DANTES
DEMONSTRATE AND ASSESS NEW TOOLS FOR ENVIRONMENTAL SUSTAINABILITY

Manual on environmental decision making

Part II: Background report

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ABSTRACT

This report was made within the project DANTES that is supported by the EU Life Environment Programme.

The focus of the DANTES project has been to demonstrate how methods and tools for environmental sustainability such as Life Cycle Assessment (LCA), Environmental Risk Assessment (ERA) and Life Cycle Cost (LCC), are practically used within these companies. Integrated usage of methods and tools for estimating environmental load from products has been analysed and structured, based on practical experiences at the companies and knowledge about environmental informatics. The project has result in a set of strategies focusing on the communication of information required for environmentally related decisions. The strategies are describing how requested information is acquired using existing tools and methods, and how the resulting information is communicated to decision-makers in an understandable way. By using these strategies the environmental work and decision-making is made more cost-efficient in any company.

In this report the underlying principles and context to the development of strategies in DANTES are described in detail. In addition, a description on how to develop new strategies is included as well as all strategies published at the DANTES web site (www.dantes.info).

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1. INTRODUCTION

The aim of this report is to describe the context and background to the structure and content of the DANTES web site, which contains information on how different companies are practically working with different tools for environmental sustainability. In particular this report provides the background to the strategy concept and on how to efficiently perform environmental decision making. The intended users of this report are persons working with environmental issues such as environmental support personnel, at companies and organizations, who have used the DANTES web site and want to read more about structured environmental work. Target groups for the manual (part 1 and 2) are also people responsible for implementing an environmental support function at a company or organisation.

The delivery "Final manual on environmental decision making" from the DANTES project is divided into two reports. The name of the first is "Manual on environmental decision making - What one can find on www.dantes.info. This report contains examples of environmental decision processes based on strategies and other content of the DANTES web site. The second report (this one) is written for people who want to read more about the methodology that resulted in the structure of the DANTES web site. This report especially enlightens the strategies published at DANTES web site and the strategy concept behind as well as information on how to work efficiently with environmental issues according to learnings from the DANTES project.

This report was made within the project DANTES that is supported by the EU Life Environment Programme.

2. RELEVANT AND COST-EFFICIENT ENVIRONMENTAL WORK

2.1 Why structured environmental work?

The environmental work performed in companies and organisations today does in many cases rather push information on the stakeholders than respond to pulls from decision-makers. The information that is communicated is moreover in some cases information which can be gathered with little effort from existing information sources using well-known tools, rather than information that really is required for specific decisions. There are evidently many exceptions from this as for example environmental information which also is requested for by authorities in regulations etc, but for the pro-active environmental work there is often not a clear stakeholder asking for the information. Within the project, a survey[1] has been performed to find different situations when environmental information is needed. The aim of the study was to identify

[1] Flemström, K., Definition of relevant environmental aspects, Chalmers university of technology, DANTES project, 2003

and define relevant environmental aspects in the participating companies. Based on the relevant questions and aspects identified in the survey, the focus of the DANTES project has been to describe how to find the needed information using existing tools and methods. To focus on the information need instead of the tool is important to perform structured and efficient environmental work.

The acquisition of data needed for environmental assessments is often a costly procedure. It is hence crucial that such gathering of information is performed in a structured way where a clear goal and scope is defined before the acquisition starts.[2] There are however many examples of performed data acquisitions that have been lacking a clear goal and scope. This has resulted in that there for example exist numerous LCA studies performed at companies where the results are not used for decision-making and the reports are only placed in the bookshelves.

In addition, there are many examples showing that it is costly to not work with environmental issues at companies and organisations. For example to use or produce substance with significant adverse impact on the environment or humans can e.g. affect a company's good name or lead to high juridical costs.

Some users need much and detailed environmental information, others need comparative information, while yet others need reliable statements or even labels.[3] This illustrates some of the difficulties when producing environmental information that not exactly correspond to stakeholders needs. These needs vary between different companies, countries, and between different roles within organisations etc.

In this report the term environmental decisions is defined as a decision taken in the area of environmental issues at any type of organisation based on information such as process, product or material information. Results from environmental assessments such as LCA and ERA, studies on environmental impact from transports etc. described at www.dantes.info can be used as basis for an environmental decision. How this can be performed in a structured and cost-efficient way is exemplified in the report *Manual on environmental decision making, (part I).*

3. THE STRATEGY CONCEPT AND BACKGROUND

3.1 Structured environmental work in terms of strategies

In the beginning of the DANTES project the participants discussed how environmental aspects, indicators and methods, tools and basic data are

[2] Pålsson, A-C., Enqvist, A., Karlsson, G., Loviken, G., Möller, Å., Nilseng, A B., Nilsson, C., Olsson, L., Svending, O., Methodology for handling forest industry environmental data, Method report, CPM report 2005:1

[3] Carlson, R., Erixon, M., Erlandsson, M., Flemström, K., Häggström, S., Tivander, J., Establishing common primary data for environmental overview of product life cycles. Users, perspectives, methods, data and information systems, Naturvårdsverket, 2005

connected which resulted in the definition of the strategy concept used in the project. One of the results from these discussions was figure 1 below illustrating the connection between any type of environmental decision-maker, environmental aspects, indicators, methods and tools and basic data. First, we have decision makers, the subjects, with environmental related requests and needs identified as problems to be solved or questions to be answered. These requests and needs can be seen as environmental concerns or environmental aspects which can be found in the policy of the company or organisation, aiming at covering their area of interest. The identified aspects can also be broken down to measurable indicators. Analysis tools and methods such as LCA, ERA and LCC, handle the requests and needs of the decision makers. In addition, different basic data is needed to produce input to analysis tools and methods. Tools for reporting and communication e.g. EPD and SDS are tools for technical dialogue and are used to make the results from the analysis methods and tools understandable to the decision makers. Many of the tools and methods for aggregation and assessment of basic data are using the same data as input or output. A general information model makes it possible to identify these common basic data which are used or produced by different tools and methods, and facilitates hence a structured, integrated and cost-efficient usage of data between different tools and methods. A general information model does also enable sharing of data between different companies and different parts of a company. The identification of the general information model has however not been a central part of the DANTES project as DANTES has been focused on demonstrating how the tools and methods meet the information needs of different types of decision-makers.

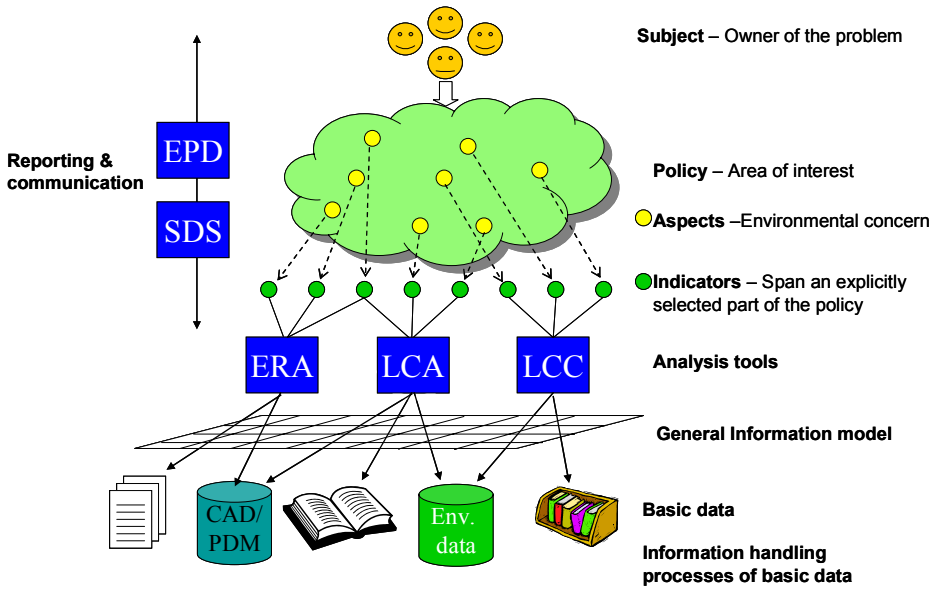


Figure 1: Grouping of tools and methods and the connection to the decision makers requests and needs

The wish to describe how different tools and methods for environmental assessments are practically used within the DANTES companies, as described above, resulted in the definition of the strategy concept within DANTES (see definition of a strategy in next section). The reason why the strategy work in DANTES has been in focus is the need to provide right environmental information at the right moment and to the right stakeholders. By structuring the environmental work performed today the future work can be improved and we can demonstrate to other companies and organizations how a number of environmental related issues can be handled in a structured way. The strategies are meant to be understood and utilized by persons with environmental tasks as part of their assignments, or by persons responsible for implementing an environmental system in a company. Previous knowledge of basic environmental tools, methods and concepts can hence be assumed in the description of the strategies.

3.2 Definition of the strategy concept

The word strategy is used in a variety of different contexts. By strategy in DANTES we mean a guideline on how the methods and tools described within DANTES, can be used to find requested information needed for environmentally related decisions, and how the resulting information is communicated to the decision-makers in an understandable way, see the figure below. A strategy describes how to handle environmental issues in a company and to reach the overall environmental goals within the company. In addition, the strategies are examples of how tools and methods are integrated and practically used within the DANTES companies.

A prerequisite to use or document a strategy is that the company or organization has decided to work towards sustainability. The key to sustainable development, as defined by The Bruntland Report[4], is the coordination and balancing of environmental, social and economic issues, the so-called three pillars of sustainability. Even though DANTES is focused on the environmental pillar and development of general corporate strategies, social or financial sustainability issues are outside the scope, the resulting strategies for environmental sustainability are possible to combine with strategies for economic and social sustainability.

[4] Bruntland, G. (ed.), "Our common future: The World Commission on Environment and Development", Oxford, Oxford University Press, 1987

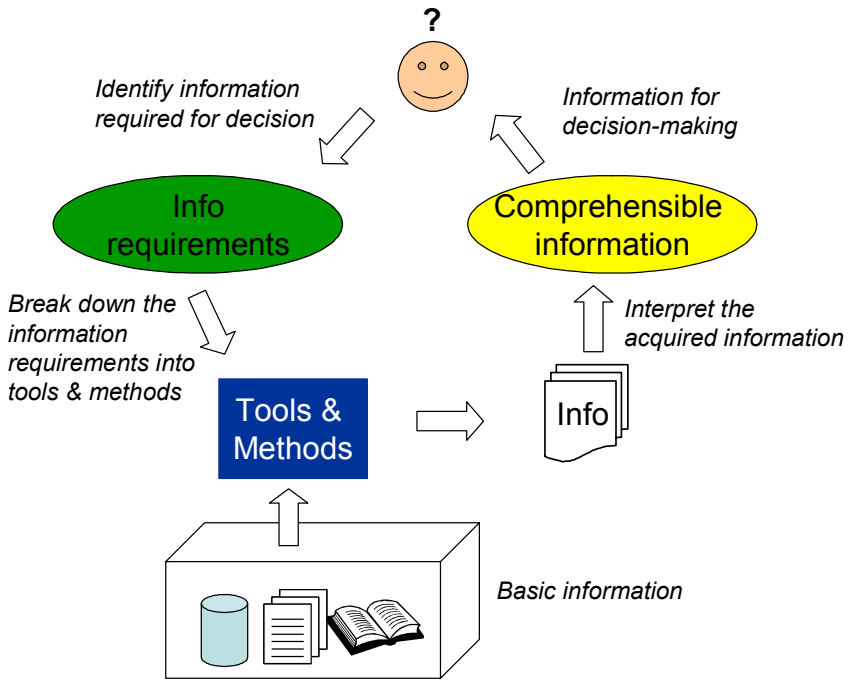


Figure 2: A strategy is a description of the journey from a question to the answer, where the required information is understood.

The purpose of structuring, documenting and publishing strategies within the DANTES project are to demonstrate how the tools and methods on www.dantes.info can be integrated and used to find answers on questions from stakeholders used in environmental decision-making, and how the resulting information is communicated back to the decision-makers in an understandable way.

Seeking information and communicating results may be carried out in very different ways depending on where these activities take place. Accordingly, the DANTES strategies are presented for different types of company functions. The strategies are divided into five groups based on which function within a company that benefit from the implementation of the strategy. The functions that hence are the target groups that can benefit from using the DANTES strategies are Marketing, Research and Development, Supply chain, Production, and Environmental support. For example a strategy about how to communicate a product's environmental impact describes how an EPD can be used in market communication. The target group for this strategy could be environmental support at a company and marketing department if they need to know how to use environmental information in market communication. It was also discussed whether management should be a separate target group for the strategies. It was however decided that management is an integrated part of all the other target groups. A decision maker within any of the target groups needs environmentally related information to be delivered together with the more

section specific information to make a decision (see figure 3 below). The DANTES strategies are describing how this practically is performed.

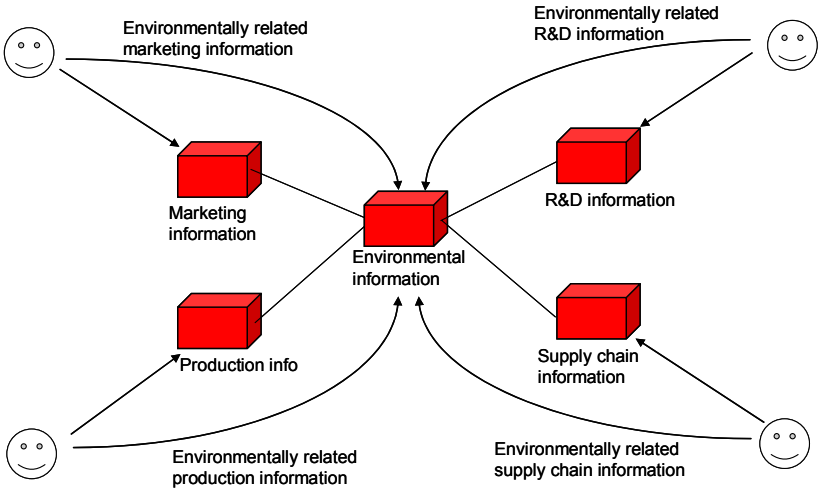


Figure 3: Different type of information (red boxes) for environmental decision making in a company and the information flow in a company illustrated by the arrows.

Based on the target group and their identified question, a work procedure is presented demonstrating an example of a step by step work procedure together with experiences and recommendations.

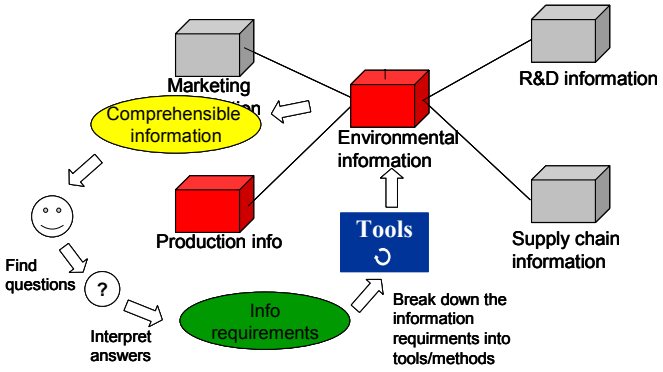


Figure 4: Relation between question, environmental related product information, tool and answer for a function within a company. The user will start with finding questions and then interpreting answers etc. and finally reaching comprehensible information (compare with figure 2).

To be able to reach an environmental target, a systematic work using the right tools and methods is necessary. The DANTES strategies describe and illustrate how this work can be performed efficiently and they are also important when putting environmental work into operation in European companies. In addition, there was an internal need within the project team

to describe and document how we are working so that this can be used for internal training as well as to get internal support.

3.2.1 Template for documentation of strategies

To make the DANTES strategies more homogeneous and structured, a template for documentation of strategies was developed. According to this template the following information should be included when documenting a strategy.

Title:
The name of the strategy should describe the content of the strategy as far as possible and should be written on the format "Strategy for *Name*", where *Name* is the title of the strategy.

Short description / sub-title:
As a complement to the title of a strategy all strategies shall have a short description where the aim for using the strategy is clearly defined and also which company's or organisation's experiences the strategy is based on e.g. "The aim of this strategy is to give practical advice on how to conduct an LCA study. The strategy is based on experiences from ABB" or "The aim of this strategy is to enhance communication of environmental requirements and performance in the supply chain. The strategy is based on an example from the railway industry and it is documented by Industrial Environmental Informatics at Chalmers University of Technology".

Background:
Description of the question or problem the working procedure described in the strategy aims at answer or solve.

- Separate clear definition of the question
- Background information including why this question is relevant e.g. Laws, requirements from customers, policy, risks – increased knowledge, public acceptance etc.

Who owns the question?

- Who is the stakeholder asking the question?
- Who benefits from the solution of the question?

Description:
Description of the work procedure

- What method/tool(s) is used to find the required information?
- How is the method/tool(s) used to answer the question(s)?
- How is the answer(s) reported and how is feedback retrieved?

Experiences:
Description of experiences from working according to the strategy including an approximation of the resources or total time (effective time and calendar time) needed to perform the strategy. In addition, potential risks, ways to eliminate these risks and business value shall be described.

3.2.2 Example of a strategy

Name: Analyzing and reducing energy use

The aim of this strategy is to illustrate how it is possible to study the energy situation at a chemical industry site and propose measures for reducing the energy use and the environmental impact. The strategy is based on experiences from Akzo Nobel.

Background

Optimizing and reducing the use of energy are always important tasks for process engineers in the chemical industries for different reasons. Traditionally, the focused benefits of energy savings are financial. The competition is continuously growing keener, especially for businesses of which the products are already balancing on the margin. During the recent decades, the focus has widened to also comprise the environmental benefits of energy savings. With support from the Environmental Code in Sweden, authorities have begun to make demands on companies to better and more thoroughly monitor, follow up and decrease their use of energy.

The purpose of this particular study was to illustrate the total energy situation at a certain production site and identify areas where it might be possible to save energy and reduce the environmental impact. Following are examples on some issues that were addressed:

- The possibility to utilize more of the excess hydrogen gas formed as a by-product in the production process as fuel for steam generation
- The possibility of cleaning, compressing and selling hydrogen gas
- The possibility of exchanging energy with nearby industries
- The possibility of using more of the energy content in the feed water
- The possibility of controlling the process to a higher extent with respect to energy use, for example by using pump speed control or installing more flow meters

Project managers who co-ordinate the technical competence, collect data and put together a complete picture of the energy situation might benefit and get ideas from this strategy. In the described example, personnel from a central environmental staff coordinated the project and assisted the local environmental department in reporting the result to local authorities.

Working procedure

1. Define scope and limitations of the study. Is the study conducted for a part of the industrial site or for a whole site? What parts are possible to affect and what parts are not? Who can provide information?

2. Conduct an initial meeting with the involved personnel and brain-storm on the possibilities of energy saving measures.

What studies have been carried out with respect to this issue in the past?

What types of fuels are used? Are there any alternatives?

Are steam and electricity consumptions monitored in detail, i.e. is it possible to identify the "hot spots"?

Is it possible to re-circulate and heat exchange to a greater extent?

Is it possible to cooperate with nearby industries in energy issues?

3. Make a preliminary outline for a project report and communicate it with personnel involved.

4. If authorities have made demands on the study, make sure to communicate the outline and the contents of the report with them before proceeding to a more in-depth level.

5. Collect figures on annual energy use as much in detail as possible. Account for the situation from a life-cycle perspective; describe the environmental impacts in the life-cycles of the different fuels and electricity.

6. Identify where measures for improvement should be taken according to these descriptions.

7. Describe potential energy saving measures in the specific plant. Account for the magnitude of the potential improvements with respect to energy savings, potential decrease of environmental impact, investment costs, pay-back periods and other factors that might be influenced.

8. Identify measures that can be realized in a short-term and a long-term perspective respectively. An example of short-term measure is to install more flow meters, while a long-term measure might be to invest in a new steam boiler. Naturally, the short-term measures also tend to be the least expensive ones as opposed to long-term and more expensive measures that need further investigations.

9. Propose EPIs related to energy. Account for possible interrelations and incompatibilities of different EPIs. See examples of EPIs, where this is further described.

10. Propose follow-up procedures and environmental goals with respect to energy.

11. Present the study to decisions makers.

12. When decisions on measures, EPIs and follow-up procedures are taken, finalize the report and present it to the parties concerned. See example of report.

13. Keep up a close dialogue with interested parties like authorities and nearby industries. Good relations are likely to lead to environmental improvements due to efficient cooperation in the long run.

Experiences

For the successful completion of this study it was of crucial importance to always remember who the commissioner of the study was. This is probably true for any study of this type. No matter if the commissioner is an authority, a corporate function or somebody else, the results must be presented so that the commissioner understands the results and receives answers to the questions that made him/her order the study in the first place. Keeping up an open and unbiased dialogue with the commissioner to make sure all are on the same track is necessary.

When proposing energy saving measures, it was important to recognize that many measures turned out to be of an investigate-further character. If data are not available and no monitoring routines exist for a certain part of a process, the measure could be to further investigate how monitoring may be carried out.

Since many different operational functions were involved, it was also important to present the results to these people at short intervals. This may be a very general piece of advice for project management, but it cannot be stressed enough. The quality of the facts and figures must be reviewed by those closest to the production. However, it was favorable to also involve some external resources in the project. Some issues may be put aside by tradition and it is often easier for someone from the outside to discover such issues.

On a practical level, it was favorable to write the report from the study in parallel to collecting information and interviewing people. This provided the writer with a better overview and it diminished the risk of missing important aspects.

3.3 Problem or question

To explicitly define the question to be answered or problem to be solved is important as discussed earlier in this report.
Environmental aspects of an organisation represent their environmental concerns that should be in focus. In DANTES we regard both environmental aspect in ISO 14001 and Impact category in ISO 14042 as environmental aspects. From the ISO 14001 perspective the impact categories are relevant issues for the environmental management system, and from the ISO 14042 perspective, they may be associated with both a characterising description of how the environment is impacted, as well as with a causal description of how e.g. a product or process gives rise to this impact.

The first step is to identify, name and define the list of aspects. There should be no unclearness about what an aspect includes. After

prioritisation of the aspects, a list of significant aspects is obtained and the environmental work within a company or organisation could therefore focus on these aspects. With help from the philosophy of the ISO 14042 framework, a cause-effect chain (characterisation method) is used to trace the relationship between an environmental impact and an aspect of e.g. an organisational behaviour or a product. For example, avoidance of killing fish, might imply avoidance of emitting cadmium from a production facility, and especially from the unit where batteries are installed in machines. The simple logic of this reasoning is in fact a *backtracking* of the methods described in the framework of ISO 14042, and it results in a logic description, and an understanding of the company's potential environmental cause-effect chains. The second step is to quantify the aspects into measurable environmental indicators e.g. the aspect Energy use could be quantified into the indicator Amount of CO_2 emissions (in e.g. kg/product).

3.4 Stakeholder

A sector independent categorisation of users of environmental information to overview product life cycles is presented in the report Carlson et al, 2005. These user categories are:

1. Science and expertise with deep interest in and understanding of many aspects of environmental information
2. Setting rules, policy, legislation etc. Generalist experts who define and decide e.g. acceptable behaviour and articfacts for businesses, consumers etc.
3. Professional decisions, using environmental information as a professional tool as a purchasing and/or technical expert
4. Everyday actions, facing environmental information as layman concerning technicalities of the decision.

