in the West. On the other hand, there is a gradual adaptation to Western standards in society, so an increasing applicability could be expected. See e.g. Sandberg, Mikael. (1999). *Green post-Communism? Environmental aid, Polish innovation and evolutionary political economics.*, p. 41.

[138] Rogers, Everett M. (1995). *Diffusion of innovations.* p. 11.

[139] Rogers, Everett M. (1995). *Diffusion of innovations.* p. 217.

- Complexity: if the innovation is perceived as difficult to understand and use, the rate of diffusion will be slower.
- Trialability: if the innovation can be tested first, the uncertainty of the consequences is reduced, and therefore diffusion is more likely to take place.
- Observability represents the visibility of the innovation. The more visible the results are, the more likely it is for an individual to adopt the innovation. Visibility stimulates peer discussion, and thereby, ultimately, diffusion.

Diffusion of technological innovations could be said to have two components: a hardware aspect related to physical objects, and a software aspect that relates to the information base for the innovation. Hardware components are usually more visible compared to the software. The lower degree of observability for software innovations leads to a slower rate of innovation. In a cleaner production context, this is clearly relevant since important innovations, including many good housekeeping measures have small or even non-existent hardware components.

The most important evaluation of an innovation is not the scientific evaluation of its consequences, but rather the subjective evaluation shared by a colleague or peer who has already adopted the innovation. This is what most people depend on for evaluation of an innovation. However, factual investigations about the consequences "are not entirely irrelevant, especially to the very first individuals who adopt [them]".[140][141]

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[140] Rogers, Everett M. (1995). *Diffusion of innovations*. p. 18.

[141] This is supported in other literature e.g. in Hennicke, P., et al. (1998). *Interdisciplinary Analysis of Successful Implementation of Energy Efficiency in the industrial, commercial, and service sector;* where it is concluded htat informal and personal face-to-face contacts between representatives of different companies work as a very important channel of diffusion.

7.2.2 Communication

Effective communication is a fundamental requirement for the diffusion of an innovation. A variety of communication channels are used and are matched to the different phases in the innovation-decision process. Whereas mass media may be useful at some stages, the actual decision-making typically involves direct person-to-person communication.

> *One of the most distinctive problems in the diffusion of innovations is that the participants are usually quite heterophilous.*[142]

Communication is most likely to occur and most effective when the involved actors are homophilous, or in other words, are similar, for example, regarding education, social characteristics, and beliefs. It is easier to accept a message from someone whom you can relate to. Heterophily, or dissimilarities between individuals, hinders the diffusion of an innovation, but may not necessarily hinder effective communication. Empathy – the ability to project into the situation of another – can substitute for homophily and thereby enable a more effective communication between heterophilous actors than would otherwise be the case.

7.2.3 The innovation-decision process

The model presented by Rogers suggests the following five steps for the innovation-decision process:[143]

- Gaining knowledge of the innovation: this represents learning about the existence of the innovation, plus some understanding of how it functions.
- Persuasion: this is the formation of a favourable attitude to the innovation.
- Decision of whether to adopt or reject the innovation.
- Implementation of the innovation.
- Confirmation that the innovation-decision was appropriate, with the risk of reversing the decision if exposed to conflicting messages about the innovation.

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[142] Rogers, Everett M. (1995). *Diffusion of innovations.* p. 19.

[143] Rogers, Everett M. (1995). *Diffusion of innovations.* p. 20.

The five-step model is intended for individuals but the process for diffusion of innovations among firms is similar. Organisations are found to innovate by first finding an innovation and then matching this innovation to a specific problem facing the organisation. An underlying reason for this seemingly irrational order of events is the observation that companies are faced with a multitude of problems but only know of a limited number of solutions. By starting with a solution, the process of finding a match has a good chance of being successful.

The process of gathering knowledge of innovations, however, and matching them up with the needs in the organisation and approaching a decision "requires an extended period of time, often several years".[144] Furthermore, any uncertainty of the consequences of an innovation makes the implementation more difficult. The more radical the innovation, the greater the uncertainty associated with it.

7.2.4 Methods used to influence the innovation-diffusion process

Key individuals influencing the diffusion process are opinion leaders, change agents and change-agent aides.[145]

- Opinion leaders belong to the local community; they can influence an individuals attitudes and behaviour, and the degree of influence is not necessarily reflected in formal position or status.
- Change agents act on behalf of change agencies and attempt to influence the behaviour among their clients. Heterophily is a typical barrier in the communication between change agents and their clients.
- Change-agent aides are homophilous with the clients and support the change agent in the process of influencing the clients. An aide could be a member of the local community.

Demonstration is widely used as a strategy to diffuse innovations. It aids those who may adopt the innovation to evaluate it, by increasing observability and providing access to experience from another adopter. Optimally a demonstration combines the competence credibility of the change agent, with the perceived safety credibility of the demonstrator.

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144 Rogers, Everett M. (1995). *Diffusion of innovations*. p. 391.

145 Rogers, Everett M. (1995). *Diffusion of innovations*. pp 26-28, 350-355.

The clients' ability to evaluate innovations is positively linked to the diffusion of innovations. A change agent should therefore aim to raise the clients' ability to evaluate the appropriateness of potential innovations themselves. "This goal, however, is seldom reached by most change agencies; they usually promote the adoption of innovations, rather than seeking to teach clients the basic skill of how to evaluate innovations themselves."[146]

It is difficult to detect variables that influence innovativeness. Therefore, studies on organisational innovativeness have become passé. However, certain characteristics of an organisation have been found to affect innovativeness; centralisation being on the negative side in this respect, and innovation champions on the positive.

7.2.5 Diffusion systems

Diffusion systems can be classified as centralised or decentralised (see the characterisation in Table 7-1). The centralised system has more of a linear one-way model of communication. The decentralised system instead focuses on the creation and sharing of information among the actors. The latter model is useful when the users have the capacity to operate their own diffusion system, which is when the users are highly competent, or when the innovations being diffused do not involve sophisticated technology. In practice, most systems are hybrids of the two systems.

[146] Rogers, Everett M. (1995). *Diffusion of innovations*. p. 357.

Table 7-1 Characteristics of centralised and decentralised diffusion systems.

Characteristics of diffusion systems	Centralised diffusion systems	Decentralised diffusion systems
1. Degree of centralisation in decision-making and power	Overall control of decisions by national government administrators and technical subject matter experts.	Wide sharing of power and control among the members of the diffusion system: client control by local systems; much diffusion is spontaneous and unplanned.
2. Direction of diffusion.	Top-down diffusion from experts to local users of innovations.	Peer diffusion of innovations through horizontal networks.
3. Sources of innovations.	Formal R&D conducted by technical subject-matter experts.	Experimentation by non-experts, who often are users.
4. Who decides which innovations to diffuse?	Top administrators and technical subject-matter experts.	Local units, on the basis of their informal evaluations of the innovations.
5. How important are clients' needs in driving the diffusion process?	An innovation-centred approach; technology-push, emphasising needs created by the availability of the innovation.	A problem-centred approach; technology-pull, created by locally perceived needs and problems.
6. Amount of re-invention?	A low degree of local adaptation and re-invention of the innovations as they diffuse among adopters.	A high degree of local adaptation as they diffuse among adopters.

