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Factors that Determine the Need of Environmental Management Accounting in Industry

Case study of Trelleborg AB

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Abstract

Environmental management accounting (EMA) is a management tool for the better consideration of environmental costs. Many benefits of EMA are discussed in the literature, but there are no comprehensive studies that weigh the benefits of EMA against the costs of its use. As a result, many organisations are uncertain about the outcomes of EMA and are, therefore, reluctant to implement such a tool. In order to help organizations to evaluate the need for EMA, the current paper aims to identify the factors that determine when the benefits of implementation outweigh the costs.

This paper also examines these factors at Trelleborg AB (a large company whose products are related to different applications of rubber) and provides recommendations regarding the consideration of environmental costs by management. Additionally, recommendations are given regarding the reporting of these costs.

Executive Summary

Companies experience various internal and external pressures to improve their environmental performance. In addition, the costs companies pay for their environmental impacts are increasing. However, conventional accounting does not provide adequate information about the environmental performance and costs and this makes them more difficult to manage.

A solution to this problem is environmental management accounting (EMA). The purpose of EMA is to provide to management the necessary information for adequate consideration of environmental costs and performance, but the special focus is on environmental costs. EMA helps companies to reveal their real environmental costs and to identify cost reduction opportunities. It also helps them to evaluate in a better way investment alternatives. In addition, by using EMA, companies can incorporate in their strategic planning the increasing environmental demands.

EMA uses two tools: (i) a tool for an accurate allocation of costs to products and processes; and (ii) a tool for improved investment appraisal. However, not every company needs to apply these tools completely. The degree, to which the implementation of these tools is necessary, depends on a number of factors and an attempt is made in this study to identify them. The relevant theories and case studies in the literature are reviewed for this purpose.

It was found that many factors influence the need of an accurate cost allocation: amount of overhead costs, proportion of environmental costs in overheads, management readiness and willingness to change, complexity of products and processes, linkage to other initiatives, information technology, costs of the implementation, performance, purpose of application, etc. These factors determine to which degree the cost allocation system is necessary to be developed. If a company needs very sophisticated system, it can examine the appropriateness of activity-based costing considering additional factors, such as the nature of the cost drivers and some institutional factors (e.g. management willingness and readiness to change).

It seems that the most important feature of the tool for investment appraisal is the accuracy of the cost allocation. In addition, it is necessary to include contingent liabilities and intangible costs in the investment appraisal analysis, if these are significant. The level of accuracy of the estimation of contingent liabilities would depend on their importance for the investment decision. Intangibles can be considered only qualitatively, as a final step of the investment analysis.

The current study also has an applied part. The factors, which influence the need of EMA, are examined at Trelleborg AB – an international company that manufactures products based on different applications of rubber. By using these factors, the consideration of the environmental costs at Trelleborg is reviewed at several levels – group level, business area level, and plant level. Conclusions and recommendations are provided.

Finally, it is suggested a structure for disclosure of the environmental costs in the Sustainability report of Trelleborg. These suggestions are based on the review of the related literature, practice, and available information from the accounting system of the company.

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1. Introduction

1.1 Background information

Companies experience growing pressure to reduce their environmental impacts by internal and external stakeholders. External stakeholders, such as investors, financial analysts, regulatory bodies, host communities, and the public, increasingly take into consideration the environmental performance of the company and this puts pressure on companies to improve this performance (UN DSD, 2000b).

In addition to the external pressures, better environmental performance, and in particular adoption of pollution prevention measures, can also be driven by internal financial benefits. The environmental protection costs of companies, including costs for monitoring, pollution reduction, waste management, regulatory reporting, legal fees and insurance, has risen significantly during the last decades. Conventional accounting considers these costs in a way that they are not recognized by managers (UN DSD, 2000a). The experiences of many companies (see, for example, Reiskin & White, 1999) show that there are many profitable options to avoid the costs for waste management, to reduce potential costs if environmental regulations become more stringent, to position the company as a "green" on the market. In order to discover these options, financial information related to environmental issues must be available to decision makers. This information is provided by environmental management accounting (EMA), which is a tool to recognize the full spectrum of environmental costs of the current production and financial benefits of adoption of pollution prevention measures (UN DSD, 2000b).

During the last fifteen years EMA has been extensively discussed in the literature. US EPA and Tellus Institute (USA) are among the first organizations that developed the theory of EMA and applied it in several industrial organizations to demonstrate its benefits (see, for example, US EPA, 1998, White, et al, 1991, White, et al, 1992). There are a number of studies that discuss the benefits of EMA and recommend it to industries. Many of these studies originate from US, but also there are authors from UK (see, for example, Bennett, et al, 1996, Gray, et al, 1993), Germany (for example, Schaltegger) and other countries. Increasing number of governments (these of Denmark, The Netherlands, Germany, Austria, Australia, China, Japan, etc.) are involved in promoting EMA to industries in their countries (UN DSD, 2000a).

However, currently EMA is not in common use in industry - most EMA users are large companies that process natural resources and are subject to extensive environmental regulation (UN DSD, 2000a).

1.2 Purposes and research question

This research has the following main purposes:

1. To identify the main factors that determine the need for EMA. EMA can be applied at different levels (e.g. company, facility, product, process). At each level, it is appropriate to apply EMA only when the benefits from this application exceed the cost. The factors

that influence these costs and benefits are important to consider for identifying the most successful[1] EMA.

2. To provide conclusions and recommendations concerning EMA at Trelleborg AB. For this purpose, it is necessary to examine the current EMA practice at the company and the need of EMA.

3. To provide conclusions and recommendations concerning the external reporting of environmental-financial information at Trelleborg. To fulfil this purpose, it is necessary to compare the current disclosure of environmental – financial information and the suggestions found in the literature, which are relevant for the examined company.

Based on these purposes, the following research question is formulated:

What are the main factors that determine the need of EMA in industry, and, based on these factors, how can EMA at Trelleborg be improved to satisfy both, the internal and external decision-making?

1.3 Structure

In order to answer the research question, the thesis has the following structure:

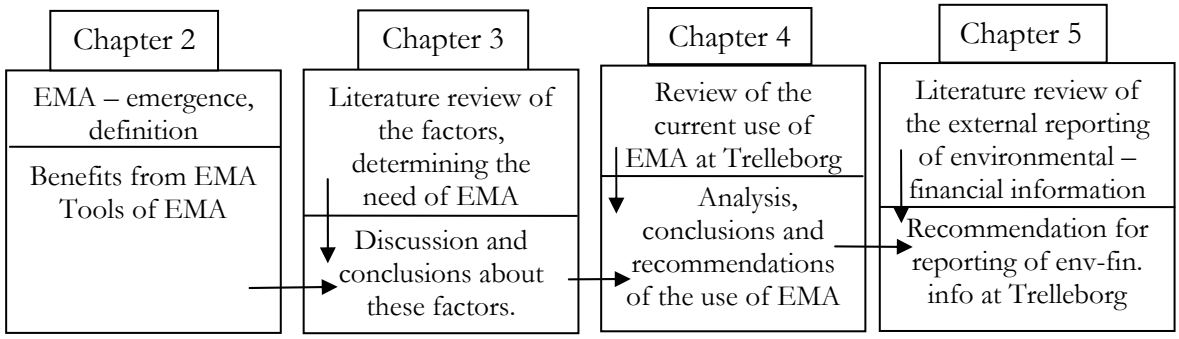

Figure 1 - Structure of the thesis and linkages.

Figure 1 presents the structure of the thesis. The main body of the thesis consists of four chapters. Chapter 2 discusses how EMA can improve the environmental and financial performance of a company. The first part[2] of the chapter is an introduction to EMA. In this part, EMA and the reasons for its emergence are briefly reviewed. The second part of chapter 2 focuses on the benefits from EMA and on the tools to achieve them. Profound review of these tools is necessary, because their application incurs the costs of EMA – the implementation require changes in the collection of the information, in the information infrastructure; this is related to organizational changes, training, etc. These costs, as well as the benefits from EMA vary, depending on the degree of application of each tool and on the specific circumstances at each company/facility/process/product. This second part is a framework for examination of the factors that influence the need of EMA.

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[1] The word "successful" is used in the thesis as synonyms of "profitable". The success (profitability) is measured by comparing the financial benefits and financial costs, resulting from EMA implementation.

[2] The parts of the chapters are shown on Figure 1 and are separated by lines.

Chapter 3 aims to identify the factors that determine the need of EMA. These factors are those characteristics of a company/facility/product/process, which influence the appropriateness to apply EMA. The first part of the chapter is a literature review of relevant theories and case studies. In the literature review, the relevant theories are very limited and the case studies, containing relevant information, present very fragmented picture. The second part of chapter 3 is an attempt to build a hypothesis about the examined set of factors. For this purpose, the results from the literature review (from the first part of the chapter) are put together by considering their relevance, validity, and importance. This part also includes analysis of those aspects of EMA, about which no literature was found during a literature review. The conclusions of this analysis are also a part of the hypothesis.

Chapter 4 examines EMA at Trelleborg AB and provides recommendations for its improvement. The first part of the chapter reviews both, the current consideration of EMA and the value of the factors (identified in chapter 3) that examine the need of EMA at different levels of the company. In addition, other relevant information, collected from interviews and observation, is presented. The second part of chapter 4 draws conclusions about the current situation and provides recommendations.

The goal of Chapter 5 is to examine the reporting of environmental – financial information of Trelleborg. For this purpose, the first part of the chapter is a literature review of the theory and the practice of disclosure of environmental costs and benefits by big international companies. The second part of chapter 5 provides recommendations for improvement of the environmental-financial reporting; the recommendations are based on both, the literature review and the information provided by the accounting at Trelleborg (from chapter 4).

1.4 Scope

EMA incorporates accounting systems in monetary and natural units. However, it seems that the theory related to EMA in natural units is not developed enough - very limited literature was found during a literature review. In addition, almost no information about related case studies is available. This hinders evaluation of EMA in natural units. On the other hand, much literature is available about EMA in monetary terms, which, according to Jasch (Jasch, 2002), is the main focus of EMA. Therefore, it is justified that only EMA in monetary units is in the scope of this study. Despite of this, EMA in natural units is introduced briefly, in order to identify the linkages between these two systems.

The research is limited to the use of EMA in industry. Public organizations and non-manufacturing companies have different activities and goals and therefore the application of EMA there differs.

According to Bebbington and Gray (Limperg Instituut, 1996, p.116), the role of accounting and financial systems is different in different organizations. They divide organizations into: (i) performance-centred (there accounting is often dominant); and (ii) values-centred (there accounting is less important). Only performance-centred organizations are considered in the thesis. Bebbington and Gray (Limperg Instituut, 1996, p.117) divide accounting systems of performance-centred organizations into two types: (i) active – accounting methods are explicitly linked to the goals of the company; and (ii) passive – accounting is driven by stock market, profit, and financial performance appraisal. Therefore, the purpose of active accounting systems is to facilitate accomplishment of organization goals, while the purpose of passive accounting systems is to adjusting the accounting information for external audiences. Since EMA is a tool primarily for internal decision-making, the thesis considers

only active accounting systems. However, most traditional companies are performance-centred and have active accounting systems (Limperg Instituut, 1996, p.116) and therefore they are in the scope of the thesis.

The applied part of the research examines the accounting of environmental costs and benefits[3], their consideration in investment appraisal, and their external reporting at Trelleborg AB. The scope of this research includes:

- Consideration of environmental costs and benefits for investment decisions at Trelleborg Group level.
- Consideration of environmental costs and benefits for investment decisions at business area Trelleborg Engineered Systems.
- EMA at 13 of the Trelleborg plants.

This scope would provide general view on the accounting and consideration of environmental costs and benefits at different levels of the company.

1.5 Limitations

Given the infancy of EMA theory and practice (Deegan, 2001), the analysis of the factors that determine its success is very limited. The literature review found almost no theory about the factors that influence the need (costs and benefits) of EMA. In addition, no theory was found about the type of EMA to be implemented. The analysis in the thesis is based mainly on information (description, analysis, and conclusions) provided by the authors of EMA case studies. Most case studies cannot contribute to the research, because it is impossible to identify there the reasons for the success or failure of EMA. Even the relevant conclusions in the most of the case studies can be questioned, because they are based on a limited number of cases and may not be representative. Moreover, each company implements a different type of EMA and therefore the conclusions are not always transferable.

Another limitation is the method used to synthesise the findings of the literature review of the factors influencing the need of EMA. These findings are very fragmented and related to only a part of the components of EMA. The factors influencing the implementation of the rest of the components are identified a priori, based on the features of these components. In addition, the findings of the literature review are prioritised based on their relevance, validity, and importance, but these criteria are applied based only on the author's limited experience in the field.

Regarding the applied part of the study at Trelleborg, the environmental costs, their accounting and consideration vary significantly among the different plants of the company. Also, there is probably a different practice among the different business units and business areas[4] and this restricts the validity of the results within the whole company.

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[3] The applied research focuses on environmental costs, but they are considered in the context of a broader group of environmental, health, and safety costs.

[4] This is not examined in the thesis, because information is collected only from one of the business areas. None of the business units is examined.

In addition, even in the scope of the research, the collected information is very limited. Only one interview was performed to examine the consideration of the environmental costs at headquarters and one interview - at business area Engineered Systems. The information of the most examined plants is limited to answers to a short questionnaire.

1.6 Methodology

One of the purposes of the current study is to identify the factors that influence the need of EMA. The methodology of this research includes a literature review and analysis. The literature review includes a general part (sections 2.6-2.9), which focuses on the benefits of EMA and the tools (which indicate the costs) to achieve them, and a specific part (sections 3.1-3.3), which focuses on theories and case studies directly related to the researched factors. The next step is synthesis of the literature and case studies (section 3.4) to form a hypothesis about the factors that determine the need of EMA. Analysis of the EMA tools was carried out to include in the hypothesis also those aspects of EMA, about which no discussion was noticed during the literature review.

Another purpose of the study is to provide conclusions and recommendations related to EMA at Trelleborg. This is achieved by comparing the current EMA and the needs of the company, identified by the value of the factors mentioned above. The necessary information was collected mainly by personal interviews and questionnaires. Since different aspects of EMA are applied at different levels of the company, the selection of interviewees was intended to include representatives from all levels.

At group level, an interview with a financial controller has been performed to examine the consideration of environmental costs for investment decisions at this level. Also, a financial controller at one of the four business areas of the company has been interviewed. At plant level, two plants were examined in more details – at each of these plants the environmental coordinator and a person from the accounting/finance department were interviewed. The interviews were semi-structured. On one hand, the interviewer was trying to cover some preliminary defined by him topics. On the other hand, a natural conversation was carried out, because the interviewer: (i) was not familiar in advance with the exact responsibilities and areas of knowledge of the interviewees, (ii) was trying to get deeper insights of the understanding of the interviewees, and (iii) aimed to enable a mutual learning process.

Because of the high variation of the practice at different plants of the company, additional information from a number of plants was necessary to be collected. For this purpose, a questionnaire was sent to 27 persons (from different plants) who are responsible for the reporting of environmental information to the headquarters. The sample includes people who are both, from a country where it is expected to understand English and their position is exclusively related to environmental issues. 11 responses have been received.

The third purpose of the study is to provide conclusions and recommendations, regarding the reporting of environmental-financial information at Trelleborg. This purpose is fulfilled through a literature review of theories and case studies, which are relevant to the conditions of the examined company.

2. Environmental management accounting as a tool for internal decision-making.

2.1 Failure of conventional accounting to adequately reflect environmental costs.

The conventional accounting uses the traditional accounting methods, which are based on the financial accounting legislation. In this legislation there is no special treatment of environmental costs. There the costs are categorized to inventory costs (including direct costs and overheads), selling costs, administrative overheads, abnormal amounts of wasted materials, labour or other production costs (IASC, 2001, IAS 2:14), etc. Environmental costs of a company could be included in any or all of these categories (US EPA, 1995, p.7-8).

Normally, accounting distinguishes two types of inventory costs (Proctor, 2002, p.28):

1. **Direct costs**. These are costs that can be economically identified with, and measured in respect to, a relevant cost object or product. Direct costs are assigned only to one of the products of the company. For example, a company that is furniture manufacturer would account the cost of materials used to make a chair as direct cost of that chair. These costs are easy to determine, because the amount of each of them can be measured.

2. **Indirect costs (or overheads)**. These are the rest of the production costs – those that cannot be economically identified with, and measured in respect to, a relevant cost object or product. Examples of such costs are supervisor's pay and insurance. Since these costs are related to several products simultaneously, they should be attached to these products.

Among all types of costs (e.g. inventory costs, administrative, selling costs, etc.), only a part of inventory costs are direct costs. All other costs are indirect - they cannot be identified with distinct products. However, management attention is generally focused on direct costs. All other costs may be obscured through treatment as overheads, distorted through inaccurate attachment to cost objects (being processes, products, or product systems), or simply overlooked (US EPA, 1995, p.8).

In addition to direct costs, also overheads are assigned to the related cost objects. In order to determine the part of the overhead to be assigned to each cost object, it is necessary to find a logical link between these costs and the cost objects. There should be some rationality and consistency in determining this link, although it does not need to be completely accurate. For example, the costs for heating and lighting of the plant could be attached to the products in proportion to the production area their production occupies; maintenance costs of machines could be attached to products in proportion to the number of machines used for each product (Proctor, 2002, p.29-31). These examples illustrate a logical link, but it is not clear that the attachment is accurate.

Production overheads should be firstly distributed among service cost centers (such as maintenance, supervision, etc.). Then the total costs of service centers can be appointed to other service centers that use their service (e.g. a part of the supervision costs can be related to maintenance) and to production centers (such as components, assembly, and finishing).

Eventually, all costs should be attached to production cost centers only. Then these costs are allocated to the products (e.g. chairs, tables) and this determines the final product cost (Proctor, 2002, p.31).

This method, called "absorption costing", is about one hundred years old. The method was created for a manufacturing era, when production used direct labor much more than it does today. Then production overheads formed only a small proportion of the total costs and it did not matter that the method for their attachment was not particularly accurate. In contrast, the production of twenty-first century is extensively based on computer-controlled automated machinery. Nowadays, production overheads are significant. They often represent more than 50% of the production costs and therefore, the method for their attachment is important. As companies become more complex, the absorption costing method may give a distorted picture of product costs (Proctor, 2002, p.35-36). At each step of allocation, the accuracy of information decreases and the final product costing could be inadequate.

The traditional methods of attaching overheads to products are all based on volume criteria (volume can be production volume, direct labor hours of each product, machine hours of each product, etc). However, the product cost, derived by using such absorption rates, will only give a true picture, if their relation to the overhead costs is a function of the volume used as criteria for allocation. Otherwise, the product costing would be distorted. For example, in a company that produces two products, administration overheads are usually attached to these products in proportion to the sales of each product. However, if the market of one of these products faces problems and its sales halved, then more administrative overhead costs would be attached to the successful product, and this would provide misleading information to management (Procter, 2002, p.37).

Environmental costs are often accounted for as overheads. An extensive research, incorporating a number of US industrial companies, concludes that each type of environmental cost is allocated to overhead accounts by most of the examined companies (White, Savage, Brody, Cavander, Lach, 1995, p.ES-6). The study shows that usually licensing, insurance, training, and other costs associated with central staff functions are allocated to overheads. Slightly more than a half of the examined companies, which allocate these costs to overheads, later reallocate them to products and processes (White, et al, 1995, p.ES-6).

2.2 Demand for EMA

The demand for EMA is a consequence of the failure of the conventional accounting to satisfy information needs related to environmental costs and performance. There is growing concern of different stakeholders over environmental performance of organizations. This leads to increasing pressure on organizations to improve and report their environmental performance. Government and non-government organizations raise their demands. Many other stakeholders (e.g. customers, suppliers, banks, insurers, shareholders) demand reduced environmental impacts (Schaltegger & Burritt, 2000, p.31-35). Although it is easy to present a green image to the external stakeholders, the positive benefits usually last only for a short time, if there is no real action behind the words.

However, conventional accounting focuses only on the financial performance of an organization and does not provide information about the environmental performance. In order to improve and report environmental performance, proper information about it is necessary. That necessitates the use of physical flow accounting to collect, summarize, and

report information about the environmental impacts of an organization (Schaltegger & Burritt, 2000, p. 31-35).

Another major disadvantage of conventional accounting is that it does not provide useful information to increase the financial efficiency of environment-related activities. Conventional accounting is ignoring events, although in some cases they directly influence the financial results, for example (Schaltegger, Burritt, 2000, p. 76-79):

1. If an adverse environmental impact happens, the "victims" (e.g. customers) could sue the company.

2. There is a trend to internalize the external impacts to society by legislation measures, such as environmental taxes or emission limits. However, conventional accounting does not reflect these potential costs and it is not possible without measuring environmental performance.