User category 2 and 3 are the one in focus for DANTES methods and tools, and also category 1 and 4 to some extent. Stakeholders of DANTES tools and methods who are willing to pay for the information and/or tools and/or methods, was identified. First, a list of all types of conceivable stakeholders was identified and then as a next step a selection of stakeholders to focus on was made based on the criterion "to be willing to spend money and time to apply the methods and tools included in the project". The master list of conceivable stakeholders includes e.g. society, local, regional and national governmental organisations, trade organisations, customers and suppliers to DANTES companies etc.[5]
The more project focused list of DANTES stakeholders who are willing to spend time and money to apply the methods and tools included in the project and therefore also the DANTES strategies contains the DANTES partners, the CPM member companies, customers and suppliers to the DANTES partners and the EU (financer of the project). The DANTES partners consist of the following sub stakeholders, in terms of functions and persons:

[5] Karlson, L., Widheden, J., Requirement analysis, DANTES report, task 7, 2002

- Environmental specialists, want detailed information, methods and tools in environmental area
- Managers, want to know if the product generate money and if it is good from a sustainability perspective
- Product managers, want to know if the product generate money and if it is good from a sustainability perspective
- Process and product developers, want support and advise when evaluating different designs or process alternatives
- Marketing and sales persons, want marketing arguments and marketing information
- Supply management, want to evaluate environmental aspects of suppliers and supplied components
- Logistics, want to evaluate environmental impact from transports

The list above has been further described in the report Requirement analysis report.

In addition, authorities, customers, management/owners, NGOs and employees are stakeholders of environmental information, methods and tools according to interviews at the participating companies.[6]

When developing a strategy it is of high importance to identify the user of the strategy i.e. the user of the information. The person who owns the question or problem identified earlier, needs to be addressed when using environmental assessment tools or methods.

3.5 Methods and tools

3.5.1 Definition of tools

A tool can be anything that from a user perspective adds value to some provided input data. The added value can for example be in terms of structure, aggregation of data, or lower complexity of the data. From a user perspective the structure and internal operations performed by a tool is practically irrelevant. The important parts in the description of a tool are instead a definition of all inputs and outputs required for using the tool as well as a description of the function the tool provides that transfers the input data into the output data. A clear definition of a tool in terms of goal and scope, boundaries and function, can help the user to choose the right tool for the given situation. The input effort e.g. number of data, required by a tool should by definition be lower than the output effort, since a tool should have a leverage effect. In addition, all input information required for using the tool need to be explicitly defined as well as the output information.

[6] Arnell, S., Manuilova, A., User requirements, DANTES project report, task 5, 2003

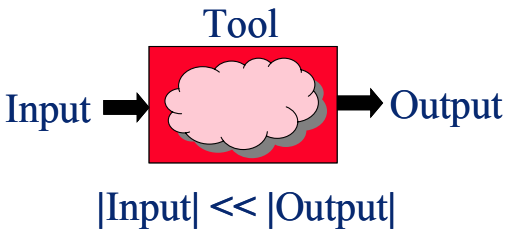


Figure 5: A picture of a tool in terms of inputs, outputs and leverage effect.

The need for a leverage effect of a tool does not imply that the total number of input values has to be smaller than the total number of resulting output values, since the structuring and documentation of the input highly contributes to the value of the output produced by a tool. The leverage effect is actually often larger for a tool that requires a lot of input values and delivers a few outputs, compared to a tool that only requires a few input values. There is a trade-off situation when choosing tools. Tools with a small scope are often easy to use and do only require a few input values, but the results are often hard to interpret, not possible to review and not re-usable. Tools with larger requirements on the documentation require more work to retrieve a result, but the study is on the other hand possible to interpret, reviewable and re-usable.

3.5.2 The tools on DANTES web site

There are many reason why LCA, LCC and (E)RA are the tools highlighted in the DANTES project. Firstly, these tools are commonly used within the participating companies during the last ten years and secondly, there exists a lot of knowledge in these areas in the project group. In addition, LCA, LCC, (E)RA, together with Environmental impact assessment (EIA) and scenario modeling, covers the assessment and analysis tools often used today.[7] The communication tools EPD, SDS and SPI have also been in focus since these are used at the participating companies.

3.5.3 Integration of tools

3.5.3.1 The DANTES integration platform

In the project an integration platform has been developed aiming at demonstrating an integrated usage of many different tools based on identified environmental aspects. A user can starting from a question find alternative ways of gathering the information needed for a decision, by using different tools or by using the same tools in a different order. The solution of a problem can be presented both as a logical structure, and as process structure.

[7] Carlson, R., Erixon, E., Erlandsson, E., Flemström, K., Häggström, S., Tivander, J., Establishing common primary data for environmental overview of product life cycles - Users, perspectives, methods, data, and information systems, Naturvårdsverket, 2005

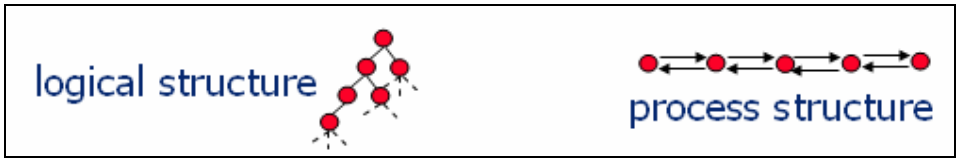


Figure 6: Any task can be broken down in a logical structure and a number of process structures.

The *logical structure* breaks down a task into a number of conditions or subtasks that have to be fulfilled in order to complete the task. The logical structure does not define any specific order in which the subtasks have to be performed. For that reason, the logical structures for a specific task does often look very similar for different users. The order in which the different subtasks are performed is instead clarified using a *process structure*. The process structure describes the actual way of working to perform a task and to find an answer to a question. The order in which users prefer to perform different activities to fulfill a task often varies a lot from user to user. For that reason the process structures for the same task are often very different between different companies and users. By using logical structures and process structures, ways of finding answers on different questions can be documented both as a logical structure of subtasks that have to be performed, as well as different alternative working procedures.

The platform does also provide information on individual tools. A tool is something that requires input and delivers output as a result (see section 3.5.1). When integrating different tools to perform a task, each tool has to be defined with a clear scope and boundaries. The exact definition of how a tool performs a subtask is irrelevant. The integration platform does hence require each tool to be defined with a clear scope and boundaries.

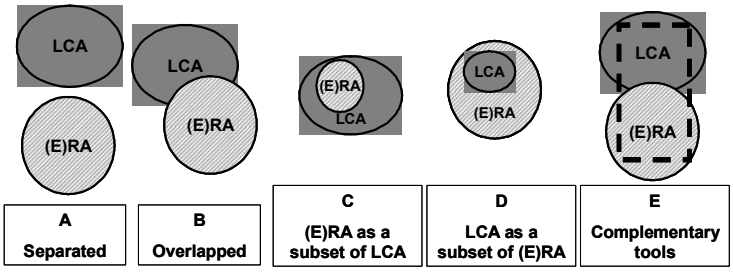
It was decided that the integration of tools would be achieved by developing strategies that describes the interrelation of tools. The work in software integration platform was hence cancelled.

3.5.3.2 LCA and ERA

The similarities, differences and interfaces between the two methods or tools LCA and ERA have also been studied and there are more complicated questions than what may intuitively be apprehended. For example there are similarities between LCA and environmental risk assessment (E)RA as described in the report "Relationships between Life Cycle Assessment and Risk Assessment – Potentials and Obstacles"[8]. Both life cycle assessment and risk assessment provide ways for structuring, evaluating and presenting environmental information relevant for different types of environmental decision making. However, in spite of the fact that the methods address neighbouring problem domains and provide

[8] Flemström, K. et al, Relationships between Life Cycle Assessment and Risk Assessment – Potentials and Obstacles, Naturvårdsverket, 2004

complementary information, the two methodologies are not yet easy to combine. In figure 7 below alternative approaches of viewing the tools in terms of simplified Venn diagrams is presented. Different methodological approaches, different scientific view-points, and different disciplinary traditions need to be bridged. To be effective and efficient tools the approaches of LCA and RA needs to be harmonised in some way. The issues dealt with both tools are very complex and it is not uncomplicated to explicitly explain all the aspects of the information provided by the tools. The study indicates that the knowledge about integration of the tools regarding technical feasibility, potential advantages and obstacles are not yet sufficiently examined, and that e.g. the different attempts to integrate LCA and RA that has actually been made have resulted in contradictory results. Both purpose and perspective of the two methods are often different and the connections between them are not fully investigated in literature to date.



(©Flemström, Carlson, IMI, 2003)

Figure 7: Alternative approaches of viewing the tools LCA and risk assessment in terms of simplified Venn diagrams.[9]

3.5.3.3 LCA and LCC

LCC can be used together with LCA to internalize external costs. One attempt to do this is described in the report "External environmental costs in LCC"[10].

Integrated tools for LCA and LCC exist today e.g. the LCC/LCA tool "Wet fermentation.xls"[11] developed by ABB. The purpose of the tool is to allow designers to evaluate the costs and environmental impact of a potential biogas plant designs and do parameter studies. The evaluation results can be used for design optimisation, in market communication, sales support etc. the scope of the tool is to evaluate the environmental impacts of different materials in a plant, emitted CO_2, saving of resources and use of electricity and fuels. In addition, the tool can calculate the cash flow of the plant.

[9] Flemström, K. et al, Relationships between Life Cycle Assessment and Risk Assessment – Potentials and Obstacles, Naturvårdsverket, 2004

[10] Steen, B., External environmental costs in LCC, Chalmers University of Technology, DANTES report, 2003

[11] Ravemark, D., LCC/LCA Tools, Wet fermentaion.xls – for wet fermentation to biogas, ABB, DANTES report, 2004

3.6 Basic information

Basic information is needed when performing LCA, LCC and ERA studies. In the report "Knowledge about the environmental impact of products: availability, needs and build-up of life cycle data"[12], the authors phrase this as that "environmental information" is "all thinkable and needed environmental information relevant for products in a life cycle perspective." In the report "Establishing common primary data for environmental overview of product life cycles
Users, perspectives, methods, data, and information systems[13]" this wide scope is limited to that 'environmental data are such data that is used for defined environmental decisions or assessments', and the authors mean that environmental data need to be defined by its users and their applications. In this report and in the strategy work within the project we use the latter definition of basic data or primary data.

3.7 Communication of understandable environmental information

3.7.1 Informatics viewpoints

Communication of understandable environmental information is a crucial step in the environmental work at companies and organisations. Understandable information is whether the information is documented so that it can be interpreted by the user. The data need to be available in a language and terminology that the users can appreciate. When communicating information both the sender and receiver of the information need to have a common agreement on the concepts communicated to avoid misunderstanding and misuse. In addition, the sender has not fully communicated the information until the receiver has understood the information and how he/she shall act based on this.
The quality is of high importance for the communication of information e.g. the quality of the information needs to be explicitly defined so that the user can evaluate if the quality of the data is acceptable for his/her purposes.

3.7.2 Communication of environmental information in practice

There are several examples demonstrating how different tools and methods are used to communicate measurable goals and environmental performance at the DANTES web site.

Methods and tools that can be used to facilitate handling and communication of environmental information in the participating companies are EPD, SDS, LCA and LCI, SPIs, EPIs and Product Stewardship.[14] Stakeholders' perception of environmental communication tools such as SDS, EPI/SPI and EPD have been studied in detail to better

[12] Naturvårdsverket (2002), *Kunskap om produkters miljöpåverkan: tillgång, behov och uppbyggnad av livscykeldata*, Swedish EPA Report 5229, p25.

[13] Carlson, R., Erixon, E., Erlandsson, E., Flemström, K., Häggström, S., Tivander, J., Establishing common primary data for environmental overview of product life cycles - Users, perspectives, methods, data, and information systems, Naturvårdsverket, 2005

[14] Imrell, A-M. et al, Stakeholders perception on environmental tools, DANTES report, 2004

understand the environmental skills among companies and find out specific needs for the environmental communication tools.[15]

To develop long-term strategy for market communication of sustainability information is one of the conclusions from the report *Environmental Product Declarations in market communication – the ABB experience*[16]. The reasons for this are e.g. the complexity to describe and communicate the sustainability performance of a products life cycle and the importance to not underestimate the time perspective of implementing EPDs. Further, employees working with and communicating using EPDs need detailed information and thorough training in LCA and EPD. Supply management, marketing and sales personnel and have so far been little involved in environmental information. Only few customers ask for EPDs but they value the information positively when they receive it. Regarding communication to customers, interviews have shown that EPDs are difficult to interpret and use, therefore interpretation keys have been developed. It is important that the information in any communication tool is easy to use, interpret and understand for the customer. In addition, training and education of employees and customers is necessary to succeed with the communication as well as an "environmental culture" within the management group and in the company as a whole.[17]

SPIs are tools for information of specific indicators and could be one way to facilitate handling and communication of e.g. environmental information.[18]

SDSs are legally required tools which answer the questions from customers about classification and labeling of chemicals, product properties and impact of products on the environment.[17]

The way different stakeholders perceive environmental information i.e. environmental communication tools depends on the awareness of environmental issues in the field they work in as well as their role in the organisation.[19]

3.8 How to make new strategies- description on how to proceed

When developing and/or documenting new strategies it is important to regard the strategy from information needs. First, the strategy developer needs to identify a stakeholder and ask (or guess based on earlier experiences) what type of environmental information the stakeholder requires for a specific environmental decision or for solving an environmental related problem. Then, these answers are interpreted and

[15] Stakeholders' perception of environmental communication tools (EPD, SPI , SDS). Overview of previous studies. DANTES internal study within task 6 - Document reactions from stakeholders, 2004

[16] Imrell, A-M., Karlson, L., Environmental Product Declarations in market communication – the ABB experience, DANTES, 2003

[17] Imrell, A-M. et al, Stakeholders perception on environmental tools, DANTES report, 2004

[18] Flemström, K., Imrell, A-M. Palm, A-L., Communication of environmental tools, DANTES report, 2005

[19] Imrell, A-M. et al, Stakeholders perception on environmental tools, DANTES report, 2004

the information requirements are identified and explicitly described. In addition, the requirements are broken down to existing and available tools and methods, both expert tools and methods e.g. LCA, ERA, support tools e.g. data input tool, material inventory and databases, and communication tools e.g. EPI result, EPD etc. The next step is to find the information required (to find the answer on the stakeholders question to be used in the environmental decision) by using a tool or method for aggregation of basic data. Finally, the results are communicated to the stakeholder in a comprehensible way.

When documenting the strategy the defined problem or question that needed to be solved as well as the target group should be detailed described. It is furthermore important that the language and level of detail of the strategy description is adapted to the target group of the strategy. The structure of the DANTES strategies i.e. the documentation format, contains of a background, working structure and experience part, see section 3.2.1 for more details, and this should be used when writing the strategy. Using the common documentation format facilitates and improves the use of the DANTES strategies. Before describing the step by step procedure on how tools and methods are used and examples of results are illustrated, the goal and scope, target group and explicit question to be answered need to be described in detail.

In the working procedure section it is important to describe the use of different tools and methods and also the outcome (output data) of the tools or methods and how this information is used. The strategy writer and also the strategy reader will then easier understand the importance of using tools for a specific purpose etc.

In the DANTES project a review procedure has been implemented in the development process of strategies. A review team has reviewed the developed strategies before publication focusing on the usage of the common format, understandability of and language in the strategies. This procedure has improved the quality of the published strategies and also made them more homogenous.

4. THE DANTES STRATEGIES

4.1 Introduction

A set of strategies developed within the DANTES project are presented on a common presentation format at the public web site. These strategies are grouped according to the company functions that can benefit from them and the target users of each strategy are explicitly described in the text. To facilitate the user to find a strategy suiting his/her needs it is possible to search for a strategy by using a list of keywords.

The developed strategies may be apprehended as ad hoc but they have been chosen by the strategy writers based on their knowledge and shall

also cover the significant sustainability work closely related to the assessment tools in focus for the project i.e. LCA, ERA and LCC. In addition, the target groups of the project web site i.e. marketing, management and research and development are also in focus. However, strategies can be developed on different levels (also illustrated in the picture below) such as:

- **Strategy for environmental communication** – Describes how environmental information is communicated between different users. The DANTES web site contains many examples of this kind of strategy.
- **Strategy for information planning** – Describes how basic environmental information is aggregated into more comprehensible information for decisions, based on identified needs. This kind of strategies that describes how different tools for environmental sustainability can be used in a cost-efficient way has previously been poorly documented, and has thus been the focus for the DANTES strategies.
- **Strategy for basic data** – Describes how basic data used in different tools and methods are related to a common general information model, and how basic data should be managed in a cost-efficient way. This question is too complex to be generally solved in the DANTES project. In some areas we have though reached very far e.g. in the LCA and DfE areas.

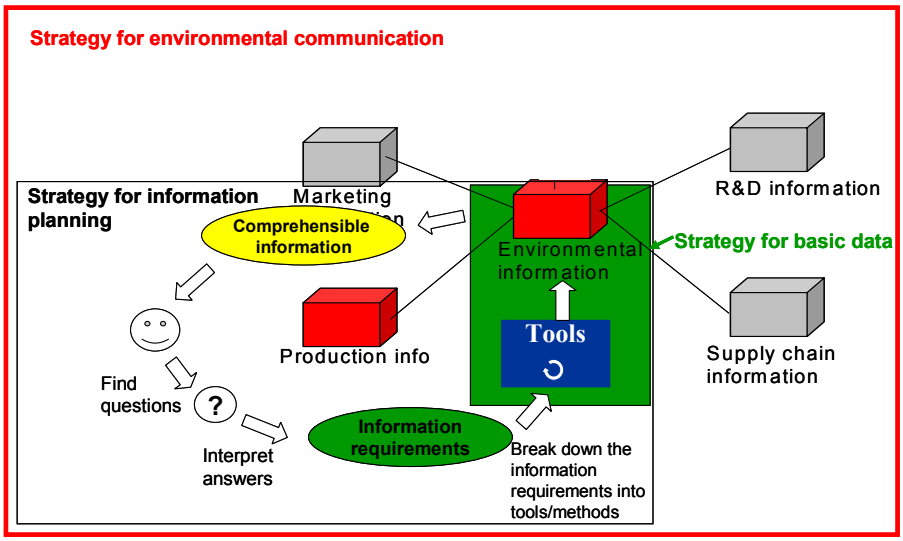


Figure 8: Strategies on different levels (can also be compared with figure 4).

4.2 List of DANTES strategies

When developing the strategies it was intended that the strategies should support use of tools and methods, and environmental decisions in product development, manufacturing as well as marketing. 23 strategies have been developed within the DANTES project in the area of environmental support, marketing, production, supply chain and research and

development representing company function that can benefit from using the strategies. These strategies are documented on a common format and described in the report "*Manual on environmental decision making – part I*" to facilitate the understanding and usage of the strategies.

The list of strategies published to date at the DANTES public web site is presented below by name of each strategy and grouped by company function;

Research and development:

1. Sustainability aspects in product development
2. Design for Environment
3. Environmental aspects in a gate model for the chemical industry

Marketing:

4. Use of EPD in marketing
5. Use of sustainability tools to answer questions from customers
6. SPI in market communication
7. Marketing tools for products

Supply chain:

8. Supply management
9. Analysis of the environmental impact from transportation
10. Use of EPIs in supply chain communication

Production:

11. Implementing an Environmental Management System, EMS
12. Analyzing and reducing energy use
13. Greenhouse gas emission trading

Environmental support:

14. How to perform an LCA
15. How to perform an EPD
16. Material declaration and recycling description
17. Handling and reporting environmental information
18. Policy controlled environmental management
19. Product stewardship implementation
20. How to perform application specific Environmental Risk Assessment, ERA
21. Eco-efficiency analysis of products or processes
22. How to perform an LCC
23. Comprehensive environmental assessment of a chemical product

All these strategies can be found in appendix and at the DANTES web site www.dantes.info.

4.3 Analysis of DANTES strategies

When analysing the DANTES strategies the first question has been; do the strategies handle the identified relevant environmental aspects and user

requirements identified earlier in the project? The list of identified relevant environmental aspects is presented in the DANTES report Definition of relevant environmental aspects.[20] The study presented in that report has been conducted as interviews at the participating companies as well as a literature study. Aspects such as emissions to air and water, use of raw material, energy use, transportation, environmental impacts from products, greenhouse gas emissions and materials' toxic properties have been handled in the strategies. However some of the identified aspects have not been included in the set of strategies and these are for example spill prevention, access to fresh water, oil leakage, use of batteries and energy as losses during usage phase or decrease of energy consumption for the customers.

The intended users of the developed strategies are marketing and sales personnel, management personnel at companies (e.g. decision-makers at different levels), environmental personnel such as environmental coordinators, environmental support and environmental information management personnel, logistic personnel, customers, suppliers and product developers. This list of intended users is very similar to the list identified as the target group of the DANTES project, (see section 3.4), and these groups are to some extent handled in the strategies. Groups such as authorities, NGOs and employees are not the direct target group of the developed strategies but could however benefit from them. One remark is that the target groups of the strategies are often very broad and it could be easier to find a suitable strategy for one's needs if each strategy's target group is more detailed defined.

The level of detail in the developed strategies differs and in some cases it can be hard to follow the described working procedure in practice. A more detailed description of the working procedure would be preferred in these cases. The different examples of sub-results are however useful. Which tools to use in the strategies are not always clear and the connection between tool and output from the tool is not satisfactory described in the strategies from an informatics point of view.

The strategies under the *R&D* area are Sustainability aspects in product development, Design for Environment and Environmental aspects in a gate model for the chemical industry. These three describe how environmental aspects can be integrated into product developers and designers every day work at different companies. All three are design for environment (DfE) methods and the user of the strategies needs to regard the target group and detailed purpose of each strategy to be able to choose a strategy suiting his/her specific purpose.

There are 7 strategies under the *Environmental support* area. Three of these are closely connected to an environmental assessment tool i.e. *How to perform a LCA, How to perform an EPD and How to perform*

[20] Definition of relevant environmental aspects, Flemström, K., DANTES project, 2003

application specific ERA. These strategies describe a working procedure in short to be used when making these assessments based on the company's experiences. The focus for e.g. the LCA strategy is on the practical experiences and the reader is referred to the LCA standards for more information about the working procedure. On the contrary, the ERA strategy is more focused on the step wise working procedure based on standards in the ERA area. The two strategies describing a method for handling environmental information and a method for policy controlled environmental work are in contrary to the environmental assessment methods strategies more focusing on the actual environmental information and on how to structure and use this information to obtain controllability within a company.

There are three strategies under the *Production* area at the web site. These are handling three different areas such as EMS in a company, energy use of a manufacturing unit and CO_2 emission trading according to the EU regulations in this area.

Under the *Supply chain* area how to handle supply management, how to analyse environmental impact from transportation and how to use EPIs in supply chain communication is in focus. There are of course many other environmental issues that can be handled and methods to be used in supply chains like in the other areas and therefore these are only some examples.

The strategies for the *marketing* area more or less cover the project group's experiences in the area on using environmental tools in market communication. The tools EPD, SDS and SPI are all handled in these strategies to different extent.

As discussed above the strategies published at the DANTES web site are heterogeneous which also is one of the ideas behind them. Environmental work within companies often differs a great deal, different departments can be involved, environmental assessments such as LCA or ERA studies, measurement emissions of CO_2 can be performed etc, and the results of the environmental work performed need to be communicated to different types of stakeholders etc. However, among a set of strategies it should be easy to find a strategy suiting the user's specific need. To facilitate this, the common documentation format has been developed and used in the project.

At the DANTES workshop, 10th of March 2005 at Chalmers over 40 persons from industry, organisations, authorities and academia participated. The strategy area at the web site was overall apprehended as a useful part full of company experience and detailed information. Current strategies did however seem to be ad hoc and the reason why exactly these were developed was not understood. In addition, some specific areas such as REACH system, cement production and education were mentioned as suggestions of new strategies to be developed as well as more integrated strategies and examples where environment does not stand alone. Further

information of stakeholders view on the published strategies is described in the report "*Evaluation report*", developed within task 2, in the DANTES project.