Source: Rogers (1995), p. 366.

7.3 Technology transfer

Technology transfer is a discipline that is closely related to the process of disseminating cleaner production in Eastern Europe. The technologies concerned in cleaner production are no different from general technology (see Figure 2-2) and could be seen as a variable subset of all existing technology.[147]

[147] Variable in the sense that technical evolution moves the frontiers of what can be said to be cleaner technologies, but also that technologies cannot necessarily be characterised in

Technology is, in the context of this discipline, viewed as information necessary to design and produce a certain piece of equipment. The information exists in codified form in designs, operating manuals, etc., but also in the minds of the people designing, producing and operating a certain technology. The information ranges from being public information to such that is retained within a limited circle. Even though information largely is non-proprietary, it is not necessarily easy for companies to access this information; each company develops over time to gather a distinct technology-related information base which in turn governs the future possibilities to acquire new technologies.[148]

> *Firms should not be viewed as entities facing a set of explicit technological possibilities. Rather, they need to be understood as entities which acquire the capabilities they have through a time-consuming and expensive process of learning. This means, at once, that the set of technologies a firm can use effectively at any time is far smaller than the set of technologies that are open to it, and that every firm is relatively unique in the capabilities it has…*[149]

An essential element for a successful transfer of technology is the building of assimilative capacity in the organisation and the surrounding industrial community. An adequate assimilative capacity will involve managing tasks such as needs assessment, identification of suitable technologies, feasibility studies, technical and financial evaluation, adaptation to local circumstances, maintenance and surveillance.

> *…the transfer of technology is not as easy as the purchase of a capital good or the acquisition of its blueprint. It involves positive and significant resource costs, reflecting the difficult task of replicating knowledge across the boundaries of firms and nations; recipients would normally be obliged to devote substantial resources to assimilate, adapt, and improve upon the original technology. . . . Therefore . . . its successful use tends to be dependent on firms and countries own capabilities. The acquisition of such capabilities is a non-trivial matter* [150]

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this respect per se; a typical end-of-pipe technology can fulfil an essential function within a cleaner production solution.

148 Rosenberg, Nathan, & Frischtak, Claudio. (1985). *International technology transfer: Concepts, measures and comparisons*. p. vii.

149 Richard Nelson, quoted in Rosenberg, Nathan, & Frischtak, Claudio. (1985). *International technology transfer: Concepts, measures and comparisons*. p. vii.

150 Rosenberg, Nathan, & Frischtak, Claudio. (1985). *International technology transfer: Concepts, measures and comparisons*. p. viii, ix.

The connections between technology policy and technology transfer are manifold and difficult to generalise. Therefore, it is problematic to make statements of specific routes to the transfer of a specific technology.

> *…not enough is known about the relation between technological policy and technological development, given the complex nature of the interactions between policy-induced decisions and the environment where they are implemented, and in the light of the extended period during which those actions unfold and results appear.*[151]

The one area that allows generalising in this context appears to be the area of education, viewed in a broader and long-term context.

> *…educational systems have played major roles in the assimilation of industrial knowledge. Its critical importance in the history of countries that have been successful in generating and absorbing innovations is one empirical regularity now recognized by most analysts.*[152]

7.4 Pollution prevention dissemination in the United States

Where the two previous sections analysed general issues of interest to the preventive agenda, this section brings the focus back to cleaner production per se. The aim of this section is to explore the issue of dissemination of pollution prevention in the United States. The term pollution prevention is used instead of cleaner production since this is the term that is used in the US.

There exists a debate within the US pollution prevention community on whether to primarily focus on promoting pollution prevention technologies in industry, or to teach the companies a methodology in order to tackle their problems themselves, but leaving the actual choices of technology in the hands of the companies. Both strategies are pursued, as well as combinations thereof.

The focus in the pollution prevention programmes has always been on performing assessments; principally cleaner production assessments as described in Figure 2-3. The assessments are often performed with the

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151 Rosenberg, Nathan, & Frischtak, Claudio. (1985). *International technology transfer: Concepts, measures and comparisons*. p. xv.

152 Rosenberg, Nathan, & Frischtak, Claudio. (1985). *International technology transfer: Concepts, measures and comparisons*. p. x.

assistance of a public technical assistance provider, or with the help of university students (see Case 7-1).[153] Several other models for technical assistance also exist, including those that make use of retired engineers and therefore can spend more time at each company. The implementation rate of the recommendations developed is slightly below 50%.[154] The diffusion of pollution prevention is perceived as disappointingly slow.[155]

The results from the assessments performed in industry have been encouraging, but have failed to create an on-going process; when suggestions have been implemented little happens unless a new assessment is made. In addition, the pollution prevention efforts have not normally been integrated with other continuous improvement efforts such as quality management.[156]

Opinions vary on how well developed the assistance programmes are. Some claim that the technology assistance programmes are still immature,[157] and will need more time before they can diffuse pollution prevention effectively.[158] Others are of the opinion that, while the technical assistance programmes need to improve further and also need to be complemented with other efforts, they are generally functioning well.[159]

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153 A large number of P2 assessments have been done by university students as a part of their curricula. The relatively low cost for these assessments has allowed a much wider spread than otherwise would have been possible, according to Gerald F. Kotas of the DoE, expressed at a meeting in Lund in spring 1994.

154 Kolwey, Neil. (2000). *Policies to promote cleaner production: Technical assistance programs in the U.S.* Guillemin, and Robert, & Goldberg, Terri. (1999). Assessing Pollution Prevention Progress in the Northeast.

155 Hirschorn, Joel S. (1997). Why the Pollution Prevention Revolution Failed – and Why it Ultimately will Succeed.

156 Waldrip, Greg. (1999). A manufacturing assistance provider's prescription for P2.

157 Most programmes have been in place for more than a decade.

158 Lindsey, Timothy C. (1998). Diffusion of P2 Innovations.

159 Kolwey, Neil. (2000). *Policies to promote cleaner production: Technical assistance programs in the U.S.*

Case 7-1 The Industrial Assessment Center (IAC) Program in the United States

Over 8 000 industrial site visits have been done in small and medium sized manufacturing firms in the United States, and 57 000 Assessment Recommendations have been documented by thirty-six contributing centres. As a result USD 265 million in savings have been identified since 1980, and an implementation rate of nearly 50% of these recommendations has been reported.[160] The programme is funded by the US Department of Energy.

The focus is on energy conservation as well as supporting waste reduction and improvements in productivity. Teams made up of faculty and students from university engineering schools perform the assessments. Normally the team performs a one-day site visit at an industrial plant that follows a pre-audit data gathering function. Following the site visit, the audit team prepares a report for the manufacturer, which includes information about the plant's energy use, processes and other operations. In addition, each report has several assessment recommendations, which are written up with sufficient engineering design to provide for anticipated savings, implementation costs and simple payback for each recommendation presented. This service is provided to the manufacturer at no cost.