A disadvantage of the conventional accounting is also that it does not consider the reputation of the company, although the reputation affects the financial results. Poor environmental image could repel the customers and consequently decrease the revenues, whilst a good environmental image could attract new customers. Conventional accounting not only fails to reflect the reputation of the company and potential environmental costs, but it also does not (as mentioned in section 2.1) always appoint fair amount of (environmental) costs to products. Inaccurate product cost information can hinder both, cost saving measures and the correct product pricing.

2.3 Definition of EMA

EMA should be considered in the framework of environmental accounting (EA). The majority of authors (e.g. US EPA, 1995, UN DSD, 2002, EMARIC, 2003) relate EA to three accounting systems: national accounting, financial accounting, and internal business managerial accounting, as shown in Table 2-1 (EMARIC, 2003):

Table 2-1

General Types of Accounting	Environmental Accounting Parallel
Management Accounting: The identification, collection, estimation, analysis, & use of cost & other information for decision-making within an organization.	Environmental Management Accounting: Management Accounting with a particular focus on materials & energy flow information and environmental cost information.
Financial Accounting: The development & reporting of financial information by an organization to external parties (e.g., bankers, stockholders).	Environmental Financial Accounting: Financial Accounting with a particular focus on reporting environmental liability costs and other significant environmental costs.
National Accounting: The development of economic & other information to characterize national income & economic health	Environmental National Accounting: National-level accounting with a particular focus on natural resource stocks & flows, environmental costs, externality costs.

As shown in Table 2-1, EMA is that part of EA, which is related to management accounting. In such context, EMA is defined as "identification, collection, estimation, analysis, internal reporting, and use of materials and energy flow information, environmental cost information,

and other cost information for both conventional and environmental decision-making within an organization" (EMARIC, 2003).

Many features of EMA are similar to those of management accounting. A way to emphasize some of these features is to contrast EMA and management accounting to financial accounting (see Table 2-2):

Table 2-2

Financial Accounting	EMA & Management Accounting
Directed to external stakeholders	Directed to internal use within the organization
Oriented towards the past. The purpose is to give fair view on the organization's operations during a certain past period and on the condition at the end of this period (Proctor, 2002, p.XVII).	Oriented towards the future. The management uses the information provided by this accounting to improve the future performance of the organization (Proctor, 2002, p. XVII).
Based on legislation requirements.	Not regulated by the legislation.

Although the similarities between EMA and management accounting, there are two main differences between them:

1. EMA focuses on environmental information;

2. EMA incorporates accounting for both monetary and physical units, while management accounting is related to monetary units only. More precisely, EMA considers (Schaltegger, Burritt, 2000, p.58-63, p.89-91):

    - Financially induced environmental impacts. The information about these impacts aims at increase of economic efficiency of environmental-related activities. That information is measured in monetary units and is an integrated part of the management accounting. Financially induced financial impacts will further be called "environmental costs"[5]. The part of EMA that considers them is "environmental cost accounting".

    - Environmental impacts that are measured in physical units. The accounting that considers them will further be called "physical flow accounting"[6]. This accounting is not a part of the management accounting. It is meant to increase the eco-efficiency of the company activities. Eco-efficiency is defined as the efficiency of use of environmental resources and could be expressed as a ratio of an output, being the value-added in the products, divided by an input, being the product environmental impacts (Schaltegger & Burritt, 2000, p.51; OECD, 1998).

In summary, EMA includes both physical flow accounting and environmental cost accounting. Physical flow accounting provides information for the physical environmental impacts caused by an organization and environmental cost accounting – for the monetary costs associated to these impacts. To facilitate the reduction of environmental impacts and the related costs, their measurement would be very helpful (White, 1995, p.27). In addition,

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[5] Environmental costs are defined in section 2.1.

[6] "Physical flow accounting" could also be meet in the literature as "ecological accounting" (Schaltegger & Burritt, 2000), "accounting for environmental performance" (US EPA, 1995), "accounting for material use" (White, 1999), etc.

this measurement is necessary for successful development and operation of an accurate environmental management system (EMS) (EAJ, 2000).

It seems that most companies are more concerned to reduce their environmental costs, then to have exact information about their environmental impacts. In this context, it is reasonable to expect that the demand for environmental cost accounting to be much higher than the demand for physical flow accounting. As a consequence, EMA focuses mostly on environmental cost accounting (Jasch, 2002). Example for this is also a study, which summarizes the results of EMA in several oil and chemical companies. This study highlights that a major issue identified by the examined companies is that environmental cost accounting information is much more useful to managers (and especially to top-managers) than real-time physical flow information, such as waste stream metering (Shields, Beloff, Heller, 1996, p.10).

In addition, during the literature review the author has not found much information related to physical flow accounting. It seems that this field is at an early stage of development and significant theoretical research and practical experience are necessary before one can be able to examine what factors influence the need of such accounting, which is a purpose of the thesis. The reasons above justify exclusion of the physical flow accounting from the scope of the thesis and the next sections focus on environmental cost accounting. However, physical flow accounting is also reviewed briefly (see section 2.4) to show how it can support environmental cost accounting.

2.4 Physical flow accounting

This section briefly presents physical flow accounting to show how it can support the environmental cost accounting. This section is based on the view of Schaltegger and Burritt, who make one of the most exhaustive summaries of the related literature.

In most cases, physical flow accounting is voluntary. The information is supposed to serve internal decision making within the organization, but this accounting could also lay the foundation for external reporting. Recently there is increasing demand for environmental performance information by powerful external stakeholders and as a result the external reporting of this information is increasing. Therefore, the design of the physical flow accounting should serve both internal and external needs. Usually, external stakeholders and company top-management need more aggregate information than operations management and for that reason the accounting should be at different levels, for example (Schaltegger & Burritt, 2000, p.260-262):

- Site oriented accounting. Site managers want to know the impacts of their plants.

- Product oriented accounting. Product managers or designers need to be informed about the impacts of their products. These impacts could be considered in life-cycle perspective and managed by using life-cycle assessment.

- Company oriented accounting. Company managers need information for assessing the corporate environmental performance and to define an environmental strategy.

Whatever the level of accounting is, some procedures are common for all physical flow accounting systems:

- Recording environmental data into appropriate accounts. First, detail material and energy flow diagrams are necessary for all manufacturing processes. These can be obtained only through observation and recording all material and energy flows. The data can be systemized in two main categories of accounts – input and output accounts. The input of different types of materials (e.g. biomass, water, mineral resources, etc.) and energy should be accounted for in separate accounts; sub-accounts can be formed for more detailed information. The outputs also should be classified in proper accounts (e.g., products, waste to landfill, waste for incineration, etc.) (Schaltegger & Burritt, 2000, p. 270-271).

- Aggregation. After recording all material and energy flows at the site where they occur, their aggregation should follow. The levels of aggregation can be different, for example: site, product, and company. The aggregated information can be obtained as direct sum of the numbers. Such aggregation could serve to identify the biggest environmental impacts and respectively to focus the attention of environmental protection activities to them (Schaltegger & Burritt, 2000, p. 273-276). However, in many cases the aggregated information is confusing, due to numerous types of environmental impacts that it contains. Then impact assessment can be used. There are many approaches for impact assessment, but here only one of them will be mentioned. This approach is has three steps (Schaltegger & Burritt, 2000, p.277-284):

    1. Classification - the impacts (e.g., carbon dioxide and methane) are grouped to predefined impact categories (e.g. global warming);

    2. Characterization – the impacts are quantified within the impact category. That is done by multiplying the physical quantity (kg) by a weighting factor that reflects the relative contribution to the particular environmental problem.

    3. Valuation – the impact categories are weighted against each other and that results in one aggregated number that reflects all environmental impacts.

- Allocation. Information could be needed about the environmental impact of certain object (e.g. process, product, or plant). Then except the direct impacts accounted for this object, the indirect impacts should be allocated on proper bases. For example, the impacts caused by the company's incinerator can be allocated to the relevant activities that cause the waste (Schaltegger & Burritt, 2000, p. 288-291).

- Environmental indicators in physical units. They are designed for control of the company's environmental performance. These indicators help the management to establish product-based, plant-based, and company-based targets (Schaltegger & Burritt, 2000, p. 299-301).

It seems that the accounting for physical flows can reveal a number of additional profitable ideas, which can be omitted by environmental cost accounting. It can not only support environmental cost accounting and EMS with information about the inputs and outputs of the company, broken down to products and processes, but can also show that the wastes or by-products from one process can be used in another process.

2.5 Benefits from EMA

There are many definitions of environmental costs and the way a company defines them depends on how it intends to use the information (US EPA, 1995, p.7). The definition of environmental costs used in the thesis is "impacts incurred by society, an organization, or an individual, resulting from activities that affect environmental quality; these impacts could be expressed in monetary and non-monetary units. They include any cost, both monetized and less tangible, with short or long-term financial consequences for the firm" (White, 1999).

The definition of EMA in section 2.1 emphasizes the central role of environmental costs in EMA's framework. Although these costs are only one of the many different types of costs, the US EPA holds that they deserve special management attention for the following six reasons (US EPA, 1995, p.1-2, p.6):

1. Better understanding of the environmental costs of products can result in more accurate product/process costing and product pricing. It seems there are two different opinions about the connection between product costing and pricing:

    a. Product costs determine product prices (Schaltegger & Burritt, 2000). According to this view, at each price level, a certain number of products can be sold. Therefore, the product cost is used to set the price, at which the profit is highest.

    b. Product prices are determined by market. Then companies need to compare their cost to the market price and to determine whether or not the profitability is high enough to justify the production. There are also other factors that influence what and how much to produce (e.g., market positioning, customer retention, long-term growth), but the product cost is the most important (White, 1999, p. 30-31).

    Depending on the case, each of these opinions is correct, but in both of them an accurate product/process costing is necessary. According to White (White, 1999, p.31), in most cases different products have different environmental costs and if these costs are not properly allocated, which is often the case when traditional accounting is used (see section 2.1), cross subsidization may occur between products.

2. Many environmental costs can be significantly reduced or eliminated as a result of business decisions, e.g. operational and housekeeping changes, investment in "greener" process technology, redesign of products or processes. Many environmental costs do not provide any value to processes, systems and products, (e.g., wasted raw materials, energy). If product/process designers have information about environmental costs of a product, they could identify easier opportunities to reduce these costs, by embodying the principles of pollution prevention in the product/process design (US EPA, 1995, p.26-27).

3. Improved information about environmental costs would reveal opportunities for cost savings, and therefore – for improved environmental performance. Improved environmental performance can lead to additional future benefits to company (e.g. increased revenues due to improved reputation).

4. The experience of many companies show that environmental costs could be compensated by generating revenues through sale of tradable pollution allowances, waste by-products, or licensing of clean technologies, for example;

5. Accounting for environmental costs can support the strategic development of a company. There is increasing customer demand for better environmental performance. In addition, there is a trend more and more externalities to be internalized in the company's costs. Therefore, it is reasonable to expect that companies would have increasing environmental costs. Their profitability can be substantially affected by the way these costs are managed (White, 1999, p.32).

6. Accurate information for environmental costs could support the operation of an environmental management system (EMS) of a company. There is an increasing customer's demand for EMS. Information for environmental costs could reveal the most profitable investments to improve the environmental performance.

The points mentioned above represent some of the main benefits from considering properly the environmental costs. The next step is to examine how these benefits can be achieved. There are two major tools for this:

- Accurate allocation of environmental costs to processes, products and systems. Such information is necessary for achieving benefits 1, 2, and 3 (see above). This tool is described in details in section 2.8.

- Improved consideration of the environmental costs for investment appraisal. This would provide the benefits from points 2, 3, 4, 5, and 6 (see above). This tool is described in details in section 2.9.

2.6 Considering external environmental costs

For different people and in different context the scope of environmental cost (and also other types of cost) is different. Environmental cost could be related either to private costs only (the costs that directly cause financial impact on a company), or to both private and social costs. Social costs are the costs borne by society; for these costs a company is not accountable for (US EPA, 1995, p.1). An accounting system that incorporates all social costs is called full-cost accounting (FCA)[7] (Bebbington, Gray, Hibbitt & Kirk, 2002).

It seems that FCA is currently not widespread among private organizations. The form of accounting used in the majority of companies virtually ignores all events that do not have financial impact on the company and this accounting aims only to maximize private financial benefits, regardless the external costs[8] (Bebbington, et al, 2002). In this way, the society as a whole is a loser, but the question here is whether a private profit-oriented company would be interested to implement FCA.

The Fifth Action Programme of the European Commission (1992) calls the accounting profession to develop FCA, so that the consumption of environmental resources are accounted and reflected in the market prices (Bebbington, et al, 2002), but it seems that the profession does not answer this call. A report that reviews the main FCA experiments and the views of many FCA experts includes the following results (Bebbington, et al, 2002):

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[7] This definition of FCA has been used in the thesis. Some authors (see e.g. Schaltegger & Burritt, 2000) do not include externalities in FCA.

[8] Although the externalities could be both social and environmental, in the thesis only environmental externalities are considered.

- There are problems to transform the external costs in monetary units;

- Most organizations are reluctant to publish information about their externalities;

- Most organizations were understandably reluctant to take responsibility for their externalities. In this case a question raises why they account them and who should take the responsibility for them.

Only few private companies have undertaken FCA implementation voluntarily[9]. According to Bennett and James (Limperg Instituut, 1996, p.58), calculation of external costs is used by some companies to demonstrate that a particular product/process creates less externalities that its alternatives. One of the most successful FCA experiments was in a public company - "Ontario Hydro" (the biggest power utility in North America) (see US EPA, 1996a), but even this company has abandoned FCA in the lead-up to its privatization (Schaltegger & Burritt, 2000). According to UNDSD, most EMA does not incorporate external costs of a company (UNDSD, 1999). The ultimate aim of a private company, held by many, is to maximize its financial results. Therefore, it is not reasonable to expect that the management would put the same value on both, private and external costs.

On the other hand, the externalities today can be internal costs in future, because:

- Property rights are increasingly assigned over the questioned environment (Schaltegger & Burritt, 2000, p.99);

- The pollution damage is increasingly included in the prices through taxes (Schaltegger & Burritt, 2000, p.99);

- There is increasing regulatory control of polluting inputs and outputs, for example prescription of "best available technology" (Schaltegger & Burritt, 2000, p.99);

- Increased eco-efficiency can increase the long-term financial results through improvement of company's reputation, eco-labels on products, and so forth.

In order to avoid these potential costs, managers need to integrate externalities to the long-term decisions of the company (e.g., strategic investments). However, the level of this integration is better to be determined by the probability of their internalization and the expected internal cost if such internalization occurs, but not by using the cost borne by society. Therefore, although it does not seem reasonable for a private company to use FCA, the externalities must be considered in order to avoid future private costs.

2.7 Identifying environmental costs

The definition of environmental costs, given in section 2.3 is too general to be able to guide an implementation of EMA. In this section more detailed guidance on identifying these costs will be provided.

[9] Some companies (e.g. water distributors in EU) are obliged to consider their full costs when determine the price of the water for their customers (Bebbington, et al., 2002).

Environmental costs include all costs that occur in relation with environmental damage and protection (Jasch, 2003, US EPA, 1995, p.11). Environmental protection costs include costs for prevention, disposal, shifting actions, planning, control, and damage repair. Environmental damage costs are the costs of waste and emissions. Waste is a material that has been purchased but that has not been utilized in a product. In this context waste indicates production inefficiency. In addition to the costs of wasted materials, all other costs related to their processing are included in environmental damage costs - the costs of energy, transportation, labor, investment, etc. (Jasch, 2003).

This composition of environmental costs can be criticized as over-restrictive, because it includes only "defensive" costs, which neither add commercial value to the company, nor provide potential for future improvement of the environmental performance. Therefore, two other types of costs are also included in environmental costs: (i) costs to improve future environmental performance; and (ii) costs associated with environment-related actions that aim to improve the business performance (Bennett & James, 1999).

The considered composition of environmental costs is very similar to the one adopted by US EPA. The latter divides environmental costs into four sub-categories – conventional costs, potentially hidden costs, contingent costs, and image and relationship costs (see Appendix 1) (US EPA, 1995, p. 8-11):

1. Conventional costs. They are direct costs (e.g., raw materials, utilities, capital goods, labor). They are considered by the traditional accounting, but are not usually associated with environmental costs. However, decreased use of materials, utilities, and capital goods would reduce both environmental degradation and use of non-renewable resources. Therefore, the management should consider the environmental aspects of these costs.

2. Potentially hidden costs. These are indirect costs and are obscured in overhead accounts. They include the following cost groups:

    - Upfront environmental costs – costs that are prior to the operation of a process, system, or facility, for example costs for siting, for product design, etc. These costs are often forgotten by management, which focuses on operating costs.

    - Regulatory and voluntary costs. These are operational costs, but they often overlooked by management, because are usually treated as overhead.

    - Back-end environmental costs. These costs of current operations occur at certain point in the future, e.g. costs of closure/decommissioning, disposal of inventory, etc. These costs may not enter in conventional management accounting systems at all and therefore may not receive management attention.

3. Contingent costs. These costs (also called "contingent liabilities") are legal obligation to make future expenditures due to current or future activity with adverse effect on environment (US EPA, 1996, p.8). The obligation may or may not incur at certain point in the future – it is probabilistic. Examples of such costs are costs for remedying and compensating for possible future accidents (e.g. oil spills). Management often forgets contingent liabilities, because according to the financial accounting legislation (see for

example, IASC, 2001, IAS 37:19), organizations should not recognize them (US EPA, 1995)[10]. According to US EPA, the main categories of environmental liabilities are obligations related to: (i) compliance with legislation; (ii) remediation of contaminated real property; (iii) fines and penalties for non-compliance; (iv) compensation of private parties; (v)"punitive damages" in case of negligence; and (vi) natural resource damage (US EPA, 1996b, p. 17). There are different approaches to estimate these costs: (i) actuarial techniques (statistical analysis of historical data); (ii) professional judgment of experts; (iii) engineering cost estimation by systematical identification of required activities; (iv) decision analysis techniques that reflect uncertainties (e.g. event tree, probability distribution); (v) event modeling when historical data is not available; (vi) scenario techniques; (vii) valuation techniques that assign monetary value on environmental damages (US EPA, 1996b, p.22-23).

4. Image and relationship costs. These environmental costs are termed "less tangible" or "intangible", although they are measurable and incur real monetary costs. Such costs are: subjective perceptions of management, customers, and employees. Image and relationship costs are also often forgotten by management, because they are not included in conventional accounting (see, for example, IASC, 2001, IAS 38:36).

It is disputable whether some of the costs in these categories should be defined as "environmental", but it is necessary to ensure that all costs that could be affected by environment–related decisions receive proper management attention. In practice usually only some of the costs mentioned above are included in EMA. The results of an extensive study by Reiskin and White (Reiskin & White, 1999, p.220-221) of many EMA practices, all of which incorporating environmental costs in their accounting, show that:

- A few companies consider only conventional costs as environmental costs;
- The majority of the companies include both conventional and hidden costs;
- A number of cases consider contingent costs;
- Only a few companies consider less tangible and intangible costs.

In practice it is often difficult to decide whether or not certain costs are environmental and in order to help practitioners, US EPA suggests three approaches for that (US EPA, 1995, p.12):

- The cost item to be treated as environmental for one purpose, but not for another;
- Only a part of the cost to be treated as environmental;
- The costs to be treated as environmental when managers agree that these costs are more than 50% environmental;

[10] Only liabilities with high probability to occur and reliable estimation are recognized. Contingent liabilities are not included in the balance sheet, but they should be disclosed in the annual report.

2.8 Allocating environmental costs by using activity-based costing

Some major disadvantages of the traditional costing methods, which are especially valid when dealing with environment- related information, were pointed in section 2.1. One response to these disadvantages has been the development of "activity-based costing" (ABC). ABC can be used either as substitution of the traditional accounting method or in parallel with it. Compton (Compton, 1996) suggests it to be used in parallel. This is probably most suitable in case ABC needs to cover only a part of the products/processes of the company. If ABC substitutes conventional accounting, except serving management accounting purposes, ABC should also comply with the requirements of the financial accounting legislation. That restricts the range of the costs, which ABC can incorporate, because (as mentioned in section 2.6) financial accounting does not recognize contingent costs, less tangible and intangible costs, nor, of course, external costs.