5. STRUCTURE AT WWW.DANTES.INFO

The aim of developing the site www.dantes.info was to demonstrate the environmental work performed at the participating companies Akzo Nobel, ABB, Stora Enso and also at the competence centre CPM and the department of Industrial environmental informatics (IMI) at Chalmers. The academic partners in the project have focused on structuring the companies experiences in a strategic way on the DANTES web site. Important to know is that the strategies have not been developed within the DANTES project, but they have been strategically selected and documented within DANTES.

The basis and also the focus of the project have been to demonstrate methods and tools used for environmental assessments, communication and environmental decision making. The methods LCA, ERA, LCC, EPD, product stewardship, Design for Environment, EMS etc has been described in detail focusing on the goal, scope and step by step working procedure. Examples of studies performed at the participating companies can also be found in reports e.g. LCA reports and certified EPDs on ABB and Akzo Nobel products.

6. CONCLUSIONS

By working with strategies within the DANTES project the participants have documented chosen parts of their successful environmental work in a structured way. Agreeing on how to demonstrate i.e. the documentation format and content of the strategies has been a time consuming task within the project but the common agreement has been a crucial step in the project results. The large number of published strategies can be seen as a proof that the work to demonstrate performed environmental work in a structured way has succeeded.

Developing new strategies will be useful for both the strategy writer and the strategy reader. With knowledge about the definition of the strategy concept within DANTES developing and/or using a strategy the advantages will be greater than the costs for doing this. By working in a structured way with environmental issues at different companies and organizations and also by communicating the results of environmental work to customers and suppliers could give a significant business value for the companies, see examples at the published strategies.

7. APPENDIX: THE DANTES STRATEGIES

DANTES Strategy for R&D

SUSTAINABILITY ASPECTS IN A GATE MODEL FOR PRODUCT DEVELOPMENT

The aim of this example is to demonstrate a working procedure on how to integrate sustainability aspects in product development projects based on ABB's experiences.

Background

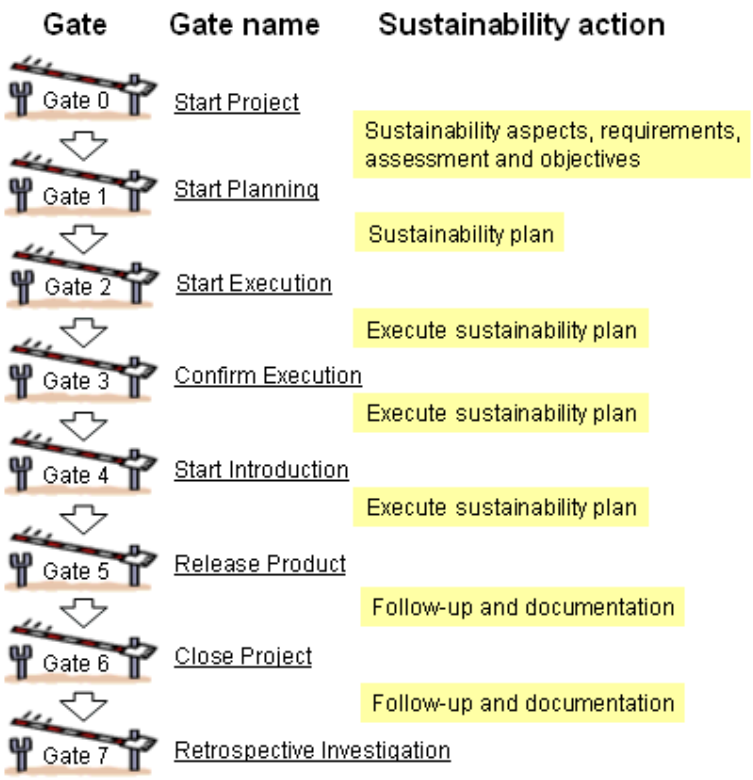
It is often much more cost-efficient to take sustainability actions (here we mainly mean environmental actions) already in a product development process than it is to correct potential environmental problems after the product have been launched. Sustainability requirement and aspects should therefore be integrated in the normal operational procedures and toolboxes in the product development process.
One common used approach in product development projects are Gate alike models.

This strategy shows how sustainability requirements and aspects have been integrated in ABBs product development process through the ABB Gate model in the same way as technical, economic and other requirements. The Gate model is an approach aimed at ensuring that product development projects are driven by business objectives and executed with full management commitment in a professional way. Several variants of Gate models are in use today and the ABB Gate model is one these variants. A Gate meeting is a decision point where the project owner evaluates the project from a business point of view and determines whether to continue the project or not.

R&D managers, project leaders and R&D personnel are the main target groups for this strategy. Conceivable results from using this strategy are lower production cost based on more efficient use of material and energy and from the customer point of view safe and energy efficient solutions.

Working procedure

Below is a graphical representation of the ABB Gate model followed by a more detailed description of each sustainability action.



At Gate 1: Sustainability aspects, requirements, assessment and objectives

The Gate 1 meeting decides whether the sustainability objectives have been defined in a well-founded way or not. A template used in ABB to support this process can be found in Sustainability plan ( ) . The following three measures have to be taken before the Gate 1 meeting:

1.) Identify sustainability requirements
The following examples of sustainability requirements could be relevant to consider:

- Laws and regulations, like restrictions in use of hazardous materials and substances (see EU Legislation).
- The customer valuation of sustainability aspects is very important to identify and understand. Examples of requirements could be to limit use of hazardous materials or to increase the energy efficiency of the product.
- Standards could sometimes put environmental related requirements on the product or product development process (as example ISO/TR 14062).
- Sustainability risks, like
  - the risk for leakage of oils or other chemical liquids to the environment from batteries and transformers for example.
  - the risk for explosion or fire for products containing gases or inflammable liquids.
  - the risk for spreading toxic substances to the environment when hazardous materials are used.

The company's own policies should be checked. It could also be relevant to check customers' or suppliers' policies.

2.) Assess the sustainability aspects
The next action is to quantify the sustainability aspects for your type of product and identify the major impacts or significant aspects to judge what feasible sustainability improvements to make in

the project. Typical significant sustainability aspects for ABB products are energy losses during operation of the product and use of hazardous materials. The LCALight tool is useful to conduct this assessment.

3.) Define sustainability objectives
All conceivable improvements identified in the previous step can not always be accomplished in your project depending on economic, technical or other types of practical constraints. You must therefore judge what sustainability objectives are realistic to accomplish in your project. The identified requirements and customer valuations are of course an important basis for this decision. Also think about sustainability marketing material already at this stage. Compile the decision into concrete and measurable objectives.

At Gate 2: Sustainability plan

In the Gate 2 assessment it is checked whether the sustainability plan have been established in a well-founded way or not. Therefore you have to make a resource and time plan to accomplish the defined sustainability objectives. The resulting sustainability plan is a very important document since it serves as the "main thread" throughout the whole project. Do not forget to communicate the plan to the project group members and other concerned. An example of a sustainability plan template used in ABB can be found in Sustainability plan( ).

At Gate 3, 4 and 5: Execute Sustainability plan

In the Gate 3, 4 and 5 assessments it is checked whether the sustainability plan is executed properly. The actions to be conducted in the project can be roughly divided into two groups.

1.) Improve the products' sustainability performance:

- Develop designs with minimal use of hazardous materials and substances.
- Reduce total weight and material use.
- Improve energy efficiency for the product.
- Improve the products recycling properties by not mixing materials, for example.
- Lengthen the product life time by improving reparability and facilitate upgrading, for example.
- The LCAlight and LCClight tools could also be useful for quick assessments and comparisons of different material or design alternatives.

2.) Development of marketing material:

- Environmental Product Declarations (EPD).
- Recycling and scrapping instructions.
- Material declarations.
- Safety Data Sheets (SDS)

At Gate 6, 7: Follow-up and documentation

The final step is to document experiences. Preferably, this could be done by using the filled out templates in the enclosures in combination with some concluding remarks.

Experiences

It is only possible to give some indications on resource demands for setting up and maintain this procedure. There are great variations depending on type of company and product

The first "one time investment" to include sustainability aspects into your own Gate model should be a relatively limited working task, since this is more a question of achieving a management commitment.

The second "one time investment" to build up a supporting toolbox is more resource demanding. You could however use the DANTES toolbox (at www.dantes.info) for a quick start. Nevertheless, you need to allocate resources to set up your own toolbox and supporting organization. The most critical aspect here is to decide how to maintain this support system on a long-term basis.

The resource demand for implementation of sustainability aspects in each product development project can vary much, from hours/days to several weeks/month of work depending on type of product.

It is easy to underestimate the calendar time needed for the implementation process.

Education programs have to be set up since sustainability issues is a new competence area for many of those involved in product development.

Access to easy to use and cost-efficient software tools as well as personnel support is critical.

In practice, energy and resource efficiency as well as waste minimization are also economic issues. Environmental considerations early in the product development cycle could therefore offer more competitive and sustainable products to the market.

Business value

Implementation of sustainability aspects and requirements in product development projects through a gate model supports industry in developing safe, energy- and resource efficient products. This could significantly increase the customer value for a product provided that the benefits are communicated to the customers in a credible and understandable way.

See also " Managing Environmental Aspects in Product Development -The ABB Experience"

DANTES Strategy for R&D

DESIGN FOR ENVIRONMENT

The aim of this strategy is to fulfill environmental requirements of a product in the design phase. The strategy is based on an example from the railway industry and it is documented by Industrial Environmental Informatics at Chalmers University of Technology.

Background

This strategy describes how market requirements can be included in the design phase and how to design products with lower environmental impact. The strategy explains how to work with Design for Environment (DfE), in terms of a method based on Environmental Performance Indicators (EPIs), a common material list and material property data for each material in the list.

The Nordic rail operator initiative on common environmental requirements on rolling stock, Nordic Manual, revealed the need for tools and methods of measuring the environmental performance already at the design stage. This rendered in the EU co-funded project RAVEL (Rail Vehicle Eco-Efficient Design) running 1998-2001, where the method on which this strategy is based was developed.

The RAVEL project was followed by REPID (Rail sector framework and tools for standardizing and improving usability of Environmental Performance Indicators and Data formats) running 2002-2004, where the method and tools from RAVEL were further developed and implemented within the railway industry. REPID was co-ordinated by the railway operators trade organization UIC (International Union of Railways) and the European railway manufacturers organization UNIFE (the Union of European Railway Industries), and it resulted in a

practical agreement on a set of EPIs, a practically useful and common material list, and an open data format. The focus of this strategy is on how a company can work practically according to the REPID methodology to decrease the environmental impact of their products.

Intended users and benefits
The intended users of the strategy are designers, environmental coordinators and decision-makers at management level in any manufacturing company. The strategy provides comprehensible and verifiable communication of environmental requirements from the customer, through different company functions and all the way to the designer in terms of EPIs. This strategy focuses on the details in the DfE methodology and how to practically work with it in the product development process. To use the full potential of the DfE methodology common agreements are needed in specific industry sectors where the whole supply chain is involved. This is further described in the DANTES strategy: EPIs in supply chain communication.

Working procedure

Using this Design for Environment (DfE) methodology results in calculated values on quantitative environmental performance indicators (EPIs). Below is a stepwise description of the working procedure divided into two parts. Part one describes how to establish the basic prerequisites for the DfE work and part two describes how to execute the method.

1. Establish a basis for the DfE work
To be able to use the method in design phases at different companies and also in communication throughout the supply chain, common agreements need to be made on some crucial concepts. These are the important bases for the DfE method, and also the common language that will be used for communication of environmental requirements and performance. The agreements have to be made in a group consisting of representatives from all different companies and functions who will be involved in the communication using this DfE-method.

1.1. Define a set of Environmental Performance Indicators (EPIs)
First a set of common EPIs has to be explicitly defined based on regulations, company policy etc. EPIs are quantitative expression of the environmental performance of the product you want to control. Each indicator has to be explicitly defined either per sector or per company. Algorithms for how to calculate each indicator has to be agreed and documented. This set of indicators will reflect the requirements which the product has to fulfill and at the same time measure the environmental impact.

Criteria of EPIs used in a DfE-system:

- They are measurable
- They are able to control and can be influenced by the DfE process
- They address important and well defined environmental issues

A definition of an EPI consists of a detailed description, algorithms and defined inputs and outputs. A detailed description of EPIs and the EPI definition process can be defined can be found here.

The calculations of the EPIs is based on common material property data. The definition of the EPIs does hence also involve the definition of the material properties that has to be acquired. See example of material property. Also the definition of other kinds of aspects which are used in the EPI definitions, such as how to calculate weight, or the definition of energy use, need to be agreed upon.

See example of a set of indicators: The REPID set of indicators 2003

1.2. Develop a material list
All users of the DfE system have to use the same or compatible material lists, since the calculation of the EPIs are based on the properties of these materials. If many parties are included in the system they all need either to agree on a common list or establish a translation between the different lists. A common material list consists of construction materials used within the industry. If incompatible material lists are used by different parts in the system, the results from the calculations will not be comparable. See example of a material list.

1.3. Acquire environmental data needed for the calculations of the EPIs
Material data needed for the calculations of the EPIs then have to be gathered, documented and inserted into a common database. This should be performed in a structured way including collection and investigation of

available information sources, finding the right data according to the material property definition and data quality requirements, documentation of the data, and finally reviewing the acquired data. Usage of a common data format, such as the ISO/TS 14048 Data documentation format, when documenting the data is highly recommended.

1.4. Implement calculation functionality for the defined EPIs
To enable calculations of the EPIs the algorithms defined in 1.1 need to be implemented as calculation functionality. The calculations of the material related indicators are based on properties of the materials in the analysed product. The calculation functionality aggregates the commonly defined properties for these materials, in accordance with the algorithms, into a score for each indicator. An indicator can be calculated for any part in the component structure. See illustration of calculation procedure.

2. Execution of the method

2.1. Specification of environmental requirements
The following work steps are performed by e.g. an environmental coordinator using a tool (e.g. a spreadsheet) where the environmental requirements and targets are defined for the product in terms of the defined EPIs agreed on in 1.1.

- *Create a DfE project with an environmental policy*
  Create a project that will keep all information regarding environmentally related requirements (selection of EPIs and definition of target values for each selected EPI) on the product together.

- *Choose Environmental Performance Indicators (EPIs)*
  A set of EPIs for a certain product is chosen from the defined list. The chosen EPIs should cover the whole life cycle of the product and be based on the same calculation basis.

- *Set target values for the EPIs*
  Target values for the chosen indicators should be set according to requirements of the project.

2.2. Verify that a product design fulfils the requirements
The following work steps are performed in the product development process to verify that a product design fulfils the requirements specified in 2.1. Some kind of easy to use tool is needed to analyze the environmental performance of products in terms of the defined EPIs based on the common material list, material property data for each material in the list, and calculation functionality for each EPI.

- *Insert product structure*
  Insert data on the product structure including a specification of which materials and components the product is made of, and also other required information as specified in the EPI definitions. The materials shall be selected from (or translated to) the common material list. To reduce the amount of work, the product structure should be imported from other systems where it already has been inserted, such as a CAD- or PDM-system. Example of a product structure.

- *Calculate environmental performance indicators*
  Perform the calculation of the indicators for the product by using the calculation functionality defined in 1.4. The calculations are based on the material list and the material properties connected to these materials.

- *Improve or communicate the result and use it for decision-making*
  Compare the calculated EPI values with the targets. In case the product fails to meet target - redesign and recalculate to see if target is reached. This can be done iteratively within engineering design until all targets are met.

  The calculated EPI values can also be used to compare different alternative designs to see which one of the alternatives that is best from an environmental point of view.
  Reports can also be generated with information about indicator results, definitions of the indicators and also reports on how the calculations were performed.

For complex products such as rail vehicles the indicators can be calculated per part in the product structure in order to find out where the hot-spots are and where to focus in order to improve environmental performance. One set of targets can be set on product level and other targets for specific sub-components of the product.

For further reading please see "Information material on REPID software training session" (M. Erlandsson, K. Flemström, 2003).

Experience

This strategy is based on a methodology and experiences from a project within the European railway industry. The experiences from implementing this EPI based Design for Environment methodology is therefore from the railway industry.

The strategy is suitable for the companies within the railway industry as there are both strong customer as well as legal environmental requirements, which forces the companies to deal with environmental issues. One sector specific feature is that the products are designed and manufactured per contract giving low production series compared to many other types of products. The major part of the companies have also in their policies declared that they are working towards sustainability. This strategy provides a methodology to increase the environmental performance of a product and facilitates the measurement of performance in order to verify that requirements are met already in the design phase.

However, data acquisition and consensus processes are time consuming and costly processes. It is important to obtain right data quality and make sure that the user of the EPIs, material list etc. agree on and understand them. Ongoing work within railway industry is to agree on common definitions and harmonize requirements. The common list of EPIs and a common material list will be maintained within a Rail Eco-Procurement board and both lists are to be brought to a standardization process within the railway industry. Furthermore, a potential risk with using this strategy is high costs for implementing it. Avoiding future costs is however the driving force for using this strategy. The costs for implementing the strategy can be reduced through collaboration between many companies sharing the costs for common information. The pioneering work performed within the railway industry does also reduce the costs for implementing this strategy within other industries.

Business value
Including environmental aspects and requirements in product development and design processes supports industry in developing safe, energy- and resource efficient products. This could increase the customer value for a product presumed the benefits are communicated to the customers in a credible and understandable way.

DANTES Strategy for R&D

ENVIRONMENTAL ASPECTS IN A GATE MODEL FOR THE CHEMICAL INDUSTRY

The aim of this strategy is to tackle health, safety and environmental (HSE) issues in product development through inclusion of HSE criteria into a Gate model. A Gate model similar to the one presented here is being used by Akzo Nobel Surface Chemistry.

Background

This guideline deals with the assessment of health, safety and environmental (henceforth referred to as HSE) aspects for chemical products and processes within the Gate model procedure. It is intended mostly for the project manager or environmental support people who are assigned to fulfil the criteria concerning these aspects.

Further information about the Gate model procedure is available here.

The criteria used in the Gate model for product development naturally differs from the model for process development and the working procedure described in this strategy covers HSE aspects for both product and process development within a chemical industry.

Working procedure

Develop Gate criteria

There are six Stages and five Gates in the Stage Gating procedure used by Akzo Nobel Surfactants Europe and Akzo Nobel Ethylene Amines. The Stages and Gates in this procedure are presented below.

Stage	Deliverable
1. Idea	develop an idea, assess its relative merits and generate a preliminary proposal
Gate 1	*Screening*
2. Concept	prove an idea and test its fit with the market
Gate 2	*Project initiation*
3. Investigation	identify a method for realization, eliminate other alternatives
Gate 3	*Business case decision*
4. Development	complete process evaluations, cost studies and generate detailed technology
Gate 4	*Validation*
5. Validation	confirm market and technology, develop detailed plan for launch
Gate 5	*Launch*
6. Launch	execute plans for realization

The project team develops criteria and appoints Gate keepers for each gate. In this example we focus on the Health, Safety and Environmental criteria.

Meeting the gate criteria

It is not always obvious how to meet the gate criteria. People with different competences are needed and different tools have to be used. The project manager have to consult people with specific competences within health, safety or environment. Guidelines on how to tackle this are useful to ensure the fulfilment of the criteria.

Three different environmental competences are useful to involve in the project and they are referred to in the examples below, namely:

1. A person working with the laws and regulations connected to HSE matters, such as transportation, storage, handling, Safety Data Sheets etc. (referred to as RA specialist). Sometimes a Safety engineer may also be needed.

2. A toxicologist and eco-toxicologist working with the human health and environmental effects of chemicals (hence referred to as toxicologist).

3. A person working with Product Stewardship or Life Cycle Assessment thereby looking at the whole life cycle of the product and taking into account resource use, air and water emissions, energy use and wastes (hence referred to as LCA specialist).

Criteria for product development **Criteria for process development**

HSE criteria used in product development

The examples of Gate criteria presented below are used by Akzo Nobel Surface Chemistry, Surfactants Europe in their product development projects. Examples of how the project manager can tackle the Gate criteria are also described.

GATE 1

Criteria	Competence and comments
Has a search for toxicological and/or eco-toxicological properties been made?	Consult a toxicologist or RA specialist. Data are available e.g. from the European Chemicals Bureau at http://ecb.jrc.it/esis/ or at other free or commercial databases. Examples of databases on the internet is available at http://meso.spawar.navy.mil/toxicity.html or at http://www.epa.gov/region02/library/databases.htm
In case of new chemicals: are safety data sheets (SDS) available for these chemicals?	Consult an RA specialist. SDS are available from ESIS, mentioned above, and from the supplier of the chemical.
Are the perceived health and/or environmental risks high?	This question is very subjective and every person will give a different answer. It may therefore be advantageous to consult a toxicologist as well as an LCA specialist in order to get an overall view of the health and environmental risks. Examples of things to consider on a screening level: - Are any scarce resources used? - Are the risks for accidents high within the production, during handling or during transportation? - Is the energy consumption high compared to other chemical products? Compare to products delivering the same function if possible. - Is the product or the constituents carcinogenic/mutagenic, reprotoxic, toxic, persistent or bioaccumulating? If it is carcinogenic/mutagenic or detrimental to reproduction it may be very

	expensive and time consuming, if not impossible, to put on the market. A persistent chemical may also have difficulties depending on the application. If the chemical is bioaccumulating or toxic the risks may need to be strictly managed based on the Risk Assessment to be conducted later in the project.
Has a literature search on product safety characteristics been made?	Consult a RA-specialist.

GATE 2

Criteria	Competence and comments
Have any toxicity and/or eco-toxicity issues been identified and will testing be required?	A toxicologist have to be consulted in order to interpret the gathered information on toxicological or eco-toxicological properties. Issues may include: - high toxicity (rats, fish, daphnia, algae or microorganisms) - carcinogenicity or mutagenicity - persistent or not biodegradable - bioaccumulating - widespread use by or high exposure to man or the environment Consult the RA-specialist about what the authorities require. General guidance on the completion of a Base set notification can be found at the European Chemicals Bureau and in the SNIF Guidance. Consult the marketing manager on whether there are any demands from the market on the environmental performance or the risks to human health of the product. Such demands can imply that certain tests may be advantageous to conduct from a competitive point of view.
May renewable raw materials be used?	Research and Development and Manufacturing. The raw material alternatives may be investigated by the LCA specialist, whether they are renewable or not, in order to find the best alternative from an environmental point of view. Information about LCA is available here.

How will the product lead to an environmental improvement compared to existing alternatives?	Marketing and Research and Development can be consulted about the alternatives on the market and a toxicologist and an LCA specialist about the impact on health, safety and the environment of these alternatives. Examples of things to compare are presented in the third criteria in Gate 1 (the question about environmental risks). The LCALight tool can also be used to make a quick comparison from a life cycle perspective.
Have any safety issues been identified? If so, specify.	An RA specialist or Safety engineer will have to go through all of the handling, production and transportation of the product in order to give an opinion on the safety. Examples of things to consider: - risks of explosion or fire - risks during storage - risks during transportation - risks for malfunction in production, packaging or filling - new hazardous materials are introduced

GATE 3	
Criteria	**Competence and comments**
Have initial toxicity and eco-toxicity studies been conducted?	Consult a toxicologist or a Contract Research Organisation (CRO) directly for making toxicity tests. This task may be co-ordinated with other tests that have to be made in order to fulfil the base set for notification.
Have a human and environmental risk assessment been started?	Consult a toxicologist. It may be beneficial to try to find risk assessments on similar chemicals first. Information about risk assessments being conducted in the EU is available in European chemical Substances Information System (ESIS). General information about Environmental Risk Assessment can be found here. The project manager may have to discuss the objectives and budget for the assessment with the risk assessment practitioner.