The students involved in the programme have a unique opportunity to see a range of manufacturing operations first hand. This is found to result in more motivated students, and the faculty gains inspiration for research and courses. Furthermore, the data generated by the assessments provide a unique opportunity to quantify the state of energy, waste and productivity management in small and medium sized industry, and the potential of the assessment process to improve efficiency. Since 1980, data has been compiled from the assessments performed in this programme.[161]

A drawback with the kind of technical assistance described in Case 7-1 lies in the short period of work at the company, which leads to a small involvement of the company personnel and therefore a lower degree of institutionalisation.

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160 The DoE Industrial Assessment Database http://128.6.70.23/database/db_f.html 10/4 2000.

161 http://128.6.70.23/iac/iac_f.html 10/4 2000

Table 7-2 Savings in the IAC Programme from 1980

# of assess-ments	Savings/ USD	Savings identified per assessment/USD	Implemen-tation rate	Average real savings per assessment/USD
>8000	265 M	~3300	~50%	1650

Source: IAC Programme as referred in Case 7-1. Calculations by the author.

A rough estimation was made in order to understand the order of magnitude of savings that are implemented as a result of an industrial assessment in the IAC programme (see Table 7-2). The overall aggregate figures were used, and the outcome is found in the range USD 1 000–2 000.

The pollution prevention agenda in the United States could be characterised by the pollution prevention agencies pursuing increasingly effective process assessments, feasibility studies, and technology demonstration. There is also a national, centralised approach to pollution prevention diffusion with centrally co-ordinated research, and a network of regional experts involved in the implementation of technology.[162]

Case 7-2 Diffusion of a cleaner technology: membrane filtration for the recycling of aqueous solutions[163]

From 1991 to 1997 the Illinois Waste Management and Research Center (WMRC), through on-site visits, identified 76 firms that could significantly benefit from implementing a membrane filter solution for in-process recycling of aqueous cleaning solutions or metal-working fluids. The firms were provided with varying levels of information:

- Awareness information, including verbal explanations of technology, fact sheets, and technical reports.
- On-site demonstration of the membrane technology in bench-scale.
- Pilot trials, involving extended in-plant testing that lasted from several weeks to several months.

[162] Neil Kolwey, Pollution prevention technical assistance coordinator, Colorado Dept. of Public Health and Environment P2 Program. Personal communication. 28 April 2000.

[163] From Lindsey, Timothy C. (2000). Key Factors for Promoting P2 Technology Adoption.

The results are presented in Table 7-3. None of the companies receiving only awareness information has adopted the innovation, although 6% of them are still evaluating the idea.

Table 7-3 Promotion of membrane filtration in 76 firms in Illinois.

Change agent assistance	# of assisted companies	Adopted	Rejected	Evaluating
Awareness info only	47	0	44	3
Awareness & on-site demo	8	0	4	4
Awareness & pilot trial	5	3	2	0
Awareness, demo, & pilot trial	16	10	2	4
Totals	76	13	52	11

Source: Lindsey (2000).

7.5 Experiences from the cleaner production programmes

Turning back to cleaner production in Eastern Europe, three cases are presented below that, among other things, illustrate some of the specific issues that are observed in the dissemination process in the region. The first case is from the Norwegian programme and is brought into this dissertation primarily to illustrate some of the difficulties in getting an on-going process in the companies. It is often difficult to obtain first-hand information on these issues, making this case particularly interesting.

Case 7-3 Confectionery plant in Kaliningrad

A confectionery plant in Kaliningrad took part in a Norwegian training school during the second half of 1998. Company representatives were trained and they developed a set of cleaner production options, involving

no-cost, minor-cost, and major-cost options. The no-cost options were most likely implemented during the course of the Norwegian training programme. The company was considered as a good company by the local project advisors, as well as by the students from Kaliningrad State University that worked together with the company in the training programme.

In April 2000, an audit team, made up of four students from the IIIEE MSc programme, one student from Kaliningrad State University, and one PhD student from Kaunas University of Technology, undertook a two-day audit of the plant in order to assess cleaner production potential and activity.

The audit team brought forward the set of cleaner production options prepared by the company within the Norwegian programme, and the company confirmed that they had implemented not only the no-cost options but also, after the Norwegian programme ended, most of the other options as well. The exception was the most costly option: a changeover to natural gas as fuel. The audit team was not able verify all these improvements, but felt confident enough that this was the case.

The compelling observation was that when reviewing the plant operations, the audit team found many other obvious improvement options. This included energy-related options such as insulation and condensate recovery, and raw material-related options such as minimisation of product loss by various process modifications.

This indicates that the cleaner production solutions were successfully transferred to the company, but that the transfer of the cleaner production methodology was not successful in the sense that it failed to provoke a continued effort.

Another student group, auditing a railway carriage company that also had taken part in the Norwegian cleaner programme, described this company to be in a terrible situation: "you would never have guessed that they had done any of the simple improvement measures". This reinforces the previous observation that cleaner production is not always continued in the company after the initial project implementation.

The second case is chosen from the Danish programme and is one of the better efforts there. The project manager once characterised it as a normal engineering project with sufficient funding to do a good job; this may be the

case but the competence in preventive environmental strategies among the project staff distinguishes it from average engineering projects. It is a good example of the process of disseminating cleaner production technologies in an industry in Eastern Europe.

Case 7-4 The Poltex programme

The Danish EPA has supported a programme for the transfer of cleaner technologies to the Polish textile industry that started in 1992. The programme comprises a survey and pre-feasibility study and three full-scale demonstration projects.

The elements of the programme included the following:

- A survey of 20 Polish companies, and detailed audits at 9 of these, in order to identify problem areas of general interest
- A survey of Danish textile industry to identify areas for transfer of knowledge and technology
- Elaboration of an idea catalogue, which describes the most interesting options discovered in the process
- Seminars to discuss and establish the findings
- Full-scale demonstration projects in, so far, three industries

Findings from the project include the following:

- With the present financial situation in Polish industry, the preventive approach is the only realistic alternative for environmental improvements, apart from closing down the facilities. Treatment alone has no realistic financial background.
- A goal of an overall 50% reduction in water, energy, and chemical consumption is achievable with an appropriate cleaner technology mix.
- The survey of the Danish textile companies revealed a broad spectrum of preventive measures suitable for transfer to Poland, but also ideas for improvements within the Danish companies.
- The demonstration projects showed that the Polish companies were sensitive to the economic risk associated with new solutions. It was managed by providing guarantees for possible losses.
- The majority of the Polish companies were enthusiastic about improving their processes. Still, they wanted to see the new solutions in

practice before they would believe in them. Also, the financial situation demanded short payback periods for investments.

One of the demonstration projects concerned the rinsing in a continuous textile-dyeing machine. By introducing a counter-current flow of the rinse water in the process, the amount of fresh rinse-water added is dramatically reduced. The counter-current operation was achieved by installing airlift pumps for pumping the rinse water between the different parts of the dyeing and rinsing process. An investment cost of approximately USD 15 000 resulted in

- Yearly savings of approximately USD 125 000
- Yearly water savings of 100 000 m^3
- Yearly energy savings corresponding to 2 600 tons of coal

Another 19 machines with potential for similar savings were identified in the Polish textile industry.

Like the previous case on the textile industry, this case also demonstrates the opportunities for industry in Eastern Europe to gain competitive advantages by avoiding investing in treatment facilities that are too large. The case however indicates the difficulties in disseminating the idea of preventing before building end-of-pipe treatment.