ABC traces more of the overhead costs directly to products than traditional costing (Kennedy, 1996). In addition, ABC achieves an increase of accuracy through a identifying a causation link (called cost driver) between products and related costs. ABC is based on the following logic: (i) products cause activities; and (ii) activities cause costs. ABC has five steps (Proctor, 2002, p.67):

1. Identification of different activities of the company;
2. Calculation of total costs of each activity;
3. Identification of the cost driver (causation factor) for each activity;
4. Calculation of the cost driver rate (cost for one occurrence of the cost driver);
5. Allocation of part of the cost of each activity to related products, in proportion to extend to which each product has caused the activity to occur.

These steps can be illustrated by the following example. A company produces two types of boxes (A and B) using the same machinery. The annual production is 60 batches of box "A" and 30 batches of box "B". One of the activities is setting up the machinery to make a batch of one of these products and it has 9,000 SEK annual costs. Then the cost driver is number of set-ups and the cost driver rate is 9,000/(60+30)=100 SEK. Therefore, for box "A" are allocated 60*100=6,000 SEK, and for box "B" - 30*100=3,000 SEK.[11]

While traditional accounting uses absorption rates based on the production volume (see section 2.1), ABC can use also different bases in case they reflect the causality in a better way. In the given example, the allocation of cost depends on the number of batches produced (although batches could have different sizes) rather than total production volume. Other examples of non-volume allocation is using of "number of purchase orders" as cost driver for buying new materials; or using "number of inspections" as cost driver for controlling quality (Proctor, 2002, p.69).

[11] In this example, it was assumed that each set-up, regardless of the product, is related to the same costs. However, if this is not the case (for example, the set-up for box "A" is more complicated than that for box "B), then the cost driver should be different (for example, number of set-up hours) (Procter, 2002, p.68).

There are some costs, such as factory rent, heating, insurance, for which a driver cannot be identified. Their allocation to products remains arbitrary even under ABC. In comparison to the traditional method for cost allocation, ABC increases significantly the accuracy when overhead costs are a large part of overall production cost and when these overheads are driven by factors other than production volume. But one should be aware that even ABC couldn't identify 'true' product costs (Kennedy, 1996).

The main benefit of ABC is to direct manager's attention. An analysis of activities precedes the introduction of ABC and this analysis often provides important insights to managers about their business. It may reveal that certain work is duplicating by different activities, or it may highlight how changes in one activity may lead to significant time and cost savings in another (Kennedy, 1996).

According to Pojasek (Pojasek, 1998, p.111), most companies that use ABC focus solely on justifying investments in cleaner production equipment and product design improvement. This approach is beneficial in the electronics and customer products sectors, where the products and processes can be changed easily. However, Pojasek highlights that most traditional industries failed to adopt ABC, because product turnover or need of new product/process design are not everyday occurrence. He considers that the most important benefit of ABC is providing the management with information about the cost behavior and the reasons for this behavior (Pojasek, 1998, p.111). As a crucial step for successful development of ABC, Pojasek suggests the use of process mapping (flow chart) to better understand the process; this would facilitate potential identification of cost savings (Pojasek, 1998, p. 112-114). The inputs and outputs should be identified at each step of the process and the related costs should be allocated to them (ACCA, et al, 2003, p.16-20).

According to Proctor (Proctor, 2002, p.76), ABC is "resource consumption" model – it measures the resources used by products, while traditional accounting is "resource supply" model – it measures the resources provided by management. The difference is the resources that add no value to products. Examples of resources that add no value are: waste, energy losses, storing materials for two weeks instead of two days, etc. Identification of such resources and activities enables management to reduce or eliminate them (Proctor, 2002, p.76).[12]

Although ABC results in more accurate product costing than the traditional costing method, it has some disadvantages. ABC is more complicated method and it consumes more resources and costs to operate. Also, it is related to significant changes of the company information system and it takes a number of years to introduce properly. In some companies (see section 24) the costs of implementing ABC overweigh the benefits (Proctor, 2002, p.76).

After identification and allocation of environmental costs to the related activities, it would be useful to summarize them in the System of integrated Environmental and Economic Accounting (SEEA), developed by the United Nations Statistics Division (UNDSD, 2001, p.15-16):

[12] For example, assume that the input in an activity is 100 kg materials and it results in 80 kg of products and 20 kg waste. To the cost of waste disposal (e.g. 200 SEK) all no-value-adding activities should also be allocated to form the full cost of waste. This includes 20kg of material purchased (e.g. at price 40 SEK/kg), and 20/100 of all energy, labor, and other costs related to the activity.

Table 2-3

Environmental media[13] Environmental expenditure category	Air/ climate	Waste-water	Waste	Soil/ Ground-water	Noise Vibration	Biodiver-sity/ Landscape	Radiation	Other	**Total**
Waste and emission treatment[14]									
Prevention & environm. management[15]									
Material purchase value of non-product output									
Processing cost of non-product output									
Total environmental expenditure									
Revenue									

According to UN DSD (UN DSD, 2001, p.15-16), the distribution of environmental costs by media and category in Table 2-3 is consistent with the existing international approaches and the requirements of some statistical laws. The environmental expenditures can be crosschecked by the accountant (or controller) and environmental manager of the organization (UN DSD, 2001, p.16). The accountant/controller can identify environmental expenditures by category, while the environmental manager – by media. Information, presented according to Table 2-3, is suitable for analysis, control, and identification of potential cost savings. The provided details would facilitate both analysis and control of these expenditures. The effect of the pollution prevention investments (past or future) can be easily assessed from financial point of view by comparison of the variation of the pollution prevention expenditures[16] and the variation of the other items.

2.9 Total Cost Assessment (TCA) as a tool to support investment decisions

The main internal management needs of environmental–financial information could be satisfied mainly by: (i) proper allocation of environmental costs to cost objects; and (ii) relation of environmental costs to investment decisions (see section 2.5). The former could be achieved by ABC (see section 2.8), while the latter (reviewed in this section) can be attained by means of Total Cost Assessment (TCA). Some may argue that investment appraisal tools are out of the scope of accounting, but it seems that many authors (e.g., US EPA, 1995, White, Becker & Goldstein, 1991) consider it as a part of EMA.

The long-term profit of a company depends to a high degree on the investments of the company. Since environmental costs are often significant, companies that can reduce them usually have considerable financial benefits. But to achieve this, it is first necessary to

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[13] Other columns (e.g. "heath & safety costs") can be added to the table (UN DSD, 2001, p.16). The existing columns can be removed, modified, or detailed.

[14] Includes the related labor, maintenance materials, depreciation of cleaning equipment, insurance, provisions for potential liabilities.

[15] Includes the expenditures related to "good housekeeping", the extra costs of cleaner technologies or green purchase, costs for environmental management, R&D for environmental projects.

[16] In case the pollution prevention measures (undertaken during the current or previous years) have effect for a period of more than one year, then expenditure is only their depreciation during the current year (see IASC, IAS 16).

measure environmental costs related to investments in a systematic and consistent way. This can be done by using TCA - "a method by which investments, particularly environmental investments, can be evaluated in a way that more accurately reflects their profitability potential" (White, 1999, p. 31-32).

According to US EPA, TCA has the following characteristics that make it better than conventional analysis (White, et al, 1991, p.23-28):

1. TCA deals with more comprehensive set of costs – conventional, potentially hidden, contingent, and less tangible and intangible costs (see section 2.6)[17];

2. TCA uses better method for cost allocation. For purposes of investment analysis, first, the cost accounting system need to allocate all costs to the activities responsible for their creation and second, the allocation should reflect the way in that the costs are really incurred. This could be done using ABC.

3. TCA expands the time horizon of the investment to fully capture all related costs and benefits.

4. TCA uses profitability indicators that account for the time value of money (e.g. net present value, internal rate of return, payback)[18].

The characteristics of TCA show that this tool is not related to environmental investments only. TCA can be applied to all types of investments and it is a universal tool that considers the full spectrum of aspects when evaluating an investment. However, TCA is especially useful for environmental investment appraisal, because (i) environmental costs are often hidden, potential, or less tangible (see section 2.7); (ii) environmental costs are usually obscured in overheads (see section 2.1); (iii) There are evidences (see, White, et al, 1991) that environmental investments have usually longer life than other investments.

According to White (White, 1999) TCA puts environmental projects on equal footing with other investment projects. Through TCA, the costs and benefits related to investment in pollution prevention measures are better revealed. Many pollution prevention projects, which do not appear to be financially viable when conventional analysis is used, may be significantly stronger and more competitive then indicated (White, 1999).

TCA information can be used by (CWRT, 2000, p.8):

- Product/process designers;
- Engineers and economists in the assessment of environmental projects;
- Business managers and analysts in developing ling-term product and business strategy.

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[17] Some (e.g. CWRT, 2000) recommend including external costs in TCA even for internal decision making in private profit-oriented companies, but (as discussed in section 2.6) they are not included in the scope of the thesis.

[18] One can argue that lately, conventional investment analysis also uses expanded time horizons and takes into consideration time value of money.

According to the results of a study (Limperg Instituut, 1996, p.125), accounting system have dominant role for medium and short term planning in 78% of the examined companies, for investment decisions in 75% of the companies and for evaluation purposes in 71% of the companies. The study shows that for other activities, accounting is not so important. For evaluation of environmental projects, only 30% of the companies use these systems as a dominant source of information (Limperg Instituut, 1996, p.125). Since TCA puts environmental projects on equal footing to all other projects, there is a potential for significant increase of the reliance on accounting for evaluation of environmental projects.

Parker (Parker, 1996, p.19) notes that TCA is method developed in United States and it is mostly suitable for US needs. He mentions another method – MILA – which he considers to be more appropriate for European applications, because, according to him, the liability costs in Europe are negligible in comparison to US, while compliance costs can be substantial. Therefore, MILA focuses mainly on conventional costs. According to Parker (Parker, 1996, p.19), one of the weaknesses of TCA is the extreme difficulty of evaluating image and relationship costs. MILA has been applied in several industries, but it seems to have very limited diffusion.

3. Factors that determine the need for Environmental Management Accounting

There are numerous literature sources that examine EMA and it seems that all of them agree that EMA improves the quality of the information used for internal decision making in a company. In fact, seems unlikely that somebody would deny the benefits that EMA provides (see section 2.5), because they are direct consequence of the tools used by EMA.

However, the implementation of EMA is also associated with certain costs. In EMA literature and case studies, the authors mainly focus on its benefits, but apparently "forget" to mention (or mention briefly) about its costs. That could be explained in many ways, for example (i) authors consider that the costs are usually much lower than the benefits; (ii) costs are difficult to generalize, because they depend to a high degree on both, the company and the way of EMA implementation; (iii) it is too early to conclude about the costs of such a new system.

Another possible reason for the emphasis on the benefits of EMA is that the purpose of most of these publications is to promote EMA. Many EMA initiatives (see, for example, White, et al, 1991, Graff, et al, 1998) are funded, developed, and reported by governments in their efforts to increase the pollution prevention measures taken by industries. According to the Expert Working Group Meeting on Government's Role in Promoting EMA (further referred to as "the Group"), by promoting EMA in industry, government environment agencies can meet their pollution reduction targets "at minimal cost to government and with minimal political resistance" (UN DSD, 1999). However, the interests of private companies are different from those of governments, and they need to weigh carefully the costs and benefits of adopting EMA.

Among the companies that do not use EMA, there are:

1. Companies that do not know about EMA and the potential benefits that it can achieve;

2. Companies that know about EMA, but are uncertain regarding the appropriateness of EMA in their specific case, as well as to which degree to develop it.

3. Companies that know that in their case the costs to implement EMA would most probably exceed its benefits.

This chapter aims to help industrial companies from the second category to be able to evaluate their need of EMA. EMA can have different scope within the company – it can be implemented at company level, at plant level, at product, or process level. (US EPA, 1995). Certain features of a company, plant, product, or process determine the costs and the benefits from different types of EMA implementation. These features are the factors that determine the need of EMA at each of the mentioned levels. To list all factors and to weigh them against each other seems impossible at that early stage of development of EMA. Here an attempt is made (mainly by synthesis of studies) to identify the most important factors.

According to a report of the Group, the biggest obstacle to more widespread use of EMA by companies is the cost and difficulty of implementing EMA (UN DSD, 1999). According to the Group, one of the reasons for this high cost and difficulty is the lack of established "off-the-shelf" EMA, and therefore each company has to design and develop its own EMA,

which is an expensive process. The Group considers this problem as the main reason for some companies (even large ones, such as AT&T, US Department of Defense) that have initiated EMA to drop it, as well as the main reason for some accounting and consulting companies to abandon as unprofitable their efforts to provide EMA services (UN DSD, 1999).

That highlights the importance of one factor - availability of established EMA for the specific type of industry and for the features of the company. Unfortunately only few industries can benefit from this. There is a limited number of EMA case studies, which are published in details (e.g., US EPA, 1996a); most of the publications of EMA case studies are too short (e.g., Graff, et al, 1998) and do not facilitate use of this experience.

According to the Group, EMA is generally more profitable for large companies, because the costs to establish EMA are similar for large and small companies. Nonetheless, larger companies have more complicated accounting and therefore for them conversion to EMA is more difficult (UN DSD, 2000a).

Section 2.5 has shown that benefits of EMA can be achieved through two tools: better (environmental) cost allocation and consideration of more comprehensive set of (environmental) costs for investment appraisal. Therefore, the purpose of this chapter can be approached by examining the factors that determine the need of a company, plant, product, or process to use each of these EMA tools. However, separate analysis of each tool breaks some of the linkages between them, such as:

1. The tool suggested for investment appraisal (TCA) includes accurate cost allocation[19].

2. Accurate cost allocation can show profitable opportunities, to which the investment appraisal tool can be applied.

3. To achieve some of the EMA benefits (see section 2.5) both tools need to be applied simultaneously.

Therefore, the benefits from simultaneous application of these two tools exceed the sum of the benefits that would be obtained from separate application of each of these tools. However, with the reservation that considering the linkages between the tools is necessary, a separate analysis of the factors influencing the need of each tool is carried out in this chapter. Separate analysis is simpler and it seems to be not only a necessary step to fulfill the purpose of this chapter, but also the most important one. In addition, the practice shows that some companies (see sections 3.4 and 3.3) apply one of these tools only (or even not all aspects of this tool) and at the same time these companies obtain significant benefits. Similarly, a study, carried out by Graff, Reiskin, White, and Bidwell (Graff, et al, 1998), divides the examined case studies into three groups – companies that use EMA for (i) product/process costing[20]; (ii) investment appraisal; (iii) strategic planning[21].

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[19] However, accurate cost allocation is not a part of TCA. This allocation serves also a number of other purposes.

[20] In other words, these companies apply EMA to increase the accuracy of cost allocation.

[21] The strategic planning is based on evaluation of different options and can be achieved through the tool for investment appraisal. For this reason, the strategic planning is not examined separately in the thesis.

As a way to achieve an accurate allocation of costs (including environmental costs) to products/processes, activity-based costing (ABC) is recommended by many authors (see section 2.8). During the literature review, the author has not noticed either any opinion suggesting the use of any other method for (environmental) cost allocation for EMA purposes, or any opinion that there is a method that would lead to a better cost allocation (than ABC would). Therefore, it is reasonable to analyze ABC. In particular, it will be examined what are the factors that determine the need to apply ABC.

3.1 Literature review of the factors that determine when a company needs ABC for environmental cost allocation.

The factors that determine the need of ABC for environmental cost allocation can be classified into two categories:

1. General factors that determine the need of ABC. No features of ABC are exclusively related to environmental costs. The studies that examine this method (see section 3.2) do not even mention that it is suitable for environmental cost allocation. ABC does not distinguish environmental and non-environmental costs and uses the same approach for both of them. In addition, all types of costs are equally important for determining the correct product costs and for identifying potential cost savings, which are the main benefits from an accurate cost allocation. This justifies the use of theories that examine the need of ABC, regardless the focused type of cost.

2. Specific factors, related to environmental costs only. When ABC is applied to environmental costs, there are additional benefits (US EPA, 1995, p.1-2):

   - Higher probability to reveal potential cost savings. Many environmental costs (e.g., waste and energy) have no value for the company. One of the main benefits of ABC is to reveal cost saving opportunities from non-value adding activities.

   - Identification of environmental cost savings, in particular from pollution prevention measures, leads to additional benefits, such as reduction of contingent environmental liabilities[22] and to improvement of the reputation of the company.

   Therefore, presence of significant environmental costs in overheads, and especially environmental damage costs (those which can be avoided by pollution prevention measures), is an important factor that would increase the need of ABC.

The general factors that make application of ABC in industry profitable are reviewed below.

Despite the benefits of ABC many companies use traditional accounting. Moreover, some companies that adopt ABC move back to traditional accounting (Daerman & Shields, 2001). Many authors have tried to evaluate the success of ABC in practice. The results of their studies are quite inconsistent. Some of these results are presented below:

[22] Additional benefit from avoiding environmental liabilities exists in case they are not included in ABC. In case they are accounted for, they would be identified easier together with the other savings, but then this accounting would not comply with the accounting legislation and is necessary to be used in parallel with traditional accounting.

- Ness and Cucuzza (1995) suggest (as quoted in Kennedy & Graves, 2001) that only 10% of the companies that adopt ABC continue to use it.

- Kennedy and Graves (Kennedy & Graves, 2001) show that UK companies that use ABC significantly increase their shareholder value. Three years after ABC implementation they have on average 27% higher value than other matching companies that use traditional accounting. Kennedy and Graves discuss four other studies of other authors that make attempt to find correlation between adoption of ABC and company value. The results of these studies are not directly comparable, since they are based on companies from different countries and the evaluation period after ABC adoption is different. However, these differences could hardly explain the magnitude of the results. One of the studies show average decrease in company value by 42% after adoption of ABC; another study shows an average decrease of 27%; the third study shows no evidence that any correlation exists; the last one shows an average increase of 12% (Kennedy & Graves, 2001).

- Shields and McEwen (1996) (as quoted in Kennedy & Graves, 2001) report that 75% of the surveyed companies that use ABC report financial benefits of using this method.

- A study (Innes, Mitchel, Sinclair, 2000) that examines the use of ABC in UK shows that between 1994 and 1999 the users of ABC decreased significantly; there is also decrease in the number of companies that currently assess it. Respectively there is an increase in the percentage of those companies that reject ABC and those that give no consideration to it.

These results are quite contradictory and hinder a clear answer whether usually adoption of ABC is beneficial for companies. However, these results show that there are many companies, for which the adoption of ABC is successful, and many companies, for which it is not successful. Therefore, it is crucial to identify the factors that determine when a company (respectively plant, product, process) would profit from ABC. These factors can be divided into two categories:

1. Factors related to the type of object (company/plant/product/process), to which ABC is applied. These factors are certain characteristics of the object that determine the costs and benefits from application of ABC to it. Here are included not only external features of the object (e.g. size of organization, type of industry), but also institutional factors (e.g. readiness of the organization to change).

2. Factors related to the way ABC is developed in a company. These factors are certain qualitative or quantitative characteristics of the implementation and operation of ABC. Even when a company, product, or process has features that make it suitable for ABC, it does not automatically guarantee the success of ABC. Important are also the processes of implementation and operation of ABC.

Here will be examined only the first group of factors. The factors in the second group are to a high degree object specific and are difficult (or impossible) to generalize. In addition, a company can count on consultants for a proper development of ABC. However, consultants might recommend ABC only to sell their service. In addition, as Nair (Nair, 2002, p.75) highlights in his analysis of ABC leaders, they often overestimate the benefits of ABC. That necessitates providing companies with a set a factors that would enable them to define whether or not they need ABC.

It was discussed in section 2.8 that ABC increases the accuracy of cost allocation by assigning production overhead costs to activities, based on the causality of these costs (cost drivers). This suggests two factors that are closely related to the benefits from ABC:

1. The amount of overheads. Companies that have above a certain ratio of overhead to total costs may benefit from ABC. However, according to Vokurka and Lummus, it may not be wise idea for companies with low manufacturing overhead or single product output to adopt ABC, because in this case the improvement in accuracy would not worth the additional costs for implementation of ABC (Vokurka & Lummus, 2001, p.40). Vokurka and Lummus conduct a study to determine above what proportion of overhead rate it is worthwhile for an organization to switch from conventional cost accounting to ABC. To answer this question, they examine four virtual companies, each of which produces the same five products. All parameters of the companies are identical, but the overhead costs are different (Vokurka & Lummus, 2001, p.40). The study concludes that it appears to be beneficial to adopt ABC in case the overhead rate is over 15% of the total costs. Roztocki (Roztocki, 1998) also highlights that high overheads increase the need of ABC.

2. The improvement of the accuracy of cost allocation. In case the cost drivers are volume based, then the traditional accounting would also result in accurate allocation and ABC would be less necessary for a company. In addition, if it is impossible to find only one cost driver that explains the cost behavior (the amount of overhead costs depend on many factors), then ABC would also not lead to an accurate allocation.

