CHALMERS

Policy Controlled Environmental Management Work

Final Report

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CHALMERS UNIVERSITY OF TECHNOLOGY
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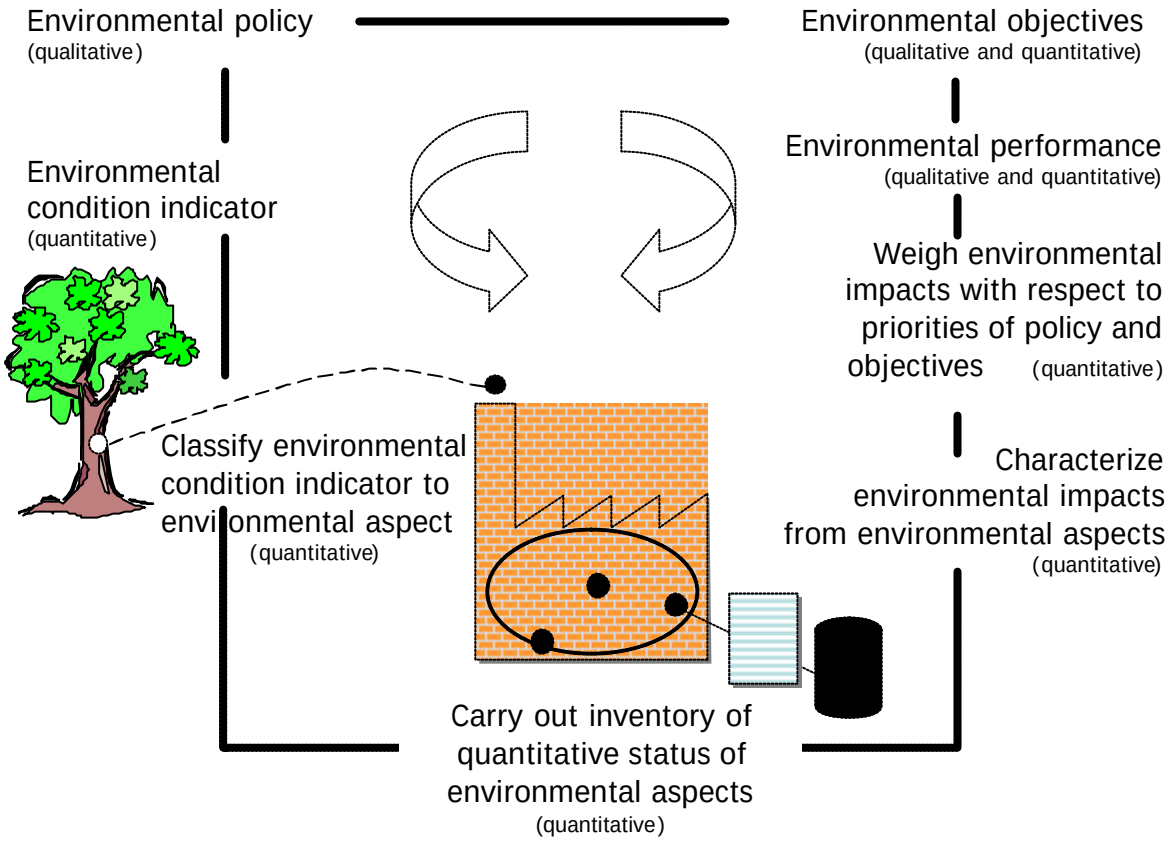
CPM Report 2004:10

Executive summary

In this project a methodology for policy controlled environmental management work has been developed. The work is divided into eight steps as can be seen in the picture below.



The environmental performance of the company is measured in terms of impact on a set of environmental condition indicators. A conceptual 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 work has been performed in a pre-study, a problem inventory and workshops with participants from both industry and academy. This has enabled the language to develop so that terms and concepts have been understood in both worlds. A prototype software tool has also been developed to support the methodology.

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1 Introduction

Previous CPM projects have delivered methodology and tools for different parts of an environmental management system, e.g. RAVEL[1], IA98[2] and CPM/SSVL[3]. This project, "Policy controlled environmental management work", was initiated to meet the need of compatibilizing and integrating the different components. The methodology developed in the project is described in "*Manual for Policy Controlled Environmental Management Work*".

The project consists of a pre-study, a problem inventory and development of the methodology in workshops. In the project is also included the development of a prototype software tool to support the results. The project was started the 1st of May 2003 and finished the 31st of August 2004 and held the working name A20.

1.1 Background

Today, there is a distance between statements in the environmental policy, tools for environmental management and other management tools. By integrating the formulation of the environmental policy with the setting of environmental objectives and targets and quality assuring the environmental information, the company management can more clearly take responsibility for and achieve control of the company's environmental performance.

The methodology used in the project is a subset of the theoretical model vision IBEIM (Integrated Business Environmental Information Management)[4]. Parts of IBEIM have been implemented within the projects RAVEL and CPM/SSVL. By connecting the methodologies implemented within the two projects, policy controlled environmental management work can be based on quality assured handling of environmental data. RAVEL and CPM/SSVL provide a structured and transparent way of working, complementing each other in that they describe two central parts of environmental management:

- formulation of environmental policy, identification of environmental aspects and setting of environmental targets with the methodology for quantification of environmental indicators developed in the RAVEL project, and
- management, control and follow-up of the identified environmental aspects and targets are treated with the methodology developed in the CPM/SSVL project.

In addition, environmental impact assessment methodology from life cycle assessment (LCA) has been adapted to fill the needs of environmental management work. IA98, a model for environmental impact assessment that is compatible with ISO 14042 has been used as basis to structure the work.

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[1] Dewulf W. (Ed.) et al, "Integrating Eco-Efficiency in Rail Vehicle Design", Leuven University Press, Leuven, Belgium, 2001

[2] Carlson R., Steen B.; "A Data Model for LCA Impact Assessment"; Presented at 8th Annual Meeting of SETAC-Europe 1998 14-18 April; Bordeaux

[3] The CPM/SSVL methodology is based on PHASETS [Carlson R, Pålsson A-C (2001): "Industrial environmental information management for technical systems", Journal of Cleaner Production, 9 (5): 429-435, Elsevier Science Ltd] and SPINE [Carlson R, Löfgren G, Steen B (1995): "SPINE – A Relational Database Structure for Life Cycle Assessment", Report B1227, Swedish Environmental Research Institute, Göteborg]

[4] Carlson R., Erixon M., Forsberg P., Pålsson A-C.; "System for Integrated Business Environmental Information Management"; Advances in Environmental Research, 5/4 (2001) p. 369-375

2 Goal and scope for the project

Project goals:

- To develop a toolbox of tools and methodology for systematic policy controlled environmental management work within a company or company group. The toolbox is aimed to support the work with environmental management systems such as ISO 14001 and EMAS.
- To compile experiences from the participating companies with regard to how the project and the toolbox affected the practical work.

The project scope is the environmental management system. The methodology development work in the project focused on the parts of the system that were identified as problem areas in the problem inventory.

3 Working methods and participation

The working method of the project has been to discuss problems in the environmental management system (EMS) and discuss and adapt the methodology needed to solve them in workshops with participants from both industry and academy. The language for discussing the EMS issues so that both worlds could understand and feel at home did not exist before the project started and a considerable part of the efforts has been put on overcoming linguistic obstacles. The linguistic development has been a cyclic process and to some extent also iterative as it has been dependent on the participation in the workshops.

A prototype software tool was developed at IMI in parallel with the workshops to support the methodology results from the project. The tool is based on the needs for support identified during the project, and it has been designed and discussed with the industrial partners during the development.

The following persons have participated in the project:

- Curt Henricsson, ABB
- Sara Paulsson, Bombardier Transportation
- Karin Gäbel, Cementa AB
- Agneta Enqvist, Duni
- Jens Tångeberg, Duni
- Raul Carlson, IMI
- Sandra Häggström, IMI
- Ann-Christin Pålsson, IMI
- Ulf Tidstrand, IMI
- Elisabeth Olofsson, SCA
- Ellen Riise, SCA
- Björn Spak, SCA
- Ola Svending, Stora Enso
- Lars Lindkvist, Volvo Car Corporation

4 Explanation of concepts used in the project

In the following, the concepts and terms that have been used in the project and in this report are explained. The explanations are based on the report *"Documentation of environmental impact assessment, compatible with SPINE and ISO/TS 14048"*[5], the ISO 14000 series of standards, SPINE and discussions at workshops.

Impact Indication Principle

The choice of how to express or indicate environmental impact is subjective and depends on the viewpoint of an "observer". This viewpoint may be expressed as a "principle", the impact indication principle. The environmental policy of a company is one example on such a principle. Other examples can be the system conditions[6] or the 15 objectives of the Swedish EPA. Based on an impact indication principle, different impact categories can be chosen, as well as different category indicators.

Impact Category

Impact categories are names of classes of environmental impacts and are represented by one or several category indicators. The impact categories are chosen to reflect the impact indication principle in question.

Category Indicator

Category indicators are names of quantifiable environmental condition indicators belonging to impact categories. The category indicators are chosen to reflect the impact indication principle in question.

Environmental Condition Indicator

The environmental condition indicator (ECI) is defined in ISO 14031[7] as a "specific expression that provides information about the local, regional, national or global condition of the environment". The environmental condition indicators can be grouped into different impact categories (global warming, acidification, ozone depletion etc), and the environmental condition indicator representing that group is then called category indicator.