Case 7-5 Tannery industry example

In April 1995, a small group of Lithuanian industrialists were invited to Denmark and Sweden as a part of an on-going cleaner production-training project.[164] The participants had distinguished themselves among the larger group of participants in the previous project activities, and a study trip was arranged to support the cleaner production suggestions developed in their companies.

Part of the group represented a Lithuanian tannery, and a visit was made to tanneries in Svenljunga, Sweden. The Swedish tanneries in this town were

[164] The project, Waste Minimisation Opportunity Audits to Introduce Cleaner Technologies in Lithuanian Industry, was carried out during 1993-95. The partners were Rendan A/S, Dept of IEE, Lund University, and APINI, Kaunas University of Technology. Financed by the Danish EPA.

connected to a relatively advanced wastewater treatment plant, designed and built to manage the effluents from the tanneries. These treatment facilities made a strong and lasting impression on the Lithuanians.

The treatment kept the effluents below the stipulated levels of pollutants. However, the treatment process was significantly affecting the production costs in the plants; the costs for treatment – including both operating and capital costs – could be as high as SEK 50 per m^3. As a consequence, one of the tanneries, with a relatively small-scale operation, was seeking to implement a process-integrated solution in order to substantially reduce the amounts of wastewater generated in the process. The solution involved installing filters at certain process steps, allowing for internal recycling of water streams. However, the fixed costs for the treatment facility would still have to be covered, limiting the gains to be made.

The representatives of the Swedish tanneries commented on the situation by saying that if the Lithuanian tanneries could manage their effluents with such a process-integrated solution, then it would result in a significant cost advantage. Had the Swedes known what they know today, they would not have built a treatment plant like the one they now have. Nevertheless, the Lithuanian company representatives clearly focused their interest on the treatment plant and not on the potential for enhanced process efficiency through internal water reuse.

7.6 Concluding remarks on the issue of dissemination

The slow process of dissemination that can be observed in the cleaner production efforts in Eastern Europe is disappointing but understandable in the light of the findings in this chapter. The potential for improvements viewed by cleaner production practitioners when assessing Eastern European industry is substantial and the benefits to the companies appear obvious, especially compared to the alternatives. This situation has probably created expectations in the system, which have now proved unrealistic. The tendency to overstate project achievements, as illustrated by Case 6-5, has most likely added to this unhealthy situation.[165]

[165] Interestingly enough, when confronting Eastern European cleaner production practitioners with this case showing the overstating of results, it turns out that nobody is

The slow rate of dissemination, based on the material brought forward in this dissertation, could be attributed to two principal reasons.

- The dissemination process is slow per se. The material discussed previously in this chapter – both experiences from related disciplines, and those from a region that has a head start of a decade – suggest that dissemination in general, and of cleaner production in particular, takes more time than would be expected at first.
- The time taken for the cleaner production process to gain acceptance is longer in Eastern Europe compared to western circumstances. This is an experience conveyed by the interviewees in the evaluation efforts performed within the scope of this research, and also supported by other sources.[166] Specific reasons for the relatively slow process in Eastern Europe are manifold and easily identifiable when considering the situation in industry in Eastern Europe (see section 3.1).

The large, if not dominating, social character of the innovation diffusion process, supported by section 7.2, also helps to explain the slow rate of dissemination. The challenges related to language and culture that are facing the donor undertakings in the region are often most substantial. If the dissemination is ultimately heavily dependent on an effective communication between the involved actors (as argued in section 7.2.2), then a slow process should not be a surprise. This is valid for the communication between Western and Eastern European actors, but also for the communication process among the various actors in Eastern Europe where the poor tradition in involving in a constructive dialogue is one of the foremost barriers in the dissemination process.

Several factors that are typical for the preventive measures contribute to the slow rate of dissemination (see section 7.2.1):

- The low visibility of preventive measures. It is easier to point at a scrubber than at half a dozen process-integrated measures achieving the same reduction in emissions from the facility.

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surprised. An explanation could be that due to their dependence on donors for financing, they refrained from complicating things by bringing up such issues, and furthermore, they may have self-interest in showing good results.

166 See e.g. Sandberg, Mikael. (1999). *Green post-Communism? Environmental aid, Polish innovation and evolutionary political economics*, and Gomulka, S., Nove, A., & Holliday, G. (1984). *East-west technology transfer*.

- The complexity caused by the process-integrated character of the preventive measures. The preventive approach requires an analysis of the production process and this needs a concerted effort from the staff.
- The inconsistency with existing values and past experiences. This goes back to the general observation of efficiency not being an issue (Chapter 3), the lack of interest in small and incremental improvements, and the common view that the solution is to buy new equipment, including end-of-pipe.
- The difficulties in seeing the relative advantage of the preventive measures. This is related to the issue of visibility, but is also linked to the lack of process monitoring and control which results in a system that gives little feedback on improvements in efficiency.

The large span in complexity in the solutions involved makes it useful to distinguish between solutions that are manageable with existing resources, particularly technical, and such solutions that require more in-depth technical assistance. The requirements to achieve dissemination are obviously different in these cases, and could be illustrated by a model such as Figure 7-3. A conclusion from this could be that both the centralised and decentralised diffusion systems could be useful in the dissemination process, varying with the types of cleaner production measures that are to be disseminated.

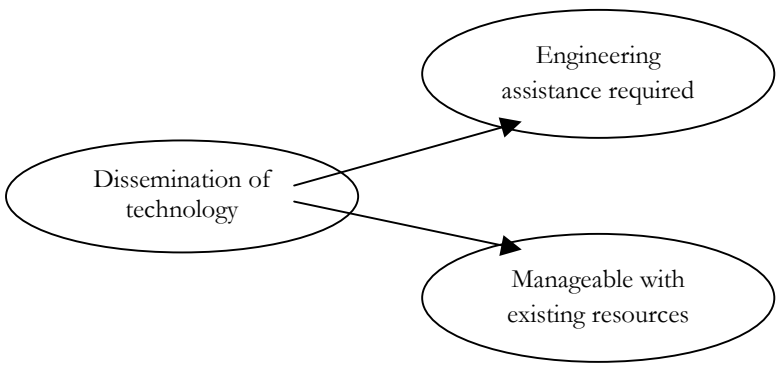

Figure 7-3 Distinctions in dissemination of technology due to technical complexity in the changes to be made

Demonstration projects are generally poorly utilised, and are therefore not evaluated in the most natural of ways; that is, they are rarely put to test and

there is consequently little feedback on their relevance. The absence of more elaborate attempts to approach the issue of dissemination has resulted in a situation where there is no discussion about what constitutes a good demonstration project. Demonstration projects will most likely play a key role in any dissemination strategy and therefore deserve attention. It is clear that a demonstration project can be more or less successful, with documentation being an important criterion for the evaluation.

The time frame that is relevant for the process varies with the object to be disseminated. Anything less than several years would be surprising when looking beyond the more basic good housekeeping measures, based on what has been discussed in the previous parts of this chapter.