Has a base set notification been started?	Have all of the data needed for a Base set notification been collected and the Competent Authority contacted? A toxicologist can be appointed the responsibility to complete a base set notification. General guidance can be found at the European Chemicals Bureau and in the SNIF Guidance.
Have all the aspects of future environmental taxes, regulations and consumer demands linked to the product life cycle been considered?	An LCA expert in co-operation with marketing and maybe even a company lawyer may be needed to answer this complex question. The LCA expert can point to environmental concerns linked to the life cycle of the product and the marketer and lawyer may know whether there is a risk of taxes or regulations connected to these concerns. Marketing may also know of any consumer demands concerning environmental performance. These demands may have arisen during testing the fit of the product with the market in Stage 2.

GATE 4

Criteria	Competence and comments
Have final risk assessments for human health and environment been completed?	Is there a need for further risk reduction measures? Can these be overcome by a refined risk assessment for certain applications, by further testing or by labelling, worker protection, information to customers or other low cost measures?
Is the base set notification completed?	Have a base set notification been completed and sent to the Competent Authority?
Have a review of the environmental aspects covering the whole life cycle of the product been	A screening LCA may be performed by the LCA expert in order to find possible environmental hot spots in the life cycle and their relative importance. Here is more information about LCA and tools that can be used.

performed?

Have all safety issues been resolved?	These can be resolved e.g. through plans for information, safety routines, protection and training.

GATE 5

Criteria	Competence and comments
Has a reassessment of the risks been made?	Have all of the issues that have been found throughout the project been dealt with? Are there questions or comments from the Competent Authorities on the base set notification that need to be dealt with? The toxicologist can go through all of the available information that has been gathered throughout the project concerning risks to human health or the environment and decide whether there are any issues of concern left.
Is any further testing warranted?	Are there questions or comments from the Competent Authority on the base set notification that need to be dealt with?
Is any further environmental risk assessment monitoring required?	Do the Competent Authority require any additional monitoring based on the notification?

There is also a simplified version of the gate model used by Surfactants Europe, which is intended for smaller projects. Most of the HSE criteria above are also included in this version, but the analyses and assessments are not conducted to the same depth of detail.

Environmental criteria used in process development

Described below are examples of how the project manager can tackle the Gate criteria used by Akzo Nobel subsidiary Ethylene Amines in their process development projects. These criteria are to be met in Gate 2 - Project initiation.

There is often only one person responsible for HSE issues, called HSE manager, which is referred to below. The Safety engineer mentioned is a person responsible for safety issues at the production site and the Site manager is the person responsible for the whole operation of the site.

Criteria	Competence and comments
Will the project follow the corporate policy of preventing or minimizing the environmental impact of Akzo Nobel's activities and products through appropriate design, manufacturing, distribution, use and disposal practices? Will the project follow the corporate policy of seeking to conduct its activities in such a way as to prevent harm to the health of its employees and other stakeholders?	This is the core environmental objective that should be kept in mind in all projects. These two questions are mainly answered by considering the questions below.
Make a survey of whether there are any perceived health and environmental risks connected to the new process.	All of the three environmental competences (or the HSE manager) can make this survey in co-operation with the process developer. Examples of what the survey may consider: • concerns for the health of people and the environment in the local surroundings due to e.g. change in handling or transportation, risks for new or increasing emissions to air or water, new waste handling • a change in raw material purity may have consequences on health, safety or the environment through larger production losses,

energy consumption or amounts of waste.

Will any new environmental permits be needed?	The RA specialist or HSE manager and also the Site manager should be aware of the permits needed. Relevant permits may be concerning emissions to air or water, or handling and transportation of dangerous chemicals.
Assess whether the new or improved process will lead to environmental improvements compared to existing alternatives.	The LCA specialist or HSE manager can go through the alternatives in co-operation with the Process developer. Examples of things to consider: • emissions, energy and water consumption and generation of waste during production - use of new chemicals e.g. in maintenance or as aid chemicals • if there is a change in supplier the transportation means and distances may change (see also "Transport and the Environment")
Assess whether there are any safety issues of concern.	A Safety engineer or HSE manager can go through the different aspects of safety and they may need input from the Site Manager or Process developer. Examples of things to consider: • increased risk of explosion or fire • increased risk for storage • increased risk for malfunction in production, packaging or filling • new hazardous materials introduced • greater consequences in case of an accident on site or during transportation
Assess whether there are any waste issues of concern.	The Process developer and the Production manager may need to be consulted. Examples of things to consider: • new packing material - an LCA specialist may be consulted to assess what the environmental implications of this are (see also "Life Cycle Assessment of Industrial Packaging for Chemicals") • new process waste
Describe whether any new safety routines, protection or training will be	The Safety engineer (or HSE manager) in co-operation with the Process developer will need to go through the changes the new process will bring and assess whether there is need for any new or changed

needed. safety routines, protection or training.

Experiences

The Gate model can, in general, be quite cumbersome to manage at first, but when the first project is finished and the information paths established the model becomes less cumbersome in the following projects.

Apart from the advantage of more thoroughly and consistently managed projects many useful contacts are made and new information found by using the model.

It may be advantageous to have a less detailed model for smaller projects, which still supports the general objective of better project management.

Business value

There are many environmental, health and safety requirements on a chemical product and costs connected to these requirements. It is therefore beneficial to know in advance how well a new product fulfills these requirements in order to avoid unnecessary costs and also to find possible advantages for the customer compared to competitors.

DANTES Strategy for Marketing

USE OF EPD IN MARKETING

The aim of this strategy is to demonstrate how EPD can be used in marketing. The strategy is based on experiences from ABB.

Background

It is not enough to develop and produce environmentally sound products. The performance must also be communicated in a credible and understandable way to customers and other stakeholders to build a competitive edge for the product and increase its market share

An EPD provides customers and the market in general with third party verified and comparable information regarding environmental performance of products and services. An EPD gives the answer to many questions often asked by customers. Such questions could be about material content, hazardous materials, emissions, waste, efficiency, recycling and environmental management systems. For energy using products, like electric and electronic products, efficiency during use of the product is of main importance.

Marketing staff as well as the customers are the intended users of this strategy example.

Working procedure

1. Decide to whom EPDs should be distributed:
    a. All customers
    b. A cross-section of all customers
    c. Suppliers

d. Other stakeholders

2. Decide for what products to develop EPD? See How to perform an EPD.

   a. All products

   b. New products

   c. Representative types of a new product family

   d. High volume or core products

3. Decide in which situations EPD should be distributed:

   a. Sales communication; together with an offer for example

   b. Exhibitions, conferences, workshops and lectures

   c. Company web sites

4. Decide in what format EPD should be distributed:

   a. As a stand alone document

   b. Integrated in a brochure

   c. In paper or in electronic format

Experiences

EPD is a good approach providing objective information and facilitating product comparison. However, EPD is a relatively complex and resource demanding concept since it is based on a full LCA. It could therefore be expected that the total number of registered EPDs will be relatively limited. One approach could therefore be to develop EPDs for core or high volume products or for new products. An additional benefit from using EPD in marketing could be a more positive image of the company.

Customers seldom demand an EPD, but they show an interest in environmental performance of a product and they value the EPD positively when they receive it. It could therefore be cost efficient to develop EPDs once since they could be reused many times.

One problem with EPDs is that some customers perceive the information in an EPD as being too complex to understand. Some first attempts have therefore been made to develop interpretation keys which make the EPDs useful also for "non-environmental specialists". Please find interpretation keys in Tools & Methods and Publications.

You can find several ABB examples of EPDs on Publications on Environmental Product Declaration.

More EPD experiences from can be found in the publication "ABB experiences of EPD"

Business value

The business value with this strategy is that it forces towards a structured way of thinking about using EPDs in marketing. Since the development of an EPD can be a resource demanding undertaking one should be clear about the purpose of communicating an EPD.

USE OF SUSTAINABILITY TOOLS TO ANSWER QUESTIONS FROM CUSTOMERS

The aim of this strategy from Akzo Nobel is to show how sustainability tools can be used to answer questions about environmental issues and communicate environmental information to customers.

Background

The goal of this strategy is to show how companies can handle environmental questions from customers and other stakeholders as well as how they can communicate environmental information and which tools that may be used.

The strategy is developed based on a survey carried out at different departments within two different business units within Akzo Nobel Surface Chemistry. These departments are Regulatory Affairs, Sales and Marketing and Customer Service. Corporate Communications also took part in the survey. The functions of all these departments are to assist customers and provide customer services in different areas such as chemical control and regulations, company policies, health, safety and environmental issues mainly related to the marketing and sales of chemical products.

The target group for this strategy is people working in departments similar to the above mentioned ones that have direct contact with customers.

Working procedure

In order to be able to describe the communication channels and use of sustainability tools within a company, it is necessary to find out how often and what kind of questions a company receives from customers and other stakeholders. A survey within different parts of the company can be used for this purpose. As mentioned in the Background section, four departments within the company were chosen for the survey. These were Regulatory Affairs, Sales and Marketing, Customer Service and Corporate Communications.

These questions can be answered by the use of the following tools:

1. Safety Data Sheets (SDS) and other product data sheets
A chemical company often receives questions about classification and labeling of chemicals, product properties and impact of products on the environment. These questions can be answered by the use of Safety Data Sheets, SDS, which all producers of chemicals are legally required to provide One section of an SDS is dedicated to environmental information. Here, eco-toxicologal data and information on for example biodegradability and bioaccumulation can be provided. The SDSs are administered and put together by the Regulatory Affairs department in co-operation with R&D departments. The Regulatory Affairs department are consulted as experts if questions from customers cannot be answered directly by information from the SDS or by the R&D departments.

Most of the times, SDSs can be further improved by including more environmental information when such is available. However, test results on chemical products concerning for example biodegradability or bioaccumulation can be difficult to interpret. Consequently, information is not added to the SDS until there is a mutual understanding and a consensus within the area of question in the company or within the business sector.

Product information papers/product data sheets are also tools that can be useful in handling customers' questions about properties of the product. Since this kind of information is not legally required in a specific format like the SDSs, such information can be more adapted to the product and its applications by the company in question.

2. Environmental Product Declarations (EPD)
EPDs are mainly used by Sales and Marketing personnel in order to provide customers with verified and comparable information on the environmental performance of a certain product. The EPD or documents on which the EPD is based can be used to answer questions about the environmental performance of the product in different life cycle phases. However, the use of EPDs in marketing is not widespread in the company. This is mainly due to the difficulties in interpretation of the information in an EPD. However, the customers

reactions on an EPD are very positive if the EPD is sent to them. Accordingly, the use of EPDs can improve the company's environmental image.

3. Frequently Asked Questions (FAQ)
Frequently asked questions and answers on Quality, Health, Safety and Environment, QHSE, is of great assistance for Sales and Marketing as well as for Customer Service staff since they receive a lot of similar questions about ISO certification, legislation and regulations and impact of products on the environment. The main purpose of FAQ is to avoid filling out separate questionnaires from customers. FAQ may be in the form of a written document or an electronic form that can be downloaded at the company website or sent directly to many customers by Sales and Marketing staff. An example of FAQ developed at Akzo Nobel Surface Chemistry can be found here.

4. Practices manuals, safety information on CDs, safety kits
Marketing staff very often receive specific questions from customers on emptying and cleaning instructions, safety and health protection measures, impact of products on human health and the environment etc. Thus, practices manuals, safety information and safety kits are well proven means of communication of information that can be used for educating customers during site visits, lectures and seminars. For example, the tools are helpful in educating customers on proper emptying of containers and use of ventilation during this process, also giving recommendation on personal protection. The safety kit that includes respiratory mask, eye-wash, gloves etc. is used for this purpose.

5. Internet and Intranet for customers and distributors
An internet site for customers and distributors can also be a good alternative and of assistance to the sales and marketing as well as customer service departments. For example, the Intranet website for distributors and customers provides useful information on the product portfolio, company policies as well as links to regulations and directives. Together with other self-instructive tools like FAQ described above, the Intranet and Internet website may prevent customers from regularly calling Customers Support, thus saving time for this department to deal with more specific questions from customers.

6. Press releases, news stories, seminars and site visits
There is always a need to establish an open dialog with neighbors and community and discuss environmental issues more extensively. Press releases, news stories, seminars and site visits can be used extensively in communication of environmental information to a wide range of stakeholders. Akzo Nobel, for example, publishes an online magazine "News & Views", which is packed with news, features, competitions and opportunities for visitor interaction.

7. Corporate Social Responsibility (CSR)/sustainability reports and environmental reports
CSR/sustainability reports and environmental reports are methods of communicating summarized information about the activities within a company in these areas. The reports help maintain the company's reputation as well as enhance credibility among stakeholders. The communication department as well as sales and marketing staff are used to answer a wide range of environmentally and sustainability related questions by sending these reports to the customers.

Experiences

Usually there are routines in the company on how to handle environmental questions. The main part of the required information can be found in safety data sheets or chemicals test result reports. There are extensive routines on how to put together, update and distribute the SDSs, which are also necessary to meet the legal requirements.

An internet site for customers and distributors is a useful alternative to Customer Support functions. It can help in communicating all necessary information on products to the customers and prevent them from regularly calling Customers Support. In reality, the Customer Support function may not have time to communicate personally with smaller customers at a regular basis. Tools like websites, FAQs and other written material is a good way to supply the smaller customers with requested and easily accessible information.

There is a significant difference between questions from customers from different countries. The environmental awareness and concern among customers from Scandinavia and Europe is typically high, while others may be further behind in this area. When preparing written material and answering questions over the phone, it is important to be aware of these differences to be able to support the customers in the best

possible way. Sometimes, specific environmental information may be too difficult to understand even for the most educated customer.

DANTES Strategy for Marketing

SPI IN MARKET COMMUNICATION

The aim of this strategy is to describe how data collection for calculating Sustainability Performance Indicators (SPIs) can be organized, a procedure of how one can work on improving the SPIs and how the SPIs can be communicated to stakeholders, based on ABBs experience

Background

Sustainability reporting is a process for publicly disclosing an organization's economic, environmental, and social performance in the form of Sustainability Performance Indicators, SPI.

- the environmental dimension of sustainability concerns an organization's impacts on all living and non-living natural systems.
- the social dimension of sustainability concerns an organization's impacts on the social systems within which it operates.
- the economic dimension of sustainability concerns an organization's impacts on the economic capacity of its stakeholders and on economic systems at the local, national and global levels.

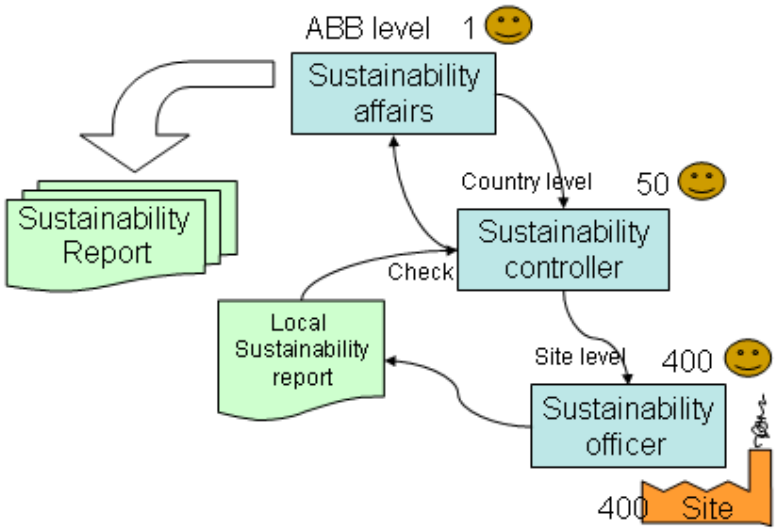
ABB uses the guidelines presented by the Global Reporting Initiative (GRI) for sustainability reporting.

The purpose of this strategy is to show how the data collection process and the continuous improvement process have been implemented in ABB and the value thereof. Other relevant Dantes pages/documents are; "Implementing an environmental management system, EMS" based on ABBs experience, a Dantes report on the sustainability performance of ABB "ABB sustainability performance" and the Dantes description of the management tool Environmental Management System

Managers, market communication staff as well as the environmental support organization are the intended users of this strategy.

Working procedure

The graph below shows how the data for the Sustainability report is collected in ABB.



Sustainability Affairs has a general responsibility for the data collection process.

All countries where ABB has production have a "Sustainability Controller" and they are responsible for establishing and communicating ABB's social and environmental policies, programs and procedures to all facilities within their countries. They also commission independent social and environmental audits, and prepare performance reports. Other duties include promoting eco-efficient technologies and developing country-specific education and training programs.

All ABB production sites have a "Sustainability Officer" and they are responsible for local environmental management programs. This includes developing manuals, planning improvements and reporting environmental and health and safety performance.

At the end of a calendar year the Sustainability Officer is responsible for submitting a report - Local Sustainability Report -where all the reported data is included. Practically, the Sustainability Officer enters (emission, energy use,…) data in a Lotus Notes database. When the data has been entered the report is marked as finished and the entered data are sent to the Sustainability Controller for approval.

When all the reports are marked as finished, the data is checked for consistency and aggregated into a Sustainability report by Sustainability Affairs (link to report). The sustainability performance of ABB is rated by independent sustainability evaluators.

Improvement process
When all the data has been entered, Sustainability Affairs has a good overview of the current situation and now a process can start to define what environmental issues ABB companies should focus on during the current year e.g. reducing energy, material use or what emission to focus on. This decision of focus issues is based on a process where different inputs are weighted, such as, coming legislation, ABBs restricted list of materials, stakeholder perception and technical possibilities.

When the focus areas (around 3 - 5) are decided, the concerned ABB companies will be requested to present a plan for measures to be taken, e.g. phasing out, plans for replacement, technological possibilities and costs.

The improvement projects are generated locally with support from the Sustainability Affairs organization. Companies producing similar products are benchmarked and a knowledge/technology transfer is facilitated. There is a continuous follow up of the improvement projects during the year by Sustainability Affairs. This way of working ensures a method for setting objectives for the environmental work, monitor and control that continually improves the environmental performance of the production process and products. At the end of the calendar year the new values are reported, the work can be evaluated and the process starts again with new focus issues.

Experiences

ABB have been reporting Sustainability Performance Indicators in both environmental management and environmental reporting over a number of years. A first set of environmental performance indicators was presented in ABBs environmental management report 1996. The numbers of indicators has gradually been refined and in the 2000 reporting the reporting included a first set of social performance indicators. In the report 2001 a further step was taken and the ABB sustainability performance is reported according to the recommendations of the "Sustainability Reporting Guidelines" published in June 2000 by the Global Reporting Initiative, GRI.

Business value
The Sustainability Reporting has given ABB high rankings in reputable sustainability performance indices which translates into tangible customer benefits and distinguish ABB from many of its competitors. Example of ratings;

- Dow Jones Sustainability Indices (DJSI) in 2003, ABB retained second place in its industry group. ABB was cited as one of the sustainability leaders in its industry, having very strong management capabilities in the environmental dimension compared to the industry average.

- The FTSE4Good indices were launched to highlight the best performers in corporate social responsibility. In 2003, ABB featured in both the FTSE4Good Europe Index and in the FTSE4Good Global Index.

- Business in the Environment (BiE) is the business-led campaign for corporate environmental responsibility, which presents annual index of Corporate Environmental Engagement. In the latest ranking (2003) ABB is top of its sector for engineering, machinery and top of the General Industrial group with a score of more than 95 percent, which places it in the top Premier League of the index.

- Bank Sarasin assesses selected companies' environmental and social performance as a basis for its socially responsible investment funds and services. In the latest assessment in 2003, ABB again scores above the industry average in every aspect of environmental performance.

- Swedish Environment Fund, ABB was ranked among the top 41 most sustainable corporations quoted on the Swedish stock exchange.

- Innovest Strategic Value Advisors, has renewed its environmental statement for ABB's 2003 Sustainability review as follows: "ABB received a rating of AAA, ranking 1 out of 24 electrical equipment companies in the sector for environmental performance…"

Experience of improvement process

During 2004 special efforts have been made to reduce hazardous material and substances. Focus was put on PCB, CFC class I and VOC-Cl. The results are;

- the business areas have established plans for replacing all transformers and capacitors in service at ABB facilities with PCB before 2007 (legislation demand 2010).

- agreements have been made with the facilities to phase out all equipment with Freon (CFC class I) during 2005

- a significant reduction of the emission of chlorinated solvents (VOC-Cl) with approximately 30% during 2004 (with a further decrease in coming years from projects now being executed).

Since the improvement focus changes every year, ABB can react and adapt to stakeholder issues arising e.g. new environmental concerns and this leads to top class environmental company. The business value of a good environmental ranking is high.

DANTES Strategy for Marketing

MARKETING TOOLS FOR PRODUCTS

The aim of this strategy is to demonstrate how different environmental product information can be used in marketing of mechanical and electrical products, based on experiences from ABB.

Background

Different marketing information, e.g. material declarations and environmental product declarations provide customers and the market in general with information regarding environmental performance of products and services.

Marketing information gives the answer to many questions often asked by customers. It could be questions about material content, hazardous materials, emissions, waste, efficiency, recycling and environmental management systems. For electric and electronic products it is common with questions on efficiency and electric losses. Different marketing documents give answers to different questions.

Marketing personal as well as the customers are the main target groups for this strategy. The background information necessary for compiling the marketing material is provided by R&D personnel and/or different experts within the areas of environment, quality, design etc.

For the active use of environmental product information it is necessary with an "environmental culture" within the management group and in the company. To actively use Life Cycle Assessment, LCA, and Environmental Product Declaration, EPD, a sustainability management program is a prerequisite and forms an essential basis. It is also necessary with training and education of people.

The aim of this example is to demonstrate how different environmental product information can be used in marketing. It is possible to use all types of marketing materials in a step-wise procedure by e.g. begin with a material declaration, proceed with recycling instruction, carry out environmental declarations and LCA-based environmental product declaration and end up with a certified environmental product declaration, EPD.

Working procedure

It is not enough to develop and produce environmentally sound products. The performance must also be communicated in a credible and understandable way to customers to build a competitive edge for your products with the sustainability performance. First you have to make clear the purpose of your marketing activity. Is the purpose to give information about material content and/or recycling, to get positive customer response, to increase the image of your company, to get positive economic influence, to provide customer with environmental information, to make comparisons between different products possible etc?

There are two different ways to select what environmental marketing material to use. One way is general, i.e. you have a general purpose for using marketing materials. The other way is based on the questions asked by customers, stakeholders etc.

Choice of marketing materials based on your purposes

In the table below you can see, depending on the purpose, what you can use as marketing material.

Purpose	Use
To provide customers with the material content of your product.	MD
To inform customers about the lack of certain harmful substances.	MD
To inform about the conformity to directives and standards.	MD
To give a recycling instruction.	RI
To give information about operation, maintenance and/or service.	RI

To give an overview of the environmental performance of your company and your product.	ED, EPD
To give customers and other stakeholder thoroughly information about the environmental performance of your product.	ED, EPD
To present a certified environmental product declaration	EPD
To give a positive environmental image of your company.	MD, RI, ED, EPD
To be in the frontline of working with environment.	EPD

Material declaration; **MD**, Recycling instruction; **RI**, Environmental Declaration (type II); **ED**, Environmental Product Declaration (type III); **EPD**

Choice of marketing materials based on questions commonly asked by customers and other stakeholder

Different marketing information answers different questions. For each question a suggestions of suitable marketing information are presented in the table.