Except the overhead rates, Vokurka and Lummus (Vokurka & Lummus, 2001, p.47) mention a number of other factors that determine the outcome of cost-benefit analysis related to adoption of ABC. They consider as important (Vokurka & Lummus, 2001, p.47):

- The diversity and complexity of product lines and operations. Increased complexity increases the benefits from ABC, because many costs are related to a number of processes and products and traditional accounting fail to allocate them accurately. Evidence that this factor affects the financial performance is provided also by Cagwin and Bouwman (Cagwin & Bouwman, 2001, p.2).

- The size of the organizations. Big organizations have higher costs and therefore ABC can reveal higher cost savings.

- Expected time to implement ABC.

According to Gunasekaran, Marri, and Yusuf, ABC can be considered when a company does not perform well, and especially when it has low productivity, low profits, poor inventory turnover, poor delivery performance, and high level employee absence from work (Gunasekaran, Marri, Yusuf, 1999). Probably the argument here implies that in this case there are more reserves for improvement and this increase the chances of ABC to be successful. On the other hand, such bad performance can be indication of poor management, which would be incapable to use ABC. Bonice Limited is given as an example of a company with excellent management and performance, but at the same time revealing significant cost savings from improved environmental cost allocation (ACCA, et al, 2002, p.5-7). However, it seems that the authors of this example want to show that there is an exception of the general rule, implying that better cost allocation reveals more opportunities in poorly performing companies.

Gunasekaran, Marri, and Yusuf recommend the use of ABC in case of implementation of new manufacturing concepts and technologies when the company has poor capability to respond to customer demands in a cost-effective way. In addition, they find ABC appropriate in case of significant changes such as new business strategies and mergers (Gunasekaran, Marri, Yusuf, 1999).

Cagwin and Bouwman find evidences for correlation between successful ABC and the following factors (Cagwin & Bouwman, 2001, p. 2-3, p.10)[23]:

- Linkage to other initiatives. In case ABC provides information to additional systems, its benefits are more.
- Importance of costs. Increased cost importance has positive relation to successful ABC.
- Available sophisticated information technology has also positive relation.
- Unused production capacity in the organization has negative impact on ABC.
- Increased competition has positive influence on ABC[24].

Many authors highlight that the benefits of ABC are not in implementing it, but in the analyzing the results it provides (see, for example, Wolosky, 1998, p.29, Nair, 2002, p.73-74). That indicates the importance of another factor – the ability of the company to use the information provided by ABC. According to Nair, many companies failed in adopting ABC, because they lack the necessary approach and culture to benefit from ABC. According to Nair, no matter how valuable the information is, human perceptions about ABC can cause it to fail, because companies they lack an understanding of their incapacities and skills. Nair thinks, that often the understanding the people in the organization and their readiness and willingness to change determines the success of ABC. Before a decision is taken whether to implement ABC, it is crucial to examine the ability of the people in the company to respond and strive for outputs from ABC system (Nair, 2002, p.74).

Some authors (for example, Nair, 2002, p.76, Wolosky, 1998) agree that, an important factor that influences the success of ABC is the management involvement. According to Nair, the most common reason for the failure of ABC projects is the lack of support from the management. According to Nair, 90% of the examined case studies that do not succeed in ABC implementation prove this phenomenon (Nair, 2002, p.76). Therefore, although to a certain extend management involvement can be improved (e.g. through showing to management the importance of such involvement), it is necessary to examine management readiness to accept, and use new ideas and concepts for improvement. Nair thinks that such readiness could partly be examined through evaluation of the success of past change programs (e.g. total quality management) and if they were unsuccessful, then the chances ABC to succeed are low (Nair, 2002, p.76).

According to Nair, ABC is too complex for many managers. It can provide multidimensional information (e.g. profit per product, profit per channel, profit by region, etc.) but most managers are not ready to utilize it (Nair, 2002, p.74). Therefore, it is crucial before

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[23] Listed are only those factors, which have not been mentioned above.

[24] The same opinion about this factor is expressed by Rozotocki (Rozotocki, 1998).

implementation analyze the information needs of management – what factors they consider when taking a decision.

Dearman and Shields consider another factor that influences the potential benefits of ABC – the cost-related knowledge of the management. They provide evidence that when managers use information provided by traditional accounting (volume-based costing) and these managers do not have knowledge that this information is biased (e.g. they do not have ABC knowledge), they have poor cost judgment performance. However, if these managers have ABC knowledge, this increases significantly the quality of their cost judgment, because they are able to de-bias to some degree the information provided by traditional accounting (Dearman & Shields, 2001). This implies that the better the cost knowledge of the management, the lower the value that ABC adds. However, the weight of this factor (management cost knowledge) is probably not significant, because one should consider both, the additional efforts put by management to de-bias the information and the limited degree to which this information can be de-biased.

3.2 Environmental costs allocation – case studies

Studies that examine the use of EMA for better cost allocation by industrial companies are reviewed below. This review incorporate only those studies, found during a literature review, which include either:

- Conclusions about the factors, influencing the particular environmental cost allocation; or

- Information that allows drawing such conclusions.

Although, there are few publications (e.g., UN DSD, 1999) that mention companies that abandon the use of improved environmental cost allocation, neither reasons for such abandonment, nor any other reason for unsuccessful implementation were found during the literature review. Therefore the analysis of the factors, which determine the costs and benefits from better environmental cost allocation, can consider only the opinion of those who implement and/or review this tool. This decreases the reliability of the findings.

An example of a company that implements EMA to allocate better its environmental costs is Cormack Manufacturing (PWC, 2002). Cormack produces bottles and caps for the food, cosmetic and health industries. The main environmental costs of Cormack are related to waste, energy, and packaging. In Cormack, EMA was implemented at different levels: (i) business manufacturing unit; (ii) key manufacturing process; (iii) individual product. The new accounting system allocated many environmental costs, which were previously accounted for as overheads, directly to cost centers (PWC, 2002, p.1).

For example, at the business unit level, such costs centers are product cost centers (pumps, sport closures, etc.) and administrative cost centers (finance administration, manufacturing engineering, etc.) (PWC, 2002, p.12). At the business unit level, due to the improved cost allocation, Cormack identified a number of costs saving opportunities that also improve the environmental performance, such as: (i) reduction in packaging costs; (ii) improved order forecasting and inventory control; (iii) investment in a compressor with high energy efficiency. Significant improvement of the environmental cost allocation and identification of cost saving opportunities was achieved also at process and product levels. Cormack considers

these EMA experiments as very successful. Some of the main findings of this study are (PWC, 2002):

- Where possible, EMA should be integrated to the current management accounting and data collection systems;
- Management involvement is a critical factor for EMA success;
- EMA should incorporate only products/processes that may reveal significant benefits.
- Evolutionary approach should be adopted in implementing EMA – firstly only the priorities should be incorporated in EMA.
- Existing EMS makes EMA implementation much easier, since the most significant environmental impacts are determined and measured.

Another study (Shields, Beloff & Heller, 1996) examined the environmental costs of five major chemical and oil companies, which use EMA. Results show that companies use various cost accounting systems, but none of them uses ABC to account for their environmental costs. One of the companies, Ciba-Giegy, uses EMA (i) to define more accurately its product costs; and (ii) to provide the management with support for managing and controlling costs. The company uses detailed overhead accounting, which enables much more accurate product costing. This helped a company to compare the production costs of different facilities and revealed an opportunity for cost savings if the certain production shifts to other facilities (Bennett & James, 1998, p.172). However, this accounting does not provide the necessary information for controlling and managing costs. For these activities Ciba-Giegy uses other methods that are simple, but sometimes misleading. According to the experts that carried out the study, the EMA in the company clearly defines responsibilities and product costing, but it is difficult to identify the environmental costs and classify them into meaningful categories (Shields, Beloff & Heller, 1996, p.22-23).

The second company included in the study (International Refineries[25]) decided to have detailed environmental cost accounting to improve their reporting and provide management with information about environmental, health and safety (EHS) costs. Instead of implementation of ABC, they extended their current accounting, because it is easier and it does not risk disruption through implementation of a completely new system. The extension is of the product coding system by adding EHS product codes to it. EHS codes are in eight categories (e.g., safety, air, water). The new system tracks EHS costs by category, media, location, etc. It includes EHS penalties and fines imposed by regulatory institutions. When accountants input the data of the incoming invoices in the accounting software, they also indicate the related EHS code (if relevant) (Shields, et al, 1996, p.24). The authors of the study discuss many strengths of such system – its simplicity, the continuous and instant cost tracking by category, the availability of useful information to decision makers, the identification of responsibilities, the ease to extend EHS codes in case of change of the activities of the company, etc. On the other hand, the authors consider two main weaknesses of the system. The first is the difficulty to compare costs of different periods, because: (i) of the lack of distinction of recurring and non-recurring costs; (ii) EHS codes may be extended

[25] This is not the real name of the company - the company insists on confidentiality.

and overlapped with the previous ones. The second major weakness is the lack of tracing the costs back to their sources, e.g. the costs of incidents or incinerators would not be related to the causing activities or products (Shields, et al, 1996, p.25).

The third company included in the study (Specialty Refiners[26]) uses environmental cost accounting mainly to attach the environmental costs to the products and activities that cause them. The company uses the information provided by their conventional accounting and, when it is necessary, the accountant department or management manually prepare spreadsheets with environmental costs. The content of these spreadsheets depends on each specific need. Specialty Refiners can modify easily their accounting by using additional codes for product costs. Extensive information is available for investment decisions, since detailed data including all invoices is stored in a database. Among the mentioned advantages of the system are its reliability, flexibility (it responds to custom requests and can be modified), it provides relatively current information (the accounting in the examined company summarize monthly data), there is excellent monitoring of the costs of investments. However, some weaknesses of the system have been emphasized – it is manpower intensive and it requires user training, because the data is complex and difficult to manipulate (Shields, et al, 1996, p.26-27). The environmental cost accounting in the forth company (Grupo Primex) seems to be weak and it is not necessary to be discussed here; the fifth company did not participate fully in the study.

Another example of improved environmental cost allocation is Du Pont - the largest chemical producer in US. Du Pont has annual expenses for environmental protection over one billion USD. Environmental costs of the company were identified (these are mainly for waste management) and separated into fixed costs (that are the same at any production volume) and variable costs (that are proportionate to the production volume) (Bennett & James, 1998, p.185). The consequences of the change of the method for environmental cost allocation can be illustrated by the following example. Du Pont had two waste management alternatives – injection of waste in deep well or bio-treatment. Traditional accounting showed that the first alternative is cheaper and the company chose it, but later the improved cost allocation revealed the following results (Bennett & James, 1998, p.158):

Table 3-1

	Variable costs / unit waste	Fixed costs / unit waste	Total costs / unit waste
Deep well injection	0.08	0.01	0.09
Bio-treatment	0.05	0.06	0.11

Table 3-1 shows that the bio-treatment has higher costs per unit of waste, because of the high fixed costs per unit. However, an increase of the waste treated in this way would be cheaper, because the variable cost per unit is lower. Du Pont had to maintain bio-treatment at some parts of the company and the fixed costs would incur anyway (Bennett & James, 1998, p.159). Therefore, the improved costing method showed that the company made a wrong decision.

S. C. Johnson Wax (SCJ) is a large private company that provides chemical specialty products. SCJ decided to implement EMA in one of its divisions. As a part of this implementation, a sample exercise focusing on the environmental costs of one pesticide

[26] This is not the real name of the company - the company insists on confidentiality.

product was carried out by the researchers. It was estimated the portion of time of personal department that was spent on environmental activities. The overhead expenses were also analyzed. The analysis indicated several additional environmental related costs that were not captured by the accounting system, including fees, taxes, R&D projects, legal expenses, EHS expenses. In total, the costs that were not captured amounted to 50% of these that were captured. This may hinder potential product substitution with a cleaner one (Graff, et al, 1998, p.76-77).

Unifoil Corporation (paper coating company) experienced pressure from regulators and customers to undertake pollution prevention measures. As a way to examine different pollution prevention options, Unifoil decided to change the current practice of allocation of environmental costs to overhead accounts and to allocate them directly to processes that cause these costs. Several profitable pollution prevention opportunities were identified – (the major project lead to almost 400,000 USD annual savings) (Graff, et al, 1998, p.99-100).

A study (US EPA, 1997) examines EMA application in 24 electroplating facilities. The report of this study contains mainly findings that can serve as guidance for electroplating companies interested in EMA. Since the report is specific for one industry only, most of its findings are not transferable to other industries, but the methodology of examination of the facilities seems to be of general use. The part of the methodology that examines when it is suitable to apply improved environmental cost allocation is of interest in this section of the thesis.

According to the report of the study (US EPA, 1997, p.9), the major difficulty in applying EMA is the difficulty to allocate the cost to different processes when these costs are caused by a number of factors (with systematic and episodic nature). The study finds that allocation of some environmental costs would be very expensive process and can often overweight the benefits, unless this information is used for other purposes (US EPA, 1997, p.9). The study does not capture insignificant environmental costs, because it is assumed that the costs to capture them would most probably exceed the benefits. For this purpose a threshold of significance is adopted – only costs exceeding 0.5% of the gross annual revenues were gathered and analyzed (Bennett & James, 1998, p.213-214). In addition, the study focuses on these environmental costs, which can be reduced through pollution prevention activities. For example, in electroplating industry it is considered that the waste costs can be reduced through pollution prevention measures relatively easy, whilst electricity costs, although significant, are considered to be difficult for reduction (US EPA, 1997, p.18-22). It is recommended to use the best practice in the industry as benchmarking; so that costs that is likely to be reduced through pollution prevention can be identified easier (US EPA, 1997, p.43).

The case study of Sulzer Technology Corporation (Bennett & James, 1997, p.334) is useful to define to which cost object to apply environmental cost allocation. EMA project has been undertaken in Sulzer and in the project it is considered as very important to define the physical boundaries (cost objects) of EMA application. These boundaries can be, for example, individual process, group of processes, a system, a facility, a department, group of facilities or departments, a corporate division or the entire company. The authors of the study think that it is important to select cost object where the identification of physical and financial data would be easy. For this purpose they investigated cost objects where the current data collection is convenient. According to them, data gathering in single facilities is very convenient. They selected one of the facilities, because it is independent from the other facilities of the company (Bennett & James, 1997, p.334). Therefore, the ease to collect data

and the independence of the cost object are factors that facilitate improved environmental costs allocation.

The improved environmental cost allocation[27] in Sulzer revealed opportunities for significant cost savings by reducing waste and electricity consumption. These savings were identified, although EMA focused only on the main inputs, outputs (waste) and costs. The project developers recommend consideration of important items only, because they think that too detailed data can be confusing (Bennett & James, 1998, p.242-245) (and probably more expensive to collect). In addition, the authors highlight that EMA provides information and expertise that can be useful for eco-balances and EMS (Bennett & James, 1998, p.246).

At Zeneca (big UK company that produces pharmaceuticals, agrochemicals, and specialties) EMA project was undertaken to assess the costs for different waste disposal options in one of the departments. The full costs of waste (including purchase of raw materials, disposal cost and capital costs) were calculated and they amounted to approximately a half of the total product costs. That revealed the profitability of several waste reduction opportunities (Bennett & James, 1998, p.62-70). Based on the case study, the authors draw conclusions, among which are (Bennett & James, 1998, p.71-72):

1. Organizational factors are the major determinant of EMA success. It is considered that developing EMA at department level is a crucial factor for the success, because it allows constant involvement of project developers and good personal relations with the production staff. The authors think that developing EMA at corporate level, or involving sites at physical distance would make the improvements difficult or impossible to achieve.

2. It is much easier to develop EMA if most data is already collected. For example, at Zeneca, it was found that much of the data needed for EMA is being collected already.

An experiment with EMA has been carried out for one of the processes (carbonizing process) at Michell & Sons (Deegan, 2001). The authors of the study find that the information needed for improved environmental cost accounting already exists in the company. They highlight that this reduces the time and the costs for revising the existing accounting system. The study identifies also a potential obstacle for EMA - those who study the physical flows and those who account for them do not necessary communicate regularly (Deegan, 2001, p.26-27).

3.3 Analysis and conclusions about the factors that determine the level of accuracy of environmental cost allocation

The purpose of this section is to synthesize the results from the literature review in section 3.1 and section 3.2. ABC is the only method for environmental cost allocation, which is suggested by the reviewed EMA theory (see, for example, US EPA, 1995, Schaltegger & Burritt, 2000). As a consequence, the theory related to ABC was reviewed in section 3.1 to identify what factors make this method suitable for a company. It was shown, that often the costs of ABC exceed its benefits.

[27] The company also implement physical flow accounting and link it to the environmental cost accounting.

Section 3.2 includes information, which relevant to the research, from case studies. These and other case studies[28], which are a part of the literature review, show that almost none of the companies, which use EMA for more accurate environmental cost allocation, use ABC. Section 3.2 discussed the methods used by companies to increase the accuracy of environmental cost allocation, as well as the strengths and weaknesses of these methods. It is demonstrated that many companies (see section 3.2) use simpler methods to achieve some of the benefits of ABC (e.g. product costing, cost control, process optimization) at much lower cost.

The author considers that most factors that determine the need of ABC can also be used to examine what level of accuracy of cost allocation a company/plant/product/process needs. However, there are also some factors that are valid for ABC only. For example, only ABC uses non-volume based overhead allocation. In addition, the institutional factors reviewed in section 3.1 (e.g., management readiness and willingness to change) refer exclusively to the use of ABC, because other cost allocation methods do not require major modifications.

All cost allocation methods attach direct cost correctly, but they have different accuracy of allocation of indirect costs (overheads). Therefore, the amount of overhead costs, as discussed in section 3.1, is the most important factors determining the need of more accurate cost allocation. When this amount is negligible, the choice of cost allocation method is not important, because it would not change much the final product/process costs.

Another important factor that increases the need of accurate cost allocation is the high proportion of environmental costs in overheads, because (as discussed in section 3.1) the environmental damage costs are relatively easy to reduce and such reduction leads to additional benefits - reduction of contingent and intangible costs. Also, very important factor seems to be the high diversity of products and processes, because then (i) the cost allocation procedure has usually more stages and the accuracy decreases at each stage; (ii) it is more difficult for management to de-bias the information, because it is difficult or impossible to track and trace the costs. Important factor is weather other initiatives (e.g., EMS, JIT) would also profit from the increased cost allocation, because this can increase the benefits significantly.

It seems that the rest of the factors, discussed in section 3.1 and 3.2, are not so important. In conclusion, the need of accurate cost allocation depends on the following factors, classified according to their priority (see Table 3-2):

Table 3-2

Priority	Factors:
I.	1. High (in relative and absolute terms) overhead costs.
II.	1. High proportion of environmental costs in overheads. 2. High diversity of products and processes. 3. Linkage to other initiatives (EMS, just-in-time, etc) that would also profit from it.
III.	1. Low time (e.g., existing information, small system modifications) to implement the new system. 2. Available sophisticated information technology. 3. Poor performance – low productivity, profits, delivery performance, inventory turnover, etc. 4. Evaluation of new concepts and technologies. 5. Increased competition and importance of costs. 6. Poor cost knowledge of the management.

[28] Most of the reviewed case studies (e.g., Graff, et al, 1998, White et al, 1995, Reiskin et al, 1999), do not include information that can contribute to the research and consequently were not included in the thesis.

ABC is the most accurate cost allocation method, but also the method associated with most cost, because it requires much data and many changes. Therefore, the need of ABC should be examined, only if the factors in Table 3-2 show that a sophisticated cost allocation method is necessary. In addition, (as mentioned above) the need of ABC depends also on other factors. Moreover, it seems that ABC is the best choice only if all of the following factors are positive: (i) Management needs ABC; (ii) Management is ready, willing to accept ABC, and to strive for outputs from it; (iii) Management is able to analyze the information provided by ABC; (iv) Cost drivers are not volume based.

After determining the necessary level of environmental cost allocation, the next step is to decide how to achieve this level in best possible way. There are various approaches. The experience of some companies (see section 3.2) shows that:

- It is more important to allocate properly the environmental damage costs, then environmental protection costs.
- Environmental cost allocation is better to be developed evolutionary;
- It is recommended that the (environmental) cost accounting integrates with priority the existing information (e.g., from EMS).
- Usually, tracing the environmental costs back to processes and products is worth doing, when these costs are significant and have one cost driver, for which the information is easily available.
- Extending the conventional accounting by additional environmental cost codes seems to be associated with extremely low costs. It is simple and instant method to improve the environmental cost information and identify responsibilities. Therefore, probably this is the fist step that should be undertaken by companies that do not have EMA.
- Another method, which is relatively simple, but useful for decision making, is to divide the costs to variable and fixed.
- It seems that the need of a more advanced environmental accounting method depends on the purpose of the company (e.g. product costing, revealing cost saving opportunities, providing information for reporting, etc.). Therefore, the cost allocation method can be chosen to serve this purpose.
- The success of implementation of an advanced environmental accounting system can be evaluated by making an experiment with one plant, product or process that is independent and has well defined physical boundaries.