The reliance on the individual, that is, the innovation champion, is noted as a key factor for a continuous process. It seems like the existence of a champion even could be seen as a condition for the dissemination. On the other hand, in order to achieve a continuous process the dependence on a single person has to be reduced and the preventive efforts become routine tasks within the organisation.[167]

Along with time there is another factor in the process: the continuous change in the innovation as it is exposed to new conditions and as new developments are made. This would probably make it somewhat more difficult to keep track of the dissemination process.

Education is put forward as a central area for achieving long-term results in the dissemination process (see section 7.3).

The issue of dissemination is that it should involve as many companies as possible. This is an important part of dissemination, but the other direction to explore is that the companies that have been involved continue to undertake improvements based on the methodology they have acquired. As observed in Chapter 5, the continued use of the methodology within the enterprise is a problem in itself, and therefore this issue should be high on the dissemination agenda. Cost efficiency is not likely to be higher for involving new companies compared to getting further work done in the existing companies.

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[167] Such a view is supported in e.g. Hennicke, P., et al. (1998). *Interdisciplinary Analysis of Successful Implementation of Energy Efficiency in the industrial, commercial, and service sector; Final Report*

An essential element in the dissemination process lies in the creation of capacity and fostering climate in the Eastern European countries. The cleaner production capacity within the enterprises is one part of this issue (as discussed in section 5.6), the other being the capacity in institutions that are engaged in industrial development.

The observation made in section 7.2.3, that companies normally innovate by taking a solution and then matching it to the needs of the organisation instead of the other way around, deserves some reflection. If this is true in the case of cleaner production in Eastern Europe then much of the methodology applied in the projects is wrong, and the lack of proper documentation is a very real problem. In particular, the Norwegian programme is normally strict about first analysing the process and identifying different alternatives prior to selecting the solution to implement. This would then help to explain the difficulties observed in achieving an active dissemination process.

7.6.1 Donor implications

The implications for the donors include the following:

- Dissemination is for various reasons a slow process.
- Dissemination within companies is as much a challenge as dissemination among companies.
- Good housekeeping measures and more substantial improvements require very different supportive structures: the first can be implemented in all companies whereas the other is restricted to stable companies and can require technical assistance.
- The commonly practiced training methodology to undertake thorough analysis prior to discussing solutions is perhaps effective as a tool for individual learning, but to start out with solutions instead could lead to quicker results.

CHAPTER
EIGHT

8. Cleaner production and the end-of-pipe support

This chapter examines the connections between the preventive approach and the support for construction of end-of-pipe equipment, and proposes and elaborates a model to integrate the preventive approach with the agenda for construction of treatment plants.

8.1 Cleaner production and the end-of-pipe support

Donor support for cleaner production constitutes a very small part of the overall environmental support in the Baltic Sea area; the bulk of the resources are channelled into wastewater treatment, waste management and also some air pollution management. Wastewater treatment has received a particular focus following the concerns for common seas, notably the Baltic Sea, and the tasks include construction and upgrading of wastewater treatment plants, predominately for municipal effluents. Donor contributions make up only a smaller part compared to what is and will be funded by domestic sources.

Treatment facilities are no doubt needed in several places, but the heavy focus in this area is problematic in several ways.

- The limited resources available are used in the end-of-pipe investments. In particular, future financial resources are locked into paying for the investments made, thereby seriously restricting the future freedom of action. The experience from the West is that once you have invested in the physical infrastructure, the high capital costs and long depreciation times make alternatives a lot less interesting from a financial point of view. The barrier also becomes psychological in the sense that the problem appears to be solved and therefore receives less attention. This long-term binding of financial resources also has sustainable

development implications in that it reduces the flexibility of choice for future generations.[168]

- Small and medium sized towns are more problematic compared to the larger cities: they have a lower population base for sharing the costs, relatively higher costs for connections to the sewage net due to larger distances, and greater possibilities for alternative solutions make the conditions less favourable for centralised treatment solutions.
- It is unclear if the treatment facilities will perform as intended. In fact, a widespread criticism exists that erected facilities will perform sub-standardly, primarily due to variations in the quantity and quality of the incoming wastewaters. Toxic content in the wastewater effectively hinders the biological treatment step from functioning properly.
- There is an obvious risk of over-dimensioning the facilities. The large dynamics in the economies in Eastern Europe at present, coupled with the high water, resource and energy intensity in the economy,[169] make predictions of future loads difficult. The potential for improvements identified in industry indicate future reductions in load.
- End-of-pipe treatment in general does increase the overall resource use of the system, when accounting for the energy and materials used in the treatment process. Treatment may be necessary at some level, but is undesirable from a sustainability perspective; if it is possible to do without treatment, the overall environmental impacts would be lower. The sustainability perspective also includes the issue of the future freedom of action; the investments in end-of-pipe infrastructure lock in resources and prevent investments in more sustainable measures for the future.

The challenge obviously lies in making the end-of-pipe treatment facility as small as possible, in order to minimise the above-mentioned end-of-pipe related problems. Also, a source reduction of toxic effluents is needed to secure proper functioning of the treatment plants. From a donor perspective, this would require running programmes to minimise water use and effluent toxicity – or minimise energy use, waste volumes and toxicity,

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168 Johansson, Allan. (1999). Cleaner production – visions for the future.

169 A criticism of this statement would be that although the resource intensity is high in relative terms, it is not always the case in absolute terms due to lower economic activity and fewer resource-consuming processes in general. This may hold true in some areas, e.g. domestic electricity consumption, but there are several indications of the opposite as well, e.g. the water consumption in Kaliningrad is several times higher that in the West on a per capita basis. The efficiency potential is undisputed.

respectively – to match the construction of the treatment facilities. A key problem in this respect is the timing: achieving reductions in loads takes time and resources, and would therefore require postponing investments at the end of the pipe.

Western countries have typically managed the wastewater issue in response to needs to reduce pollution by erecting (or upgrading existing plants) treatment plants. The investments made have been covered by raising fees for the users, thereby giving incentives for implementing preventive measures, and the end result is oversized treatment facilities.[170,171]

The support for wastewater management in the region does not entail any serious efforts to reduce industrial effluents at the source in order to minimise treatment needs and improve the effectiveness of the final treatment. On the contrary, the activities show neglect for the issue of industrial effluents in general, and of preventive measures in particular. From the receiving end, concerns are emerging over the large costs associated with wastewater treatment.[172]

Case 8-1 Wastewater treatment in Kaunas, Lithuania

While working with companies in a cleaner production project in Kaunas in the first half of the 1990s, the company representatives became upset over a message they received. It turned out to be a requirement for new effluent standards as a consequence of the construction of the new wastewater treatment plant for the city and these requirements were radically stricter compared what the current operations resulted in. It soon became evident

[170] Wenzel, H., Knudsen, H., Sojka-Ledakowicz, J., Machnowski, V., Hansen, J., Birch, H., Pedersen, B., & Jozwik, A. (1999). *Cleaner technology transfer to Polish textile industry: Idea catalogue and selected options.*

[171] This development is bad business for the utilities managing the treatment facilities because they lose their payment base. Therefore, fees are shifted from running costs to fixed, once again taking away the incentives for the companies to implement the cleaner production practices, and the treatment facilities thereby appear less oversized than they actually are. However, this does not take away the basic point that the system could be made better, both from environmental and economic point of view, if more effluents are reduced at the source. The problem is the over-investments made. This analysis is valid not only for wastewater treatment plants but also for energy utilities and waste management business. A plausible policy response could be to maximise the share of the charges that is allowed to be fixed.