Environmental Aspect

An environmental aspect is an "element of an organization's activities, products or services that can interact with the environment" according to ISO 14001. The environmental performance indicator of ISO 14031 is an environmental aspect that is a "specific expression that provides information about an organization's environmental performance". In this project it is implied that the environmental aspect is quantified.

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[5] Carlson R., Pålsson A-C. "Documentation of environmental impact assessment, compatible with SPINE and ISO/TS 14048" IMI Report 2002:1

[6] 1) Holmberg, J., 1995. Socio-Ecological Principles and Indicators for Sustainability, Ph.D. Thesis, Institute of Physical Resource Theory, Chalmers University of Technology and Göteborg University, Göteborg, Sweden.
2) Holmberg, J. 1998. Backcasting — a natural step when operationalising sustainable development. Greener Management International. — the Journal of Corporate Environmental Strategy and Practice. Issue 23: 30-51. (Autumn 1998)

[7] ISO 14031:1999 (1999): Environmental management – Environmental Performance Evaluation – Guidelines, European Committee for Standardization, Brussels

Classification
Classification assigns environmental aspects to environmental condition indicators or impact categories, which means that the practitioner makes a number of implicit choices. In this methodology it is called "Classify environmental condition indicators to environmental aspects". The classification are in some cases seen as a special case of the characterization, where it is decided if the characterization factor is 0 or ? 0 for a certain category indicator.

Characterization
The list of environmental aspects and the life cycle inventory (LCI) have both the form of a list of inputs and outputs. The characterization links the inputs and outputs with their impact on the environmental condition indicators quantitatively. The characterization method is the method used to model the relation between the environmental aspect and the environmental condition indicator (see below).

Characterization Method
The characterization method relates the environmental aspect quantitatively to an environmental condition indicator. The environmental impact is modeled with a certain method that can be used for one relation or several. Depending on level of detail of the modeling of the environmental impact, different information about the inputs and outputs is needed, e.g. name of substance, amount, environmental conditions and geographical location. The numerical expression of the relation between an environmental aspect and an environmental condition indicator is called Characterization Factor (CF). An example is shown below:

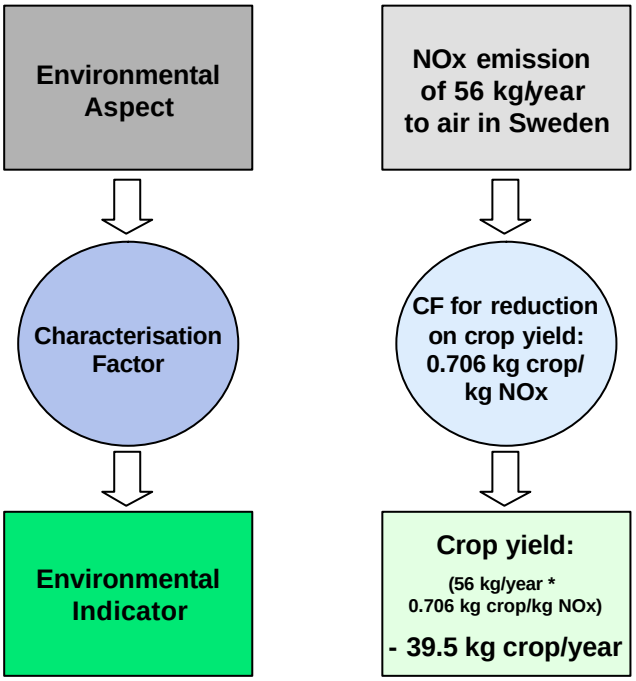

Figure 4.1. The relation between an environmental aspect and an environmental condition indicator.

Prioritization

Prioritization is a subjective and quantitative measure of the relative importance between different environmental impacts. In LCA, this prioritization is called weighting. Different weighting methods can be used to compile and calculate the relative weights of indicators, and each different method results in different sets of relative Weighting Factors (WF).

A prioritization method is associated with a set of category indicators. Each indicator is associated with a weighting factor, expressing this indicators relative significance to the other indicators in that set. The aim is to get one single score for a studied object instead of one score for each category indicator.

It is important to distinguish between weighting, which is made between category indicators, and identification of significant environmental aspects, where the prioritization is made between environmental aspects. The selection of significant environmental aspects can be based on the prioritization between category indicators.

Impact Assessment

A full impact assessment includes the three concepts classification, characterization and prioritization, in a logical sequential order and together with a definition of the impact indication principle and the scope of the intended application of the impact assessment. The scope typically encompasses several complementary category indicators, a geographical area, and the consideration of many different stakeholders. When creating an impact assessment method, the environmental policy can be used as guidance to select a set of suitable category indicators and to prioritize between those category indicators in different trade-off situations. One must also have a clear opinion of the natural environment included in the scope, and of which inputs and outputs that are implied by the scope. The impact assessment method describes how impact indication principles, classification methods, characterization methods, and prioritization methods have been selected and combined.

Technical System, Environmental System, Social System

The technical system contains the human activities producing services or goods and impacting the environment. It can be companies, manufacturing sites, production lines or life cycle scenarios for products. The environmental system is the resources, animals, plants, climate etc. The social system consists of people; customers, neighbors, environmental experts, employees, managers etc. and provides the values or rather attitudes against various changes in the environment.

In the interface between the social and the technical system, people appreciate the value of the good produced by the technical system. In the interface between the social and the environmental system, on the other hand, people react to the consequences in the environment caused by the activities in the technical system. The indication of an environmental problem and the prioritization between different environmental problems occur in the interface between the social and the environmental system.

There is also an interface between the technical and the environmental system in which there is a continuous exchange of energy and matter. The use of renewable and non-renewable resources, emissions and occupation of land are examples of activities that occur in this interface. The environmental impact is estimated in terms of the negative change implied by the technical system upon the environmental system, as evaluated by the social system.

5 Results

5.1 Pre-study Results

The methodology originated from an idea of how to perform policy controlled environmental management work, based on previous results from the CPM projects RAVEL[8] and CPM/SSVL[9]. The work in the pre-study was focused on understanding and testing the idea. Duni, at this time the only participating company, used the ideas during their work with implementation of a global co-coordinated environmental management system. A language with which the ideas could be discussed at an industrial company did not exist and was developed during the project. The research goal was mainly to enhance the understanding of the conceptual difficulties that arise when implementing a qualitative environmental responsibility into operative business. For more information, see the report[10] (only available in Swedish).

A model for environmental management work was created (Figure 5.1) where the methodology from RAVEL and CPM/SSVL were combined. This model was the starting point for the methodology developed in the main project.

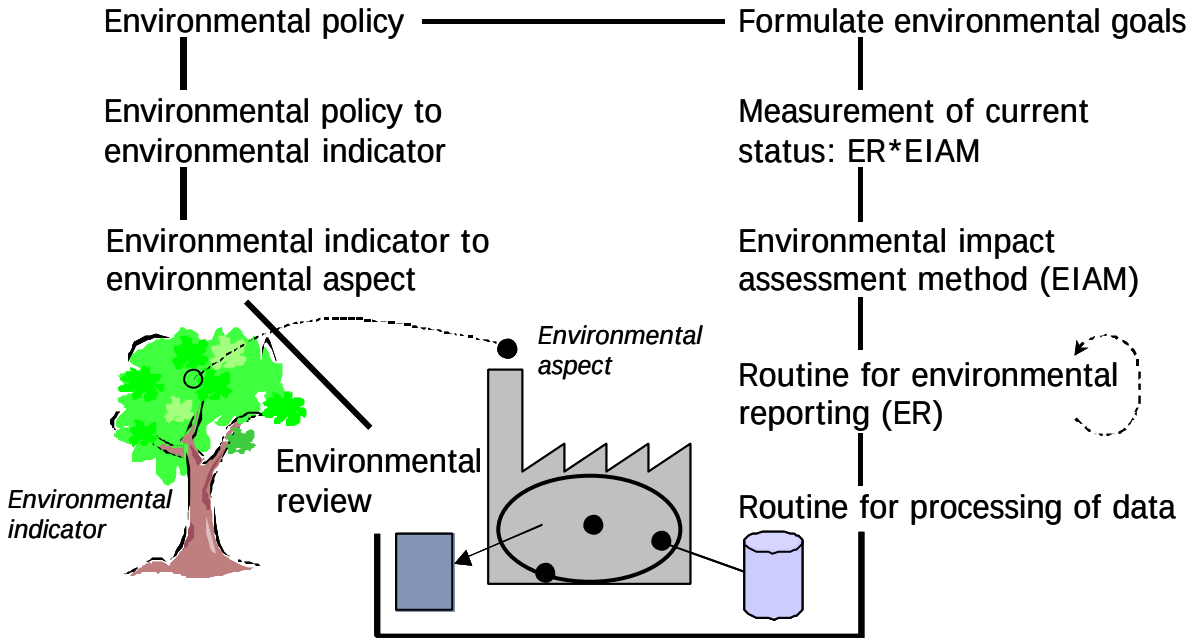

Figure 5.1. Pre-study model for policy controlled environmental management work.

[8] Dewulf W. (Ed.) et al, "Integrating Eco-Efficiency in Rail Vehicle Design", Leuven University Press, Leuven, Belgium, 2001

[9] The CPM/SSVL methodology is based on PHASETS [Carlson R, Pålsson A-C (2001): "Industrial environmental information management for technical systems", Journal of Cleaner Production, 9 (5): 429-435, Elsevier Science Ltd]] and SPINE [Carlson R, Löfgren G, Steen B (1995): "SPINE – A Relational Database Structure for Life Cycle Assessment", Report B1227, Swedish Environmental Research Institute, Göteborg]

[10] "Implementering av ett globalt koordinerat miljöledningssystem genom att använda och testa metodik och verktyg utvecklade inom CPM, och genom att koppla miljöpolicy till miljöindikatorer"; CPM report 2003:2

5.1.1 Conclusions

The conclusion from the pre-study was that it may be effective to start the environmental management work at a company with a conceptual analysis of the environmental policy, i.e. an analysis of what is actually stated in the policy about environmental responsibilities. The result from the analysis is a clearer understanding of the actual environmental responsibilities that the company shall deal with. The relation between the top management, responsible for the environmental policy, and the operative environmental work with quantified environmental condition indicators; information management etc. can thereby be strengthened.