Question	**Use**
What are the material content of the product?	MD, RI, ED, EPD
What is the weight/weight-% of different materials or substances in the product?	MD, ED, EPD
Does the product contain any hazardous substances?	MD, RI, ED, EPD
Are there any RoHS-substances in the product?	MD, RI, ED, EPD
In which way can the product be dismantled?	RI
Are there any components that need special handling?	RI
Are there any batteries in the product?	MD, RI, ED, EPD
In which recycling fractions could the materials in the product be sorted?	RI
What is the energy consumption during operation?	ED, EPD
Which are the emissions from the operation?	ED, EPD
How is the product transported?	ED, EPD
How is the product packaged?	ED, EPD
Has the company implemented an environmental management system	ED, EPD
Has the company implemented a quality management system?	ED, EPD
How is the product disposed?	RI, ED, EPD
Which directive requirements does the product conform to?	ED
Is there any PVC in cables?	MD, RI, ED, EPD
Do plastic parts contain flame retardants?	MD, RI, ED, EPD
Are there any harmful substances in paint/varnish	MD, RI, ED, EPD
Are paints solvent based?	ED, EPD
Can the product be reused after end-of-life?	RI, ED, EPD
Which is the standard specification of the product?	ED
Which are the maintenance instructions?	ED
What are the risks arising from malfunction?	ED
What is the environmental risk in case of fire?	ED
Which are the energy resources and material resources used for the different life cycle phases, i.e. manufacturing, operation and disposal?	EPD
Which are the emissions and waste for the different life cycle phases, i.e. manufacturing, operation and disposal	EPD
What environmental impact has the product during the different life cycle phases, i.e. manufacturing, operation and disposal?	EPD

What is the eco profile of the product?	EPD

Material declaration; **MD**, Recycling instruction; **RI**, Environmental Declaration (type II); **ED**, Environmental Product Declaration (type III); **EPD**

Decide to whom the information should be distributed. Consider the following categories:

a. All customers that require environmental information

b. A cross-section of all customers

c. To customers you are sending an offer

d. To suppliers

e. Authorities etc

Decide in which situations information should be distributed. Consider the following alternatives:

a. Together with an offer in a package with other information material such as safety data sheets, specific technical information etc.

b. A general sending-out to stakeholder supposed to be interested

c. Customer events, visits, exhibitions, conferences, workshops and lectures

d. Internet

Choose products for environmental product information. Consider the following alternatives: Information for

a. All new products

b. Products or systems

c. Products in large production volumes

d. Products that are just launched

e. Representative types of a new product family

Decide in what format the information should be distributed. Consider the following alternatives:

a. Off-print

b. Brochure

c. Electronic format

d. Advertising pamphlet

Experiences

There are different alternatives to choose between when presenting environmental performance of a product. You should define what kind of information you want to communicate to your customers and stakeholders and to let that be influencing your choice.

In many cases a material declaration is just enough and there is no need for any more information, especially if it is a product with no energy use and where no special maintenance is required.

Recycling instructions are often required by the customers when the product is of the character that it could be rather difficult to dismantle. The customers also want to know the material content and especially if there are any hazardous substances. Of special interest is also to declare and also mark on the product different types of polymers.

Environmental declarations type II are used to provide a more comprehensive declaration compared to material declaration and to increase your environmental image in order to give a competitive advantage. By using environmental product declarations type III (based on life cycle assessment, LCA) you will give your company a strong environmental profile, i.e. you really show that you are aware of environmental matters and that you have the knowledge and experience of working with these. An EPD, that is a certified environmental product declaration, gives thoroughly information about the environmental performance of a product. It is however time- and resource consuming and there is a need of environmental competence in your organization. For more experience of EPD see "Use of EPD in marketing". Sometimes it is enough with an environmental product declaration that is not certified but at the same format as an EPD. The difference is that it is not reviewed by a third party and the cost for developing it is less compared to an EPD.

In order to successively increase the environmental competence it is advisable to start with simple material declarations and in a stepwise manner carry out more comprehensive declarations based on the former ones. It should be easy and flexible to carry out marketing information and preferably no special education or competence should be needed. For EPDs and other environmental product declarations type III, environmental support may be needed from specialist.

Business value

The business value of this strategy is that one can, based on common questions from customers, decide what type of marketing material that is relevant to develop for a product. It is a bad return on investments to produce marketing materials that answer questions that no customer is asking.

DANTES Strategy for Supply Chain

SUPPLY MANAGEMENT

The aim of this strategy is to involve the suppliers in the environmental improvement work of the company. The strategy is based on experiences from Stora Enso.

Background

The purpose of this strategy is to show how Stora Enso in a systematic way has involved the suppliers in the environmental improvement work of the company. The main target groups are purchasers, persons responsible for environmental issues in logistic departments and other interested parties.

Stora Enso is an integrated paper, packaging and forest products company producing publication and fine papers, packaging boards and wood products. Analysis of the supply chain showed already at an early stage that raw materials, services and transports play an important role for the environmental profile of the end products. It therefore appeared necessary to involve the suppliers in the environmental improvement work of the company, so that at every stage from raw material to end product, the impact on the environment would be minimized.

This was done through the development of a computer based system called SE Purchasers' Compass (Company management performance assessment). The system assists purchasers in Stora Enso by evaluating the environmental improvement work of the suppliers, something that will hopefully also benefit the customers in the end. The leading idea is that the implementation of an externally audited environmental management system, such as ISO 14001 or EMAS, provides a very convincing demonstration of the suppliers' commitment to continual improvements. However, the main purpose of SE Purchasers' Compass is not to phase out suppliers not having implemented an environmental management system yet. Such suppliers are instead encouraged to improve their performance. For smaller companies it is not always feasible to be ISO 140001 certified or EMAS registered, why other solutions might be acceptable in those cases.

Wood is by far the most important raw material for Stora Enso. The company is also a large purchaser of transport services. Stora Enso Transport and Distribution is responsible for transporting products from mills to customers, and negotiates its own agreements with transport suppliers on a regional basis. The other main categories of materials and services purchased by Stora Enso are binders, pigments, chemicals, fuels, packaging, paper machine clothing, maintenance, repair and IT investments. The purchasing of these raw materials is carried out at corporate level by Stora Enso Purchasing and at local level by different Stora Enso Local Units.

Stora Enso Environment, Stora Enso Purchasing and Stora Enso Transport and Distribution are jointly responsible for the development and administration of the SE Purchasers' Compass system. The main reason for a mutual tool is to prevent that various production units or purchasing organizations within Stora Enso make different demands on the suppliers. It is a way to set a minimum level for the environmental demands.

Working procedure

Method and tool used to find the required information

The SE Purchasers' Compass system is based on questionnaires (see table below) which are sent out to existing suppliers including each of their production sites. The database is situated on a web platform within the company internal network. To be able to work, the user needs authority, a computer connected to the internal network and correct browser settings.

Table 1. Principles of selection

Principle of selection	**Responsibility**	**Questionnaire**
General suppliers	**Stora Enso Purchasing** is responsible for the handling of "General suppliers" with Group agreements with Stora Enso and their "Manufacturing units" . **Stora Enso Local Units** are responsible for the handling of local suppliers.	*General suppliers + Manufacturing units*
Transport suppliers	**Stora Enso Transport and Distribution** is responsible for the handling of finished product transports i.e. transport companies transporting outgoing products. Questions regarding transport of raw materials are included in the questionnaire for Manufacturing units.	*Transport suppliers*
Service suppliers	**Stora Enso Purchasing** is responsible for the handling of contractors with Group agreements with Stora Enso.	*Service suppliers*
Wood suppliers	**Stora Enso Local Units** are responsible for the handling of wood raw material suppliers**.**	*Wood suppliers*
Recovered paper suppliers	**Stora Enso Local Units** are responsible for the handling of Recovered paper suppliers.	*Recovered paper suppliers*

Send out of a questionnaire

Before sending out a questionnaire the purchaser checks in the SE Purchasers' Compass database if the supplier in question has already been evaluated. If the supplier is not registered and/or evaluated the responsible purchaser sends out of a questionnaire through the system in accordance with table 1.

Example: Questionnaire to "General suppliers" and "Manufacturing units"

The "Questionnaire for Environmental Assessment of General Suppliers" is always sent out to the partner having an agreement with Stora Enso. The agreement partner is then responsible for sending out one or several questionnaires to its manufacturing units. The evaluation of the suppliers' environmental management performance is accordingly based on the answers from both the agreement partner and its manufacturing units. Examples of questionnaires for "General supplier" and "Manufacturing units" could be found here.

Input of data

It is the responsibility of the inquirer to see to that the questionnaire is returned correctly filled out and

that the required data is fed into the SE Purchasers' Compass web database. The assessment is then made automatically according to an interpretation key. The result, i.e. the environmental management status of the supplier, will then be directly accessible to all Stora Enso units. It is also the responsibility of the one who has sent out the questionnaire to inform the supplier of the assessment result.

Continuous investigation
Based on the answer to the questionnaire the supplier is either approved or subjected to continuous investigation. A poor answer always leads to further investigation. Continuous investigation means everything from contacting the supplier on the phone to ask a question to representatives from Stora Enso visiting the site. If deviations still exist after the site visit, a decision is made about a no approval or rejection. In most cases, this is done by an environmental jury consisting of the environmental jurist of Stora Enso, a representative from the purchasing organization and Stora Enso Environment. It is also possible to consult the Senior Vice President of Stora Enso Purchasing or Stora Enso Transport and Distribution or as a last step the Chief Executive Officer of Stora Enso. The individual environmental management performance of the supplier is however taken into consideration in this process.

Updating of supplier information
It is the responsibility of the supplier to look for supplier information in SE Purchasers' Compass prior to the negotiation. After the negotiation the purchaser should comment upon the result of possible environmental commitments or other relevant environmental issues in the system. Supplier information older than two years should if necessary be updated, so that a new evaluation could be made.

Renewal of questionnaires and criterion of selection
Stora Enso Environment designs new questionnaires and updates existing ones in co-operation with representatives from Stora Enso Purchasing and Stora Enso Transport and Distribution against the background of viewpoints from the users as well as changing conditions in the surrounding world.

Experiences

The status among existing suppliers regarding the implementation of Environmental Management Systems as well as the scoring points have improved substantially since the start in 1996. However, the questionnaire on which the system is based cannot it itself force the environmental development of the individual supplier. It is rather meant to "take the temperature" of the present environmental management within the supplier company. To bring about actual measures, the purchaser will during the negotiation together with the supplier identify what shall or can be done and weave this into the assignment or agreement.

One ought to have a realistic view on the amount of resources needed and understand that years of development are behind a well functioning system like SE Purchasers' Compass. The first version in 1996 was a client server application. The present web version is completely redesigned and suffers evidently from some teething problems to be corrected. Creating new questionnaires as well as updating interpretation keys and routines are in the pipeline. Five administrators, geographically scattered, support the purchasing organization within Stora Enso. There is also an administrative committee carrying out regularly meetings for follow up.

The effective time for the purchaser to send out questionnaires and register the answers in the system database is however a matter of minutes, provided that there are no technical problems. The same counts for the supplier to fill out the questionnaire if the papers are in order. The calendar time might however be longer, approximately two or three months. If the supplier is delayed, reminders and completions are needed. SE Purchasers' Compass being regarded as an administrative burden is the main threat here.

Commitment among involved personnel and purchasers as well as support from their management is vital. The actual minimization of impact on the environment is probably both dependent on how the questionnaire is communicated in advance to the supplier and how the result is evaluated afterwards. This calls for active purchasers. It is crucial to connect the results to the agreements to the utmost possible extent so that the supplier is motivated to make improvements.

Business value
The foremost business value of the strategy is that Stora Enso through this work have been able to keep and in certain cases even gain new customers. SE Purchasers' Compass prevents different parts of Stora Enso from approaching the same supplier with different environmental demands through questionnaires. The

mutual system also makes it possible to share relevant supplier information within the company. It puts environment on the agenda among other purchasing criteria and probably also helps the environmentally responsible of the suppliers, since they can show explicit environmental customer demands to their organization.

DANTES Strategy for Supply Chain

ANALYSIS OF THE ENVIRONMENTAL IMPACT FROM TRANSPORTATION

The aim of this strategy is to illustrate how to identify and minimize the environmental impact from transportation. The strategy is based on experiences from Akzo Nobel Surface Chemistry.

Background

The demands on companies regarding environmental issues have increased and now concern not only the direct impact from the production site but also other activities like transportation related to the company. Authorities have, at least in Sweden, begun to ask about the environmental impact connected to transports in relation to license applications.

The purpose of this strategy is to show a working procedure used to identify and minimize environmental impact from the transportation of raw materials and products to and from a production site. The target groups are logistic departments or environmental support functions, who might conduct this type of study at the request of the site management. Using this strategy provides the basis of the decision whether the transport represents a significant share of the total environmental impact caused by the company or not.

The strategy is developed based on experiences from studies conducted by personnel from environmental departments and on-site environmental coordinators in co-operation with logistics and marketing departments at Akzo Nobel.

Working procedure

1. Define scope and limitations of the study
Decide which transport to include, for example the transport of raw materials and products. Include all different kinds of product and raw material transport between the company and the customer even if they are combined with different means of transportation. Other kinds of transportation may also be included, e.g. employees' journeys to work and business journeys.

2. Define a preliminary list of Environmental Performance Indicators (EPIs)
Define a preliminary list of EPIs. Consider what type of quality assured data that may be obtainable about transportation. See example of EPIs for transportation.

3. Prepare a questionnaire for transport companies
Prepare a questionnaire for transport companies and carry out a survey. Note that a short and simple questionnaire is more likely to result in sufficient answers from the transport company.

4. Collect inventory data
Collect inventory data for all transport of raw materials and products, e.g. tonnage, distance, means of transportation etc. Logistic departments can usually assist with data. Use for example an Excel sheet for documenting and working with inventory data.

5. Calculate transport distances
Look up distances by using internet tools, e.g. ViaMichelin web site for land transport or MariTimeChain.com for sea transport.

6. Collect data on energy use and emissions
Collect data on energy use and emissions from different means of transportation. If specific data on energy use and emissions from different means of transportation collected during the survey among transport companies is missing or impossible to use, use instead generic data from NTM (the Network for Transport and the Environment) web site.

7. Calculate total emissions and energy use
Calculate total emissions and energy use for transport of goods. Use for example an Excel sheet for the calculations.

8. Compare the transport emissions to other emissions Collect data on emissions related to production processes. Make some research at SCB or municipality websites to find out the magnitude of emissions in for example the local area, the region and in the whole country. Compare the emissions generated from transportation to these emissions to account for the significance of the environmental impact from transportation.

9. Analyze and draw conclusions from the result
What means of transportation is responsible for most environmental impact? Is the environmental impact from transport significant from a local and a global perspective? Is it possible to change the means of transportation for a certain group of raw materials or products? Are there other possibilities of improving the environmental performance of transportation?

10. Prepare EPIs
Define and calculate EPIs. Bear in mind the type of information that may be interesting for the company according to corporate and business unit policies and future provisions in licenses issued by authorities. Decide how to follow-up the EPIs on a yearly basis. See example of yearly follow-up. Set objectives for next year. Identify possible improvements.

11. Write a report
See example of a report for a transport study performed by Akzo Nobel Surface Chemistry, Cellulosic Specialties.

Experiences

The results from the study have shown that the most common emissions from combustion are similar or larger for the total transportation than from the production site. Accordingly, it is important to make an effort to decrease the environmental impacts from transport and realize that this area is as important as working with environmental improvements directly connected to the production.

Time needed to perform the study depends on the amount of different transports and transport companies involved in the study. The possibility to get information about the transported goods from logistic departments is also crucial as well as the number of people involved in the data seeking process and where these people are situated in the organization. If a group of people is involved in the data seeking process, it is important to make sure that everyone uses the same terminology and collects transport data in the same format. Regular meetings are often necessary.

Sometimes, it is difficult to get information from transport companies, especially about fuel consumption and emissions per transported ton*km. It is often better to keep the questionnaire to the transport companies short and simple than the other way around. In this way, the transport company is more likely to answer all questions quickly and correctly.

Business value
The environmental impact can be in the same range for transportation as for production at sites. By analyzing the environmental impact of transportation, sub optimization can be avoided as it becomes clear where improvements make the largest difference. Otherwise, the focus of improvements might be placed on activities that do not have as much impact on environment as transportation.

Furthermore, if the demands of authorities are accomplished and reasonable measures are followed; unreasonable demands and high costs for lawyers can be avoided. Being one step ahead of legislation and demands from authorities decreases the risk of costly surprises, because you are well-prepared for coming changes. Finally, a company earns goodwill by working with the entire supply chain.

DANTES Strategy for Supply Chain

USE OF EPIS IN SUPPLY CHAIN COMMUNICATION

The aim of this strategy is to enhance communication of environmental requirements and performance in the supply chain. The strategy is based on an example from the railway industry and it is documented by Industrial Environmental Informatics at Chalmers University of Technology.

Background

This strategy describes how environmental requirements and targets can be communicated between different companies in the supply chain, and how the fulfillment of these requirements and targets later can be verified.

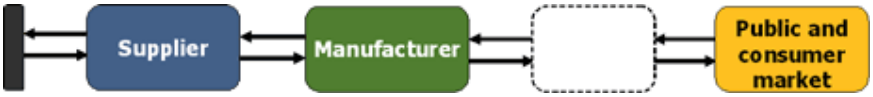


Figure Communication of environmental performance in the supply chain

The strategy enhances the communication of environmental requirements and performance between different companies in the supply-chain (see figure above). Furthermore, it effectively provides the important connection between market requirements and the product design. The communication is based on quantifiable and measurable Environmental Performance Indicators (EPIs). EPIs are quantitative expressions of the environmental performance. When introducing environmental issues into business relations it is crucial that the customer and the supplier have the same understanding of requirements and performance. This strategy describes how a common language can be established and utilized in the communication between different companies in the supply chain.

The context in which this strategy was developed and implemented is described in the R&D strategy Design for Environment. This other strategy describes how a design for environment process can be implemented and used within a company, to verify that the requirements and targets which are communicated in the supply chain are fulfilled in the product development process.

Intended users and benefits

The intended users of the strategy are persons involved in the purchasing process. By using this strategy any manufacturer can communicate environmental requirements and targets to their suppliers. The suppliers can calculate the actual environmental performance in terms of the defined EPIs and communicate the results back to the manufacturers. The suppliers can also utilize the same language when communicating environmental performance with their sub-suppliers, and the manufacturers can use the language when communicating with their customers. Hence, the whole manufacturing company can benefit from the result of working according to the strategy since the product will most likely better fulfill their stakeholders' environmental requirements.

Working procedure

The different steps when using this strategy in supply chain communication can be summarized as follows:

1. Understand and agree on a list of commonly defined Environmental Performance Indicators (EPIs). For more information on the indicator definition process see the strategy Design for Environment. See example: The REPID set of indicators 2003

2. Understand and agree on a common material list including material property data needed for the calculations of the EPIs. For more information on how to compile a common material list and acquire material data see the strategy Design for Environment.

3. The customer sets target values for each selected indicator. The target values are based on the policy of the company, regulations, customer demands etc.

4. The selling company or organization strives to comply with the target values during their design work. The fulfillment of the requirements is verified by calculating the environmental performance in terms of the agreed EPIs. For more information on how this is performed see the strategy Design for Environment.

To make the communicated information useful it is important that the EPIs are interpreted in the same way by senders and receivers. Consequently, the EPIs must have the same meaning and value no matter who has entered the information or which software that has been used. Work according to this Design for Environment (DfE)-methodology does hence require:

- Acceptance of the agreed indicator list (or a subset)
- Compliance with the common material list
- Common calculation routines to measure the environmental performance

For this strategy, a DfE-methodology which aggregates the declared material data according to defined algorithms arriving at calculated values for the EPIs is needed. A transparent data communication format that supports the methodology is also central as well as a tool (such as a spreadsheet) where the customer can insert their environmental requirements and targets in terms of the defined EPIs.

Experiences

This strategy is based on a methodology and experiences from projects within the European railway industry. The experiences from implementing EPIs in supply chain communication is therefore mainly from the railway industry.

The way of working suggested in this strategy is not yet part of the daily business in the railway industry, but have opened up the dialogue and even affected customer requirements. Today it has become more common to perform material inventories and analyses. Some of the EPIs developed within the railway industry have been a demand to use for several years although not denominated EPI.

The establishment of a common set of EPIs, a common material list, and a common communication format within a line of business is a consensus process that requires a lot of time and resources. The resource demand is highly dependent on the information need of the defined EPIs and the size of the material list, and can hence vary much, from months to years of work. It is furthermore easy to underestimate the calendar time needed for making the common agreements.

Education programs do also have to be set up since all involved parties need to have a common understanding of the method and the EPIs.

Through the REPID project, a common language has been created allowing a whole sector to communicate easier. A sector wide understanding on definitions or terms for communication of environmental performance is thus under development in the railway industry. Manufacturers are introducing or sharpening their procedures to gather information, operators are gathered in a project called PROSPER to set common requirements. All this is supported by EPIs and aims at continue to give better rail vehicles.

Business value
The railway industry spent much time and resources on this rather long process. It is however important to remember that the results from the procedure are of vital importance not only in the area of environment. A common material list, or well-defined translations between different material lists, would also facilitate more cost-efficient management of the data in many other areas within a company.

DANTES Strategy for Production

IMPLEMENTING AN ENVIRONMENTAL MANAGEMENT SYSTEM, EMS

The aim of this example is to demonstrate a working procedure on how to implement an environmental management system based on ABB's experiences.

Background

An environmental management system (EMS) is a systematic approach to achieve the environmental goals in a organization. An environmental management system includes concrete objectives, plans of action and a clear division of responsibility for environmental questions

The key idea of environmental management is that a company's environmental aspects are managed in the same way that production, quality and finance are managed. An EMS will deliver three key outputs: legal compliance, continual improvement, and a program reflecting the views of interested parties. See also Tools & Methods - ISO 14001.

Everyone affected by the implementation of an environmental management system are the intended users of this strategy, for example, Project leader, Site managers, Environmental experts, etc.

The working procedure below for implementation of an EMS is purely generic. The working procedure does not take into account local circumstances, local needs, or qualifications of the team members.

The Dantes strategy "Handling and reporting environmental information" could also be of interest.

Working procedure

The main steps in implementation of an environmental management system, EMS, are:

1. Commitment by top management to developing the EMS
2. Planning the EMS project
3. Planning the EMS
4. Implementing the EMS
5. Internal checking of the EMS
6. Certification of the completed EMS

Step 1. Commitment by top management to developing the EMS

Management commitment is crucial since they has to allocate resources, and have to have an understanding of the scope, expected deliverables. A project have to be set up and the need for external support have to be

evaluated. The project must be clearly announced throughout the organization and driving project leader have to be appointed

Step 2. Planning the EMS project

The project now starts. The implementation of an environmental management system is not a one-man show; identification, assessment and documentation of environmental aspects involves all functions of the organization whose activities could interact with the environment. It is also important to train the key persons early in the project, since the lead-time can be significantly shortened if the key members of the teams have been provided with specific training on the basic requirements of an environmental management system.

The project leader and the project team also have to establish an action plan where milestones and responsibilities should be identified. The team have to define the physical and organizational scope carefully, paying particular attention to organizational boundaries, management systems for health and safety and quality, suppliers, customers use of products, off-site work and new projects. It is e.g. of special importance to identify overlaps with ISO 9001 (quality control) and other management system since many of the modules used by an EMS can be found in ISO 9001 and other systems. If the quality system is efficient and effective, it will probably be appropriate to re-use those modules.