3.4 Factors that determine the need of TCA – analysis and literature review.

This section aims to identify the factors that determine the need of TCA. It includes analysis of the features of TCA and a literature review. The section includes only those findings from the literature review that can contribute to the research.

The four features of TCA, which distinguish it from conventional investment appraisal, were discussed in section 2.9. Analysis of these features is used here as the first step in identification of the factors that influence the need of TCA. A separate analysis of these features is justified, because they are independent from each other. Below, an attempt is made to identify the factors influencing the need to apply each of the features:

1. Better cost allocation. The related factors were discussed in section 3.3.

2. Taking into consideration extended set of costs – conventional, hidden, contingent, and less tangible and intangible costs. The necessity to take these costs into consideration would depend on both, their importance for the particular investment and the efforts to identify them.

    - Conventional (direct) costs are normally considered in all investment appraisals.

    - Consideration of indirect costs is very important, because (as discussed in section 2.1) they often represent more than 50% of the total product/process costs. It is also important how accurate is the allocation of these costs. The need of accurate allocation was examined in section 3.3.

    - Contingent must be considered when they are significant. However, in order to evaluate their significance, they need to be examined at least roughly. The accuracy of their estimation would depend not only on their amount, but also on the difficulty to estimate them and on the sensitivity of the investment decision to a little increase/decrease of costs.

    - Intangible costs. These costs also must be considered only if they are important. For this purpose, the sensitivity of the image and relationship of the company to the particular investment must be examined.

3. Expanding the time horizon of the investment analysis. Such expansion (including at least rough estimation of the additional costs and benefits) seems to be always recommendable, because it does not seem to require much effort, while it can provide better picture of the investment.

4. Taking into consideration the time value of money. It seems that considering the time value of money for investment appraisal is largely accepted in all contemporary investment appraisals. This requires minimum costs (time), but is valuable tool for comparing different investment options, and therefore is always recommendable.

The analysis of the TCA features can be complemented by relevant information from a literature review (see below).

In its attempt to promote pollution prevention among industries, US EPA conducted several experiments with TCA. Initially, TCA was tested in three projects (White, et al, 1991). One of the projects in a paper mill examined conversion from solvent (heavy-metal) to aqueous (heavy-metal free) paper coating. The company analysis of this investment concluded that it is not profitable (it has negative net present value). At the same time, TCA of this project showed that it is very profitable. It appeared that the conventional analysis did not include many important factors. The team that used TCA discovered additional capital costs and direct operating costs. It also found significant indirect (hidden) costs and potential liabilities

related to the current solvent coating. Indirect costs (potential savings) were related to waste management, utilities, pollution control, insurance, etc. Significant savings appeared from avoided liabilities related to the waste incinerator of the company (White, et al, 1991, p.54-62).

Another TCA experiment, conducted by US EPA, was for a water/paint separation at Metal Fabrication Company. Although many additional types of costs were not included by the own analysis of the company, TCA did not show much different results, because these costs were not substantial. The third TCA experiment was related to evaluation of byproduct recovery at Diversified Chemical Company. The own analysis of the company of this project included all types of costs, except future liabilities. By taking these liabilities into consideration, the project was slightly more attractive (White, et al, 1991, p.54-62). None of the analyses of the three companies or TCA included estimation of less tangible and intangible costs, because they are considered too difficult to evaluate. The main conclusions, made by the team that conducted the experiment, are (White, et al, 1991, p.79-80):

- The conventional analyses of companies do not consider a range of costs and savings, especially indirect and less tangible ones. This substantially weakens these analyses.

- When the product/process redesign is more upstream and fundamental, the project would benefit more from TCA, while downstream projects would benefit less from TCA.

- It is suggested that it is most likely TCA to have crucial significant effect on project profitability in a big manufacturing facility, producing consumer products, using a large volume and various hazardous materials, relying on off-site waste disposal, and applying elementary investment analysis. These factors are very important, but the authors of the study draw attention to the fact that these are only preliminary conclusions, based on a very limited number of case-studies.

Later, TCA has been applied in a number of projects. Many of them are summarized by Tellus Institute (Graff, et al, 1998). For example, in Polaroid, a project for a closed-loop batch still solvent recovery system was evaluated. TCA revealed two important factors that were not taken into consideration by the company preliminary analysis: (i) this project would increase the safety of one of the waste handlers; (ii) implementing this system would allow the company to produce (instead of buying from external company) at low cost a major product (Graff, et al, 1998, p.19-20).

An example of the importance of correct estimation of contingent liabilities is a project of a large manufacturer in the automobile industry for phasing out transformers that contain PCBs (Graff, et al, 1998, 86-87). The company has carried out an economic analysis, in which included all expenditures, intangible costs (reputation), and potential liabilities that would result in case of spill, rupture, or leakage. Later, a team was asked to use TCA for the project evaluation and this team revealed that the most significant cost are related to contingent liabilities in case of fires (this has not been not considered in the preliminary analysis) and spills. These liabilities were estimated, based on historical data. The team identified other costs that were not included in the original analysis – the costs of the other facilities of this vertically diversified company, which would result in case of spill or fire. TCA revealed much higher contingent liabilities (over 5,000 USD per transformer) (Graff, et al, 1998, 86-87).

An example for the importance of the intangible costs is a project in Majestic Metals for replacement of the conventional paints spray guns with low-pressure ones (Graff, et al, 1998, p.30-32). The low pressure guns are more efficient and they would reduce both raw material use and volatile organic compound (VOC) emissions from solvent evaporation. The project was approved by calculating raw material savings only. Later became apparent that significant intangible benefits resulted from it: (i) The project helped the company maintain its pollution prevention leadership role and it got two major new customers from providing publicity of their pollution prevention efforts; (ii) The worker health and productivity were increased (Graff, et al, 1998, p.31).

There are examples of companies that carry out TCA and consider less tangible and intangible costs qualitatively. For example, a metal parts manufacturer had several alternatives for CFC degreaser and chose to implement the one with more environmental benefits, although this was not the most profitable one (Graff, et al, 1998, p.33-34). Another example is a project for replacing the ventilation system in the plating area of SAE Circuits. The financial analysis of the investment showed that the investment was extremely unprofitable. However, the company approved the project, because of two reasons that were considered qualitatively: (i) the project would improve the worker health and productivity; and (ii) it would prevent potential future investments (liabilities) to comply with regulatory requirements – the company plan to increase its production and as a consequence the increased indoor pollution may lead to a regulatory action (Graff, et al, 1998, p.54-55). When examining a project for producing energy from biomass, Niagara Mohawk Power Company considers qualitatively some environmental benefits (less carbon dioxide emissions) that could result in better image and reduction of potential liabilities related to possible internalization of these effects (Graff, et al, 1998, p.61-62).

3.5 Conclusions about of the factors that determine the need for TCA

The case studies discussed in section 3.4 present a very small part of all applications of TCA in practice. Most of the case studies aim to demonstrate the necessity to apply TCA for investment appraisal, but they do not provide a clear answer what factors make TCA more or less necessary. It seems that the analysis of the features of TCA (see section 3.4) contribute most to the research.

It seems that the most important advantage of TCA, in comparison with conventional investment appraisal, is related to proper consideration of the overhead costs. This consideration depends on the allocation method. The factors that determine the need of accurate cost allocation were presented in section 3.3.

Many examples, where potential costs determine the outcome of the investment evaluation, are available in literature (some of them provided in section 3.4). At the same time, there are also many examples where the consideration of potential costs does not change the investment profitability. However, in order to determine the importance of these costs, it is necessary to estimate these costs at least roughly. The necessary accuracy of the estimation depends also on the difficulty to estimate them and on how important is to provide very accurate evaluation of the particular investment.

During the literature review, no example was found of a company that put monetary value on intangibles resulting from environmental investments, although improved environmental performance can lead to increase of the shareholder value (market price) of a company. Some

companies (see section 3.4) consider qualitatively these intangibles and they may have decisive role when the profitability of the different investment alternatives is approximately the same. It is necessary to consider these costs when the investment affects the image and relationship of the company. However, due to the difficulty to assign monetary value on these costs, probably qualitative consideration is justified.

As discussed in section 3.4, to consider an expanded time horizon and time value of money is always recommendable, because they are associated with very low costs, while the benefits from them can be significant.

4. Environmental Management Accounting at Trelleborg

The purpose of this chapter is to provide conclusions and recommendations about EMA at Trelleborg. These conclusions and recommendations result from comparison of:

- The current EMA at Trelleborg. The use of the tools of EMA (the tool for more accurate environmental cost allocation and the tool for better investment appraisal) are examined at Trelleborg at different organizational levels.

- The need of the company to apply the tools of EMA. This need is examined by identifying the value of the factors, identified in chapter 3.

The scope of this chapter is:

- EMA at Group level.

- EMA at Business Area Engineered Systems.

- EMA at 13 of the Trelleborg plants.

The main constraint to this research is limited information. Because of the large scope, limited time to collect data, no possibility to transfer results, the collected information is not sufficient for detailed analysis. In particular, most restricted is the information about the allocation of environmental costs (almost no accountants are interviewed).

The focus of the chapter is on environmental costs and benefits, but the analysis is sometimes extended to all EHS costs and benefits, because:

- The accounting of health and safety issues and their consideration for investments seem to be similar to those of environmental issues. In addition, sometimes one person at plant level is responsible for all EHS issues;

- There is a separate system within the company for collection of EHS data. These data is required together by the headquarters and is reported together in the Sustainability report of the company (Trelleborg, 2003d). Therefore, suggestions to change the collection and reporting of environmental data can affect also the collection and reporting of health and safety data.

4.1 Overview of Trelleborg AB

Trelleborg is a global industrial company that develops and manufactures products based on many applications of rubber. Trelleborg was founded in 1905. The head office of Trelleborg is in Sweden. At the end of 2002, the company had about 15,000 employees in 40 countries. In 2002, the net sales were 18 billion SEK. Trelleborg has four business areas (Trelleborg, 2003c):

1. Trelleborg Automotive - the biggest business area - accounts for more than a half of the sales of the company. Trelleborg Automotive produces noise- and vibration-damping systems for light vehicles.

2. Trelleborg Wheel Systems. Produces tires and complete wheel systems for heavy vehicles.

3. Trelleborg Engineered Systems. It develops and manufactures industrial hose systems, systems for sealing, protection, and comfort. These are based on polymer materials.

4. Trelleborg Building Systems. Produces sealing profiles, bitumen- and rubber- based products for water-proofing applications.

Each of these Business Areas consists of Business Units[29]. Business Units consist of plants.

The goal of Trelleborg is to achieve market leadership and economies of scale in the areas of R&D, production, marketing, and service. To achieve this goal, Trelleborg (Trelleborg, 2003c):

1. Focuses its operations on customer's needs. This is especially valid for customers in automotive and construction industries. The emphasis is in Europe and US.

2. Strives for leading positions within clearly defined product and market areas. Today, about 80% of the core operation sales are from products with leading market positions.

3. Has a decentralized organization, which is motivated and governed by clear objectives and unified reporting system, and is based on cost efficiency and common corporate culture and values.

4. Is strongly result-oriented through definition of clear and realistic objectives and systematically following and measuring the results.

According to Lars Olsson (2003, August 19) (financial controller at Business Area Engineered Systems), different plants at Trelleborg have different accounting. There are no requirements to different plants related to the type of accounting they have, but all plants are obliged to report identical information to the headquarters. The reported information should not only be classified in the same way for all plants, but there are also detailed guidelines to ensure that the information in each item has the same content (e.g. items include the same data and these data are processed accordingly). For this purpose, the data from the accounting systems is reconciled[30] (Olsson, 2003, August 19). These reports are prepared monthly and include mainly aggregated data necessary for the consolidated report of the Group[31] (Leijonberg, 2003, August 15). This reporting system, called Hyperion Consolidation System (further referred to as "Hyperion"), is the only one regular financial information system within the company. In addition, financial controllers can ask plants to provide

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[29] For example, business area Trelleborg Wheel Systems consists of four business units: (i) Agri and forest tires Europe; (ii) Tires Overseas; (iii) Tires America; (iv) Industrial Tires Europe.

[30] Sometimes the data provided by the accounting systems of different plants do not comply with the reporting requirements, because, for example, some plants are recently purchased and have not adapted their accounting yet, or due to different accounting legislation requirements in some countries. In this case, the data need to be reconciled, or in rare cases, when the differences are significant, even a second accounting system need to be established to provide the necessary data.

[31] The consolidated report is presented in Sweden and the data comply with requirements of Swedish legislation.

detailed information about some reported items, but such information is requested rarely – mainly when there are significant changes over time (Leijonberg, 2003, August 15).

4.2 Environmental activities and costs at Trelleborg

EHS activities within Trelleborg are decentralized and based on the specific conditions at each plant. The main EHS responsibilities are borne by plant managers. The major environmental impacts of the company are attributable to the use of energy, water, raw materials, chemical products, emissions to air, noise, solid and liquid waste (Trelleborg, 2003c).

The environmental objectives adopted in 2002 are mainly related to introduction of ISO 14001, EHS training, energy and water saving measures, waste reduction, increased recycling of rubber waste, improvements of work environment, and reduction of atmospheric emissions (Trelleborg, 2003c). In the middle of 2003, most of the plants have implemented ISO 14001 and the aim of the company is to certify all plants. Certified EMS is demanded increasingly by customers, particularly by customers in the automotive industry (Trelleborg, 2003b). The chemical industry (to which the company belongs) is widely believed by the public to be highly polluting (Limperg Instituut, 1996, p.15) and probably EMS at Trelleborg is an adequate demonstration that the environmental issues are taken seriously.

In 2002, the EHS expenditures of Trelleborg are 73 M SEK. The main part of them is for waste management and administration. EHS investments are 68 M SEK. Half of them are improvements to work environment, and the other half are environmental improvements, mainly related to air-cleaning equipment and waste-water treatment. Detailed information about EHS costs is presented in Appendix 3 (Trelleborg, 2003b).

Hyperion (the financial system within the company) does not include any information about environmental costs and benefits. According to Leijonberg (2003, August 15) (a financial controller at Group level), it would be interesting to compare environmental costs of different plants. He considers that these costs can be followed by their inclusion in Hyperion or by establishment of a separate information system.

According to Leijonberg, normally plants have environmental cost centres, but the accounting for environmental costs varies significantly among plants. Some plants have environmental departments consisting of several persons and normally there the environmental costs are accounted for and analysed in more details. In contrast, in other plants, not much attention is paid to environmental issues (e.g., where the only responsibilities for these issues are borne by the production manager) (Leijonberg, 2003, August 15).

The consideration of environmental costs depends also on the level of sophistication of the accounting system of each plant (Leijonberg, 2003, August 15). At some plants, these costs may be incorrectly allocated to processes and products. Since there is no manual for environmental cost treatment within the company, these costs are sometimes allocated to production overheads, or to administration overheads.

The only EHS costs reported by plants to the headquarters are required annually by the Trelleborg vice-president responsible for the environmental affairs (Leijonberg, 2003, August 15). The reporting of these costs is not a part of Hyperion and is established mainly to

provide information for the sustainability report of the company. Each report includes (Trelleborg, 2003a):

- EHS investments during the current year, classified by environmental media;
- Planned EHS investments during the next year, classified by environmental media;
- EHS expenditures for: (i) administration; (ii) fees; (iii) fines; (iv) waste handling; (v) ISO 14001; (vi) external services;
- Expenditures for water, fossil energy, and electricity;
- Total amount of environmental savings.

In addition to the information, reported to the headquarters, plants present their budget to the respective business unit. This budget includes also information about the environmental costs of the plants (Leijonberg, 2003, August 15).

The level, where an investment request is approved, depends on the size of the investment. The investment approval is at plant level (for small investments), at business unit level, at business area level, or at Group level (for the most significant investments). According to Leijonberg, there are mainly two types of investments:

1. Investments where the pay-back period is considered.
2. Investments forced by legislation (e.g., environmental compliance). These investments have to be approved to avoid legal problems, which, in some cases can result in closing down the plant.

At Trelleborg, the costs are allocated at plant level (depending on the accounting method at each plant) and therefore it is necessary to be examined at each plant individually. Investment decisions are taken at all levels of the company (plant, business unit, business area, and Group level) and therefore, it is necessary to examine investment appraisal methods at all of these levels. The following sections of the chapter include: (i) brief review of EMA at 11 plants; (ii) relatively detailed examination of EMA at 2 plants; (iii) examination of EMA at business area Engineered Systems; and (iv) EMA at Group level.

4.3 EMA at plant level

This section presents briefly and analyzes results of a questionnaire about the environmental costs at plant level at Trelleborg. The purpose of the questionnaire is to get information about: (i) EMA at plant level, (ii) the opinion of the environmental coordinators about the used EMA, (iii) the degree of knowledge and communication of environmental– financial information. The questionnaire was sent to 27 persons (from different plants) who are responsible for the reporting of environmental information to the headquarters. 11 responses have been received. All questions and answers, given by the respondents, are presented in Appendix 5.

At about a half of the plants, the accounting system generates all or almost all of the environmental cost data (see Appendix 5 - question 1). In most of the other plants, the

accounting is one of the several information sources. At two plants, the accounting does not provide any environmental cost data. Some of the answers, where the accounting system is not the main data source, indicate that significant work is required to calculate the environmental costs, mainly from primary data. At these plants, if the environmental cost data is important and is needed regularly, it can be integrated in the accounting system.

The recipients of the environmental costs information include a broad circle at all plants. Therefore, it seems that the environmental cost data is well communicated. However, much more data is necessary to draw firm conclusions here.

The accounting system provides detailed enough environmental cost data at most plants. At some plants, (some) environmental costs are not accounted for as such. At others – the level of details is not sufficient – at these plants the environmental coordinators can consider higher demands to the accounting. One of the respondents (see, Appendix 5, question 3-a) indicates an important problem – the decisions concerning product design are taken at higher corporate levels, but these decisions do not consider properly the environmental costs of a product (which can be measured at plant level only).

Only at three plants, the environmental costs are broken down to products and processes (see Appendix 5 question 4). Availability of data about the (environmental) costs of products and processes indicates the sophistication of the environmental cost allocation method. It can be examined if a sophisticated cost allocation method is necessary at each plant, by using the factors, identified in section 3.3.

The next question (see Appendix 5 question 5) refers to particular environmental cost data – those requested for the Sustainability report of the company. The answers show that most plants do not rely on estimates or use very little estimates. The data comes mainly from the accounting system. However, as indicated by the answers of questions 1 and 3, much of these data is not readily available - it is collected from a number of other accounts or individual invoices.

The expenditures for waste management are the most significant environmental expenditures of Trelleborg (see Appendix 3). Nine of the respondents of the questionnaire (see Appendix 5 question 6) consider these expenditures significant at their plants. At almost all plants, there is available information about the full costs of waste, including disposal fees, cost of wasted materials, etc. This shows that all aspects of waste costs are considered at the examined plants and a potential project for waste reduction can be evaluated easily. Information about the waste, caused by each process, is available at most plants, where the waste costs are significant. However, at two plants with significant waste costs, such information does not exist. Identification of the reason and quantity of the waste costs is the first step to reduce them and perhaps more detailed measurement is necessary.

At about a half of the plants (see Appendix 5 question 7), environmental costs are not sufficiently considered, when investment decisions are taken. Investment appraisals are among the most important activities and accurate enough information that considers all aspects of the investment is necessary. The answers to this question indicate a serious problem. Much more attention is necessary to be paid to investment appraisals.

It seems (see Appendix 5 question 8) that the monitoring of future environmental regulations is excellent and this may save significant environmental costs in future. Only one plant does

not monitor this legislation. One of the responses recommends such monitoring by those who develop the product design.

Potential environmental liabilities that result from legislation changes are considered at most plants (see Appendix 5 question 9). However, it is not clear why some do not consider these changes, even when they are regularly updated about them (as indicated at the previous question). Also, it is not clear how some plants consider them without having information about these changes (as indicated at the previous question).

The responses to the questionnaire show that the situation is very different at each plant and they must be examined individually. General conclusions and recommendations, based on statistical data from the questionnaire, are inadequate.

The respondents provided very informed answers and this show their excellent knowledge about the available information within the plant, the way this information is collected and used. The respondents were able to identify many problems.