The pre-study shows that the working method used, comprising methodology from the RAVEL and the CPM/SSVL projects, may be effective for creating a systematic connection between a company's qualitative environmental policy and its quantified measurement of environmental performance. It also provides a basis for both internal and external environmental communication.

5.1.2 Issues identified for the main project

Some problem areas were identified with which more pedagogic and methodological work was needed:

- *Translation of environmental policy to environmental condition indicators*
  Routines and systematic is needed as there is little experience of making this translation.
- *Development of the language*
  Linguistic tools to define environmental condition indicators, prioritization between indicators etc.
- *Choice of system boundaries*
  Develop knowledge of how the environmental condition indicators impact the choice of system boundaries.
- *Development of environmental impact assessment method*
  Develop systematic for the modeling of a consistent and reliable impact assessment method that expresses the values of the company.
- *Scientific establishment of the work procedure*
  Scientific paper describing the work procedure, published in a scientific journal.
- *Development of tools to support the work*
  Develop prototype tools and manuals to support the handling of environmental information.

5.2 Problem Inventory Results

The purpose of the problem inventory was to identify the parts of the environmental management system that were the most relevant to work with in this project, and to study the accomplishments that had already been made in this area.

The first part of the inventory consists of interviews made with the participating companies in August 2003. The interviews were based on the structure for policy controlled environmental management work developed for the pre-study (Figure 5.1). The interviewed company representatives identified the areas where they meet the most difficulties in their work. The second part of the inventory consists of a literature study. The objective of the study was to investigate the work that has been done in the area by other parts, and to compare the

environmental management system with the quality management system to identify features that benefit policy implementation in the quality management. For more information, see *"Problem Inventory Report"* CPM Report 2004:9.

5.2.1 Interviews

The general results from the interviews were that a main difficulty with environmental management work is the follow-up. Many different factors obstruct; a vague environmental policy, the subjectivity of assessment methods, ill-fitting indicators, a rigid environmental management system in a variable world etc.
Another problem is the inconsistencies between methods used in different units of the companies. There is also a lack of trust in the reliability of the information that forms the ground for decisions.
Four main problem areas were identified;

- the environmental impact assessment method
- the environmental condition indicators
- the environmental policy
- the quality assuring of data

5.2.1.1 The environmental impact assessment method

The demands of the impact assessment method that were experienced as not met were; relevancy of the method's trade-offs for the company, comprehensibility, transparency and consistency. Less dependence on individuals is also critical to make the method reliable. The interviews showed that there was low faith in the existing impact assessment methods. The most urgent deficiency is the lack of local adaptability. The local aspects are valuated as most important by the companies, yet the assessment methods available do not consider local impacts. The ability of a specific setting with information about the local conditions was proposed.

5.2.1.2 The environmental condition indicators

Indicators that are useful in a general context are difficult to find. They have to be both relevant to the company and need to be possible to use for comparisons at the same time. Some companies had problems with that the indicators can not keep up with the fast changes in the business.

5.2.1.3 The environmental policy

The environmental policy must be formulated in a clear, unambiguous and comprehensible way to be useful. The policy should be easier to follow up, and the environmental objectives as well.
Generally, the environmental policy and objectives are a result of the aspects found at the environmental review. The review is often made by a consultant, who may sometimes also perform the valuation of the identified aspects. The views of what aspects are most significant come sometimes from traditions.

5.2.1.4 The quality assurance of data

Environmental data is continuously acquired at the production sites. The quality of this information is essential for the reliability of the results derived from it. The management of the environmental data must be performed so that the quality can be assured.

The CPM/SSVL project developed a methodology for handling environmental data. The experiences are that the methodology is working well but is laborious to implement[11].

5.2.2 Literature study

5.2.2.1 Comparison with quality management

Policy implementation, making the policy operative, is an issue also for quality management and is usually called policy deployment in the literature. The policy is a mean to create a common shape and focus of the daily work in an organization, which will help the different parts to move in the same direction. The policy implementation is facilitated by employee participation in the process to break down the policy to objectives and targets.[12]

It is important to quantify the targets to enable feed-back on the measures taken; "what is measured is improved". The level of control of a management system depends on the rate of the feed-back loop, and of the accuracy of the information communicated. [13]

5.2.2.2 Previous work with environmental management systems

In the research area of environmental management systems, the lack of credibility of the information is a key issue. Reproducibility of the assessment of environmental aspects is important for the credibility. The key to stringency and transparency and hence to reproducibility is structured and detailed documentation[14].

The environmental condition indicators must be relevant for the businesses' activities but still enable comparisons with other businesses. Sets of indicators have been developed by many organizations. The contents of these sets range from a handful of general indicators to hundreds of specific ones. The advantage with general indicators is that they are relevant to nearly all organizations despite their genre and do therefore allow for comparisons. The disadvantage is that they are poor measures of the environmental performance of most companies, and there is a need for additional, company specific indicators that can give an accurate appraisal of the organization's performance[15,16,17].

The assessment of environmental aspects contains a subjective valuation. The guidance in literature on how to weigh different forms of environmental impacts against each other is vague.

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[11] The impression concerning the degree of difficulty to implement the method differed strongly among the project members during the start of the implementation, ranging from 'almost the same as before' to 'do no understand how to do'. At the end of the project, when manuals had been developed, most project members agreed that the methodology was quite easy to understand and to implement.

[12] Yoji Akao (1991): "Hoshin Kanri, Policy Deployment for Successful TQM", Productivity Press Inc, Oregon

[13] Camilla Nord, Eva-Karin Olsson (1994): "Quality Policy Deployment – Måldialog för Överensstämmelse mellan Visioner och Dagligt Arbete", Studentlitteratur, Lund, Sweden

[14] Thomas Zobel (2001): "Environmental Policy Deployment in an Environmental Management System Context – Experiences from Swedish Organisations", Luleå University of Technology, Sweden

[15] Hendrik A. Verfaillie and Robin Bidwell, (2000); "Eco-efficiency measuring; a guide to reporting company performance", WBCSD

[16] ISO 14031:1999 (1999): Environmental management – Environmental Performance Evaluation – Guidelines, European Committee for Standardization, Brussels

[17] 2003/532/EC, Commission recommendation of 10 July 2003.

The subjective choices can be made transparent if they are based on the values that are expressed in the environmental policy and also sufficiently documented.

5.3 Workshop Results

The model of policy controlled environmental management work from the pre-study was developed further in the main project. Discussions at workshops with participants from both industry and academy tested the ideas in a wider perspective. To some extent, the discussions were a repetition of the ones of the pre-study as development of common language and understanding of the ideas is a process per se. A lot of work was put on overcoming the linguistic difficulties. The methodological work focused on the parts of the environmental management system that were identified as problem areas in the problem inventory, the environmental policy, the environmental condition indicators, the environmental impact assessment and the quality assurance of data. IMI has also developed a prototype information system that will support the methodology developed in the project.

During the course of the workshops, the policy controlled environmental management work has from being an abstract idea turned into a concrete methodology ready for implementation. The methodology has been tested and discussed without being taken apart but has been accepted by the project members. It has also shown robustness in that it has survived a change of project leaders.

5.3.1 Environmental Policy

The policy is a statement of the company's values and can be used as a tool for enhancing the controllability of the management system. If there are business advantages for environmental measures that go beyond the legislation, the realization can be helped by a properly working environmental management system. Money can be saved by being prepared for the future needs for improvements. As an example, investments on short term that will soon need to be replaced again can be avoided.

The problem with putting the policy into operation is that it is generally formulated for another audience than the factory. The top management creates the formulation for commercial purposes, whereas the factory needs concrete guidance on how to manage their aspects. The company may use other complementary value documents, like guidelines or strategies that provide the operative support, or work with two policies; one external and one internal.

5.3.1.1 Comparison between different impact indication principles

The issues mentioned in the environmental policy are mostly problems that are internationally agreed upon. To find an impact indication principle to the project that is valid internationally, the principles of The Natural Step, the Swedish EPA, EU and GRI/WBCSD were examined.