Step 3. Planning the EMS

The EMS project team should first identify the organization's environmental performance. An initial review will provide much useful information about the company's current status in terms of environmental compliance, potential liabilities and environmental opportunities. The initial review should also identify and rank the environmental requirements and aspects of the organization's work to identify the most significant ones and those that need to be controlled and monitored.

The team together with top management have to agree on objectives and targets for site environmental performance and the team have to design a EMS program to achieve these objectives.

To help the planning one could ask for other companies' experience, since lots of useful information can be obtained from companies already having implemented an EMS.

Step 4. Implementing the EMS

The next step is to design and produce the documentation. In particular, the environmental manual and procedures and work instructions necessary to implement the program. For example, working instructions relating to waste management, chemical handling, transports or other significant environmental aspects.

EMS project team and relevant parts of the organization have to identify, needed to establish and ensure a proper functioning of the EMS. the management of significant aspects and the monitoring program needed to track the site's progress towards meeting its objectives.

The team also have to ensure that all employees are provided with general training and if needed, specific training, on environmental matters.

Step 5. Internal checking of the EMS

When the EMS is in place the team has to check the completed documentation against the standard to ensure all requirements have been.

Step 6. Certification of the completed EMS

In a initial visit the certifiers review the processes on site and the various operations of the EMS. There is a possibility to close-out any non-conformances found by the certifiers.

At the audit visit, the certifiers conduct a detailed audit of the functioning EMS. When everything is OK the organization can be certified!

There will be follow-up audits where the certifiers will visit the site. The sequence for the surveillance visits is however negotiable. The most common period between the visits is currently 6 months, but, based on experience, the time between the visits tends to become longer.

Experience

ABB has implemented environmental management system on almost all (>500) production sites all over the world and some general experiences on different topics are:

Project leader
The project leader needs to be familiar with the company's processes and motivated i.e. wanting the project to succeed. The project leader have to be accepted within the whole organization.

Project team
Use a multi-disciplinary project team for the EMS project - The team should have as wide a range of experience as possible. Do not hesitate to bring in additional people/experts for particular issues.

Pre-planning
The project leader and team should plan the project carefully before they begin. Look at the generic plans in the working procedure, then develop your own. Resist the temptation to descend into detail, instead, aim for a broad plan with all the major milestones identified and with agreements within the team for deliverables and due dates. Stick to your plan if you can, changing it only as needed. Effective planning is crucial to the success of complicated projects such as implementing a management system.

Keep it simple, practicable
Try to make the EMS as simple as possible. Use graphic rather than full-text procedures if they fit the company culture, combine system procedures where possible, and try to keep documentation short. The time and effort required to develop an EMS is geometrically related to the complexity of the documentation.

Detail
Develop a broad picture of what you want the EMS to look like, what the system documentation will contain, how it will work, etc. before thinking about detail. If the overall model does not work, the detail is worthless.

Originality
There are no marks for originality. Try to find people who have done it already, and see how they did it. Ask them what went well, what was tough, what they would do differently next time. Learn from their experience.

Time frame
Completion in nine to fifteen months would be a reasonable target for an organization with 50-250 employees with a work time of three to five man months.

Aim for employee buy-in, ownership
Always involve the employees when performing the initial review and when writing the procedures and instructions. Employees need to feel it is their system, and that it can be easily changed as their or the company's needs change.

Existing management system
An existing management system can reduce the work and the amount of "newness" managers have to face. ISO 9001 contains many of the building blocks ISO 14001 needs, and these can be reused with little or no modification.

Choice of certifier
There may be advantages in using the same certifier as for the ISO 9001 system, but if they do not agree with your approach it will generate much additional work. You have to make a decision. If you think your approach is right for you, find another certifier. There are plenty.

Involve the certifier early
Although it would be unpleasant to hear the certifier say he thinks your approach is misguided and that he is unwilling to certify anything based on it, it would be far better to hear that at the beginning of the project than near the end, when you have invested time, effort and credibility. If you involve the certifier early, you have time to change your approach or your certifier.

Business value
The strategy describes a generic implementation of an EMS, however the strategy alone will not be enough for a successful implementation. Additional expertise and information is needed but the experiences gained

from implementing EMS in ABB companies could anyway by valuable when planning and executing an EMS project.

DANTES Strategy for Production

ANALYZING AND REDUCING ENERGY USE

The aim of this strategy is to illustrate how it is possible to study the energy situation at a chemical industry site and propose measures for reducing the energy use and the environmental impact. The strategy is based on experiences from Akzo Nobel.

Background

Optimizing and reducing the use of energy are always important tasks for process engineers in the chemical industries for different reasons. Traditionally, the focused benefits of energy savings are financial. The competition is continuously growing keener, especially for businesses of which the products are already balancing on the margin. During the recent decades, the focus has widened to also comprise the environmental benefits of energy savings. With support from the Environmental Code in Sweden, authorities have begun to make demands on companies to better and more thoroughly monitor, follow up and decrease their use of energy.

The purpose of this particular study was to illustrate the total energy situation at a certain production site and identify areas where it might be possible to save energy and reduce the environmental impact. Following are examples on some issues that were addressed:

- The possibility to utilize more of the excess hydrogen gas formed as a by-product in the production process as fuel for steam generation
- The possibility of cleaning, compressing and selling hydrogen gas
- The possibility of exchanging energy with nearby industries
- The possibility of using more of the energy content in the feed water
- The possibility of controlling the process to a higher extent with respect to energy use, for example by using pump speed control or installing more flow meters

Project managers who co-ordinate the technical competence, collect data and put together a complete picture of the energy situation might benefit and get ideas from this strategy. In the described example, personnel from a central environmental staff coordinated the project and assisted the local environmental department in reporting the result to local authorities.

Working procedure

1. Define scope and limitations of the study. Is the study conducted for a part of the industrial site or for a whole site? What parts are possible to affect and what parts are not? Who can provide information?

2. Conduct an initial meeting with the involved personnel and brain-storm on the possibilities of energy saving measures.

- What studies have been carried out with respect to this issue in the past?
- What types of fuels are used? Are there any alternatives?

- Are steam and electricity consumptions monitored in detail, i.e. is it possible to identify the "hot spots"?
- Is it possible to re-circulate and heat exchange to a greater extent?
- Is it possible to cooperate with nearby industries in energy issues?

3. Make a preliminary outline for a project report and communicate it with personnel involved.

4. If authorities have made demands on the study, make sure to communicate the outline and the contents of the report with them before proceeding to a more in-depth level.

5. Collect figures on annual energy use as much in detail as possible. Account for the situation from a life-cycle perspective; describe the environmental impacts in the life-cycles of the different fuels and electricity.

6. Identify where measures for improvement should be taken according to these descriptions.

7. Describe potential energy saving measures in the specific plant. Account for the magnitude of the potential improvements with respect to energy savings, potential decrease of environmental impact, investment costs, pay-back periods and other factors that might be influenced.

8. Identify measures that can be realized in a short-term and a long-term perspective respectively. An example of short-term measure is to install more flow meters, while a long-term measure might be to invest in a new steam boiler. Naturally, the short-term measures also tend to be the least expensive ones as opposed to long-term and more expensive measures that need further investigations.

9. Propose EPIs related to energy. Account for possible interrelations and incompatibilities of different EPIs. See examples of EPIs, where this is further described.

10. Propose follow-up procedures and environmental goals with respect to energy.

11. Present the study to decisions makers.

12. When decisions on measures, EPIs and follow-up procedures are taken, finalize the report and present it to the parties concerned. See example of report.

13. Keep up a close dialogue with interested parties like authorities and nearby industries. Good relations are likely to lead to environmental improvements due to efficient cooperation in the long run.

Experiences

For the successful completion of this study it was of crucial importance to always remember who the commissioner of the study was. This is probably true for any study of this type. No matter if the commissioner is an authority, a corporate function or somebody else, the results must be presented so that the commissioner understands the results and receives answers to the questions that made him/her order the study in the first place. Keeping up an open and unbiased dialogue with the commissioner to make sure all are on the same track is necessary.

When proposing energy saving measures, it was important to recognize that many measures turned out to be of an investigate-further character. If data are not available and no monitoring routines exist for a certain part of a process, the measure could be to further investigate how monitoring may be carried out.

Since many different operational functions were involved, it was also important to present the results to these people at short intervals. This may be a very general piece of advice for project management, but it cannot be stressed enough. The quality of the facts and figures must be reviewed by those closest to the production. However, it was favorable to also involve some external resources in the project. Some issues may be put aside by tradition and it is often easier for someone from the outside to discover such issues.

On a practical level, it was favorable to write the report from the study in parallel to collecting information and interviewing people. This provided the writer with a better overview and it diminished the risk of missing important aspects.

Business value
Reducing energy consumptions leads to reduced costs. It is important to be aware of the energy consumption, which might not be obvious at first look. Analyzing the energy use is the first step towards receiving control over energy costs.

In new investments, energy and also money can be saved by using the most energy efficient technology. Furthermore, discussions with nearby industries can lead to benefits in forms of cooperation and energy exchange.

It is vital to a full view of the energy consumption within a site, since many different persons and business units with different interests are involved. Many times energy saving activities are run in different parts of the company. By coordinating the activities, money can be saved and the results of the activities can be higher.

DANTES

DANTES Strategy for Production

Print this page

GREENHOUSE GAS EMISSION TRADING

The aim of this strategy is to give ideas regarding Green House Gas Emission Trading impact calculations through the description of a preliminary model developed within Stora Enso

Background

The main target group for this description of a calculation model are Emitters that needs to keep track of the costs for their Carbon dioxide emission allowances. But also economically responsible of that companies can benefit from the results. In the long run might also for instance future verifiers and authorities benefit from a consequent model. See also More about the Kyoto protocol for the background of the Greenhouse Gas Emission Trading and an impact calculation model for the pulp-and paper industry.

Since the rough estimation tool, based on an LCA flow model that is described under Working Procedure below is adapted to Stora Ensos pulp- and paper production units special needs, the actual calculation model will not be distributed here. The main purpose of the description below is instead to give ideas for those who likes to create a similar model themselves. Those really interested are also welcome to contact Stora Enso Environment for a demonstration or discussion regarding necessary adjustments to fit the line of business in question.

Prerequisites for using the actual computer based Excel model is first of all that the user has checked beforehand that it is applicable on own process conditions and/or having made the necessary adjustments. Each line of business has to develop according to its circumstances. What this will cost could however only be estimated by the business in question. The emitter is also recommended to investigate future development of instructions from authorities and of similar calculation tools. For instance can general calculation tools from WBCSD and WRI (World Business Council for Sustainable Development and World Resource Institute) today be downloaded from the Internet. This was however not the situation when this model was developed.

Information gathering might also take some time. But provided that everything is in order, the entrance of data into the model and the calculations are a matter of minutes or hours for the user.

The calculation model makes it possible to elaborate with costs for emission allowances that have to be bought in the nearest 1-5 years. The influence of increased production and thereby the possible influence of increased fossil CO2 (Carbon dioxide) emissions on costs for new emission allowances that has to be bought could also be analyzed. It is also possible to study the result of changes in the fuel mix for instance if more bio energy (carbon neutral fuels) are used instead of fossil Oil or Coal. The amount of fossil carbon dioxide, shown under the headline "Actual mill data", will be reduced accordingly.

Working procedure

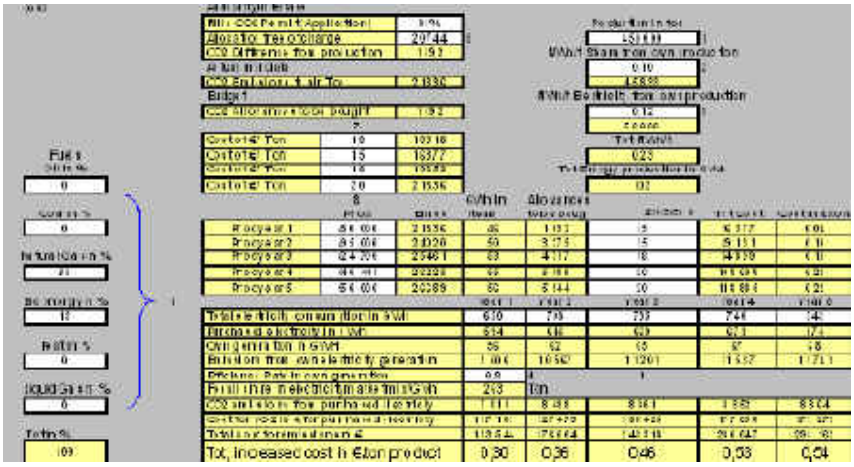


Figure. *Principe for Excel based Greenhouse Gas Emission Trading impact calculation model for the pulp- and paper industry developed within Stora Enso* (click on picture)

Provided that all necessary preparations have been made it is just to put in figures in the 10 numbered cells that could be seen in the example above, see further description below.

1. Next years estimated production in tons.

2. The estimated or actual steam requirement in MWh from own production, for one ton product produced. If no steam is produced, enter the required steam demand.

3. The estimated or actual electricity requirement in MWh from own production, for one ton product produced. If no electricity is on site produced the number is cero.

4. The actual or estimated energy efficiency of the on site produced Steam and Electricity.

5. Authority Interface. The carbon dioxide (CO2) emissions allocation that are granted to the Emitter free of charge in tons. If there is no knowledge of your allocation, calculate that 95% will be free of charge.

6. Make an estimation of fuel consumption in percentages per fuel type over a year. If steam or electricity is delivered from external sources, find out the used fuel mix, and enter them in the model. (The difference is that one has no influence over the used fuel mix in that case. But the model can be used as an emission controlling device of energy suppliers.)
   Converting factors of CO2 (IPCC 2003) to be used in kg/GJ:
   Oil 77.3
   Coal 94.5
   Natural Gas 56.06
   Bio Energy 0.00
   Peat 106.0
   Liquid Gas 63.2

7. Budget. Deduct the emission rights that are given for free from the forecasted emissions. This will give an opportunity for elaborating with short time (during a year) cost for purchased emission allowances or if a surplus will occur, and then the value will be presented.

8. Start with the predicted production figures as a base for a five year production forecast. If there are no knowledge of the coming years production, then a creep of 2%/year should be used.

9. Here one can elaborate with the cost for purchased emission allowances for the next coming five years. Recommended numbers are for year 1. 15€, year 2. 15€, year 3. 18€, year 4. 20€ and year 5. 20€.

10. Put in figures for total electricity consumption in GWh each year

Experience

The calculation model is new and the experience of it is still rather limited, but it has been initially tested by approx 98% of Stora Enso's pulp-, paper- and board producing units in Europe during the last year. It is a rough tool that is estimated to achieve up to 80 % certainty with the information that already exists at the production sites. To achieve a higher level of certainty the model has to be adapted to more site specific circumstances. The time and cost for that has however not yet been estimated.

Business value

The most evident business value for Stora Enso of this Excel based calculation model is the possibility to at least make rough prognoses of future Carbon dioxide emission (allowances) costs. It enables in a cost-efficient way to plan the future production and fuel mix. The calculation model can in that sense also serve as a basis for a dialogue between the Emitter and its Customers.

DANTES Strategy for Environmental support

HOW TO PERFORM AN LCA

The aim of this strategy is to give practical advice on how to conduct an LCA study. The strategy is based on experiences from ABB.

Background

Life Cycle Assessment, LCA can be used in many applications, e.g. in product development projects to identify significant environmental aspects. The LCA results could then be used to provide a base line for decisions about product improvements. The LCA results can also be used in marketing to communicate the environmental benefits to customers, e.g through the LCA based communication tool Environmental Product Declaration (EPD).

LCA experts and R&D personnel are the main target groups for this example of a strategy. R&D personnel, marketing & sales department as well as customers benefit from the result of using this example.

In ABB there are two very different routes to conduct an LCA:

Screening LCA

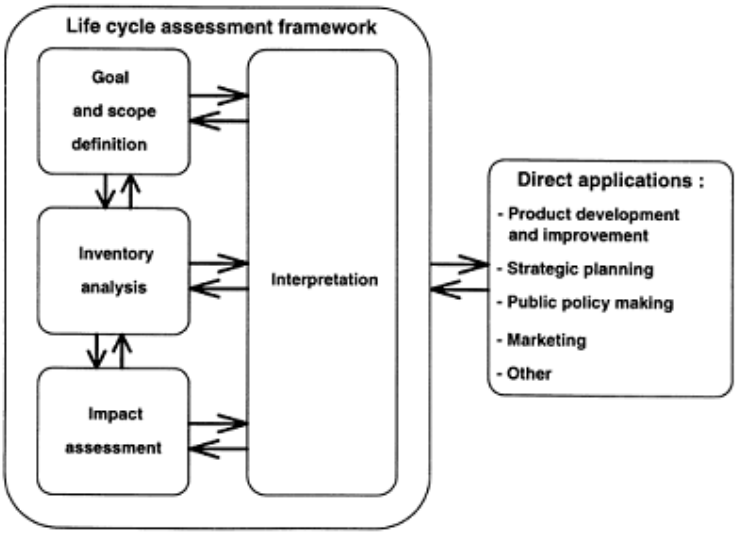
The first type of LCAs, screening studies, are the most common type of LCA studies in ABB and are conducted by people in the line organization on a more "daily" basis, e.g. when comparing two different types of materials in a product development project. These LCAs are conducted on a lower level of detail than complete LCAs. Here you could use the WEB based LCALight Tool that is easy to use but a little bit more restricted in its function than "full scale" LCA tools. LCALight is however sufficiently advanced and detailed to give the requested information for a lot of "daily decisions".

Extensive LCA

The second type is extensive LCAs to be used in EPDs. It is however not realistic or relevant to conduct a large number of extensive LCAs on a more regular basis. Extensive LCAs are resource demanding and request a high level of environmental competence, skill in using LCA tools as well as practical LCA experiences. It could therefore be efficient to engage LCA specialist for conducting these types of irregular LCA studies. Here we recommend using some type of commercial LCA software tool, such as the EcoLab or SimaPro tools since these are designed for advanced and comprehensive LCA studies.

Working procedure

The ISO 14040 series of LCA standards gives the principles and framework for conducting an LCA study. More information about the LCA methodology is presented here.



Figure; Phases of an LCA according to ISO 14040 Life Cycle Assessment -Principles and framework

Dantes provide a free, simple web-based LCA tool: LCALight. There are a number of commercial LCA tools, see for example a list from www.life-cycle.org. For gathering information from suppliers, the LCI Questionnaire can be used.

Experiences

An overall piece of advice is that you should spend enough time in the goal and scope definition and the interpretation phases, and avoid overspending time in the data inventory phase. Additionally, try to involve the result user and other relevant stakeholders as actively as possible in the LCA process.

Goal and scope definition

Proper definition of goal and scope is important. Realize that it is a resource demanding task to conduct a full LCA. In practice it is not always necessary to conduct full LCAs. Sometimes you only need rough results. A limited LCA could be relevant if the goal is to compare two construction materials in a specific phase of a product development project. On the other hand, a comprehensive LCA could be relevant if the result will be communicated to an external audience.

The intended use of the results is important to consider in the goal and scope definition phase. Common LCA applications in ABB are product development and marketing. In product development projects LCA is used to identify significant environmental aspects for defining sustainability objectives according to the ABB Gate model. In marketing, LCA results are used to communicate environmental benefits to customers through LCA based EPDs.

Inventory analysis

The inventory phase is the most time consuming step of an LCA. The needed inventory data are often difficult to retrieve since you need to involve various actors in the supply chain, mostly outside your own company's control. The level of ambition to collect data "for every screw" could be a little bit too high among LCA practitioners who are conducting their first LCAs. The advice is to be realistic already in your goal and scope definition regarding what inventory data that should be collected.

Even if limiting system boundaries is difficult you should try to make a first estimation of what materials, components and processes components to be included in the LCA as early as possible in your study. You

could make a first telephone contact with potential data suppliers to check if it is expected that suppliers could provide you with input data or not.

The inventory data quality is difficult to handle in practice. Unfortunately there are no commonly accepted numerical criteria available to easily assess the data quality. The data quality requirements depend on the situation and application where the data are used, why there are no "good" or no "bad" data in absolute terms. Imagine two products containing polycarbonate. The first product contains 50% polycarbonate and the second 3% polycarbonate. It is obvious that a crude inventory data set for polycarbonate might be of enough quality for the second product but probably not for the first. A practical advice to overcome this is to conduct a first screening LCA to identify critical materials and processes and then spend most time on retrieving inventory work for the critical data sets.

Impact assessment
Selection of impact assessment method must be based on the studied system since this varies a lot between different product systems. A common impact assessment method used in ABB is GWP, Global Warming Potential, since ABB's products are converting or transmitting energy in one way or another.

You can evaluate the results on different levels, for example:

- Life cycle inventory analysis results in summarized inventory values in mass or energy units, for example "The studied product releases 40.000 kg CO_2 during its life cycle". This is an objective way to present the results. It is however not easy to interpret the results without being an expert in ecology.

- Characterization results in different environmental impact categories. GWP, Global Warming Potential, and AP, Acidification Potential exemplifies two such categories. This way of presenting the results is common and it is used in EPDs, Environmental Product Declarations.

- Weighting shows the results aggregated into one single number for each assessed product. This is an optional part of an LCA and should always be used with care.

Interpretation of the results
The last concluding part of an LCA study is to interpret the result in relation to the intended audience. To do this you need to understand the intended application. Since LCA is a complex tool there is a risk of confusing the users with a very large amount of figures, tables and diagrams, that may all be relevant but difficult to understand. A piece of advice is therefore to spend enough time in structuring the report from a user perspective.

Business value
It is good business to understand the environmental impacts of your product system since cost efficient improvement actions could then be taken and business relevant information could be selected for use in market communication.

DANTES Strategy for Environmental support

HOW TO PERFORM AN EPD

The aim of this strategy is to give guidance on how to conduct an EPD, Environmental Product Declaration. The strategy is based on experiences from ABB.

Background

EPD provide customers and the market in general with third party, verified and comparable information on environmental performance of products and services.

LCA experts and R&D personnel are the intended users of this example and marketing personnel and customers are the intended users of the EPDs.

Since an EPD is based on an LCA study it is a prerequisite to have access to LCA competence and tools.

Working procedure

A certified EPD is based on ISO 14025/TR and information from a Life Cycle Assessment, LCA, according to the LCA ISO-standards 14040-43.

The working procedure requires the following actions:

1. Check whether or not a Product Specific Requirement, PSR, is published for your type of product. A PSR outlines how to conduct the underlying LCA and thus allows comparisons between different EPDs of the same product type. The published PSRs can be found on the website of the Swedish Environmental Management Council.
   If there is a published PSR for your type of product, go to 4.

2. Contact the Swedish Environmental Management Council to announce the interest to introduce a new product or service into the EPD system.

3. Outline a suggestion for a PSR, to enable comparisons between declarations. Link to PSR guidelines. Below find the main actions in developing a PSR.

   - Decide goal and scope for the LCA, e.g. system boundaries, functional unit and allocation procedures.
   - Invite stakeholders to an open consultation meeting.
   - Contact the Swedish Environmental Management Council for approval of the PSR.

4. Carry out the LCA according to the PSR. See description of the LCA methodology, advice on how to perform an LCA where a questionnaire template for collecting Life Cycle Inventory data is found.

5. Compile an EPD based on the LCA study and other information (information about the product and manufacturer, recycling information etc.). Several certified EPDs can be found on the DANTES website and all of the certified EPDs are available on the EPD website. These can be useful as examples.

6. Contact a certification body to verify the EPD.

7. Send an application form to the Swedish Environmental Management Council for registration of the certified environmental product declaration. The registration fee is SEK 10.000. The annual fee is 0,1 per mille of the net sale of the product or service with a minimum value of SEK 10.000 and a maximum value of SEK 25.000.