There is no common recipe for each plant. Each plant ought to find a solution individually, depending on its specific circumstances, because the local management know its business best. Headquarters can only ensure proper education of the management – to make it aware of the importance of using EMA tools.

Later, the consideration of EMA at 2 plants is examined in more details.

4.4 EMA at Värnamo site

This section examines EMA at one of the plants at Värnamo site, Sweden. The examined plant belongs to the business area Building Systems. The plant is certified according to ISO 14001 and it has an environmental and safety manager - Per Tevebring. The plant produces rubber profiles and rubber sheets for industry and consumers.

The main environmental aspect of the plant is rubber waste. Over 5% of the production does not meet the quality requirements and results in waste. The waste is sent to incinerators and the plant has significant costs for it (Tevebring, 2003, August 26). Tevebring recognizes that these costs are only a small part of the real cost of the waste, which include the costs of all wasted materials (expensive chemicals), labour cost, operating costs, etc. According to both, Per Tevebring and Louise Ahlander - financial controller (Ahlander, 2003, August 28), the costs of wasted materials are well defined and there is information about the costs of waste, including disposal fees and wasted materials. Moreover, according to Ahlander, the costs of wasted materials can be allocated down to each machine and process causing the waste, although the accounting does not use ABC method. Ahlander considers that there is very good tracking of all material waste costs and this provides useful information to evaluate savings of a potential project for waste reduction.

Despite the high rubber waste costs, Tevebring (Tevebring, 2003, August 26) claims that there is no possibility for waste reduction. Most of the waste is caused by defect production of the machinery and the rest – by a personal mistake of the machine operators, when they

mix the chemicals[32]. Tevebring considers that there are no better technologies and therefore examination of waste reduction investments is not relevant.

The other main environmental aspect is polluted water from cleaning of chemicals that are spilled on the floor by the operators of the machines. According to Tevebring (Tevebring, August 26), the spilled quantities are minimal and are therefore associated with only minor costs. More costly is the process of their daily cleaning. The open processes of manual mixing of hazardous chemicals is causing indoor pollution and there are sometimes (although seldom) health problems resulting from it[33].

According to Tevebring (2003, August 26), other environmental aspects and costs are not significant. The accidents are seldom and their nature is usually mechanical. Tevebring assures that new machines are analysed by experts to evaluate their safety and sometimes - environmental performance.

Tevebring (2003, August 26) reports the environmental costs and savings to the headquarters (these data are used for the Trelleborg sustainability report). However, most of the reported data, according to Tevebring, is not available in the accounting system. These data are normally estimated, but some of it is collected from individual invoices. Estimation is made by him or the production manager. According to Tevebring, it would be useful if this data existed in the accounting system. According to Ahlander (Ahlander, 2003, August 28), for the accounting for the environmental costs there is an environmental cost centre, which includes administrative costs for personnel working with environmental issues, and other overhead costs concerning both plants in Värnamo. In addition, as Ahlander states, within the production cost centres there are accounts for indoor environmental costs.

According to Tevebring (2003, August 26), the investment decisions within the plant are based on pay-back period unless the investments are required by the legislation. Only small investments can be approved by the plant manager. For bigger investments, a group, which includes an engineer, an economist, and other relevant experts, proposes an investment request to the managing director of the business area Trelleborg Building Systems. The investment request for approval at Business area level is standardized for all types of investments[34]. The requisites on the request form show that before the request is sent to the business area manager, the investment should be approved by the financial manager, production manager, and division manager. In addition, it should be signed that the environmental consequences are analysed (probably for compliance with the legislation). There are no requirements to provide these consequences and this implies that they are not incorporated in the investment decision taken at higher corporate levels. On the other hand, detailed financial data is required, including description of the overhead costs involved. However, if the environmental costs are not incorporated in the investment appraisal of the plant, they cannot be considered also at a higher level, even qualitatively.

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[32] Machine operators are motivated to make fewer mistakes by linking the amount of waste to their salary.

[33] In this case, for example, an investment decision to capsule this processes and make them automatic can consider savings from: (i) spilled chemicals; (ii) waste due to personal mistake; (iii) costs for cleaning the floor; (iv) costs for ventilation, (v) direct costs for damages on workers health; (vi) indirect health costs (lower productivity, lower worker retention); (vii) payment to the workers, who mix the chemicals; (viii) avoided potential liabilities if the related legislation become more stringent; (ix) avoided costs for supervision, documentation, maintenance of ISO14001, EHS management administration.

[34] A copy of the investment request form has been observed by the author.

In addition, the criteria for investment approval are not always clear at the plant level. Tevebring (2003, August 26) provided an example of an investment request that was sent for approval to business area level. Although the investment leads to significant energy and water savings and it has pay-back period less than two years, it gained approval five years after the request was submitted - this prevented significant savings during this period.

According to Tevebring (2003, August 26), the fact that the company is certified according to ISO 14001 is sufficient evidence for an excellent environmental performance. He considers that in case the company has ISO 14001, further improvement of the environmental performance would not lead to additional benefits. Therefore, it is not relevant to consider intangibles in the investment appraisals. However, potential liabilities, according to Tevebring, should be incorporated in the investment appraisal, not only because of the possibility of legislation change, but also because the municipality sometimes requires improvement of the environmental performance when there are meetings of the representatives from the plant with the municipality (3-4 times per year).

In conclusion, the cost allocation method at the plant is considered to be sufficiently good. The need of accurate environmental cost allocation is relatively high, because: (i) the amount of environmental costs is high, (ii) it was observed that there are a number of products and processes at the plant, (iii) there is EMS that can also benefit from accurate and detailed environmental cost information, etc. The existing system, as reviewed above, meets these requirements.

On the other hand, the communication of environmental cost information can be improved, because examples were found that these data is estimated even when it is available.

Investment decisions taken at plant level consider most environmental costs properly. The important conventional and hidden costs are considered. More emphasis is necessary to be put on contingent costs, which can result from legislation change. Other contingent costs and intangible costs are not significant for the plant.

4.5 EMA at Material Department, Trelleborg site

This section examines EMA at the Material department of the Trelleborg site, belonging to business area Trelleborg Wheel Systems.

According to Per Nilsson (Nilsson, 2003, August 27), environmental and quality manager[35], the biggest goals of the department are reduction of waste and energy costs. The waste is important, although wasted materials are only 0.24% of the input. About 95% of all waste is rubber. The disposal fees of the waste that goes to landfill are highest. The reasons for the waste can be many – forgotten input of chemicals by the responsible person, machine problems, etc. However, it is not followed within the department which is the exact process or person, responsible for the waste. Nilsson recognises that the quality problems are also environmental problems, because the production rejects are waste.

According to Nilsson (2003, August 27), the disposal costs are followed monthly. For each type of waste, the following information is available for: (i) number of containers for each

[35] He is also responsible for the technical materials. He is one of the four persons at the department dealing with environmental issues.

type of waste; (ii) rent costs per container; (iii) place where the waste occur; (iv) tons of waste; (v) destination of the waste (e.g. landfill or incinerator); (vi) disposal fees per container (dependant on the destination and type of waste); (vii) total waste payment. There are also figures for the full cost of waste – including disposal costs and the costs of wasted materials.

Nilsson (2003, August 27) mentions some initiatives for reduction of waste costs. Some of the waste is sold to other companies and this generates income. Increasing amount of waste is incinerated at the new incineration facility at Malmö, but further increase is impossible, because some waste rubber cannot be incinerated.

Investment decisions, according to Nilsson (Nilsson, 2003, August 27), can be taken by many people, depending on the kind of investment and its amount. If the investment is within the budget of the responsible manager, he can approve it. Otherwise, the request is sent for approval at higher level. Nilsson believes that in investment decisions, it is considered that environmental costs would increase in future due to legislation change.

The accounting of the department uses ABC and this is the only accounting used within the department (Samuelson, 2003, August 27). However, not all costs are allocated to products based on causality principle. For example, according to Nilsson (2003, August 27), the depreciation of the cleaning equipment is allocated to all products based on the price per kilogram, although, as he recognizes, the reason for this is the use of certain chemicals. Similarly, as Samuelson (Samuelson, 2003, August 27) states, the cost of accidents is allocated to all processes and products, although only one process causes it. Usually each overhead account includes several types of costs and these are allocated together to activities and products. There are three calculation modules – for purchase, production and sales. Each module calculates and allocates the costs to processes and products. This forms the final product and process costs (Samuelson, 2003, August 27).

Nilsson (Nilsson, 2003, August 27) considers that the choice of chemicals is evaluated very carefully. Trelleborg has a special chemical committee that examines whether all aspects of chemical substitution are considered. The profitability of each chemical, process, and product is examined regularly at the department.

The department use an excellent accounting, which is able easily to adjust to the management needs. Currently, the allocation of some environmental costs is not very accurate and these costs are not defined for each process, but the reason for this is the insignificance of these costs. The author is convinced that the imperfections of the accounting are well-known and the information is successfully de-biased. In addition, the author is convinced that the investment appraisals within the department are highly qualified, and that they integrate the necessary technical, financial, and environmental aspects.

4.6 EMA at business area Engineered Systems

This section examines EMA at business area level, based on an interview with Lars Olsson (2003, August 19) - financial controller at business area Engineered Systems.

According Olsson (2003, august 19), the decision for approval of significant investments is taken at business area level[36]. Investments are classified into different categories – they can be

[36] In case the investment is very significant, the decision for it is directed to headquarters.

forced by legislation (then their profitability is not examined) or they can be driven by financial benefits. However, seldom investments belong to one category only. According to Olsson, environmental issues become increasingly integrated in all processes and it is difficult to separate them. Often non-environmental investments have environmental impacts or environmental investments are combined with efficiency improvements. Investments that belong to one environmental category only, according to Olsson, are end-of-pipe measures. Such measures are forced by the legislation and do not lead to financial benefits. He considers as preferable efficiency improvements, which lead also to financial benefit. However, he considers difficult to obtain information from the financial system about the savings that are related to the efficiency improvement (pollution prevention) investments.

According to Olsson (2003, August 19), environmental considerations are included in the evaluation of all major projects within the business area Engineering Systems. He thinks that there is awareness of the increasing environmental legislation demands. Also, he thinks that it is recognized within the business area, that the best solution is to incorporate these demands at an early stage - when investment decisions are taken – rather than making changes after the project is implemented, which is usually more costly. According to Olsson, at the business area level, environmental benefits resulting from investments are considered qualitatively - when a choice is made between two alternative investments with similar pay-back periods, then environmental factors are determinant.

Olsson (2003, August 19) indicates that often the production technology within the business area does not vary significantly among plants and in these cases the improvements are transferable. This is facilitated by the good dialogue among the plants within the business area. In general, according to Olsson, best available technique that is economically feasible is implemented in all plants within the business area, despites the lower legislative requirements in some countries; this prevents treat of change of emission limits.

According to Olsson (2003, August 19), the plants within the business area have environmental cost centres. Moreover, he believes that the EHS information that the plants report annually (see section 4.7) is properly accounted for and is available in the plants. On the other hand, he recognizes that there are no requirements to the accounting systems of the plants, there are only requirements regarding the reported data in Hyperion. Taking into account the differences between the accounting systems of the plants, it is not clear whether or not they account for their costs accurately. Olsson emphasizes that consistency over time is more important than complete accuracy. He considers that consistency allows revealing improvements.

Olsson (Olsson, 2003, August 19) thinks that plants should not be asked to report details, because the collection of detailed data is time consuming. If details are necessary, for example for environmental costs, he recommends that the environmental manager makes a definition of the costs needed and the accounting system respond to these needs.

The most common EHS investments of the business area are related to improvements of work environment, such as taking away monotonous tasks by their automation, capsulation of processes to improve the health of the workers, etc. Among the environmental expenditures, the most significant are for waste management. Olsson considers that the environmental accidents are very unusual (and therefore these costs are low) not only in the business area, but in the Group as a whole. He highlights that among the chemical industries, the rubber industry is one of the safest in this respect (there are almost no exothermic reactions) and that most of the accidents are mechanical (Olsson, 2003, August 15).

The information, provided by Olsson, indicates that the investment decisions within business area Engineered Systems (at the business area level and at the plants within this business area) consider fully the environmental costs, including contingent and intangible costs. Contingent costs from possible legislation changes are sufficiently considered, other contingent costs (accidents, etc.) are negligible, and intangible costs are considered qualitatively.

4.7 EMA at Group level

This section examines the consideration of environmental costs in investment appraisals at Trelleborg Group level. At this level, investment decisions are taken about the biggest projects of the company. The section is based on information provided by Ivar Leijonberg – financial controller at Group level.

Due to continuous losses, Trelleborg wants to sell a plant, purchased some years ago. No environmental costs were considered to incur in relation to this sale. The land of the plant has been contaminated before the purchase of this plant by Trelleborg. Surprisingly, it has been found that the legislation does not allow selling a plant with contaminated land. The cleaning costs were estimated to be over 20 M SEK. Because of the substantial amount of environmental costs, the vice-president, responsible for environmental affairs, was involved in the project. He is the only person who follows environmental costs at group level. Involved in the project were also the environmental manager of the plant and one of the accountants (Leijonberg, 2003, August 15).

This example shows a consequence of overlooking potential environmental liabilities (legal obligation to clean the contaminated land) when the plant has been purchased. Recently, measures are taken to prevent such mistakes in future. There are detailed instructions within the company[37] how to carry out due diligence. Today, before purchasing of a plant, the existing contamination is investigated. When the legislation of the country, where the plant is situated, does not oblige the plant to clean it before the purchase, it is ensured that Trelleborg will not be responsible (in case of changes in legislation) for cleaning of contamination caused by the previous owners. Currently, when considering projects for new plants, environmental issues are very important, with an emphasis on the environmental costs resulting from the current or possible future environmental legislation (Leijonberg, 2003, August 15). According to Leijonberg, expected environmental legislation changes are well communicated within the Group on meetings for environmental issues.

According to Leijonberg (2003, August 15), consideration of the biggest projects at Group level guarantees their quality. It seems that today the environmental costs are well considered when plants are purchased. It is also important to examine how these costs are considered in other projects at Group level.

4.8 Discussion

Previous sections include conclusions and recommendations. This section provides some additional discussion.

[37] Including instructions on the home page of Trelleborg in Internet: www.trelleborg.com

Different plants have different accounting. It cannot be expected that the accounting of all plants provide any common information, except the data reported in Hyperion. Since no environmental information is included in Hyperion, every plant decides independently how to account its environmental costs (also health and safety EHS costs) – whether to account them in an environmental cost centres or to accumulate them in overheads together with other costs. The level of details of this information and the way of allocation can vary significantly among plants.

It seems that the environmental cost data, requested by plants annually, is used only for the Sustainability report of the company. In this case, the data does not need to be accurate[38], because the accounting of each plant is adjusted to the internal needs and the legislative requirements. Changes can be made only when necessary. The author considers that external reporting of the information does not justify changes of the accounting. Proper internal consideration of the information is much more important than its external reporting[39]. If the data is used only externally, no requirements for proper collection are needed. The current system for annual collection of the information is probably the best solution for it.

The accounting must provide the necessary information for the consideration of the EHS costs at plant level. However, since these costs are different at the different plants, they should be accounted for differently, by taking into consideration their importance. For example, a plant that has significant waste costs may need detailed information for each type of waste, to allocate these costs down to each process and product, and to calculate the full costs of waste, whilst a plant with negligible waste amounts and costs may have only one overhead account for waste costs and to allocate them to products at random basis. The way of accounting of EHS costs can best be decided at plant level, by considering the needs of the environmental, technical, and financial personnel. The author thinks, therefore, that common EHS data should be requested by headquarters for external reporting only. The control of the accounting and the consideration of EHS costs do not require standardized accounting by all plants.

In addition, probably accountants should be obliged to provide these data[40], because:

1. Examples were found that even when the data exist in the accounting system, it is still estimated by environmental managers and these estimations sometimes differ many times from the real figures. Other mistakes, such as indicating the numbers in thousand USD, instead of in USD, or not understanding the difference between expenditure and investment, were also found. This significantly decreases the quality of the reported information. In general, accountants have better skills to report the financial data, because they know where it is located and how it is collected (which helps to reconcile, if necessary).

2. When accountants are obliged to provide the data, they would have an incentive to integrate it in the accounting system. It is not justified to oblige plants to have the

[38] There are no regulatory requirements about the quality of the reported data in the sustainability report. Best estimates of these data are (according to the author) accurate enough to meet the needs of external stakeholders.

[39] For example, if the costs of waste are estimated wrongly, e.g., the mistake is 100 000 SEK, it is not likely that this mistake would be material (able to change the decision) for the external decision maker. However, if this data is not considered properly for internal decision making, it may hinder revealing the real profitability of a waste reduction opportunity.

[40] Currently environmental managers provide it.

requested data in their accounting system, because in some cases it would be related to significant restructuring of the system and the data would be not consistent[41]. However, when such incorporation is easy, the accountants could do it.

It is not clear how the environmental aspects are considered at higher level – business unit, business area and Group level. For example, there are almost no environmental experts at higher levels of the company. In addition, plants provide very limited information to the higher corporate levels, when investment approval is requested. That hinders consideration of many aspects that can reflect on the environmental costs.

All interviewees mentioned that the investments are evaluated based on pay-back period. However, this indicator does not consider the life-span of the investment. It was indicated in section 2.9, that the environmental projects usually have longer life than other projects. Consequently, the applied evaluation method shows environmental investments less profitable than they really are. Considering NPV of the investments would prevent this mistake. In addition, dividing the investment into two groups: (i) considering the pay-back period; and (ii) forced by the legislation, hinders adoption of pollution prevention measures, which are not as profitable as other investments, but would prevent future costs due to regulation requirements.

[41] The consistency of the data over time is very important for both internal control and compliance with financial accounting legislation.

5. Reporting of environmental - financial information at Trelleborg

5.1 Literature review

As discussed in section 2.2, EMA is a tool for internal decision making. EMA provides more accurate information for the product/process costs reveals the "real" profitability of pollution prevention measures. It is important that EMA is not designed for external reporting – establishing EMA is a difficult and costly process (see section 3) and a part of its information is not useful for external stakeholders (e.g. accurate product/process costing, less tangible and intangible costs). On the other hand, this does not imply that EMA cannot be used to increase the quality of the external reporting.

There are certain trends in the financial accounting legislation related to disclose of environmental-financial information. For example, in future IAS is expected to include special requirements for disclosure of environmental costs (especially fines, penalties, pollution permits, and emission rights), recognition of provisions for these costs, etc. (FEE, 1999, p.1).

Therefore, in future it is expected that companies will be obliged to disclose (and therefore, to use standard definitions and account for) environmental – financial information in more details. All main accounting standards setting bodies (such as IASC, ACCA, FASB) are planning to set certain requirements for more detailed accounting and reporting of environmental information, including environmental – financial information (ACCA, 2002). In a publication of ACCA (see, ACCA, 2002) are discussed the most recent national and international trends of both accounting legislation and practice, regarding social and environmental issues. Any other changes (except the planned ones) are not likely to occur in near future, because of both, the conservatism of the accounting profession and the long procedures before incorporating the changes in the legislation.

Companies should take these trends into consideration, in order to be prepared for the forthcoming changes. A proactive company would go even further, beyond the regulatory requirements, and try to satisfy the information needs of its external stakeholders when they are recognized. The Global Reporting Initiative (GRI) provides guidelines to companies to report not only financial, but also social and environmental information (GRI, 2002, p1). This extended report, called sustainability report, has much larger audience then the financial report. According to GRI, the main purpose of sustainability reports is to satisfy the information needs of this broad audience (GRI, 2002, p.16) and further, this section examines what environmental- finance information the external stakeholders of a company need.

According to Ian Ash, BT's Director of Corporate Relations, there is no clear value of reporting financial information related to environmental issues. He comments that inclusion of environmental – financial information in the reports of the company on the surface sounds sensible, but in fact it is not, because (Doyle, 2003):

1. There are not standard accounting rules for reporting environmental costs and benefits; According to him, most activities are related to be both direct and indirect costs and savings. However, if only the direct ones are reported, this information

would be misleading. For example, the use of recycled paper for photocopying can reduce total paper costs, but it can also increase costs of maintenance of the copier.

2. It is not clear how environmental-financial data would be evaluated. As an example, he raises the question, how would high environmental costs be interpreted - would they be seen as a sign of environmental commitment, or as a symbol of an earlier failure to consider environmental issues into the planning process. Ash considers that there are many hidden issues in the financial data on environmental performance. This hinders the interpretation of these data and therefore their reporting is not useful.