The environmental priorities of the EU are:

- Tackling climate change and global warming
- Protecting the natural habitat and wildlife
- Addressing environment and health issues
- Preserving natural resources and managing waste

The Swedish EPA has set 15 environmental targets:

1. Reduced Climate Impact
2. Clean Air
3. Natural Acidification Only
4. A Non-Toxic Environment
5. A Protective Ozone Layer
6. A Safe Radiation Environment
7. Zero Eutrophication
8. Flourishing Lakes and Streams
9. Good-Quality Groundwater
10. A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos
11. Thriving Wetlands
12. Sustainable Forests
13. A Varied Agricultural Landscape
14. A Magnificent Mountain Landscape
15. A Good Built Environment

The WBCSD/GRI has developed common indicators to measure environmental performance. They are divided into core indicators and additional indicators and grouped as below:

- Materials
    - Total materials use other than water, by type
    - Percentage of materials used that are wastes (processed or unprocessed) from sources external to the reporting organization
- Energy
    - Direct energy use segmented by primary source
    - Indirect energy use
- Water
    - Total water use
- Biodiversity
    - Location and size of land owned, leased, or managed in biodiversity-rich habitats
    - Description of the major impacts on biodiversity associated with activities and/or products and services in terrestrial, fresh-water, and marine environments
- Emissions, effluents, and waste
    - Greenhouse gas emissions
    - Use and emissions of ozone-depleting substances
    - NOX, SOX, and other significant emissions, by type
    - Total amount of waste by type and destination
- Emissions, effluents and waste
    - Significant discharges to water, by type
    - Significant spills of chemicals, oils, and fuels in terms of total number and total volume
- Suppliers
    - *No core indicator*
- Products and services
    - Significant environmental impacts of principal product and services
    - Percentage of the weight of the products sold that is reclaimable at the end of the products' useful life and percentage that is actually reclaimed

- Compliance
    - Incidents of and fines for non-compliance with all applicable international declarations/conventions/treaties, and national, sub-national, regional, and local regulations associated with environmental issues
- Transport
    - *No core indicator*
- Overall
    - *No core indicator*

The Natural Step has chosen the four system conditions, described in the next section, as impact indication principle.

5.3.1.2 Choice of impact indication principle

The different sets of impact indication principles in the different approaches are essentially the same and their different indicators may be fully overlapping each other depending on how the terminology and nomenclature is understood. The system conditions[18], developed by John Holmberg and Karl-Henrik Robèrt, were chosen to begin the work with in the project.

An advantage with the system conditions compared to other approaches is that it is based on a system view with system conditions and this is easy to understand for the top management. The scientific principles described through the system conditions include and summaries the other approaches. They also accomplish to the Brundtland definition on sustainable development[19].

According to the system conditions, the reason for the existing disequilibrium in the environment is that substances from the earth's crust (fossil fuels, minerals etc) are systematically brought up to the nature by humans. Substances from the society's production (chemicals, toxic substances) are also systematically brought into the nature, and residents of the nature (plants and animals) are forced away from their natural habitats.

The impact indication principle of the system conditions is:

In the sustainable society, nature is not subject to systematically increasing....
... concentrations of substances extracted from the earth's crust
... concentrations of substances produced by society
... degradation by physical means
and, in that society ...
... human needs are met worldwide

[18] 1) Holmberg, J., 1995. Socio-Ecological Principles and Indicators for Sustainability, Ph.D. Thesis, Institute of Physical Resource Theory, Chalmers University of Technology and Göteborg University, Göteborg, Sweden.
2) Holmberg, J. 1998. Backcasting — a natural step when operationalising sustainable development. Greener Management International. — the Journal of Corporate Environmental Strategy and Practice. Issue 23: 30-51. (Autumn 1998)

19 '[Development that] meets the needs of the present without compromising the ability of future generations to meet their own needs.' The Brundtland Report Our Common Future from 1987.

5.3.2 Choice of environmental condition indicators

The environmental policy is a statement of the company's values. The values are the view-point from which the environmental problems are found. A conceptual analysis is made of the policy to find the established environmental responsibility of the company. Based on the analysis, indicators that are relevant measures on the state of the environment are chosen. This work can be transparently performed if it is documented, e.g. by underlining phrases in the policy that point out specific indicators and explaining the choices and interpretations that have been made.

Three impact assessment methods, originally developed in the LCA (life cycle assessment) context, have been available in the work; the EPS 2000[20], EDIP[21] and Eco-indicator 99[22] methods. If the indicators are chosen from the sets of indicators that are developed in these methods, it will simplify the impact assessment.

The breaking down of the policy to environmental condition indicators and further to environmental aspects is difficult if the policy is vaguely formulated. Many times a company uses other complementary documents, like guidelines or strategies that provide the operative support.

If the policy does not express any values, the company may decide to use an impact assessment method that includes ready-made value-based choices. This implies that the company chooses to adopt the values that are the basis for the specific impact assessment method. In this case, it is recommended to make sure that the values in the method are in line with the general policy of the company.

In this project the system conditions described above were chosen to constitute the conception of the world, four system conditions that have all equal importance. This view provides a basic support for decisions, and the next task will then be to evaluate which of the system conditions that is in the most critical state. When it is understood which problems that are the most critical, quantified measurements of the environmental performance are needed for the follow-up of the work.

5.3.3 Choice of environmental aspects

The effects on the environment from each aspect of the company are investigated. The environment is modeled with environmental condition indicators and the aspects are assigned to one or more indicator on which they impact. This is compatible with the classification step of LCIA in the ISO 14042 standard. Development of a cause-effect model demand expert knowledge and is therefore generally very expensive. The existing characterization models (EPS 2000, EDIP and Eco-indicator 99) include cause-effect models that do not usually fit the

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[20] Environmental Priority Strategies in product development. 1) Steen B (1999): A systematic approach to environmental priority strategies in product development (EPS). Version 2000 – General system characteristics CPM report 1999:4, Chalmers University of Technology, Sweden
2) Steen B (1999b): A systematic approach to environmental priority strategies in product development (EPS). Version 2000 – Models and data of the default method CPM report 1999:5, Chalmers University of Technology, Sweden

[21] Environmental Design of Industrial Products. 1) Henrik Wenzel, Michael Hauschild and Leo Alting (1997): Environmental assessment of products Vol. 1 methodology, tools and case studies in product development, London Chapman & Hall
2) Michael Hauschild and Henrik Wenzel (1998): Environmental assessment of products Vol. 2 Scientific background, London Chapman & Hall.

[22] Mark Goedkoop and Renilde Spriensma (2000) " The Eco-indicator 99 A damage oriented method for Life Cycle Impact Assessment" Methodology Report, Second edition

company very well, but as there are no others available, and creating new ones are too expensive, they will generally have to do as starting point.

5.3.3.1 The ISO 14031 environmental performance indicators

The ISO 14031 environmental performance indicators are compatible with the definition of environmental aspect in this project. In the standard, the following structure of the organization's operations is made:

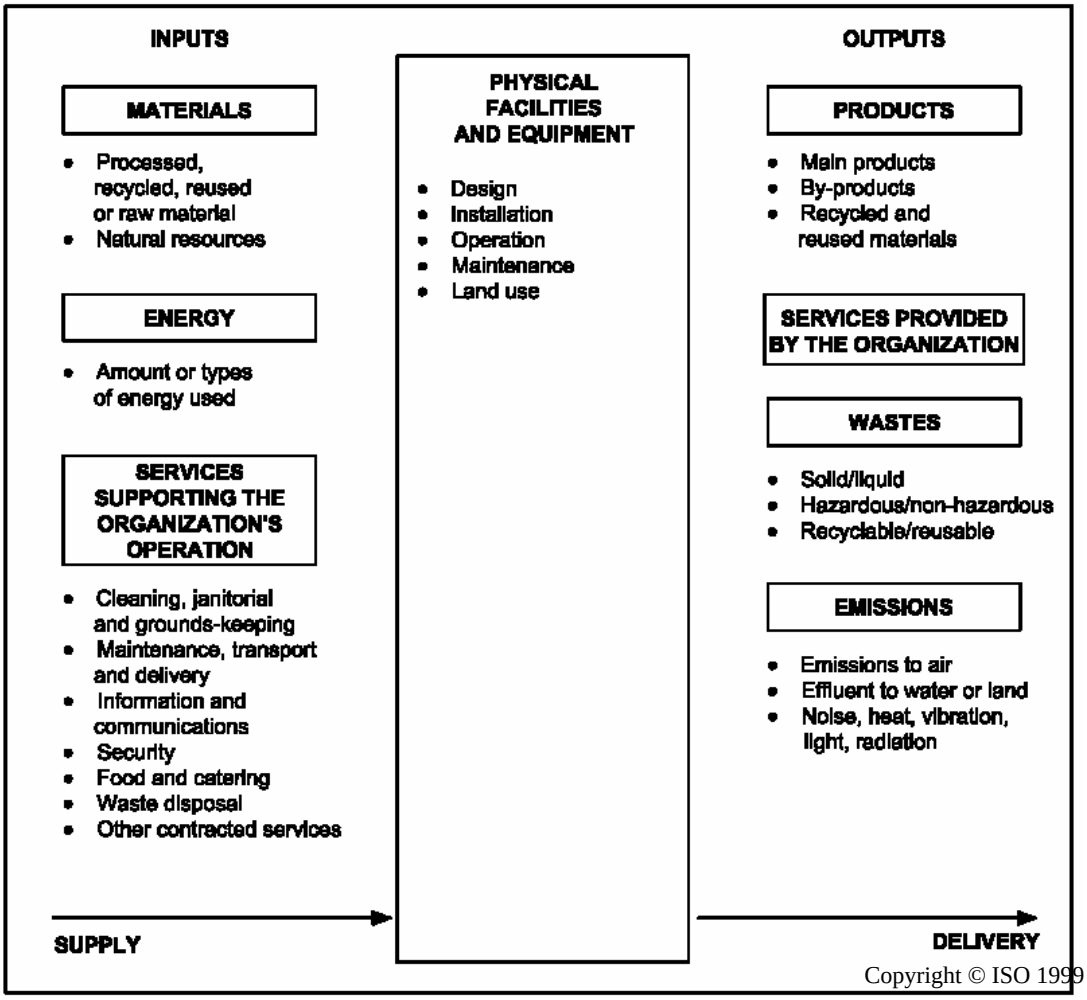


Figure 5.2. The ISO 14031 environmental performance indicators.

These 24 groups can be used as categories of environmental aspects. For each category there can be one or more aspects.