8. The EPD is finally published on the Swedish Environmental Management Councils homepage and the EPD logotype can be used.

Experiences

Development of an EPD is a relatively costly and complex task and it is important to have management and marketing people involved in the process. Access to supporting tools as well as to personal support has also been identified as a critical issue.

Working with EPDs in a company requires involvement of different categories of people. Environmental controllers and specialists have a key role since they often are best suited to coordinate the work. This must however be done in close cooperation with management functions. Product development functions provide inventory data for material content and manufacturing processes. Supply management often needs to assist in collecting inventory data for e.g. supplied components. Marketing people and other users of the EPD must consider how to implement the EPD in their sales strategies.

The person(s) conducting the LCA/EPD need a high level of environmental competence as well as an understanding of the analyzed product. It could be cost efficient to engage an LCA/EPD specialist if EPD development will not be a regular activity. Additionally, it is relevant to give basic information about the LCA/EPD concepts to all involved. One important experience is that it is both difficult and time consuming to collect inventory data from suppliers.

In the case a PSR has to be developed you have to calculate with a rather time- and resource consuming work. In the process of developing PSR it is extremely important to engage other parties, such as branch organizations and competitors. When many people are involved it is natural that things will take time, but this involvement is necessary in order to get a PSR that is firmly established in the branch. Unfortunately the interest from others may be quite little in some cases even if you have informed all relevant parties. The only you can do then is to carry out the PSR from you own perspective. But this should really be an exception.

Since the number of products in a company in general is large it is not realistic to always develop and maintain EPDs for all products. Instead the approach could be to develop EPDs for high volume and/or high strategic products. Some type of complementary and more limited environmental claims (type II , according to ISO) could then be developed for the remaining part of the product mix.

To develop an EPD is as stated earlier rather time consuming. First of all you have to develop a PSR if there is no PSR for your product. This will take 40-80 working-hours. The calendar time for developing a PSR is rather difficult to estimate since often there are many parties involved, but you may say 2-8 months. Then you have to carry out an LCA which will take typically 50-200 actual working-hours and 2-6 months in calendar time. Finishing the EPD will take another 20-80 working-hours and 1-2 months in calendar time.

Business value
It is good business to communicate the environmental impact of your product since it shows that you are working with product related environmental issues and this leads to reduced environmental risks of the product for your customer.

DANTES Strategy for R&D

MATERIAL DECLARATION AND RECYCLING DESCRIPTION

The aim of this strategy is to describe how to design a material declaration and recycling description for a product, based on ABBs experiences.

Background

Material declarations and recycling descriptions are market communication tools. A material declaration states which materials that are present or not present in a product and a recycling description indicates how a product should be recycled.

Material declarations and recycling descriptions are also an indication to a customer that the company that issues them have some system in place that can handle questions on material content and recycling of its products.

The strategy was developed with mechanical/electrical products in mind but could be used for other types of products.

The strategy is intended for someone who would like a framework and a guideline from which to start developing material declarations and recycling descriptions for products e.g. environmental experts, marketing staff or product managers.

Working procedure

Material declaration
A material declaration is a disclosure of the types of materials (metals, chemicals, plastics, alloys, etc.) that a product contains and/or hazardous materials (heavy metals, toxic chemicals, etc.) that the product does not contain. No standard format for a material declaration exists.

A "positive" declaration is here defined as a declaration of the materials in the product and a "negative" declaration is a declaration of the hazardous materials the product does not contain.

An example of a "positive" material declaration.

Product A contains:

Substance	Weight
Steel	50 kg
Copper	3 kg
Polyetylen	6 kg

When making a "positive" material declaration, there are a number of issues that have to be decided, e.g. lowest level of total weight to declare, which materials and additives to declare. For more information, see Material declaration.

An example of a "negative" material declaration.

Product A does not contain

Group	Substance
Polychlorinated Biphenyls	PCB
Metals	Cadmium
	Lead

For the negative listing of "materials not present" in a product some issues have to be addressed, e.g. legal, standards, materials, functions. For more information, see Material declaration and some examples.

How to collect information about the materials in the product.

Generally, a product is built by components, some designed and manufactured in your company and others bought from suppliers or contractors.

Identifying the materials present/not present in products/components designed and produced in-house should not be very difficult. Use, for example, CAD system, drawings, specifications, or if possible interview the designers.

An purchased component can be of two different kinds, either the component is designed specifically for your company or it is a general, off-the-shelf component. For components designed specifically for your company, getting information can be somewhat difficult, but usually someone in the organization has a direct contact with the producer and can help you with getting the material data. For general, off-the-shelf, components getting information can be more difficult. Your supplier may not know the material data and does usually not have a direct contact with the actual producer of the component. One possible way to get information is to make a direct contact with the producer, e.g. by sending a questionnaire on material content, but success is not guaranteed.

If no material data for a component can be obtained, one could still make a material declaration stating what is included/not included. For example, "This material declaration presents all materials except for the control unit for which no data could be found"

The material declaration can be presented in many different ways, either as a standalone fact sheet for one product (similar to an SDS - for chemicals) or as a presentation for a whole product range. Material declarations can also be included in manuals, marketing material, product descriptions, etc. For more information, see description of Material declaration.

Recycling description
A Recycling description is a document describing how a product should be treated at the end of its lifetime. No standard format exists but it should include a material content listing, drawings of the product that indicates where the different materials are placed and a description of how the product should be disassembled and in which potential recycling fractions the different components should be sorted.

As a first step, clarify the legal requirements for your type of product. Is there a recycling system in place or is one planned for your product? Does your product have take back requirements? What type of information does a recycler need to safely recycle your product? Does your product include components that need special handling/treatment e.g. batteries? The RoHS and WEEE directives state legal requirements for electrical products.

Now, make a disassembly instruction of your product by making a description, in figures/pictures as well as in text, of how the product should be disassembled (the need for special tools or handling). List the materials in the different components or materials into different recycling fractions. Describe components that need special handling e.g. components containing batteries

The recycling description can suggest one or several recycling methods e.g. copper wire to copper recycling. The recycling description should also describe the packaging materials and how the packaging materials can be recycled.

When all of the information has been gathered you are ready to write the recycling description and a possible outline of the document is given below.

- Introduction – describing the company, contact address/person, environmental management system in place (certified ISO 14001, EMAS),
- Production (where, how, suppliers,…)
- Materials in product (Material declaration)
- Product use (emissions, energy use,…)
- Transports
- Packaging
- Product disposal
    - Recycling system – take back
    - Disassembly
    - Materials in recycling fractions
    - List of potentially harmful materials and handling of them

See information on Recycling description and some examples.

Experiences

To make a material declaration is not a difficult undertaking. The main difficulty is to collect the information on materials for purchased components. Gathering material information from producers of standard components can be difficult.

To get material information on electronics can be especially difficult, e.g. because the materials in the electronic component are confidential.

If you want to make one (or only a few) material declarations, manual handling of data will be sufficient but if you want to make material declarations for all of your products and update them when components change, a system for handling the information should be established. Within such a system it should be natural for purchasers to request material information from suppliers.

Three examples on how Ericsson, Motorola and Nokia have tried to solve the problem of communicating material data with suppliers are linked below.

- Ericsson
- Motorola
- Nokia

To make a recycling description requires somewhat more work than a material declaration, but one can use the material information gathered when making a material declaration as a starting point for a recycling description.

Under Tools & methods there are more

- examples of material declarations
- examples of recycling descriptions

Business value
Developing material declaration and/or recycling description for a product can be a cost efficient way of showing that a company is working with product related environmental issues and might be sufficient for answering environmental questions from customers.

DANTES Strategy for Environmental support

Print this page

HANDLING AND REPORTING ENVIRONMENTAL INFORMATION

This aim of this strategy is to describe how to efficiently handle and report environmental information based on work within the forest industry and Industrial Environmental Informatics at Chalmers University of Technology.

Background

As society increases its focus on environmental issues, demand for environmental data from industry has also increased. The recent introduction of product related environmental information has placed new demands on industry to handle environmental data. Data needs to be easily used for different applications to respond to various stakeholder needs. Therefore, the possibility to reuse and verify data is essential to enable efficient yet credible data management.

This strategy describes how to efficiently handle and report environmental information for production systems, e.g. a production site, a part thereof, or parts of a product's life cycle. Applications for which environmental data are needed are e.g. reporting to authorities, EMAS statements, process development, emission trading (all using data representing the production site or parts thereof), environmental product declarations and labeling, LCAs, customers' supplier evaluations (all typically using data representing specific products). Emission trading through the European Emission Trading Scheme (ETS) is the European way to ensure the commitments ratified in the Kyoto protocol. Click here for more information on ETS and the Kyoto Protocol.

Environmental coordinators, persons working with environmental support and decision makers in companies can benefit from using this strategy, provided that it is supported by the management of the company.

This strategy is based on an internationally standardized format for documentation of environmental data (ISO/TS 14048 data documentation format) and a scientifically proven procedure (called PHASETS, PHASEs in the design of a Technical System) for establishing calculation models for production systems. More information on the ISO/TS 14048 is available in the report "Introduction and guide to LCA data documentation using the CPM data documentation criteria and ISO/TS 14048 Data documentation format" and at: www.imi.chalmers.se.

The results of this strategy can be implemented in the organization's management system, e.g. ISO 9001 and ISO 14001. The working procedure of the strategy is presented below. The strategy is fully described in Methodology for handling forest industry environmental data (see Method report and Manual)

Working procedure

The structured procedure for implementing ISO/TS 14048 and PHASETS in order to handle environmental data at production sites includes 4 steps. The procedure was developed to fit the Swedish pulp and paper industry, but could be adapted also by other industry sectors. The steps are:

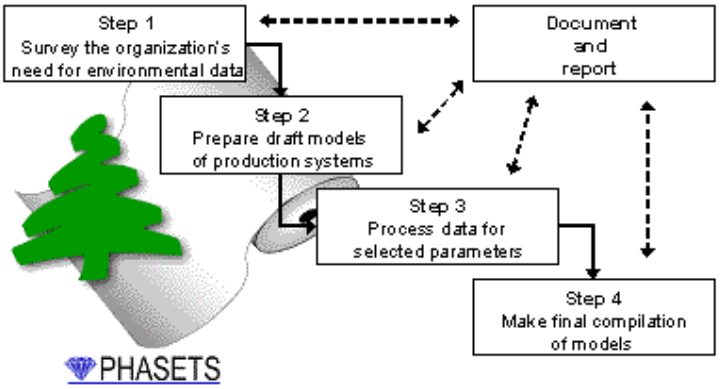


Figure 1: Working procedure for implementing ISO/TS 14048 and PHASETS in pulp and paper industry.

Step 1 – Survey the organization's needs for environmental data, by identifying stakeholders requesting environmental data and their requirements on that data. The survey is conducted to determine which models are needed and to prioritize further work. See example on identified stakeholders and their needs for environmental data.

Step 2 – Prepare draft models of production systems, which describe the production of the selected products or product groups based on the survey of environmental data needs. Depending on the stakeholders' requests, these models can either be simple or compiled of many sub-parts, see example of a model of a production system. In this step the parameters to be reported are also selected. An example of a reported parameter is fossil CO2. However, the system boundaries depend on the stakeholders' scope. In the European Emission Trading Scheme, only the emissions from the juridical site are included, but other related reporting schemes, e.g. The Greenhouse Gas Protocol, also include greenhouse gases from external upstream sources. Examples of other parameters can be found in the report Methodology for handling forest industry environmental data – Manual, appendix 2. This report also describes how data can be collected at the production sites.

Step 3 – Process data for selected parameters. The processing includes e.g. specification of parameters and measurement systems, acquisition of measured values and compilation of measured values into mean values. In the pulp and paper industry, a great deal of environmentally related parameters are measured, however method of measurement, frequency and exact location of measurement varies and need to be documented in order to draw the right conclusions from a reported parameter. E.g. the reliability of a parameter measured continuously might be higher than for a parameter measured once a year. Allocation issues for the draft models are also investigated. Few stakeholders set specific demands on how allocation should be performed when deriving product related environmental data. Suggestions on how to allocate in these cases can be found in the report Industrial Management of Environmental Data. Allocation is the partitioning of environmental impacts on two or more products resulting from one process. Allocation is needed, when

further modeling that separates the two (or more) products from another, is not possible.

Step 4 – Make a final compilation of models, based on the information that has been acquired and prepared in the previous stages of the implementation. A model in this context is a calculation procedure made from linked unit processes (please compare LCA). An example of a model is available here. The resulting models are then typically designed to correspond to the most detailed requests. Possibly, alternative calculation models can be designed for less detailed requests, e.g. when only site related information is needed.

Report and document
Document and report all results from the steps above in the ISO/TS 14048 LCA – data documentation format to facilitate quality assurance and verification of the procedure and data. The ISO/TS 14048 format specifies the information that is to be documented and how the documentation is to be structured. Both documentation and reporting is facilitated by using the appropriate software that is based on the ISO/TS 14048 format, e.g. LCI@CPMand WWLCAW both designed at IMI, Chalmers. The use of internationally standardized format for data documentation facilitates easier communication, verification and data quality assurance (please see LCA more about)

Experiences

The working procedure was developed in a co-operation project between the Swedish Forest Industries and Chalmers University of Technology. It was successfully implemented and tested in five companies: Kappa, Korsnäs, M-real, SCA and Stora Enso.

The experiences from the implementations are that this strategy:

- Improves structure and organizes environmental data in an orderly manner.
- Enhances the possibility to reuse data for new applications, e.g. Emission Trading and Integrated Product Policy, IPP.
- Facilitates transparency and verification of data.
- Can be adapted to complex as well as simple production systems and products.
- Is cost efficient to implement.

Business value
No analysis of the strategy's potential to save money or time has been conducted. However, it was the common understanding during the development of the strategy that it would save resources. Depending on the degree of integration with the organizations environmental management system and the complexity of the environmental information, the efforts to implement the strategy varies. For this reason some of the participating companies mentioned above have chosen not to make use of the strategy, while others find it useful and adding business value.

DANTES

DANTES Strategy for Environmental support

POLICY CONTROLLED ENVIRONMENTAL MANAGEMENT WORK

The aim of this strategy is to introduce a methodology for improved controllability of the environmental management system, which was developed within CPM at Chalmers University of Technology.

Background

This strategy aims at using the environmental policy as an operative tool in the environmental management system. The policy is a statement of the company's values and expresses the aim with its environmental work. The controllability of the environmental system is improved if all parts of the environmental work can move in the same direction.

The main intended users are persons working with environmental information management in companies with an implemented ISO 14001 environmental management system e.g. environmental coordinators and people working in environmental departments. The results will benefit the management and other decision makers in industrial companies as it will facilitate the decisions by providing all information needed to make them.

The methodology behind this strategy was developed in a project called "Policy controlled environmental management work" that was carried out between 2003 and 2004 at the Centre for environmental assessment of Product and Material systems at Chalmers University of Technology. More information can be found in the report and manual from the project.

The methodology implies that the company has an environmental management system implemented, but can also be used as a guide for how to implement one.

Working procedure

The environmental performance of the company is measured in terms of impact on a set of environmental condition indicators. An analysis is made of the environmental policy to find the relevant environmental condition indicators. The impact on the indicators from the company's environmental aspects is calculated by means of quantitative cause-effect models. These models have been borrowed from LCA methodology where they are called characterization models.
The working method is divided in eight steps as can be seen in the figure below.

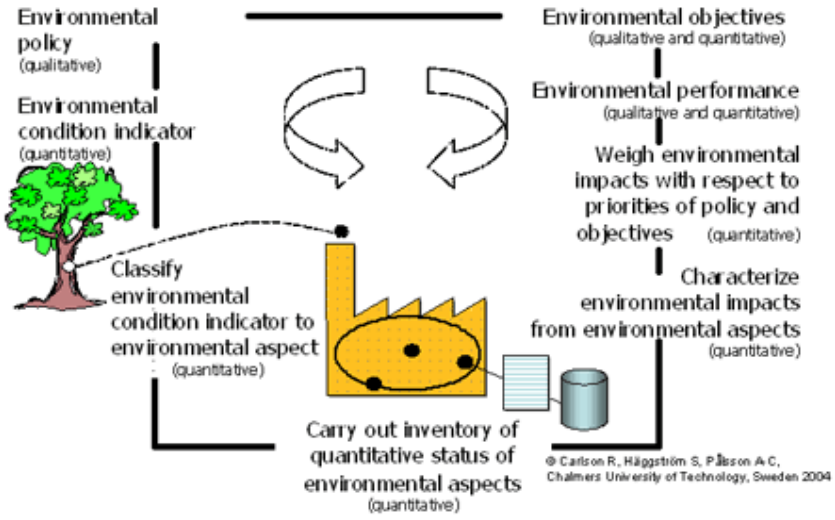


Figure Policy controlled environmental management system.

The contrary arrows suggest that either direction is possible to follow. It is possible to start the work at any step. Below is described one working path with beginning at the formulation of the environmental policy.

Actions:

1. Formulate the environmental policy
The environmental policy is formulated. The policy expresses the company's viewpoint and aim with its environmental work.
Company Ltd example

2. Extract environmental condition indicator
An analysis is made of the statements in the policy to find the established responsibilities of the company. Environmental condition indicators are extracted as the consequences of the statements of the environmental policy. These indicators are measures of the state of the environment and should be quantitative and relevant for the company.
If possible, the work in the next step is simplified if the environmental condition indicators are chosen among the indicators of existing impact assessment methods (EPS 2000, EDIP and Eco-indicator 99) that have documentation and ready-made characterization methods.
Company Ltd example

3. Classify environmental condition indicator to environmental aspect
The environmental condition indicators are translated into environmental aspects. This step is compatible with the classification step in the ISO 14042 standard. The environmental aspects are the inputs and outputs from the company's activities that impact the chosen environmental condition indicators (i.e. are linked to characterization parameters) together with the aspects that are not covered by the policy but are still needed because of laws and regulations, customer/supplier demands, internal use etc.
Company Ltd example

4. Carry out inventory of quantitative status of environmental aspects
This step involves acquisition, processing and reporting of numerical environmental data and modeling of the production system based on the environmental aspects of interest. The list of environmental aspects from the last step may be complemented with aspects that are not covered by the policy but are still needed because of laws and regulations, customer/supplier demands, internal use etc. This step corresponds to the environmental review and the general measuring and monitoring according to ISO 14001. Allocation is also made at this step.
Company Ltd example

5. Characterize environmental impacts from environmental aspects
The environmental effects of all the aspects of the company are quantified with characterization methods. In this step the characterization methods that link all aspects with the environmental condition indicators are prepared. There is a choice of using existing methods, creating new ones, or adapting existing methods to the company's needs.
Company Ltd example

6. Weigh environmental impacts with respect to priorities of policy and objectives
A quantitative subjective prioritization is made of the effects on the environmental condition indicators. The method with which this will be made is chosen in this step. The priorities shall be based on the policy and can also be used to identify the company's significant aspects. The company can choose to develop company specific priorities instead of using the weighting methods of existing impact assessment methods such as EPS 2000, EDIP and Eco-indicator 99.
Company Ltd example

7. Calculate the environmental performance
In this step, the actual calculations are performed. The current status of the environmental performance of the company is measured in terms of impact on the environmental condition indicators from the activities performed by the company. The characterization factors and the priorities from the two previous steps are used. Company Ltd example

8. Set/update environmental objectives
The results from the calculation of the environmental performance are used to set environmental objectives and targets. The environmental objectives are set at company level to avoid sub-optimizations at individual sub-units.

Experiences

The methodology is intended to be used in the existing environmental management work and will therefore theoretically not consume any additional resources. The implementation phase will however demand time resources for understanding and settling of the theories and the vocabulary. The quality assured information management might also need to be established in case it does not fulfill the demands.

The user of the methodology should be aware of the limitations. The issues that were identified in the project are listed below:

- The effort of collecting new data is bound to lead to existing data being overused and applied for cases for which they are not suitable. It is important that the data user understands the limitations of available data, and take responsibility not to overuse data.

- Further support for local impact assessment needs to be developed; a possible solution can be to use the PHASES methodology for this.

- There is a risk that environmental impacts are only searched for "under the light of the lamp" and that the real environmental problems are not detected. There is a need to integrate new knowledge (finding more connections between aspects and indicators) and use experiences gained from practical work.

The methodology was developed in the project "Policy controlled environmental management work" by IMI and six participating companies; ABB, Cementa, Duni, SCA, Stora Enso and Volvo Car Corporation. The methodology has been integrated in practical work to various extents. The company representatives have documented the experiences from the companies (Appendix II in the report).

A software prototype tool that supports the methodology was developed for educational purposes. The participating companies have shown great interest in the development of a commercial tool that can be used in the industry. However, a commercial tool does not exist to date.

Business value
Using this strategy will improved controllability of the environmental management system at companies as well as benefit the management and other decision makers in industrial companies as it will facilitate the decisions by providing all information needed to make them.

DANTES Strategy for Environmental support

HOW TO PERFORM APPLICATION SPECIFIC ENVIRONMENTAL RISK ASSESSMENT (ERA)

The aim of this strategy is to give guidance on how to perform site or application specific Environmental Risk Assessments, based on experiences from Akzo Nobel.

Background

Conducting a risk assessment is required by the regulatory framework of the EU for existing chemicals (on the market before 1981) that are of particular priority and also for new chemicals before being put on the market (after 1981). Conducting risk assessment will also be required by the new chemicals policy REACH for chemicals of high concern (more information about REACH can be found here). A risk assessment determines the risk to human health, workers and the environment posed by a chemical and an environmental risk assessment only considers the environmental part of a risk assessment. More information about environmental risk assessment can be found here.

This example of an ERA strategy is based on two case studies; a mining application and an asphalt application. A report summarizing these two case studies can be found here.

The strategy is intended for someone who would like a framework and a guideline from which to start working with site or application specific initial ERAs. The descriptions may require basic knowledge of the regulatory framework of the EU concerning chemicals and also some knowledge of how chemicals behave in the environment. The Technical Guidance Document (TGD) on Risk Assessment has been used extensively for

calculations and assumptions in the case studies. Please consult the report mentioned above if the explanations in the working procedure seem unclear to you.

Working procedure

1. Finding the routes of release
Try to find information on how the chemical or product containing the chemical is used and handled and in which quantities. Also try to find information on the geography and lay-out of the site, process or application. Make a picture or map of the site, process or application and find the flows of the chemical in this picture.

By looking at this picture or map and considering how the chemical is handled; how and where can the chemical reach the environment and in which quantities or concentrations?
– By air or water?
– To water treatment plant?
– Continuous, intermittent or single release?

Result: a schematic picture or map that includes all of the flows of the chemical with quantities and all of the possible releases to the surrounding environment. An example is presented here.

2. Gather environmental information
Once the chemical has reached the environment, how does it spread?
Based on how and where the chemical can reach the environment, information on the site specific environmental conditions at these release points is needed. The information can include temperatures, soil type(s) and their hydrological conductivity, water flows and temperatures. Distances between the points of release and species or other things of interest to protect, e.g. a river, a water protection area or the ground water are also needed.

Try also to find all information about the physico-chemical properties of the chemical. Especially the octanol-water partition coefficient (Kow), volatility, molecular weight and degradability (biodegradation, photolysis and hydrolysis) are important parameters for modeling the chemical in the environment.

Search in the European chemical Substances Information System (ESIS) for any Risk Assessment made for the chemical or similar chemicals. The risk assessments found in ESIS can also provide information about how other people have modeled chemicals in the environment.