[172] Personal communication by Harri Moora, Stockholm Environment Institute in Tallinn, 10 April 2000.

that these effluent standards were not going to be enforced, as the effect would have been the closure of several of the companies.

The planning and construction of the treatment facility had proceeded without involving the companies connected to the sewage system. The first notification the companies received was this letter stating the levels of pollutants that were deemed necessary for the proper functioning of the treatment plant.

Case 8-2 Wastewater treatment in Liepaja, Latvia

The Swedish assistance for construction of a wastewater treatment facility in Liepaja, Latvia resulted in the successful erection of the facility. However, it proved to be difficult to get it working properly; the normal Swedish approach to demand strict effluent limits for the connected industries turned out to be unfeasible. Enforcing such limits would in practice have meant closing down the industry, and this was of course unacceptable to the municipality. At this stage the donor in question started to look in to the possibilities to reduce pollution at the source in the industry, but had no funding available to do anything substantial.

Case 8-3 Efforts in cleaner production and end-of-pipe treatment at a Czech enterprise

KOH-I-NOOR is a 400-employee company in Prague, producing articles such as clips, pins and buttons. Eighty percent of the production is galvanised, and the metal plating operation is the main source of pollution from the production processes. The company failed to comply with wastewater regulations and was forced into planning for a new effluent treatment plant.[173]

[173] The information for this case is provided by Vladimir Dobes, Czech Cleaner Production Centre.

In 1994 the company joined an interactive training course on cleaner production within the framework of the Norwegian programme. Within this course, options to improve the galvanising operations were discovered and implemented, resulting in substantial savings to the company in 1995. The cleaner production approach was applied further and this gave further reductions in resource use in 1996. The results were as follows:

- The implementation of the no and low investment option in the end of 1994 resulted in yearly savings of a total of USD 160 000.
  - Water savings: USD 40 500
  - Savings in galvanising chemicals: USD 73 000
  - Reduced nickel consumption: USD 39 000
  - Electricity savings: USD 7 500
- The continued efforts during 1995 resulted in additional yearly savings of USD 61 000. Investments of USD 45 000 were made in a nickel recovery unit and reconstructions of the sewage and water system. The financial savings were associated with savings in fresh water and nickel.

How did this affect the planning for the new treatment plant? The cleaner production efforts in the company had substantially reduced the load to be treated, which also resulted in a reduction in the costs for the new treatment plant (see Table 8-1).

Table 8-1 Wastewater plant construction at Koh-I-Noor

Wastewater treatment plant	**Prior to cleaner production project (1994)**	**After cleaner production project (1995)**	**Continuation in application of CP methods (1996)**
Wastewater to treat (m^3/h)	17.8	7.7	4.8
Required investment for the new plant (USD)	624 000	424 000	188 000

The end result from the cleaner production undertakings in the company during 1994 and 1995 were reductions in operational expenses of USD 221 000, plus reduced investment costs for the new treatment plant of USD 436 000. Furthermore, the company had learned and adopted a new approach to environmental issues.

8.2 A model for linking the preventive agenda with the construction of treatment plants

8.2.1 The problem to be addressed

Construction of wastewater treatment plants, although probably justifiable for society in many cases, entail costs that constitute a burden for the city or the company that buys them. This is perhaps less of a problem, for example, in the Scandinavian countries where these costs are affordable without compromising the other qualities of life. However, this becomes problematic in the Eastern European context where competition over the limited financial resources available is fierce.

So, what are the alternatives to end-of-pipe treatment? Although the avoidance of treatment facilities is a worthy ambition, doing without modern treatment facilities is not likely, at least not in cities. Alternative treatment methods such as wetlands and infiltration in soil have a clear potential in less densely populated areas, but will not be discussed further in this dissertation. The challenge with regard to the design of treatment facilities is to focus upstream in order to:

- make them as small as possible, that is to minimise the treatment load;
- effectively remove impurities from the effluent, that is, typically to minimise variations in quantity and quality of effluents and avoid the discharge of toxics that disturb the biological processes in the treatment; and
- make the remaining sludge as clean as possible, that is, to minimise the content of metals and other toxic compounds.

The problem is that the incentives for industry to minimise their effluents come after the treatment plant has been built, and the capital and operating costs for the plants are being covered by effluent charges. If a company then decreases their effluent volume, the result is an over-dimensioned treatment plant that has to be paid for anyway, for example, by raised fixed costs for the users.[174]

Another problem is that preventive measures involve more actors and actions and therefore typically need a longer time to be implemented than it takes to build a treatment plant. The time to obtain real results is, therefore,

[174] This is also illustrated by the tannery industry case (see Case 7-5).

often longer. It is also easier to predict the outcome from a treatment plant compared to preventive measures.

This reasoning is valid for treatment facilities at both the company and municipal level.

8.2.2 A model for efficient wastewater management

The objective of the model is to reduce the costs for treatment of wastewater by reducing the loads to, and consequently the size of, a planned treatment facility. This can be at either the company or the municipal level. The objective is furthermore to improve productivity in industry by conserving water, energy and raw materials in the production processes.

The means to do this is to create an incentive structure where companies are influenced to undertake process-integrated changes before the treatment processes are dimensioned.

Prior to establishing treatment facilities, the following is suggested:

- Raise effluent fees paid by the companies to the levels they will have after the construction of a treatment facility.
- Make the charges 100% variable in order to give a maximum incentive for the company to reduce the effluents. The charges could be based on, for example, effluent loads and BOD content. It is important that the indicators used as a basis for the charges are clearly measurable in order to give an unambiguous incentive structure and allow for efficient feedback.
- Allow a "prevention-period" of a couple of years for implementation of cleaner production measures.
- Use the money raised to support industry with consulting assistance on cleaner production measures, and to make investment money available for more substantial cleaner production changes in the companies.