5.3.3.2 The link from sustainability to aspects

The following link was found between the Brundtland definition of sustainability, the four system conditions which are further divided into categories according to ISO 14031 (natural resources, recycled material, energy etc) to environmental performance indicators/aspects (crude oil, electricity, pulpwood etc).

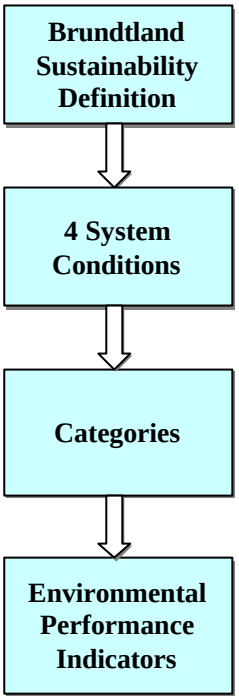


Figure 5.3. The link from sustainability to aspects.

5.3.4 Environmental impact assessment

A full impact assessment includes the three concepts classification, characterization and prioritization. Currently, there is no guidance on how to perform the environmental impact assessment in the ISO standards for environmental management system. It is up to the organizations themselves to be responsible for the reliability of the modeling and measuring of its environmental impact and the prioritization of different impact categories. In a policy controlled environmental management system, the prioritization is based on the policy.

5.3.4.1 Structure for environmental impact assessment: The IA98 model

In the project a model for environmental impact assessment that is compatible with ISO 14042 and SPINE[23] has been used as basis to structure the work. The model was developed by Raul Carlson and Bengt Steen in 1997-1998[24]. A simplified model with the concepts discussed in the project is shown below and the original model is shown in Appendix I.

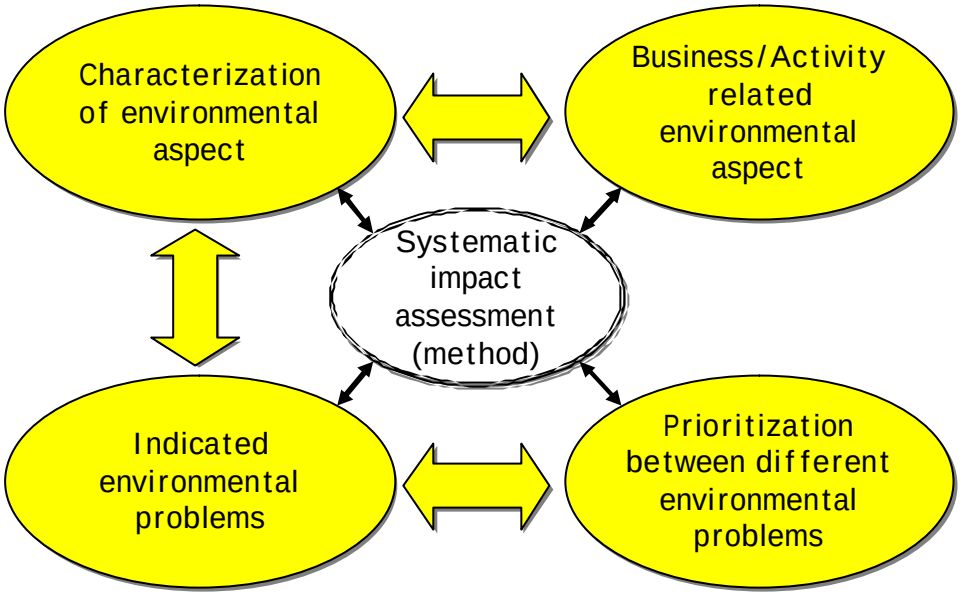


Figure 5.4. The simplified IA98 model.

The expressing of environmental impact as an *environmental problem* is a subjective choice and dependent on the viewpoint of an "observer". Depending on who the observer is, he or she will have different principles and viewpoints. These are called "Impact Indication Principles" in the Carlson-Steen model. The environmental policy of a company is one example on such a principle. When the principles applied to find the problem are defined, the way the cause and effect of a problem is modelled can be understood.

The *characterization* is a description of the way different aspects will impact the environment. A characterization method is used to model the relation between *environmental aspects* and environmental condition indicators with mathematical relationships (characterization factors). The nature is described with environmental condition indicators. They should be quantifiable, representative measurement points.

The impact assessment method may also include a *prioritization* or weighting of the different environmental condition indicators.

Classification assigns environmental aspects to environmental condition indicators or impact categories, and the practitioner makes here a number of implicit choices. The classification can be seen as a special case of the characterization, where it is decided if the characterization factor is 0 or ? 0 for a certain environmental condition indicator.

5.3.4.2 Finding environmental problems and indicators

The environmental issues must be experienced as environmental problems by people if they are going to be interested in paying for measures to avoid the consequences. If the environmental

[23] Carlson R, Löfgren G, Steen B (1995): "SPINE – A Relational Database Structure for Life Cycle Assessment", Report B1227, Swedish Environmental Research Institute, Göteborg

[24] Carlson R., Steen B.; "A Data Model for LCA Impact Assessment"; Presented at 8th Annual Meeting of SETAC-Europe 1998 14-18 April; Bordeaux

impacts from the company's aspects are described in the local perspective and followed to the point when they affect humans, people will be interested.
The language of the environmental issues differs between companies and people. The general public observes and cares about the effects of the deterioration of the environment, e.g. lower catch from fishing. If anyone experiences lower catch as a problem then it is a problem. Environmental problems or impact categories – it is the same concept but different "languages". Companies do not speak of environmental problems in terms of e.g. low catch from fishing, but of the impact categories that may contribute to the low catch like eutrophication or acidification. Thus, the general public's care for low catch from fishing is by the companies considered through e.g. controlling their SO_2 emissions.

An average consumer is generally not capable of, nor should need, making their own assessment of a product before purchasing it. Instead, there should be an environmental label on the product that signifies that the product as a whole is environmentally sound. The different businesses should be responsible for assessing their specific components and that the results are compatible for communicating with other businesses.

John Holmberg, head of the Department of physical resource theory at Chalmers, participated in one of the workshops with a presentation of the method Backcasting. Backcasting provides an opportunity to start the work from the target situation instead of starting from the present situation. Strategies are then developed for how to reach the target situation. The advantage is that the strategies that will bear the whole way to the target can be identified. The company will not spend resources on investments that will only make smaller improvements but are not sustainable in the long run.
John Holmberg reminded of the risk that environmental impacts are only searched for "under the light of the lamp" and that the real environmental problems are not detected. The system view with which the system conditions (see 5.3.1.2) were developed is a way to avoid this. The companies are many times concerned with problems that are of high complexity, because these are the ones pointed out by the interested parties such as authorities, customers and neighbors. To control the situation, a structure where the complex problems fit in must be developed to reduce the complexity.

5.3.5 Characterization

The effects of the company's aspects on the chosen environmental condition indicators are investigated scientifically with a characterization method. This generally leads to a paradox problem: the existing methods are generally judged as too ill-fitting for the company but it is too expensive to consult environmental expertise and create new ones. A compromise could be to start with a ready-made method and have the internal competence adapt it to the company in a transparent way. Thus the options for characterization methods are:

- Develop new characterization methods from scratch.
- Adapt existing characterization methods.
- Use existing characterization methods as they are.

When the characterization methods are created, there is a choice to either follow the aspects to a selected end-point or as far as it is economically justifiable. The former way is more correct but can be very expensive. EPS 2000, EDIP and Eco-indicator 99 have characterization methods for the most common environmental aspects and the end-points vary between them.
The characterization methods, though they are scientific, are always approximations. They are limited because the scientific knowledge still has gaps. Variation of vulnerability to a substance between species and threshold values that are set to the value where a potential effect can not be excluded are examples of limitations of characterization models. The information in a database

will also always risk becoming out-of-date, but it is too expensive to start from scratch and not reuse work that is already done.
After the scientific investigation of the environmental consequences of the aspects, a prioritization is made to decide which aspects that are the most critical to work with. The prioritization must never be allowed to compensate for a bad characterization method.

5.3.6 Prioritization

Prioritization involves the subjective weighting between different environmental impacts. One part of the prioritization is the identification of significant environmental aspects. In environmental management systems it is generally performed with a panel procedure or some kind of checklist at production sites.
The companies participating in the project have very different methods for identification of the significant environmental aspects. It can be interdisciplinary groups, with specified requirements of the education needed for the roles of the group, or environmental specialists. Some companies use methods that includes ranking the aspects with numbers of priorities while other choose not to use numbers to avoid that serious aspects are disregarded because of that the amount is small. Below is described a procedure for prioritization of environmental aspects with an inter-disciplinary and person independent panel that were developed and discussed at the project workshops.

5.3.6.1 Person independency

Experience indicates that a panel procedure can be constructed to be person independent; panels at different production units that consist of people in the same functions have come to the same conclusions with regard to ranking of environmental aspects. The key is to populate the panel with personnel representing specified functions within the company, and educate the panel participants in ISO 14001 and the system conditions.
The person independent panel will need support via systemizing and documentation. The goal is not that the group will reach understanding; the different functions are appointed to continually guard their own interests. It is probably an advantage with new people; they must however have the same frame of reference as the rest of the group. It must also be considered that a company will only have certain people available to participate in the group. There should however be minimum requirements to be fulfilled in order to consider the panel person independent. A certain critical mass is needed.
It could be useful to have two panels. One with environmental personnel that only consider the environmental significance and one mixed panel that also considers the economical, technical, legislation and business aspects. The first step could then describe the environmental consequences without negotiation with other factors, and assess the aspects from a pure scientific view. This will make it easier to compare long term aspects with short term aspects and may possibly lead to environmentally sounder decisions. The panels need also to have real influence in the company.