Result: a list of all of the available environmental information about the points of release and the physico-chemical properties. An example is presented here.

3. Modeling the exposure

Work out a model of how the chemical spreads and how it is distributed between air, water, soil and sediment (whichever is relevant at the different release points) based on information about the environmental conditions and the physico-chemical properties. The Technical Guidance Document (TGD) can give guidance on how to model chemicals in the environment. EUSES (European Union System for the Evaluation of Substances) is a software tool that also can be used to model the exposure of a chemical, but it needs to be set with site specific environmental conditions, otherwise it will use default parameters that represent the EU.

Use site specific information on the needed parameters, e.g. hydrological conductivity or depth to ground water. If no site specific information is available, try to find more general information about the area such as temperatures, precipitation or type of soil normally found in the area. As a last resort average data for the EU can be used (which is included in the EUSES model).

Use chemical specific data on physico-chemical properties. If no chemical specific data is available, the TGD has guidance on how to calculate certain parameters from the structure of the molecule using so called (Q)SAR (Quantity Structure Activity Relationships). A simple QSAR computer program that has been developed by the US EPA, called EPISuite, can be found on the internet and downloaded here for free. There are also commercial software models that can be used for modeling a chemical release in a river, such as CORMIX or Visual Plumes.

Air releases can be dealt with by using the EUSES model, but generally the air releases are spread out over such a large area that the concentrations become very low and do therefore not constitute a risk to the environment. Chemicals that are toxic, bioaccumulating and persistent can however accumulate in the

environment and reach toxic concentrations in the environment as well as in species higher up in the food chain.

Result: Predicted Environmental Concentrations (PECs) for the compartments water, sediment and soil, for each of the different release points.

4. Determining the effect level
Try to find as much information on the eco-toxicity of the chemical as possible. Start by finding the Safety Data Sheet (SDS) for the chemical and if needed there are databases for information on chemicals available on the internet, e.g. TOXNET or ESIS.

Safety factors, called assessment factors, are applied to the lowest of the available toxicity data and these factors depend on the availability of toxicity data. The value of the assessment factors that should be applied can be found in the TGD.

If no toxicity data can be found for species in sediment, the equilibrium partitioning method can be used to find the Predicted No-Effect Concentration (PNEC) for sediment, as described in the TGD. If the equilibrium partitioning method has been used to find the PNEC for sediment an additional factor of 10 has to be applied to the assessment factor.

Result: Predicted No Effect Concentrations (PNECs) for the chemical in water, sediment, soil and water treatment plant (whichever is applicable).

5. Determining the risk characterization ratios (RCR)
The RCRs are calculated as the ratio between the PEC and the PNEC for each of the environmental compartments

Result: a table with all of the RCR figures for the different compartments and release points.

If any of these RCR figures are higher than 1, further development of the model or more site specific measurements may be needed.

Experiences

A general finding from many risk assessment studies is that chronic eco-toxicity data are often lacking. The assessment factors (safety factors applied in order not to underestimate the risk) for the Predicted No-Effect Concentration (PNEC) are therefore high. Essential physico-chemical properties, such as figures for biodegradation or the octanol-water partition coefficient (K_{ow}) are also often lacking and this results in difficulties in modeling the environmental distribution of the chemical. The QSAR (Quantifiable Structure Activity Relationship) models for calculating the K_{ow} for surface active chemicals are not reliable, which makes it even harder to model these kind of chemicals.

In the kind of initial risk assessment that is described here many assumptions, hypothesis and worst case scenarios are discussed and analyzed. This is OK in an initial assessment, but it may be hard to know whether the assumptions or choices would be accepted in a review of a full risk assessment. In the European chemical Substances Information System (ESIS) many chemical risk assessments can be downloaded and answers of how to approach the chemical modeling may be found in these.

To learn about modeling the distribution of chemicals in the environment it may be educational not to use a software tool, but to calculate it "by hand", using the Technical Guidance Document (TGD) as guidance. EUSES (European Union System for the Evaluation of Substances) is a useful tool, but in order to know what happens "behind the interface" the equations and default figures have to be known.

DANTES Strategy for Environmental support

PRODUCT STEWARDSHIP IMPLEMENTATION

The aim of this strategy is to give guidance on implementing Product Stewardship in a chemical company, based on experiences from Akzo Nobel.

Background

Product Stewardship is a code about responsibly managing the health, safety and environmental aspects of a product throughout its life cycle. More information about Product Stewardship (hence referred to as PS) can be found here.

This strategy is intended for people being assigned to implementing PS in a chemical company, but can be used by anyone as a guideline for implementing PS or similar systems.

The strategy describes how PS was implemented in the management system of the Akzo Nobel subsidiary Ethylene Amines and also how information was spread and people involved within the company. In this case Akzo Nobel Corporation had adopted PS and put a demand on the subsidiary companies to implement it in their organisations. One person cannot make PS work by themselves. Management has to be committed and every employee has to take an active part in the PS work. Akzo Nobel Corporation has therefore issued a guideline for the implementation of PS in the subsidiary companies.

Working procedure

1. Create work documents

Akzo Nobel has issued a general guideline for implementing PS in an Akzo Nobel subsidiary company and The Swedish Plastics and Chemicals Federation has issued a document that describes PS work within different departments, including checklists of statements that each manager could consider. The latter document is in Swedish and can be ordered from Industrilitteratur.

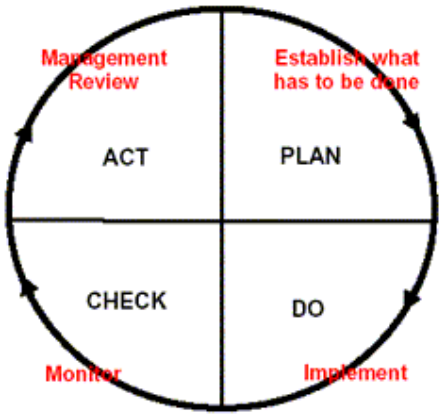
Checklists for particular functions and managers within the Ethylene Amines subsidiary were developed based on these two documents and people were assigned the responsibility for these checklists. The checklists include the statements from the Swedish Plastics and Chemicals Federation, responsible person, a rating of how well the statements are fulfilled, comments and links to relevant documents. The statements are in the form "I have enough knowledge of …" or "There is a routine for evaluating…". Examples of included statements can be found here.

2. Learn about present status

In order to have a base status with which to compare improvements, the current status for each statement have to be investigated. The person responsible for a checklist with these kinds of statements evaluated how well his or her department/area of responsibility complied with the statements by rating the present status.

3. Implement Product Stewardship into existing management systems

Product Stewardship, just like Environmental Management Systems, is about continuous improvements, i.e. a continuous cycle of planning, implementing, checking and reviewing.



In order to establish a working procedure that supports the continuous improvement and involves the right people a PS process was included in the objectives in Ethylene Amines' management system. The PS process includes a short description of the activities to be carried out, their timeframes, the person(s) responsible and relevant documents.

4. Inform and involve all employees
The responsibility of PS cannot be placed upon only one person. Every employee needs to be involved in order to make the work with PS run efficiently. They need to know how the work is being managed, what their roles are and how they can contribute to the work.
All employees were informed by setting up an intranet site, where PS is introduced to novices and the practical and organisational issues are explained. The site also presents links to the checklists for each concerned department manager, where they can see the statements that apply to them and also make changes and updates to the checklists.
Presentations were held for all employees with the aim of involving them and making them think in terms of environmental impact in their daily work. These presentations included the following issues:

- Concept of sustainable development and Corporate Responsibility
- Background to Responsible Care and Product Stewardship
- Introduction to the Life Cycle concept and Life Cycle Assessment
- The PS working procedure at Ethylene Amines
- Introduction to REACH

A deeper presentation and mini-workshop was held for those actually responsible for a checklist and those with more influence on the environmental impact of their products. The aim of the workshop was to come up with suggestions for decreasing the environmental impact and for raising the esteem for the company. These presentations were presented on the intranet site as well.

5. Kick-off
All of those who are responsible for a part of the PS checklists naturally need to get a bit more involved so, after having the organizational structure in place and the personnel informed, a kick-off meeting was held. The agenda included:

1. an update on PS in order for everybody to be in the same frame of mind
2. a short brainstorm around possible activities within PS on the basis of the targets and objectives for the company
3. preparations for the PS workshops to be held within each department (see below)
4. information on how to communicate proposals for and results from PS activities.

6. Activities for improvements
In order to establish continuous improvement, activities with allocated resources and appointed responsibilities have to be set. Proposals for such activities were collected by arranging small workshops within each department, at which the targets and objectives of the company as well as the statements/requirements in the checklists were discussed. The PS manager and/or someone else

knowledgeable in the concepts of PS and health and environmental issues held these workshops. By having such workshops the people in each department also became more involved in the PS process as well as reaching the targets of the company. Not only do they have to do some of the actual work, but they were also involved in planning the work.
Resources in the form of money and time as well as responsibilities were set for the chosen activities and they were followed up on a regular basis.

7. Present the work to other interested parties
One step towards raising the esteem for the company can be to present chosen parts of the work being done within the framework of PS to authorities, organizations, media and the public. This was done by making a PS page on the Ethylene Amines' official web site, where the background to PS and the underlying concepts are explained and the actual work with PS within the company is presented.

A new web site of Ethylene Amines is currently under construction and the PS information will be included in the new web site.

Experiences

It is vital to involve top management as well as the department managers in order to get resources for the PS activities and the best way to do this, in our view, is to incorporate the PS process into an existing management system. Since the management system is regularly reviewed, the PS activities will always be on the agenda.

It is also important to let as many employees as possible be involved in the PS activities and to have a person (PS manager) who has the overview and who can make priorities among the activities in order to achieve the most environmental benefit from the PS work. Having the employees involved in working with environmental issues and also in attaining the goals of the company will raise their job satisfaction and bring better overall quality to the company.

Work that have sprung from some other activity or decision may have a positive environmental effect and can be worked with and presented within the framework of PS, e.g. development of more energy efficient processes or decreasing the water content of a product.

The time needed for this implementation depends largely on the level of ambition. The time required by the PS manager(s) to accomplish all of the steps in the working procedure of this strategy was about 60 to 80 man-days during about one year.

Business value
The business value of implementing Product Stewardship is for example that it clarifies what is done and what is not done within the company. People in the whole organization not only the top management, is involved in managing the health, safety and environmental aspects of products.

Furthermore, visualization of the health, safety and environmental aspects of products lead to improvements, if targets are set and actions taken. By implementing product stewardship, weak areas that otherwise might be forgotten are found.

Product stewardship is a way to show stakeholders how we are working with these questions and the progress achieved.

DANTES

DANTES Strategy for Environmental support

HOW TO PERFORM AN LCC

The aim of this strategy is to give practical advice on how to conduct an LCC study. The strategy is based on experiences from ABB.

Background

LCC is a method to analyze the total cost of acquisition, operation, maintenance, and support of a product/system/service throughout its useful life, and including the cost of disposal. This LCC analysis can provide important inputs in the decision making process, for example;

- evaluation and comparison of alternative design approaches;
- assessment of economic viability of projects/products;
- identification of cost drivers and cost effective improvements;
- evaluation and comparison of alternative strategies for product use, operation, test, inspection, maintenance, etc.;
- evaluation and comparison of different approaches for replacement, rehabilitation/life extension or retirement of ageing facilities;
- allocation of available funds among the competing priorities for product development/improvement;
- assessment of product assurance criteria through verification tests and its trade-off

R&D and marketing & sales personnel are the main target groups for this strategy. R&D personnel, marketing & sales department as well as customers benefit from the result of using LCC.

Working procedure

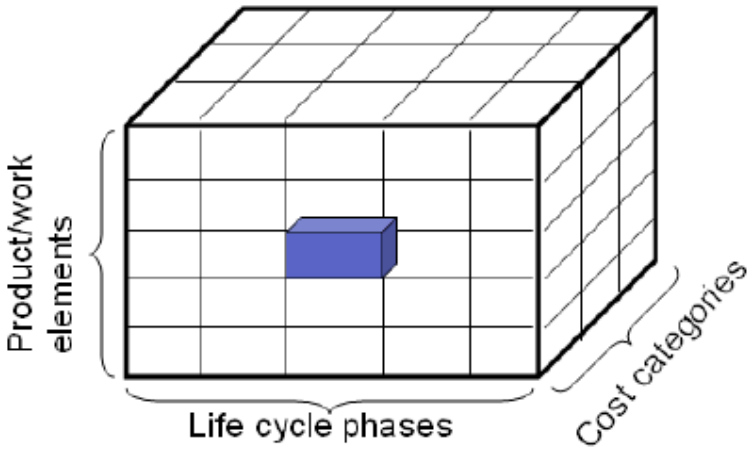
This strategy describes how one can identity the costs factors and suggests different approaches to estimate them. Furthermore, the possible development of LCC tools is described.

Identifying the cost elements
For someone with experience of the product and knowledge of the driving cost elements setting up and calculating the LCC is not a major problem.

With less experience of LCC, a more structured approach is necessary identify the required cost elements by breaking down the cost structure of the product in three different dimensions.

1. Break down the product in subsystems (e.g. power source, control system, etc.) and work packages (e.g. erection, decommission, etc.).
2. Break down the product in life cycle phases (e.g. development, acquisition, operation, service, etc.)
3. Break down the product in cost category of applicable resources (e.g. labor, materials, fuel/energy, overhead, transportation/travel, etc.)

The three different cost dimensions can be illustrated by a three dimensional matrix (see figure below). The blue element in the matrix can, for example, be the cost of the energy to run the power source (dimension 1; power source, dimension 2; operation, dimension 3; energy). This kind of systematic approach ensures that all relevant cost elements will be included.



Estimating costs
When all possible cost elements have been identified (i.e. all elements of the matrix) one has to find or estimate the cost for each element. Many elements will be zero or almost zero (e.g. energy cost of the development of the power source) and require no cost estimation. Some costs are well known (e.g. by quotations from suppliers) others have to be estimated and there are three basic methods that are commonly used:

- engineering cost method - involves the direct estimation of a particular cost element by examining the product component-by-component or part-by-part. It uses standard established cost factors, for example firm engineering and manufacturing estimates
- analogous cost method -cost estimation based on experience with a similar product and technology in the past.
- parametric cost method - uses significant parameters and variables to develop estimates which are usually in the form of equations. A parameter reflects a conversion factor from one system of units to another. A price like cost per manhour, for example, converts person hours into costs. An example of an empirical ratio is the number of maintenance person-hours per failure of a given component, which may be known by experience.

Once the costs have been estimated the present value of all future costs and incomes have to be calculated by "net present value". Once all the present values of all costs have been calculated the LCC calculations are trivial (i.e. summation of the costs).

Making a cost estimation/sales support tool
Instead of making a LCC analysis of one specific solution, one could develop a LCC tool. Instead of estimating the costs one has to estimate costs based on a parameter, for example;

- Cost of pump = factor * (throughput [kg/s])
- Cost of pump operation = factor * (throughput [kg/s])
- Cost of tank = factor * size of tank (= throughput [kg/s]*residence time* density)

Now all costs (of pump, tank and operation) are parameterized (this does not have to be linear) on the throughput and this could be modeled in, for example, excel.

As an additional feature, one could allow the user discreet choices e.g. tank of steel or stainless steel. The cost of the tank is then dependent on the throughput and the user choice.

- Cost of tank = factor(steel or stainless steel) * (size of tank)

LCA-like evaluation
Yet one additional feature would be to include a LCA-like evaluation of the data from the cost model. Using the parameterized example of pumps and tank above, the throughput also can be used to estimate the material use (size of tank and pump, as well as tank material) and energy use (electricity to operate the motor driving the pump)

Using the parameterized model, the user gets a cost estimate as well as an LCA-like environmental evaluation based on a few simple inputs.

Soft values
In a sales situation when one want compare two products there are a number of additional parameters that one needs to consider. These can not easily be included in the LCC or LCA-like evaluations described above. A tool could assist a more systematic evaluation of these "soft values" between two products by simply compare values for the two products and give a qualitative estimate of the difference. Examples of "soft values" are; Noise, Fulfillment of standards, Selection of color, Ease of scrapping/recycling, Distance to service, etc.

Experiences

ABB have, within Dantes, developed five combined LCC-LCA tools, as described in the working procedure. These are used as sales support tools.

The experiences from developing these tools are

- The process takes longer time than anticipated, both in calendar time and in work time, due to the number of people that have to give feedback and input.
- One has to include the stakeholders early in the discussion to ensure that one is on the right track
- One has to discuss with many different stakeholders (some with conflicting views, some with negative view)
- One has to be prepared to change the objectives as the work goes forward
- Once the tool is developed it has to be reviewed by stakeholders in several cycles
- Feedback from customers is very valuable when developing a sales support tool
- Even if the tool fulfill the expectations the immediate success is not guaranteed
- Environmental evaluation of differences played a minor role in this work but received some interest

Tool
Under heading "Tools & Methods"/"Software" on Dantes.info a simple, excel-based LCC tool (LCCLight) is available for download. This excel tool can be modified to suit your specific needs.

Publications - general experience

- DANTES LCC-LCA tools

Publications - experience and descriptions of tools

- Wet fermentation plant (Biogas, wet process)
- Dry fermentation plant (Biogas, dry process)
- Transformer management tool (Transformer selection)
- AX1 LCP tool (MV Switchgear selection)
- Battery (Battery selection for backup power)

Business value
It is good business to understand the cost structure of your product system since efficient improvement actions could then be taken. Business relevant cost information could be selected for use in market communication.

DANTES Strategy for Environmental support

COMPREHENSIVE ENVIRONMENTAL ASSESSMENT OF A CHEMICAL PRODUCT

The aim of this strategy is to describe how and when Environmental Risk Assessment (ERA) and Life Cycle Assessment (LCA) can be used in combination to assess the environmental impact from a chemical product, based on experiences from Akzo Nobel.

Background

A comprehensive environmental assessment of a chemical product should preferably include all the possible detrimental effects on the environment that the chemical may give rise to during its life cycle. Background data for such an assessment would include e.g. aspects like the inherent properties of the chemical and properties of the local and regional environment as well as the resource consumption and emissions the chemical causes during its life cycle. There is no single tool available that includes all these different aspects, but a combination of tools can present a good overview of possible detrimental effects.

The aim of an **Environmental Risk Assessment (ERA)** study is to assess whether there may be a risk to the environment from possible releases of a specific chemical substance.
Life Cycle Assessment (LCA) is the assessment of possible environmental impacts from all the activities necessary for the existence of product. Environmental impacts from resources used, emissions emitted and wastes produced by the activities in the life cycle from raw material extraction through processing, manufacturing, use and waste handling are accounted for in the LCA. An ERA and an LCA can therefore complement each other to form a comprehensive environmental assessment of a substance.

Akzo Nobel has performed an ERA, an LCA and a comparative LCA on an additive used in very small quantities in asphalt pavement. The experiences from the studies are summarized in this strategy and the report can be downloaded here. A report about the relationships between Risk assessment and Life cycle assessment can be downloaded here.

People working with environmental support within a company or involved in research & development or marketing functions may benefit from a more holistic view in their environmental assessments of chemical products.

Working procedure

There may be two starting points for making a comprehensive assessment of a chemical product; an ERA with complementary information from an LCA or an LCA with complementary information from an ERA.

Environmental Risk Assessment with a complementary LCA
The result of an ERA may indicate a possible risk to the environment from a chemical substance. The Risk Management process that follows includes a Risk benefit analysis that should analyse the impacts and benefits of the substance. In this analysis the substance may be compared with its functional alternatives from a life cycle perspective, i.e. not only focusing on the environmental effects caused by the chemicals themselves, but also including other activities needed for the chemicals to exist. Including an LCA in such a Risk benefit and comparative analysis will give a more holistic picture of the environmental effects caused by using an alternative substance.
It may however be difficult to obtain LCA data for the alternative substances, especially if these are produced by competitors and a screening LCA may therefore have to be sufficient. Such a screening LCA may e.g. consider only the extraction of needed raw materials, the general production processes of the alternatives as

well differences in waste handling. The result can then be presented as a comparison of e.g. the use of natural resources and energy needed.

Life Cycle Assessment with complementary ERA
An LCA does not usually include an assessment of the ecotoxicological effects of all of the emissions in the Life cycle inventory (LCI), since there are at present no generally accepted models for assessing the ecotoxicity of substances in an LCA. Performing an ERA of each of the emitted substances during the life cycle of the substance is not practically achievable since an LCI may include more than a hundred emitted substances.
An ERA of the assessed substance does however give additional information, especially if the substance is known to be toxic.
A comparative LCA of e.g. cloth bleaching products, where the traditional chlorine is compared to less toxic alternatives, would not give a complete picture if the toxicity of the compared products was not included.
A good approach may therefore be to include a screening ERA if the products themselves or other substances in their life cycles are toxic, persistent or bioaccumulating. This information will then complement the LCA as one more parameter to consider in the decision making.

The ERA as well as the LCA methodology are quite complex and time consuming. An initial screening ERA or LCA may therefore be benficial to perform is order to see whether a deeper analysis is necessary. ECETOC (European Centre for Ecotoxicology and Toxicology of Chemicals) has published a web tool for performing screening risk assessments and there are a number of different methods for conducting screening LCAs, of which some can be found in the report State of the art study of LCA and LCC tools.

The ISO 14040 series presents the principles and framework for performing an LCA study and the Technical Guidance for new and existing chemicals (TGD) presents the methodology for performing a Risk Assessment.

More information about the ERA and LCA methodology is presented here.

Experiences

The results from the ERA study mentioned in the Background show that the chemical may pose a risk to the environment due to emissions during the construction and use phase, while the LCA study points out the production of one of the raw materials as the main contributor to environmental impact. These studies show that an ERA as well as an LCA may be needed in order not to suboptimize the improvement activities. Having studied the product from both perspectives also gives a more complete picture of the environmental impact associated with the product and, which increases the credibility of the producing company.
Another conclusion from the LCA study is that the additive contributes very little to the environmental impact of the asphalt pavement.

The comparative LCA study shows that the alternatives to the asphalt additive, i.e. lime and cement, have larger environmental impacts than the additive. This is due to the fact that the additive is used in much smaller amounts than the alternatives in order to provide the same effect. A comparative LCA study performed in this way can provide a more complete picture of the environmental consequences of e.g. banning a substance from the market.

To perform an comprehensive environmental assessment including ERA and LCA is a time and resource demanding task and it is probably only worth while for a few products. The time and resources needed are much dependant on the complexity of the system and whether the required data are available.
It is difficult and in our view not useful to join the two different methods Life Cycle Assessment (LCA) and Environmental Risk Assessment (ERA) into one integrated tool, but there are definitely benefits from considering chemical products from both perspectives. It is important to include both the ERA and LCA thinking in the decision-making process in e.g. product development or discussions with customers and not consider either the impact of the chemical itself or e.g the emissions of carbon dioxide.

Decreasing carbon dioxide emissions are closely related to energy savings and financial issues, e.g. through the new emission trading. Many NGO´s have specific concerns regarding air emissions such as carbon dioxide, sulphur oxides and nitrogen oxides. LCA methodology can assist in gathering the information that is required.

Knowing whether the product may cause detrimental effects in the environment, in the short as well as the long term, helps in avoiding unwanted surprises later on. ERA is one tool that can help in determining this,

because possible risks are clearly presented for all of the life cycle steps, from the production to the end use and the waste handling. ERA studies can also assist in deciding if toxicity tests and/or exposure measurements are useful or necessary to perform, which makes it easier to plan the needed resources.

A risk assessment will probably be required in the safety report of the new chemicals policy, REACH, and ERA will thereby be an important tool in the future registration and authorisation process of chemicals.