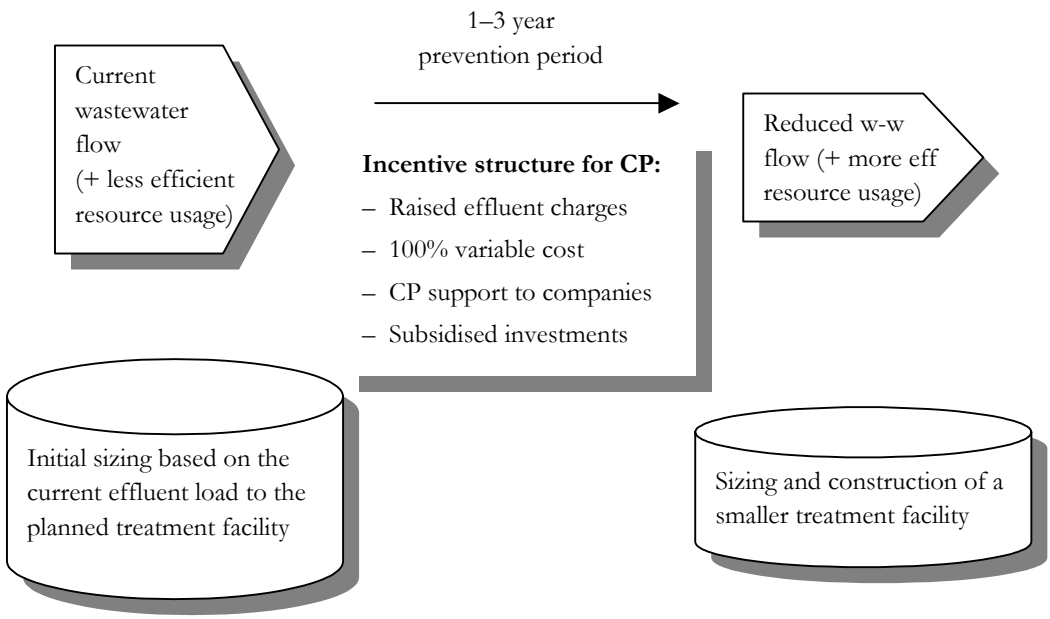

Figure 8-1 A model for efficient waste water management

The time allowed before dimensioning the final treatment plant – the prevention period – is a parameter to be adjusted as experience develops. Time should allow for the establishment of a cleaner production programme, performance of feasibility studies of larger investments, implementation, and a follow-up. The case of the Koh-I-Noor company (Case 8-3) illustrates what can be accomplished in a two-year period. The prevention period will most likely be longer in the case when it concerns the planning for a treatment facility with multiple users – for example, a municipal facility – compared to the case with treatment for a single industry.

It is possible that benchmarks such as BAT effluent levels could substitute for time and allow an earlier start of the dimensioning of the final treatment plant before the process-integrated measures are fully exploited.

The model requires co-operation and shared objectives on the promotion of the preventive agenda among industry and local/regional authorities. It was intended for municipal wastewater management and is applicable for both industries and households. It could also be applied at the level of an individual company where internal charges could be used to create incentives for departments to implement preventive measures.

The model was inspired by an idea put forward by Olav Nedenes during the early 1990s to allow companies to postpone investments in end-of-pipe treatment provided that they pay higher charges and take part in an official cleaner production programme.[175] Inspiration has also come from the Danish efforts to connect support for municipal wastewater treatment with water-saving programmes and cleaner production activities in industry connected to the municipal treatment facility (see Appendix 4).

The principle of the model could also be applied to the waste management agenda, where the costs to get rid of waste and requirements on sorting of wastes constitute key drivers for companies to minimise the generation of wastes. The energy efficiency area already has a similar concept in the so-called energy-service companies.

It is also possible that environmental authorities, without any consideration of wastewater treatment, could go in and use, for example, BAT as a baseline to demand fees from companies who exceed these levels. A response might typically be that the companies in the current situation could not afford such costs, which in turn would raise the question of how would be able to pay for their share in the treatment facilities that are erected presently.

[175] Nedenes, Olav. (1993). *The Norwegian programmes on transfer of know-how in cleaner production in eastern European countries.*

CHAPTER
NINE

9. Concluding chapter

9.1 Conclusions

The main conclusion of this dissertation is that donor priorities in the environmental support to Eastern Europe are clearly unjustified.[176] The conclusion is based on:

- That there are significant benefits from the cleaner production efforts in the Eastern European industry.
- The very small share of the cleaner production efforts compared to the total environmental support.
- The problems observed in making the other forms of environmental support function properly, for example wastewater treatment.

One question raised at the start of this dissertation was the following: If cleaner production is desirable, then why is it not more widely pursued by the donor community? Cleaner production has been found to be desirable for the following reasons:

- It is an approach to environmental improvements that is feasible to undertake in the financially constrained situation that exists in Eastern European industry.
- It contributes to restructuring and improved business performance of industry.
- It enables Eastern European industry to leapfrog in the sense that over-investments in resource-intensive end-of-pipe equipment is avoided.
- It contributes to individual learning and improvement processes.

[176] Some of the following conclusions have previously been presented in articles and reports by the author.

The reasons why cleaner production is not more widely pursued by the donor community include the following:

- There is no readily accessible capacity to perform the work. The knowledge is there but currently not in a form that is usable for the donor agencies.
- The donors are occupied with supporting the environmental part of the acquis (EU law), which largely is defined in terms of end-of-pipe treatment.
- The preventive approach demands a greater involvement from the side of the recipients compared to transfer of end-of-pipe technologies.

The other question to be answered by this research is: Why is the interest in cleaner production in Eastern Europe stagnant?

The stagnant interest appears to stem from exaggerated expectations on the dissemination of cleaner production practices due to the great potential for improvement and the over-stating of results that has occurred.

The process of dissemination should not be expected to be fast, and there are several factors contributing to the slow process:

- Dissemination of innovations is an inherently slow process.
- Preventive innovations are particularly slow.
- The financial instability of industry in the region effectively hinders medium- and long-term planning, and thereby prevents businesses from investing.

Additionally, the donor programmes have not effectively addressed the issue of dissemination.

9.2 Policy implications

The third research question asks: What can be done to improve the dissemination of cleaner production in Eastern Europe? The strategies to pursue in order to improve implementation and dissemination of cleaner production practices include the following:

- In general, a broader effort is needed that uses more channels and involves more actors. The objective is to create a fostering climate for the preventive approach, corresponding to the observed wide range of both external influences and internal capabilities that all affect the cleaner production performance of the company. The effort needs not

only be broad in relation to Eastern Europe, but should also involve more of the Western community. The latter is a challenge, primarily due to the lack of insight into preventive environmental strategies in Western Europe in general.

- The efforts need a longer time perspective and have to be better merged into the long-term course of events. Ad hoc activities that have failed to create on-going processes in the Eastern European industry constitute a clear indication of the potential for improvement.
- It is necessary to create clear incentives for the preventive approach. It is imperative to use models where the preventive approach is actively pursued, such as the model for connecting prevention and wastewater treatment proposed in Chapter 8.
- Building core cleaner production capacities in the region is crucial for a strong local ownership of the process, and therefore for a sustained effort. In parallel to training efforts it is imperative to create structures to utilise the capacity that is created, or there is an obvious risk that the capacity built by the training efforts will be lost.
- Good housekeeping is central to the improvement process. It is possible for all companies, and failure to undertake the most cost-effective measures becomes a serious impediment in the process of restructuring.
- Universities in Eastern Europe are significantly under-utilised and deserve a higher priority as one of the actors in the promotion of cleaner production. Their potential to contribute would be enhanced by raising the scientific credibility of the preventive approach.
- The substantial social character of the process of disseminating the preventive approach, together with the poor traditions in sharing information in the region, makes communication a key factor for improvement.
- A better documentation of, for example, demonstration projects and general educational materials, is required for the capacity building in the area of cleaner production in the region.
- Feedback functions need to be improved in the process of promoting cleaner production in the region. This includes feedback on the methods to perform the various sub-processes involved in order to get a more systematic improvement of the methods and materials used. This requires improved reporting, documentation and improved access to information.