5.3.6.2 The panel procedure

The work with identification of significant environmental aspects through a panel procedure was broken down into four steps:

- Step -1: Define the available knowledge frames
- Step 0: Identify the environmental aspects
- Step 1: Identify the significant environmental aspects
- Step 2: Set environmental objectives

Step -1

The available knowledge frames are defined. This step includes constructing the competence profiles for the people that will populate the panel.

Step 0

The identification of environmental aspects is a process that demands a certain competence (of the activity, LCA, environmental science, legislation etc). The ISO 14001 definition of environmental aspects can be used as support when compiling the list with aspects. The aspects are usually divided into groups of aspects. This division can be made in different ways e.g. the type of aspect where the GRI indicators (see 5.3.1.1) or the ISO 14031 EPIs (see 5.3.3.1) can be used as support. Another possible division of the aspects could be according to their origin; historical, present, constructions, production etc. This would enable to take different types of aspects to be considered, and not only the present aspects.

Step 1

In step 1 the significant environmental aspects are identified. A model of step 1 can be seen below:

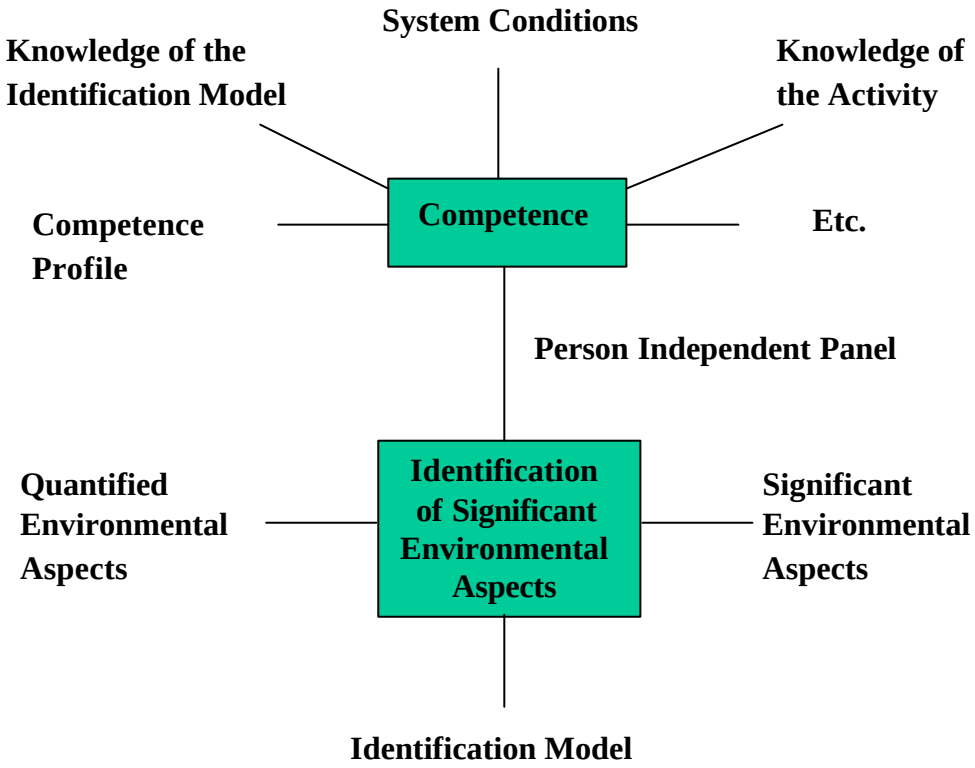


Figure 5.5. Identification of significant aspects.

Step 1 is supposed to be an objective assessment of the environmental consequences of the different environmental aspects of the company. The subjective evaluation is not part of this step but is done in step 2. The input to step 1 is a list of quantified aspects, an identification model and competence from the person independent panel. Thus, to find the significant environmental aspects the panel uses a well specified and documented identification model and the competence of the different members.

The choice of identification model is described in the following section. The competence profile is the requirement specification for the competence needed. Education and interest in the issue is part of the competence, as well as in-house knowledge about the activity.

Step 2
In step 2 the environmental objectives are set. It is difficult for a single production unit to take responsibility for the whole life cycle of the products; it can generally only focus on environmental issues that its production causes, like waste, noise, energy consumption, dust etc. The objectives are therefore set at company level so that the different units will not sub-optimize the environmental performance of the company as a whole. The significant aspects of each unit are aggregated to a list that will support the setting of objectives.
The controllability and efficiency is enhanced if all units have the same instructions on how to perform the identification instead of using different methods at different business units. This can be made if a common frame of reference is created for the involved people, through education in ISO 14001 and the system conditions. Local panels at the different production sites find significant environmental aspects, using a common method, e.g. a common set of questions to be answered and assessed for each aspect. The list of significant environmental aspects of each site can then be easily aggregated at group level. The aggregated list will constitute the total significant aspects for the entire company and will be used for setting environmental objectives. The objectives are communicated down to the production sites where they work with them but will be followed-up at group level. The local panel will need support via systemizing and documentation.
The ISO 14001 does not demand that all significant environmental aspects must have objectives set on them. The company can choose which significant aspects to work with, and which to disregard by themselves. The company cannot however choose which aspects that are the significant.

5.3.6.3 The identification model
The choice of identification model is a separate process, at the same level as step 0 (identification of the environmental aspects). A model for this process can be seen below:

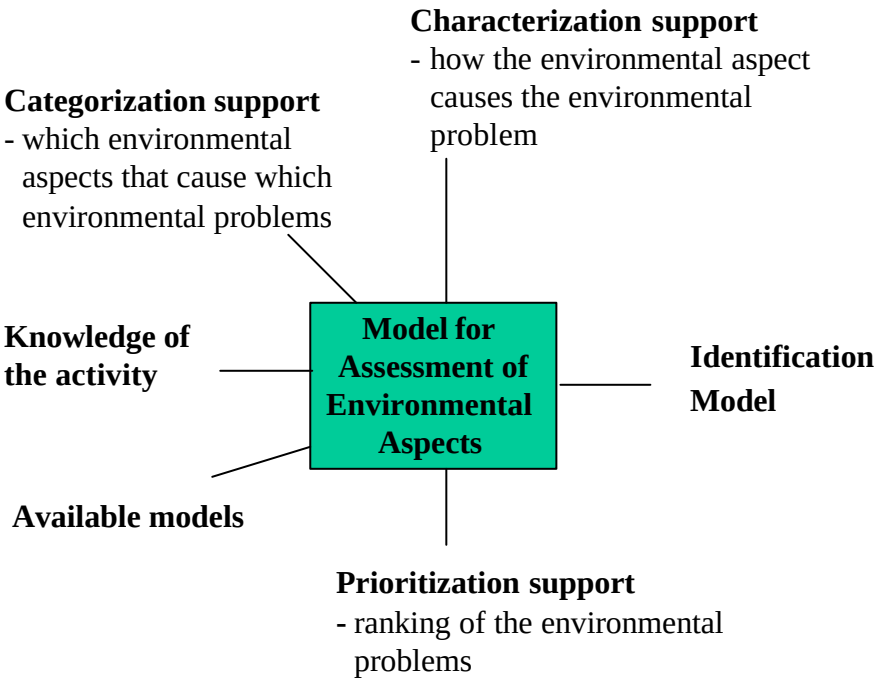


Figure 5.6. The identification model.

The identification model is created based on available models, knowledge of the activity and support for categorization, characterization and weighting. It can be described as a filter that the aspects pass through. The identification model has to match the list of environmental aspects from step 0.

The *categorization support* provides support for which environmental aspects that cause which environmental problems. The system conditions are one example on a list of environmental problems that can provide categorization support. The *characterization support* provides a qualitative and quantitative description of how the aspect contributes to the environmental problem. The EPS 2000, EDIP and Eco-indicator 99 can provide characterization support. The *weighting support* provides a prioritization of the environmental problems.
The organization makes a statement of its attitude by making the prioritization. For instance, the 15 Swedish environmental objectives are not scientific but a statement made by the Swedish EPA. The environmental policy will be used as basis in the prioritization. The organization might prioritize an aspect that is not significant due to competitive aspects or technology improvements but is enhanced by the policy.
The identification model is developed with the general structure described above but the resulting model will be specific for the company that developed it. The four system conditions are the basis for the identification model with this method and this will give compatibility between different businesses.

5.3.6.4 The environmental effects of the environmental management system

The transparency and understandability of the environmental impact assessment will enhance the credibility of the results. The credibility is important if the environmental performance of the organization is going to be improved as this comprise many times that the company management will have to make inconvenient decisions. An organization may spend resources on environmental work while the condition of the environment still gets worse. In such a case, it is not the environmental management system that is insufficient but the weighting of the significance of the environmental consequences in competition with other business consequences.
The long term strategy must be the basis for the short term strategy. If environmental sustainability is the long term goal of the organization then the short term goal has to be to move in that direction.

5.4 Development of the supporting tool

A prototype software tool for policy controlled environmental management work has been constructed to support the methodology developed within the project. The tool is an information system that will help structuring the information. An information system can not make own decisions, if there as an example are two support texts with incompatible views, these will be presented as they are. The environmental department at the company will then have to take the decisions. The information system structures and standardizes the environmental management system (as CAD with design).
An earlier tool from IMI, WWLCAW, provided the idea basis for the scope and functionality for the new tool. The tools are constructed from the viewpoint of the SPINE[25]-model; there is a technical system, a social system and an environmental system with interfaces between them.
The features of the prototype tool are described below.