GRI does not provide guidance of the components that reported environmental costs[42] and benefits should include. However, the "transparency" principle of GRI requires full disclosure of all processes, procedures, and assumptions in report preparation (GRI, 2002, p.24), and therefore an organization must specify exactly how it defines as environmental costs and benefits, to what degree these costs and benefits are captured by the accounting. The European Federation of Accountants (FEE) also emphasizes that when environmental costs are disclosed, it should be explained also the way in which such costs are identified, to ensure that comparisons between organizations would not result in misleading conclusions (FEE, 1999, p.2).

Therefore, the first step is to ensure that the disclosure of environmental costs is transparent and detailed enough. However, this is not enough to make this information meaningful for external stakeholders, because they do not understand whether these costs are necessary – the stakeholders lack information regarding environmental and/or economic benefits to which these costs lead. According to Wennberg, it would be good if the report contains information about the efficiency and effectiveness of the environmental costs (Wennberg, 2003, August 12). She suggests comparing environmental costs and the related savings. Since some environmental costs lead to long-term savings, the value of the reported information would increase, if it includes also (Wennberg, 2003, August 12):

- The savings and cost avoidance[43] realized during the current year as a result of environmental investments during previous years;

- The savings and cost avoidance anticipated during future years as a result of the environmental investments during the current year.

Such information can be useful for investors and environmentally oriented readers, and can be provided for projects related to (Wennberg, 2003, August 12):

- Waste reduction (contemplating higher prices of raw materials);

- Energy savings (contemplating higher energy prices);

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[42] The term "environmental costs" (as used also in the previous sections) refers to environmental expenditures (costs for the current period only), environmental investments (costs for non-current assets) environmental liabilities (future costs).

[43] Cost avoidance is the difference between the environmental expenditures of the previous year and the hypothetical amount that would have been spent this year, if the environmental costs increase/decrease at the same rate as production volumes. Compared to cost saving, which is the difference between the costs of the current and the previous year, cost avoidance demonstrates in a better way the real effect of the initiatives undertaken during previous years (Bennet&James, 1998b).

- Product design, when it considers recycling and re-use (contemplating future Extended Producer Responsibility);

- Reducing greenhouse gasses (contemplating regulations related to Kyoto Protocol).

Reporting information about such projects would give better picture for the sustainable strategy of the company and can be indicator for cost efficiency. For example, GRI discusses how waste minimization programs and sale of waste can result in cost leadership (GRI, 2002, p.69). However, the main accounting standard setting bodies do not seem to plan disclosure of the benefits (cost savings or revenues) related to the environmental costs, although such information can be interesting to different stakeholders.

Guidelines for disclosure of environmental accounting information are provided by the Ministry of Environment – Japan (MEJ). These guidelines suggest disclosure of (MEJ, 2002):

1. Environmental conservation costs. They are classified into the following categories:

    - Business area costs. Here is required information for three types of sub-categories: (i) pollution prevention costs; (ii) Global environmental conservation costs; (iii) Resource recycling costs.

    - Upstream/downstream costs;

    - Administration costs;

    - R&D costs;

    - Social activity costs[44];

    - Environmental remediation costs.

    For each of these categories is necessary to be specified: (i) Key activity that incurs these costs; (ii) The part of these costs which are investments; and (iii) The part of these costs that are expenditures[45].

2. Environmental conservation benefits. The guidelines suggest disclosure of detailed information for three major groups of benefits:

    - Benefits corresponding to business area costs;

    - Benefits corresponding to upstream/downstream costs;

    - Other environmental conservation benefits.

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[44] Only social activities related to environmental protection are included.

[45] Instead of "expenses", the guidelines use the term "costs". However, the use of "costs" in this sense is inconsistent not only with the accounting legislation (see IASC), but also with the classification used in the guidelines. Many companies (see further in this section) use either "expenses" or "expenditures" in this sense.

5.2 Review of the current reporting practice by big international companies

It would be helpful for private manufacturing companies to know the current practice of reporting of environmental – finance issues. A review of the disclosed environmental – finance information of the biggest international companies would be even more valuable, because these companies most probably have higher quality reports and they can serve as benchmarking. Reviewing the reports of different companies would show different reporting options (for example, not every company has sophisticated enough accounting to provide detailed information) and it can facilitate a company to select an appropriate one. Further are reviewed the environmental/sustainability reports of year 2002 of some randomly selected big international companies.

ABB discloses the following environmental – financial information (ABB Ltd, 2003):

1. Their fines for non-compliance with the legislation;

2. Total payments for: (i) Country sustainability controllers; (ii) Local sustainability controllers; (iii) Sustainability affairs – central.

3. Total amount of sustainability costs at: (i) Group level; (ii) Country level; (iii) Site level. As sustainability costs ABB considers only the costs of running the sustainability network, including personnel costs, costs for developing of sustainability tools, education and training.

Canon discloses information for (Cannon, 2002):

1. Environmental conservation costs, presented according to MEJ Guidelines;

2. Total amount of environmental revenues;

3. Cost savings during the year as a result of the following activities: (i) Energy conservation measures; (ii) Resource conservation and recycling; (iii) Logistics streamlining.

Mazda discloses only its environmental conservation costs, classified according MEJ guidelines (Mazda, 2002).

Mitsubishi discloses information about (Mitsubishi, 2002):

1. Environmental conservation costs, classified in categories that are very similar to the ones suggested by MEJ guidelines, but the level of details is higher – some of the categories are further divided to subcategories.

2. Cost savings from reduced energy use, paper use, and waste generation.

The environmental-financial information, disclosed by Sharp, includes (Sharp, 2002):

1. Environmental conservation costs, categorized in way that is similar to the one proposed by MEJ guidelines.

2. Monetary effects of environmental protection measures. Three such measures are mentioned: (i) energy savings; (ii) sale of recyclables; (iii) reduced disposing of waste.

3. Monetary effects for product users. These cost savings are due to less energy consumption at consumer's stage.

Philips provides the following environmental – financial information (Philips, 2003):

1. There are a couple of examples for financial savings as a result of environmental projects;

2. Provisions for environmental liabilities.

Ricoh discloses the following environmental- financial information (Ricoh, 2002):

1. Environmental conservation costs, presented according to MEJ guidelines;

2. Environmental conservation benefits, presented according to MEJ guidelines;

3. Detailed information about the social costs (the costs borne by the society). They are calculated through environmental impact assessment and presented in monetary terms.

4. Penalties and fines;

5. In addition to the information disclosed in Ricoh's Sustainability report, the company publishes on their web page the environmental costs and savings related to each substantial environmental project.

6. On Ricoh's web page there are also Ricoh's plans for future environmental conservation measures, including the costs and savings resulting from these measures.

P&G discloses the following environmental-financial information:

1. Increase of environmental revenues due to increased recycling rate.

2. Penalties and fines for non-compliance;

3. Contingent environmental liabilities;

4. Total amount of EHS investments and total amount of EHS expenditures.

The only environmental- financial information disclosed by Shell is related to its settlements, compensation and fines (Shell, 2003).

Siemens discloses its environmental costs, classified into the following categories: (i) waste management; (ii) Protection of soil and water; (iii) Noise prevention; (iv) Air quality control; (v) Nature and landscape conservation; (vi) Environmental management; (vii) Fire protection; (viii) Radiation protection; (ix) Others. Each of these cost categories are broken down into expenditures and investments (Siemens, 2002).

Tetra Pak does not disclose any environmental-financial information (Tetra Pak, 2003).

Sony discloses (Sony, 2002):

1. Environmental conservation costs, classified into the following categories: (i) product design; (ii) product recycling; (iii) pollution prevention; (iv) for reducing environmental impact (these include costs for energy conservation and global warming measures, resource conservation and recycling measures, water resource measures, reduction of hazardous materials, others); (v) green purchasing; (vi) administrative costs; (vii) R&D costs; (viii) Communications and community relation activities; (ix) Environmental remediation costs. Each one of these categories is further divided into environmental expenditures and environmental investments.

2. Environmental conservation effects. They represent the reduction of the social costs (in monetary terms) as a result of environmental conservation measures. These effects are divided into categories (greenhouse gasses, water, etc.). The private savings of the company are not indicated.

Most of the companies, reviewed above, disclose also their efforts to develop EMA. Some of them review in details their progress in implementing EMA – which processes or costs it incorporates, what steps will be undertaken in future, etc. According to Deegan (Deegan, 2001, p.28), given the infancy of EMA, explicit consideration and associated publicity of EMA can provide competitive advantage.

In addition to these companies, it is interesting to review the best practice in environmental-financial reporting. Many authors (e.g. Muller & Sturm, 2000, Adams, 2002) refer to Baxter's reports to show the way the environmental- financial information should be disclosed. Baxter International discloses the following environmental - financial information (Baxter International, 2003):

1. Environmental costs. These are presented in two major categories: (i) Costs of basic program; (ii) Remediation, waste and other response costs (proactive action can minimize them). Each of these categories is further divided into sub-categories (see Appendix 2). In the list of costs are included only environmental expenditures, including depreciation.

2. Savings and cost avoidance realized in the current year due to previous years efforts. These are divided into the following categories: (i) Reduced air toxics; (ii) Reduced energy use and related greenhouse gas emissions; (iii) Reduced regulated waste generation; (iv) Reduced non-hazardous waste generation;[46] (v) Increased recycling; (vi) Reduced packaging; (vii) Reduced water use.

3. Environmental savings during the current year that result from initiatives undertaken during the current year (for details, see Appendix 2); Additional information for these savings is available on Baxter's web page.

[46] The savings in the four categories above are per unit of production value.

4. There are many examples of pollution prevention projects (energy saving, waste reduction etc.) undertaken during the year, including the related annual savings (also in monetary terms) that are expected to result from them.

5. There is description of the activities that cause the most significant clean-up costs and environmental liabilities, including the amount of these costs and liabilities.

6. Fines for non-compliance.

Baxter discloses only those environmental costs and benefits, which are associated directly with environmental management activities or environmental improvement targets. It doesn't include indirect costs, such as upstream/downstream costs. Baxter includes the depreciation of previous investments in the current expenditures (see Appendix 2) and this shows better picture of the costs related to the current year and allows comparison with the related benefits. The environmental investments during the current year are not disclosed; they will be disclosed (as depreciation) in future, when the benefits from investments occur.

According to Bennett and James (Bennett & James, 1998, p.308), Baxter's approach to disclose the financial benefits resulting from environmental related activities, raises the awareness of environmental factors and generates motivation. They consider that this reporting can direct the attention to environmental issues and raise the importance within the company of environmental management, because this reporting can change the perception on environmental issues in the company– instead of a burden for the company, they can be viewed as a cost saving opportunity.

Based on Baxter's experience, Bennett and James emphasize that high quality reporting at a corporate level requires long time to establish data collection in facilities and meanwhile the best possible is to make reasonable and open estimates. According to Bennett and James, in order to overcome opposition at local level, the implementation of high quality reporting system in large and decentralized organizations should be evolutionary. First the value of the statements can be demonstrated by using approximations. Then these statements will be perceived as reasonable and the additional information required to improve them will be more readily provided (Bennett & James, 1998, p.309).

Some companies, reviewed above, disclose information about their savings in natural units (e.g., energy savings, water savings) and they can easily calculate and disclose the savings in monetary units. Except Baxter, none of the companies report their full expenditure (including depreciation) during the current year and that underestimates them. In addition, only Baxter discloses comprehensive information about its savings during the current year. None of the companies disclose the complete information about the future benefits that are expected to result from the environmental investments of the current year; such information is provided by a couple of companies, but only for certain investments.

For a decision maker (internal or external), the value of the environmental – financial information, disclosed by almost all companies, is low. However, high quality reporting requires also sophisticated accounting systems, which few companies have. In addition, even if a company has an advanced accounting system, such as the one of Baxter, Bennett and James (Bennett & James, 1998b, p.20-21) note that many additional time-consuming calculations and data adjustments were required for the preparation of the environmental – financial statement of Baxter. In addition, it is very difficult (and probably often useless for internal decision making) to separate environmental costs and savings from other costs and

savings, or to calculate what the environmental costs of the current year would be if past environmental improvements were not take place.

5.3 Recommendations to Trelleborg

The current disclosure of the EHS costs and savings of Trelleborg is comparable to the disclosure of the most international companies, reviewed in chapter 2, and therefore it probably meets the expectations of the external stakeholders. However, some companies (e.g. Baxter) demonstrate an environmental – financial disclosure of much higher quality. The author strongly recommends to Trelleborg to follow the logics (structure) of the Baxter's environmental – financial statement. The suggested way of reporting is explained in details later in this section. However, if for any reason[47], the existing structure of the environmental reporting is preferred at Trelleborg, some suggestions to improve it are provided in Appendix 4.

The amount of the environmental costs is not enough for the stakeholders to draw conclusions. Probably the only exception is the costs for environmental fines and penalties, which are one of the criteria for evaluation of the management. The most important role of the disclosure of environmental – financial information is to demonstrate that environmental activities are not a burden for the company, but aid to achieve financial benefits. That can improve the view of external stakeholders on the company, but also would focus the attention of the employees on the environmental issues and pollution prevention measures would be recognized easier.

Following Baxter's model of disclosure of environmental costs as the best practice, most of these costs can be found in the accounting system of the plants at Trelleborg. The main focus can be put on the environmental expenditures, because they reflect the efficiency of the environmental activities during the current year. These expenditures can be presented in the following way:

1. Environmental protection expenditures (or "expenditures for basic program"). These include the measures for improvement of the environmental performance. These can be further divided, for example, into: (i) expenditures for environmental management, including costs for environmental administration, training programmes, etc.; (ii) expenditures for fees (e.g. for auditors and attorney), licenses; (iii) expenditures for operations and maintenance of pollution controls; (iv) depreciation of pollution controls (cleaning equipment);

2. Environmental damage expenditures. These include remediation, waste, and other response expenditures and can be classified, for example, into: (i) fines, penalties, settlements; (ii) waste disposal; (iii) remediation costs; etc.

3. Environmental savings. These include all income, savings and cost avoidance from measures undertaken during the current year. They can be classified into: (i) air toxics cost reduction; (ii) waste disposal cost reduction; (iii) waste material cost reduction; (iv) recycling income; (v) income from selling of waste; (vi) energy cost savings; (vii) water cost savings; etc.

[47] For example, the information in the suggested report is too difficult to collect

4. Cost avoidance in the current year from efforts initiated in the previous six years[48].

5. Result from environmental activities = (3) + (4) – (1) – (2).

The classification of the expenditures within each group can vary, above only examples (not exhaustive ones) were provided. See Appendix 2 for more complete structure. The environmental damage expenditures (see above) reflect the environmental impacts of the company (in monetary terms). Their disclosure over years is one way to follow the company's damages on environment. However, since these costs depend on other factors (e.g. production volume, disposal fees, etc.), the next group – environmental savings – would aid to understand better the real effect of the environmental measures undertaken during the years.

The most difficult (time consuming) part of the proposed report is to calculate the cost avoidance from initiatives undertaken during the current year and previous (e.g. six) years. The experience at Baxter shows that the major difficulty is during the first year when such calculation is required, because then the data for the previous years is collected. The following years the data is only updated[49]. Of course, the difficulty to make these calculations depends on their accuracy. Even if not accurate calculations are made, the author recommends this way of presentation of the environmental – financial information[50].

At Baxter, the accounting system provides data that fits the need of the environmental – financial statement. An evolutionary approach has been adopted at the company – after adoption of the current reporting practice, initially the data were not available in the accounting, but the company developed its accounting for several years. Currently, the reported data at Baxter is reliable. In addition, the report is audited by external auditor (Baxter, 2003; Bennet&James, 1998). More data is necessary to be estimated by Trelleborg, but this does not seem to be an obstacle to this reporting.

In addition, it is important to demonstrate the profitability of some major pollution prevention projects. Financial figures can be attached to the information about the pollution – prevention projects throughout the Sustainability report of Trelleborg and together can be indicated both, environmental and financial consequences of the projects. For this purpose, the plants can be asked to submit these data for the biggest investments. No additional information about the investments (such as total amount) is necessary.

The health and safety costs[51] can be shown separately from the environmental costs and savings. Their amount can be shown also in details, because these investments: (i) are significant; (ii) are made with various types of purposes (e.g. reduction of indoor pollution, automation of processes, etc); or at least their components can be clarified on both, the request to the plants and the external report.

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[48] Baxter considers that the average life of an investment is six years.

[49] To facilitate the calculations during the following years, the savings for each year in natural units (e.g. 3% of the waste) can be collected in a database.

[50] If the data is roughly estimated, implications may occur in case Trelleborg plans to use external auditing of its reports.

[51] In 2002, only H&S investments were presented, but not H&S expenditures.

6. Conclusions and Recommendations

EMA can help companies in many ways. EMA can result in improved product costing and pricing. It reveals the real costs of the products and processes and cost reduction opportunities can be identified easier. EMA offers a better tool to assess all types of investment opportunities. It sometimes improves significantly the quality of the decisions, especially when high environmental costs are involved. EMA helps the strategic planning of the company by incorporating the increasing environmental demands at an early stage. It helps to consider properly the influence of the activities of the company on its reputation. It helps a company to measure its environmental performance and to identify profitable ways to improve it.

6.1 Conclusions about the factors that determine the success of EMA

EMA uses two tools to achieve the benefits discussed above – an accurate cost allocation and an improved method for investment evaluation.

Many factors determine the need of accurate cost allocation. The most important is presence of high overhead costs. Other important factors are also: high proportion of environmental costs in overheads, high diversity of products and processes, and linkage of this allocation to other initiatives. Other factors that increase the chances for success of an accurate cost allocation are: low time and costs to implement the new system, sophisticated information technology, poor performance, application of the tool for evaluation of new concepts and technologies, high competition, and poor cost knowledge of the management.

ABC is the method that allows the most accurate cost allocation, but it is also associated with much cost and therefore is not always the best option. When the need of an accurate cost allocation is high, implementation of ABC can be examined. However, in addition, a successful adoption of ABC requires also positive value of the following factors: the management needs very high degree of accuracy and is able to use the results of ABC, the management is ready and willing to accept and improve ABC, and the cost drivers are not volume based.

The other tool of EMA is total cost assessment (TCA) – a tool for improved evaluation of investment opportunities. The most important component of TCA seems to be the cost allocation accuracy (see above). Other two components of TCA are expanded time horizon and consideration of the time value of money. Considering these two components is associated with minimum costs, while it can lead to significant benefits and, therefore, their application (at least with approximation) is almost always recommendable.

TCA includes also consideration of potential liabilities and intangible costs. The degree, to which it is necessary to consider them, depends on both, their significance and the sensitivity of the investment decision to cost changes. Many potential liabilities, if properly allocated, are reflected in the costs of the products and processes. Others, which occur rarely or refer to new investments, need to be estimated additionally. If it is necessary to consider the intangible costs, they can be estimated qualitatively as a final step of the investment decision.

6.2 Conclusions and recommendations to Trelleborg

The accounting system of most plants is the main generator of environmental cost data. These data at most plants is detailed enough, but the accounting of most plants does not allocate it to individual products and processes. The main environmental costs of most plants are for waste, but the waste costs are accounted for and considered properly. Most plants receive sufficient information about expected future legislation changes and incorporate this information in investment appraisals. In addition, the environmental cost data is communicated very well within each plant.

The accounting systems at the different plants at Trelleborg vary significantly. These systems provide only limited common information – that information is sent to the headquarters and it does not include environmental costs. The information at each plant about the environmental costs is different and depends on many factors, such as significance of each environmental aspect, its consideration by management, accounting method, etc. It is not necessary to require from the accounting of each plant to provide common standardized information for environmental costs, because such information is difficult to be provided and it would not improve its analysis and control. The only environmental information that plants need to provide to the headquarters is for external reporting.

For investment appraisals at plant level, the most important conventional and overhead costs are considered sufficiently. In general, in these plants, the overhead costs are allocated with the appropriate level of details. Contingent costs related to possible legislation changes are considered. Other contingent costs, such as accidents, may not be considered for investment decisions, because of poor allocation, but these are not very important. Intangible environmental costs and benefits are not considered as important when the plants have ISO 14001.

At higher levels – business unit, business area, Group level – are taken the decisions for significant investments. At these levels, less information is available about the environmental aspects related to the project and, therefore, environmental costs can be identified more difficult. In addition, at these levels (excluding the vice-president, who is responsible for the environmental affairs) there are no environmental experts to incorporate the environmental considerations in the investment decisions. Only quantitative financial information of the investment evaluations is sent in the investment request form to higher levels. The biggest projects of the company (purchase and selling of plants) are examined carefully and potential liabilities are avoided at early stage. The chosen financial indicators for investment evaluation do not show environmental investments on equal footing with other investments. In addition, incorporation of intangible costs in the decision making seems to be seldom. The investments at higher levels are approved when they have short pay-back period or are required by the legislation. However, such classification hinders approval of those pollution prevention opportunities, which have slightly higher pay-back period than other investments, but which can prevent the need costly of end-of-pipe solutions later.