Donors in general have a formidable task in transferring the accumulated knowledge necessary for the promotion of the preventive approach in Eastern European industry, particularly in a way that ensures that information reaches the relevant actors and contributes to a continuous and systematic build-up of capacity in the countries. The varying – and increasing – ability to manage cleaner production-related activities in the recipient countries suggests the need for a diversity in practical projects and an increase in demand for local ownership, both practically and financially.

9.2.1 Final reflection

It is surprising that the governments in Eastern Europe do not take a stronger position in the active promotion of the preventive approach. The preventive approach will, as shown in this research, clearly benefit the industry and the region. In addition, it is surprising to observe that companies do not take stronger position on the preventive approach; failure to undertake more substantial investments could be understandable in context of the struggle for survival that characterises large parts of industry in the region, but there is no excuse for not implementing the good housekeeping measures.

9.3 Further research

The need for institutionalisation of cleaner production practices in the company, justifies looking further into the integration of cleaner production principles with formalised management systems, for example EMAS and ISO 14001, as well as less formalised or less rigorous approaches. EMAS and ISO 14001 per se do not necessarily lead to environmental improvements.

The product issue in environmental protection has not been high on the agenda during the last decade. This lower priority seems reasonable with regard to, among other things, the low level of product development going on in the region at that time, as well as the large need for improvement in production processes. At this stage, it is more appropriate to venture into the product field and build a domestic capacity.

A challenging area is found in models for the integration of preventive measures with the existing processes for construction of end-of-pipe treatment – for example wastewater treatment facilities – in order to minimise the size and cost of the treatment facilities, and to obtain the

environmental and economic benefits associated with the preventive strategy. Of particular interest in this case is the systematic use of benchmarks on what can be obtained with a preventive strategy in the process of dimensioning treatment facilities, as is the tricky issue of the timing of the preventive and the cleaning efforts. The preventive efforts need enough time (and effort) to, for example, allow a company to cope with new effluent limits set in connection with the construction of a treatment plant. The speed of the infrastructural investments to meet the requirements of the acquis adds to the challenge.

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Abbreviations

APINI	Institute for Environmental Engineering, Kaunas University of Technology
BAT	Best available techniques
BOD	Biological Oxygen Demand (wastewater parameter)
CEE	Central and Eastern Europe
CEEC	Central and Eastern European Countries
CP	Cleaner Production
CPC	Cleaner Production Centre
DKK	Danish crowns
EAP	Environment Action Programme
EMAS	Eco-Management and Audit Scheme
EMS	Environment management system
ERCP	European Roundtable on Cleaner Production
EPA	Environmental Protection Agency
EU	European union
HELCOM	Helsinki Commission = Baltic Marine Environment Protection Commission
IIIEE	The International Institute for Industrial Environmental Economics
IPPC	Integrated pollution prevention and control
ISO 14000	International Organization for Standardization, Series for environmental management
kW	kilowatt (a unit for power use)
kWh	kilowatt hour (a unit for energy use)
NEAP	National Environmental Action Plan
NEFCO	Nordic Environment Finance Corporation
NGO	Non-government organisation
NIF	Norwegian Society for Chartered Engineers [Norske Sivilingeniørers Forening]
NIS	New Independent States
NOK	Norwegian crowns

OECD	Organisation for Economic Co-operation and Development
PP, P2	Pollution Prevention
PVC	Polyvinylchloride (a plastic)
R&D	Research and development
REC	Regional Environmental Center for CEE
SEK	Swedish kronor
SME	Small- and Medium-sized Enterprise
UKS	Uzbekistani som = Uzbek currency
UNEP IE	United Nations Environment Programme, Industry & Environment
UNIDO	United Nations Industrial Development Organisation
USD	US Dollars
WEC	World Environment Center
WCPS	World Cleaner Production Society

Appendix A

Recommendations

Adopted by the participants of the UNEP IE CLEANER PRODUCTION INVITATIONAL EXPERT SEMINAR "INTRODUCING CLEANER PRODUCTION IN EASTERN EUROPE" HELD IN KAUNAS, LITHUANIA, 8-9 SEPTEMBER 1994

Thirty participants from 14 countries; Austria, Denmark, Estonia, France, Latvia, Lithuania, the Netherlands, Norway, Poland, Russia, Slovakia, Sweden, Ukraine and United Kingdom, working in international organisations, ministries of the environment, industry, industrial associations, consulting firms, environmental organisations and universities, took part in the seminar. At the final session the following recommendations were adopted by the participants for consideration by governments and organisations, supporting improvements of environmental performance and production efficiency in Central and Eastern European (CEE) industry.

- **Governments should raise substantial additional funds in order to establish Waste Minimisation Programmes in the CEE countries**, based on the observation that not more than 10 million US$ have been used by Western donor countries for all Waste Minimisation projects in the CEE countries, in spite of the fact that the results from current project are very positive, indicating for the targeted objects reductions of the use of raw materials and energy and/or of the creation of wastes and emissions in an order of 15-25% with no or low cost investments.
- **Programmes training industrialists and local experts in performing systematic waste minimisation opportunity assessments should be supported.** These programmes need a long time perspective and continued support to achieve optimal results. Such programmes should train production managers in market economy decision making and the establishment of environmental management in companies. These programmes should stimulate local involvement and adaptation of the waste minimisation methodology.

- **Investments in high-cost, end-of-pipe, cleaning facilities in companies and in municipalities should not be supported without prior waste minimisation programmes being performed.**
- Governments and local authorities in CEE countries are requested **to support waste minimisation activities in their economic and industrial policies,** and especially **to refrain from maintaining high subsidies on energy, raw materials and waste disposal.**
- Governments and international organisations should make funds available for **financing low-cost waste minimising investments** by industry in CEE countries.
- The establishment of **local waste minimisation centres** to improve technical information dissemination is of crucial importance for the medium and long-term results.
- The development of **industry specific Cleaner Production indicators** to enable benchmarking between CEE companies and between CEE and Western companies should be encouraged.
- **Co-operation and improved exchange of experiences** between Waste Minimisation programmes should be stimulated.

Håkan Rodhe

Preventive Environmental Strategies in Eastern European Industry

An analysis of donor support for cleaner production

The preventive approach to industrial environmental problems has been promoted in the West for up to two decades. Since 1991, this approach has been continuously introduced in Eastern European industries by donor countries. The cleaner production programmes undertaken in Eastern Europe reveal substantial opportunities for conserving energy, water and raw materials, while also increasing the profitability of the firm.

However, it can be difficult to benefit from this potential and actually implement cleaner production measures for several reasons. Some of these reasons are associated with tradition inherited from the centrally planned economy. This dissertation discusses the incentives and barriers for the preventive agenda in the context of external influences and internal capabilities to the Eastern European firm.

Nevertheless, the donor support for the preventive agenda appears unjustly prioritised in light of the benefits associated and the small resources put into the area. Other conclusions include the recognition of the need to create structures that increase the incentives for Eastern European industry to undertake cleaner production measures. As an example, a model is outlined to integrate preventive measures with the planning and construction of wastewater treatment facilities.

IIIEE Dissertation 2000:7

The International Institute for

Industrial Environmental Economics

Lund University, Sweden

ISSN 1402-3016

ISBN 91-88902-18-8

ISRN-LUTMDN/THME-00/1006-SE