Policy

The new tool is constructed so that the work is performed "inside" a policy. The policies, or Impact Indication Principles, are structured in different levels. The environmental policy of the whole company is at the highest level. Under are the "policies" of the included units. These policies can be e.g. more operative strategies and guidelines or be the local environmental policy (where local environmental goals that are not relevant at the company level are also included).

[25] Carlson R, Löfgren G, Steen B (1995): "SPINE – A Relational Database Structure for Life Cycle Assessment", Report B1227, Swedish Environmental Research Institute, Göteborg

The sub-policies inherit the mother policy with the possibility to add or change. This structure has the advantage that the user is always working with the relevant impact indication principle for the system in question. There can be an arbitrary number of sub-policies, so that the strategies of any part of a company can be documented and used for the processes involved. The policy definition field will contain a text formatting functionality so that the interpretation of the policy into environmental condition indicators can be explained by underlining words etc.

Inventory

The tool provides the possibility to import SPINE- and ISO/TS 14048-communication files (xfr and xml), so that previously documented information can be utilized. This import needs attention to the units as the LCA information documented in SPINE or 14048 formats has a functional unit and the environmental management system information is documented on yearly basis. It is explicitly shown if any aspect is missing a link to a characterization model.

Characterization

The environmental condition indicators are linked with environmental aspects with characterization methods. As said in 4.1.3, the existing characterization methods are often judged as ill-fitting for the company at the same time as it is too expensive to create new ones. A compromise is to start with a ready-made method and have the internal competence adapt it to the company in a transparent way. The tool will provide all three possibilities for characterization methods. The indicators, characterization methods and weighting methods of Eco-indicator 99, EDIP and EPS 2000 are available in the tool; with the possibility to adapt them. It is also here explicitly shown if any environmental condition indicator is not linked to a characterization model.

Prioritization

The term "priorities" is chosen for the subjective ranking of environmental condition indicators. Either the weighting methods of EPS 2000, EDIP and Eco-indicator 99 can be used to make priorities, or the company can make its own prioritization.

Calculation

The tool can perform the calculations in two ways; either calculate only the characterization of the system or both the characterization and prioritization. The first option will result in a list with impacts on the environmental condition indicators that have different units and can not be aggregated. The second option results in a list with the subjectively evaluated impact on the indicators that can be aggregated.

5.5 Experiences from the companies

The extent to which the results from the project affected the practical work varies a lot between the participating companies. The experience of environmental management systems differed when the project started. Duni on the one hand, implemented a globally coordinated environmental management system in the pre-study and this work has in most parts had clear influence from the project. On the other hand, some of the companies did already have established environmental management systems and merely participated with the aim of interchanging experiences. An account from each company of how the work was affected can be found in Appendix II.

The prioritization of environmental aspects was an issue that was experienced as a problem for many of the companies and a lot of work was put on it in the project. The methodology of prioritization is one part of the results that has been useful in practice. Many company representatives have also experienced linguistic difficulties in their practical work and another useful result has therefore been the language that was commonly developed at the discussions at the workshops and could be shared by all participants.

The companies that have had the possibility to update their policy have made it clearer and easier to follow up. Other "value" documents have been created in case the policy does not give enough practical guidance. The connection between the value documents and the environmental objectives has been clarified. Two companies have worked with connecting the environmental aspects to environmental condition indicators. It has been possible to do so with some environmental aspects but not all due to the lack of characterization methods.
In addition to the methodology, another result from the project is the prototype software tool. The companies have shown interest in the development of the prototype tool into a commercial product that can be used in practice to manage the information for the environmental management system. This possibility will be investigated in the next phase of CPM. The prototype tool will in its current condition be used for educational purposes and also for the original purpose; to support the work with the methodology.

5.6 Issues identified for future work

The user of the methodology should be aware of the limitations of the toolbox for policy controlled environmental management work. The issues that were identified in the project are listed below:

- The limited amount of data in the database.

Regardless of the size of the database, there will always be missing data. The effort of collecting new data is bound to lead to that the existing data is overused and applied for cases for which they are not suitable. It is therefore important that the data user understands the limitations of available data, and take responsibility to not overuse data.

- Integration with other software tools

At the moment the tool covers the needs of the environmental management system, but it is an advantage if there are other needs that can be covered with the same tool. The user will not have to change to a different software environment for each problem.

- Local impact assessment

Further support for local impact assessment needs to be developed; a solution can be to use the PHASENS methodology[26] for this.

- Finding other connections between aspects and indicators

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 and use experiences gained from the practical work.

- Commercialization

The prototype software tool was constructed to support the methodology and for educational use. The participating companies have shown great interest in the development of a commercial tool that can be used in the industry.

[26] Carlson R., Pålsson A-C.; *"PHASES Information models for industrial environmental control"*, CPM Report 2000:4

6 Methodology

6.1 The methodology picture

The resulting picture of the methodology differs from the one developed for the pre-study. The environmental review, the data processing routine and the environmental reporting has been aggregated into one step called "Carry out inventory of quantitative status of environmental aspect". For these steps, the methodology developed in CPM/SSVL was considered as sufficient and they were not worked with in the project. The environmental impact assessment method with which a lot of work was done has on the contrary been divided into a "Characterization part" and a "Prioritization part". Thus there are now eight steps instead of nine.

The working method is described in detail in "*Manual for Policy Controlled Environmental Management Work*". The Swedish version of the methodology picture can be found in Appendix III.

The methodology consists of eight steps (see figure 6.1). In each step, a specific task in policy controlled environmental management work is performed. Each step can be performed independently of the other steps. The lines in figure 6.1 indicate how the different steps are related to each other and the arrows indicate that the different steps may be performed in any direction.

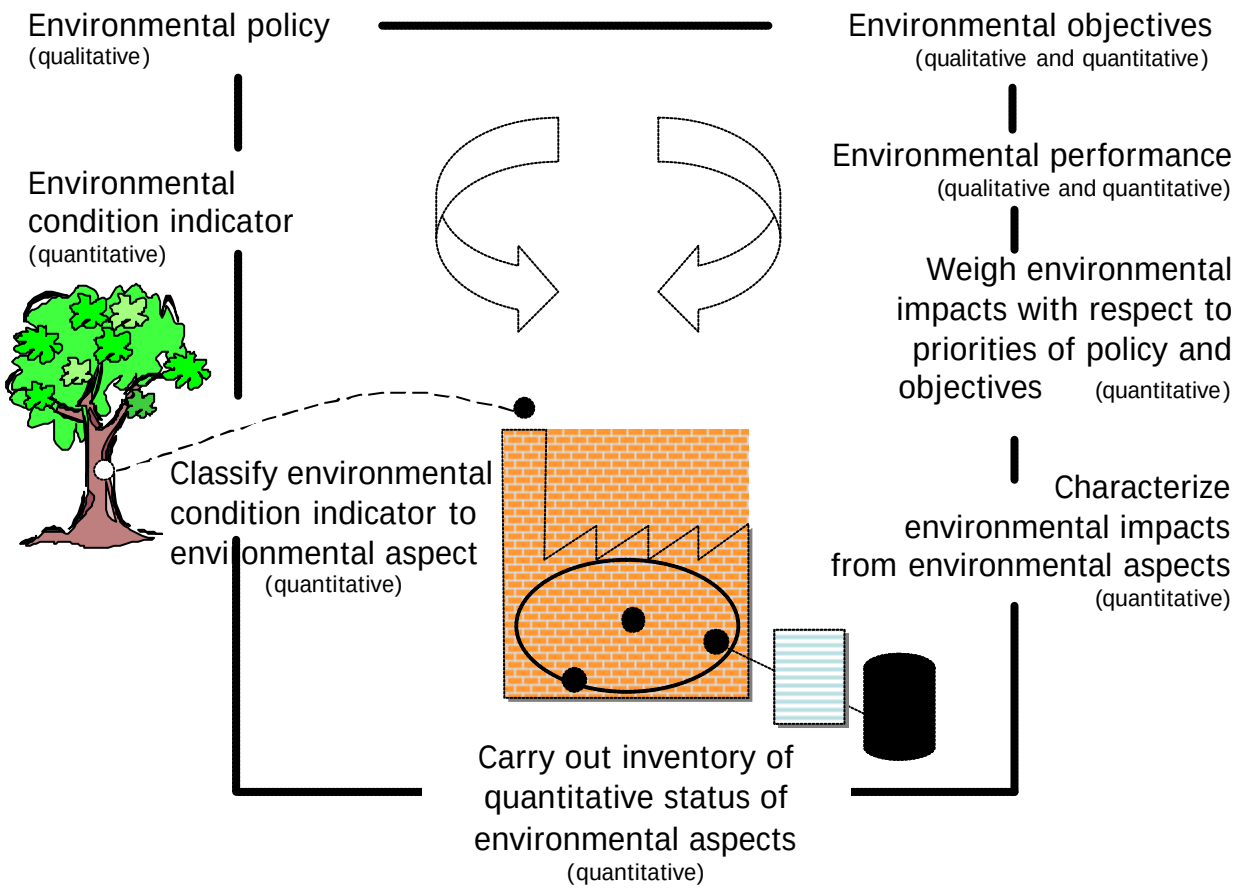


Figure 6.1. Policy controlled environmental management work.

6.2 Work description

Environmental policy

The environmental policy is formulated. The choice of how to express or indicate environmental impact is subjective and depends on the viewpoint of the observer. This viewpoint may be expressed as a "principle", the "impact indication principle". The companies express their impact indication principles in their environmental policy.