A new structure of the external reporting of the environmental – financial information is suggested. It includes disclosure of environmental protection expenditures, environmental damage expenditures, savings and cost avoidance during the current year, due to measures undertaken during the current and previous years. In addition, the expected savings of the major pollution prevention projects of the company can be disclosed together with the description of these projects in the Sustainability report.

6.3 Concluding comments and further research

The theoretical part of the research was based on a very limited empirical data and therefore the conclusions are uncertain and incomplete. Probably many other factors influence the need of EMA. The study does not provide an exhaustive guidance to companies to what degree and how to develop their EMA. In future, when EMA becomes more widespread, more comprehensive research would be possible.

A major problem of theoretical research is the large scope – EMA has many components and there are a number of ways to apply each of them. In addition, the implementation faces many practical implications, which were not examined in the study.

Regarding the research at Trelleborg, it would be much easier to examine in details certain preliminary defined issues, for example to apply a set of criteria to examine the company. This was one of the purposes of the current research, but the author was not confident in such approach and he did not perform interviews with sufficient number of employees who can provide the necessary information. To examine the cost allocation at each plant, much more accounting information is necessary to be collected.

Further research at Trelleborg can be carried out in two main directions. The first direction is detailed examination of each plant is necessary. Since the examined area is related to the responsibilities of different employees (environmental manager, production manager, accountant, financial controller, engineer, etc.), a personal interview must be performed with all of them. This is the only way to understand the situation fully and to provide recommendations. However, this research would take too much effort. It is probably easier to educate the necessary employees at each plant how to evaluate their need of EMA.

The second direction of future research is to examine how investment decisions are taken at business unit, business area, and Group level. The author collected very limited information regarding this issue. Examples of a number of projects are necessary to be reviewed, by taking additional information from the plant which is affected by the project.

Further research would benefit if it is based on a guidance that describe how to evaluate investments, and in particular – how to consider environmental costs.

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Abbreviations

ABC	Activity Based Costing
EA	Environmental Accounting
EHS	Environment, Health & Safety
EMA	Environmental Management Accounting
EMS	Environmental Management System
EPA	Environmental Protection Agency
FCA	Full Cost Accounting
IAS	International Accounting Standard
NPV	Net Present Value
TCA	Total Cost Assessment

Appendix 1

Examples of Environmental Costs Incurred by Firms

Potentially Hidden Costs		
Regulatory	**Upfront**	**Voluntary (Beyond Compliance)**
Notification	Site studies	Community relations/ outreach
Reporting	Site preparation	Monitoring/testing
Monitoring/testing	Permitting	Training
Studies/modeling	R&D	Audits
Remediation	Engineering and procurement	Qualifying suppliers
Recordkeeping	Installation	Reports (e.g., annual environmental reports)
Plans	**Conventional Costs**	Insurance
Training	Capital equipment	Planning
Inspections	Materials	Feasibility studies
Manifesting	Labor	Remediation
Labeling	Supplies	Recycling
Preparedness	Utilities	Environmental studies
Protective equipment	Structures	R & D
Medical surveillance	Salvage value	Habitat and wetland protection
Environmental insurance	**Back-End**	Landscaping
Financial assurance	Closure/ decommissioning	Other environmental projects
Pollution control	Disposal of inventory	Financial support to environmental groups and/or researchers
Spill response	Post-closure care	
Stormwater management	Site survey	
Waste management		
Taxes/fees		
Contingent Costs		
Future compliance costs	Remediation	Legal expenses
Penalties/fines	Property damage	Natural resource damages
Response to future releases	Personal injury damage	Economic loss damages
Image and Relationship Costs		
Corporate image	Relationship with professional staff	Relationship with lenders
Relationship with customers	Relationship with workers	Relationship with host communities
Relationships with investors	Relationship with suppliers	Relationship with regulators
Relationship with insurers		

Source: US EPA, 1995, p.9

Appendix 2

Baxter's Environmental – Financial Statement

ENVIRONMENTAL COSTS

COSTS OF BASIC PROGRAM

Corporate Environmental — General and Shared Multidivisional Costs
Auditors' and Attorneys' Fees
Corporate Environmental and Energy — Engineering
Corporate Environmental — Information Technology
Division/Regional/Facility Environmental Professionals and Programs
Packaging Professionals and Programs for Packaging Reductions
Pollution Controls — Operations and Maintenance
Pollution Controls — Depreciation
Total Costs of Basic Program

REMEDIATION, WASTE AND OTHER RESPONSE COSTS (PROACTIVE ENVIRONMENTAL ACTION WILL MINIMIZE THESE COSTS)

Attorneys' Fees for Cleanup Claims, NOVs
Settlements of Government Claims
Waste Disposal
Environmental Fees for Packaging
Remediation/Cleanup — On-site
Remediation/ Cleanup — Off-site
Total Remediation, Waste and Other Response Costs

Total Environmental Costs

ENVIRONMENTAL SAVING (income, savings & cost avoidance from 2002 initiatives)

Air Toxics Cost Reductions
Hazardous Waste Disposal Cost Reductions
Hazardous Waste Material Cost Reductions
Non-hazardous Waste Disposal Cost Reductions
Non-hazardous Waste Material Cost Reductions
Recycling Income
Energy Conservation Cost Savings
Packaging Cost Reductions
Water Conservation Cost Savings
Total Report-Year Environmental Savings
As a percentage of the Costs of Basic Program

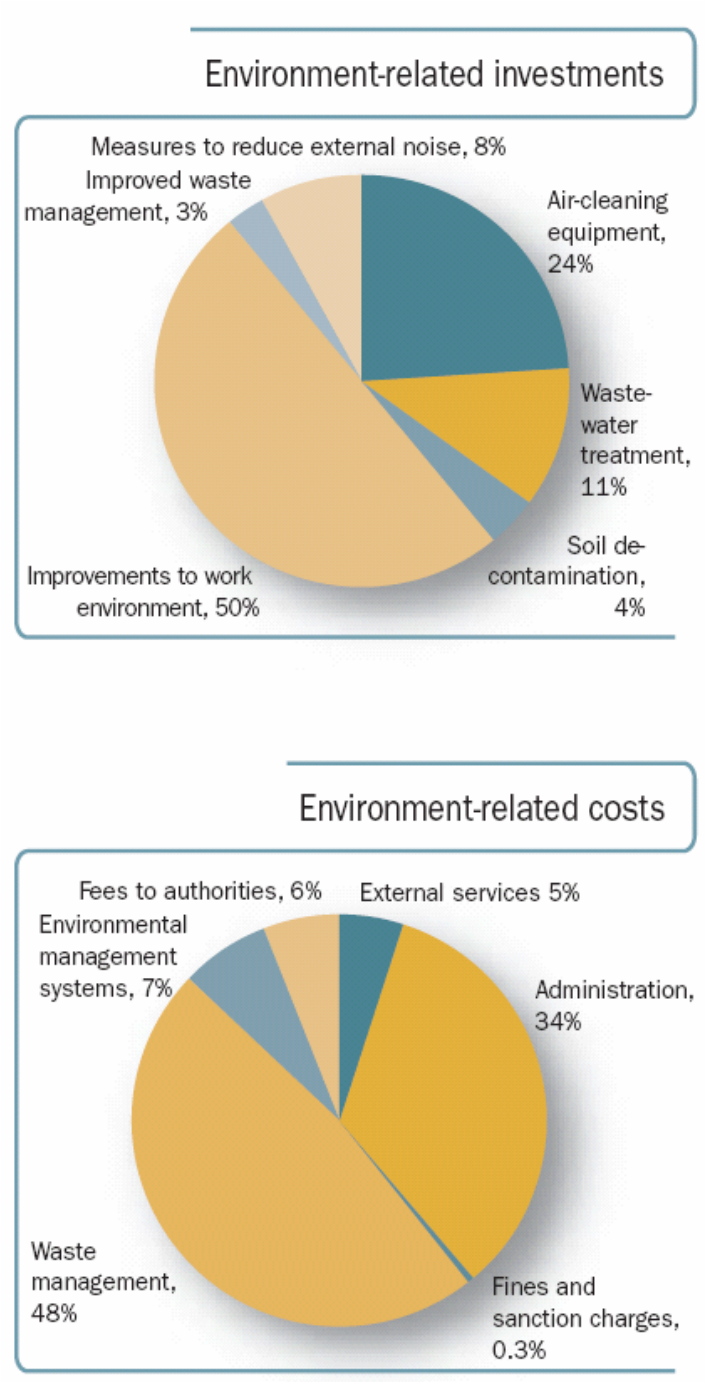
SUMMARY OF SAVINGS

Total Report-Year Environmental Savings
Cost Avoidance in Report-Year from Efforts Initiated in the Six Years Prior to Report-Year
Total Income, Savings and Cost Avoidance in Report-Year

Source*: Baxter International Inc. (2003). Sustainability report 2002.*

Appendix 3

Environmental costs of Trelleborg



Source: www.trelleborg.com

Appendix 4

Suggestions for improvements of the current environmental-financial reporting.

The author recommends that the report follows the structure of the Baxter's reporting. However, in case it is preferred that the structure of the report is the same as in year 2002, some comments may be considered:

- Although the meaning of the word "cost" is clarified on the last page of the report, it is better to use expenditures, in order to avoid confusion.

- Environmental expenditures and environmental investments can be classified in the same way. It would be visible the amount that is expensed and the amount that is invested for each type of activity. Currently, the operational costs (personnel, electricity, etc.) for the waste-water and air cleaning equipment are not included anywhere.

- Using the same classification for expenditures and investments, it would be suitable to present them in a table (in addition to the graph). According to GRI (GRI, 2002, p.34): "Graphics should be a supplement to—not a substitute for—text and narrative disclosure of information. In general, raw data should accompany graphical presentations, either alongside or in appendices. Graphs should always clearly indicate the source of their data."

- The detailed information for environmental expenditures and investments can be shown for the previous years (easier if a table is presented).

- The level of details of savings can increase, for example, savings from waste, energy, water.

- The improvements to the work environment can be presented separately. Their nature is very different, for example they include automation processes, which previously were done manually. Also, these costs are very significant and can be shown in more details (or, at least, it can be indicated what they include).

- The classification and the types of the expenditures in the text and on the graph differ and it is not clear what is presented on the graph.

Appendix 5

Environmental cost questionnaire

This appendix includes the questions and answers of a questionnaire about the environmental costs at plant level at Trelleborg. The respondents are listed below (indicated are the respondent's e-mail and the date when the answer was received):

a) Douglas Harre (doug.harre@trelleborg.com) (5-Oct-2003)
b) Helene Blanc (helene.blanc@trelleborg.com) (1-Oct-2003)
c) Karl-Erik Karlsson (karl-erik.karlsson@trelleborg.com) (5-Oct-2003)
d) Michael Lueken (Mike.Lueken@trelleborg.com) (25-Sept-2003)
e) Terry Coffey (terry.coffey@trelleborg.com) (26-Sept-2003)
f) Sverrir Snorrason (sverrir.snorrason@trelleborg.com) (8-Oct-2003)
g) Thibaut Jung (thibaud.jung@trelleborg.com) (9-Oct-2003)
h) Deb Sopczynski (deb.sopczynski@trelleborg.com) (10-Oct-2003)
i) Rob Nikkels (rob.nikkels@trelleborg.com) (12-Oct-2003).
j) David Hanson (david.hanson@trelleborg.com) (13-Oct-2003)
k) David Sawyer (David.Sawyer@trelleborg.com) (21-Oct-2003)

The order of the answers to each question corresponds to the order of persons on the list above. Some of the answers are not provided fully - the less relevant information is removed.

1) How the environmental cost information is generated? Is it from the accounting system only or also other sources are used?
   a) The accounting system provides 50% of the cost information. However, much of the environmental activity involves group participation and many other departmental areas (engineering, manufacturing, maintenance, etc) contribute to the remaining 50%;
   b) Mainly from the accounting system (purchase orders, contract for waste handling, etc.) but for some internal costs (e.g. time spent for environment purpose not on a regular basis) is estimated. There are no cumulative figures in the accounting system – they are always recalculated from different data from several accounting listings.
   c) We make a budget for environmental costs and since we follow up our budget and result of our environmental work, the figures are generated from our accounting system
   d) All info is generated from accounting data
   e) The accounting system is the key component but significant input comes from purchasing.
   f) Environmental costs are registered in the accounting system.
   g) From the EHS office.
   h) Other sources are also used, purchase records, etc.
   i) The accounting system and it is not divided to the environmental cost.
   j) Collecting information from invoices, revenues, expenses, capital expenditure etc
   k) Information is gathered from a variety of sources, e.g. accounts for power & water costs, purchasing for waste costs, purchase orders, etc.

2) Who are the recipients of this information?
   a) At the plant level - plant manager, production manager and the participating program manager. Information may also be shared down to the plant floor level when necessary. At the business group level - to the president of the group (Trelleborg Automotive Americas) along with all persons who may be interested. Also, much of this information is shared between individual plants in order to continually improve our system.
   b) The plant Director and I are receiving the complete information. Other people in the plant receive some information depending of their responsibilities.
   c) Members of the management team, supervisors, and in some cases - all personal.

d) Some of the info is reported as key environmental measureables on a monthly basis and posted for all within our plant and is then used for the annual Trelleborg report.
e) Senior managers and selected interested parties within the plant
f) Trelleborg Rubore management.
g) Plant director, production managers, administrative managers, EHS, corresponding member for each service.
h) Trelleborg AB, the Sandusky plant and the corporate office in South Haven Michigan (CIP3 projects).
i) T-Zweden environmental affairs
j) The local senior management team is informed of monthly expenditure.
k) Internal management, Trelleborg, external bodies (e.g. Environment Agency, Biffpack Packaging Waste Scheme, DTI)

3) Do you think that the accounting system provides detailed enough environmental cost data? If no, please specify.
   a) On the local level by processes, yes. There is a lot of interaction and management involvement in our environmental management system. We have daily meetings in which all items of our plant activities are openly discussed and evaluated including environmental and safety activities. On the daily level there is often not a lot of detail on cost data, however at the end of each month we recap all of the information for review. At the local level by product, no. All of our product design, sales, and costing is done at the corporate group level (Trelleborg Automotive Americas). I find that there is very little input into the environmental cost of the product unless it is something required by the customer. Then too often it is an after thought and is returned to the local level for implementation.
   b) The accounting system is giving detailed costs data (orders by orders) but no cumulative data. The data are not by product or process but this is not necessary.
   c) No, because accounting only provides figures/balances on certain accounts and not detailed information of environmental work
   d) Yes
   e) Yes as long as it was set up correctly.
   f) Yes.
   g) Yes
   h) No, some are not captured there, some products are bought locally for maintenance and not listed as environmental
   i) No, the definition of environmental costs is not clear.
   j) The accounting system contains details of all costs, but there is no assembled environmental centre. To get a total environmental cost, an individual has to investigate the various cost centres and extract the relevant data.
   k) Yes, in general, for the more straight forward items, but not e.g. capital expenditure

4) Is it clear what the environmental costs for each process and product are? If no, please specify.
   a) At the local level, yes. At the group level, no. Same reason stated above.
   b) The data for waste handling are in total and not by process or product yet in the accounting system.
   c) No this could be better but the resources for environmental work are limited.
   d) Yes
   e) No. The system is not detailed enough to go down to each operation
   f) Yes
   g) No, there is no data for product and process costs
   h) I do not feel that it is clear concerning environmental costs – they seem to be forgotten a lot of times.
   i) No, it is part of our daily work and the definition of environmental costs is not clear.
   j) No, data for the individual process/product cost is not available.
   k) No. Not broken down to process/product but mainly to site e.g. power & water.

5) To which degree did you rely on estimates when you reported the information to the headquarters about the environmental costs in 2002, or the data was provided by the accounting system?
   a) About 70% of the information is from accounting and other direct costing methods. 30% is estimated - factors that cannot be pre-measured (future production levels, climate conditions, raw material cost, etc.).
   b) More than 90 % is from accounting system. The estimate is only on internal time spent on environmental issues.
   c) The information came originally from accounting system and was controlled and verified by the environmental department. We believe that the reported figures are correct.
   d) Do not rely on estimates.
   e) No estimates, as far as I know.
   f) The data was provided from the accounting system, except for the environmental training which was an estimate.
   g) No estimates
   h) Most data is from my own record-keeping.
   i) 50% estimates;
   j) No estimations were made.
   k) Significant amount is from the accounting system, but also some estimates were made

6) Are the waste costs significant at the department/plant/plants under your responsibility?
   a) yes; b)yes; c) yes; d) yes; e) yes; f) yes; g) yes; h) no; i) no; j) yes; k) yes.

If yes, is there available:

6.1.) information about the full cost of waste (including not only the disposal fees, but also the cost of wasted materials, the labour associated to the waste handling, etc)?

All respondents answer "Yes" to this question, except:

k) No, but this information could be deducted with effort.

6.2.) information about the waste caused by each process?

   a) Yes;
   b) The scrap and internal ppm is known through quality indicators by process
   c) Yes;
   d) Yes;
   e) We know the significant waste streams, which are about 80% of the waste.
   f) Yes;
   g) No;
   h) Yes
   i) N/A
   j) Yes
   k) No, but could be deducted with effort.

7) Do you think that the environmental costs (including costs for cleaning equipment, insurance, cost for control and supervision, health costs, cost of accidents, etc) are fully considered when a new investment decision is taken? If no, please specify.
   a) No, it depends upon the investment size, cost, level of importance, and possible legislative requirements of the investment. I find that for the most part other than the purchase of another property or business, that "due diligence" is not performed as often as it should be in the total environmental investment of machinery, material, insurance, etc.
   b) Yes. I am signing all purchasing contracts for new equipment in order to take into account all legal and management aspects for safety and environment, even if we do not always calculate costs. Some of the costs are potential only at this stage
   c) No because we are fairly new as ISO 14000 certified company and are as such working our way into the system trying to find out all the benefits of the system.
   d) yes--informally
   e) For any new product, we review the environmental impact, packing, disposal, ELV/WEEE, this is also applied to plant and equipment

f) Yes.
g) Yes now.
h) No I do not. I feel production always is considered first.
i) Yes, as far as possible;
j) No. Environmental costs are subject to budgetary control and new investments simply access these budgets.
k) Not fully. Insurance, H & S, cleaning, control & supervision generally are, but not accidents.

8) How does your plant monitor future environmental regulations and do you think this monitoring is good enough?
   a) At the local manufacturing level - yes, if the plant has an effective EMS. However I am not sure how much monitoring of legal requirements is performed by those responsible for the development of the products we produce. In some ways, we at the manufacturing level are restricted by the product requirements, tool, and process design (What compound is to be used, whether the part is painted, metals, what type of oils used in assembly, etc.) Our product determines much of our legal environmental impact and the design of this product does not always take into consideration environmental requirements of those manufacturing plants producing the product.
   b) We have this monitoring through the documentation required for ISO 14001. We are receiving update of the legislation every month. Based on this we are updating our existing and future non-conformances with regulations. At the management review, we are defining the action plan to reduce the discrepancies and then we are doing the investment planning associated.
   c) By active participating in different comities that are monitoring these changes, from the web site of Natlikan, from review of available environmental journals. In addition, the company is under governmental supervision and therefore gets good information.
   d) Monitored through published notices from EPA/DEQ and by corporate environmental representative.
   e) We use an external body (Natlikan) and have found them to be professional.
   f) Current legislation is monitored. Different sources are used to monitor possible changes but this might be an area for improvement.
   g) We have two systems for monitoring, one of which is formal.
   h) Yes.
   i) No, it is very difficult to monitor new environmental regulations.
   j) We subscribe to Natlikan and we have competent persons on site.
   k) We have recently arranged for the Natlikan Legislation List service and this is considered to be sufficiently good.

9) Are estimates of future environmental costs, which result from expected changes in the legislation, included in new investment decisions?
   a) No, same reason stated above
   b) Yes with the budget decision making
   c) Yes, as far as they are known.
   d) Yes--informally
   e) Yes CCL for example
   f) Yes
   g) No.
   h) Not sure.
   i) Yes
   j) We have recently introduced a requirement to perform an Environmental Impact Assessment for projects which demands an answer to this question
   k) No. Changes to materials/processes are reviewed at the Environmental Steering Committee Meeting as are legislative changes. The impact will be considered and to some extent reflected in the annual budgets/investment decisions.