The policy should be formulated in an operative way. The company can develop one external policy and one internal that is more operatively formulated or use other complementary documents, like guidelines or strategies that provide the operative support.

Environmental condition indicator

A conceptual analysis is made of the policy to find the established responsibilities of the company. The environmental condition indicators are extracted as the consequences of the statements of the policy. Indicators that are quantitative and relevant measures on the state of the environment are chosen. This work can be transparently performed if it is documented, e.g. by underlining phrases in the policy that point out specific indicators and explaining the choices and interpretations that have been made.

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 that have documentation and ready-made characterization methods. This choice does however demand an interpretation of the environmental impact assessment method to make sure that the values in the method are in line with the general policy of the company.

Classify environmental condition indicator to environmental aspect

The effect on the environmental condition indicators from the environmental aspects at the company is investigated. This step is compatible with the classification step in the ISO 14042 standard. Characterization models are cause-effect models that can be used to find the links between indicators and aspects. They are generally very expensive to develop and existing models as the EPS 2000, Eco Indicator 99 and EDIP can be used, if the indicators of the method are interpreted in a similar way to the company's environmental condition indicators. The environmental aspects are assigned to one or more environmental condition indicator.

Carry out inventory of quantitative status of environmental aspects

This step involves acquisition, processing and reporting of numerical environmental data for the production plant, business unit or entire company and also modeling of the production system based on the environmental aspects of interest. This corresponds to the environmental review and the general measuring and monitoring according to ISO 14001. This part of the methodology has not been developed in the project. The result from a previous CPM project, the CPM/SSVL[27] methodology, was considered as sufficient to fill the needs.

To the list of aspects shall be added those that are not covered by the policy but still are needed because of laws and regulations, customer demands etc. The result is a list with all the environmental aspects of the company and a quantitative value for them.

[27] The CPM/SSVL methodology is based on PHASETS [Carlson R, Pålsson A-C (2001): "*Industrial environmental information management for technical systems*", Journal of Cleaner Production, 9 (5): 429-435, Elsevier Science Ltd] and SPINE [Carlson R, Löfgren G, Steen B (1995): "*SPINE – A Relational Database Structure for Life Cycle Assessment*", Report B1227, Swedish Environmental Research Institute, Göteborg].

Characterize environmental impacts from environmental aspects

This step involves selecting or developing characterization factors for all relations between aspects and indicators. Characterization factors are obtained by a characterization method. This generally leads to a paradox problem: the existing methods are judged as too ill-fitting for the company but it is too expensive to consult environmental expertise and create new ones. A compromise could be to start with a ready-made method and have the internal competence adapt it to the company in a transparent way. Thus the options for characterization methods are:

- Develop new characterization methods from scratch.
- Adapt existing characterization methods.
- Use existing characterization methods as they are.

The last alternative can only be used if the environmental condition indicators are chosen from an existing method.

The characterization factors are used in the calculations that are performed in the step "Environmental performance".

Weigh environmental impacts with respect to priorities of policy and objectives

This step involves setting priorities by selecting or developing a prioritization method. Prioritization is a subjective ranking of the (adverse) environmental impacts from the company's activities. The prioritization method shall be based on the policy and can be used both to prioritize between environmental condition indicators and to identify significant environmental aspects. The company can develop company specific priorities or use ready-made weighting methods.

The prioritization can be made less person independent if it is made by an interdisciplinary panel and this method is therefore chosen in the project. The alternatives to a panel procedure are e.g. to use some kind of checklist, have an environmental expert make the prioritization or use the weighting methods of EPS 2000, EDIP and Eco-indicator 99. The impact indication principles of such ready-made prioritization methods however, will probably differ from the company's environmental policy.

Environmental performance

The current status of the environmental performance of the company is measured in terms of impact on the environmental condition indicators. The characterization and the prioritization methods from the previous steps are used to calculate the impact on the environmental condition indicators from the activities performed by the company.

Further information that can be produced in the calculations is for example:

- The company's significant environmental aspects
- The products with most detrimental environmental impact
- The environmental performance of the company compared to previous years

Environmental objectives

The environmental performances of each unit are communicated and aggregated. The objectives are set at company level to avoid that the individual units set objectives that will sub-optimize the environmental performance of the company as a whole.

7 Conclusions

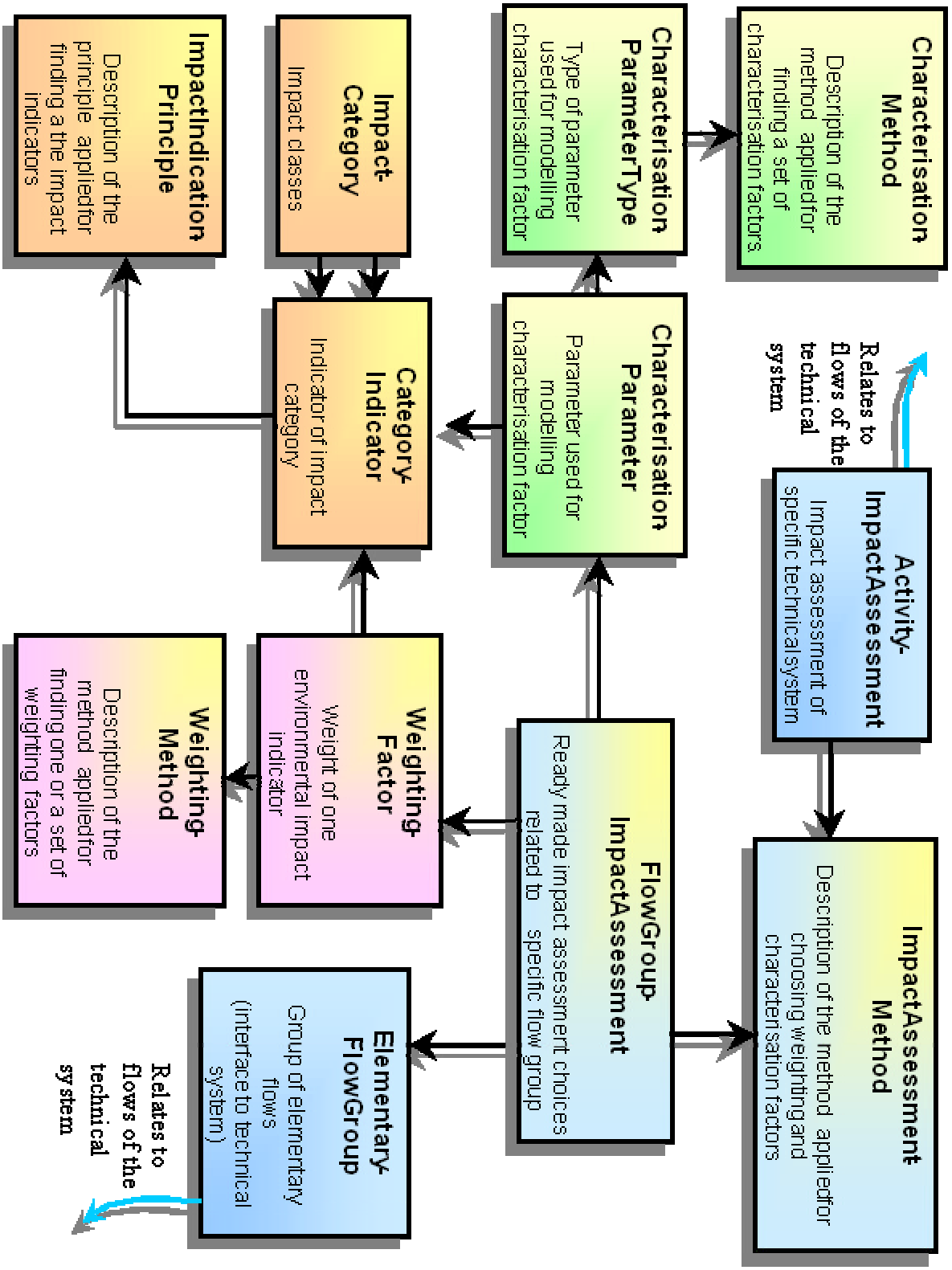
A methodology for policy controlled environmental management work has been developed to enable a higher controllability of the environmental performance of an organization. The difficulties in improving the environmental performance of a company do seldom lie in the environmental management system but in making inconvenient decisions. The environmental consequences are seldom given the same priority as the other business consequences. However, by establishing a clear connection between environmental policy and environmental priorities, objectives and decisions, the basis for them will be more transparent and easy to communicate both internally and externally.

The developed methodology will also enable a company with several production units to make the different environmental management systems uniform by using the company policy as the common basis.

A difficult part of the developed methodology is the relation between environmental condition indicators and environmental aspects. Expert knowledge is needed to perform the classification and the characterisation. Today, there are few public available impact assessment methods and the content in them is far from sufficient. The EPS 2000, EDIP and Eco-indicator 99 methods can be used as a starting point but more knowledge must be put into the environmental management system if it shall be able to account for all environmental impacts that are caused by a company.

Appendix I

The IA98 impact assessment model



Appendix II
Experiences from the companies

Company name: ABB Ltd.
Unit: --
Application: See below
Description: So far, the result of the A20 project (policy controlled environmental management) has not been used at all within ABB. The A20 tool will however, along with a great number of other new Sustainability tools, be included in a package for education and training of environmental engineers, designers, process engineers, manufacturing engineers and our own network of sustainability controllers. Tentatively, the training will be performed in at least five countries during the Autumn.

Company name: Duni AB

Unit: Group

Application:

Description:

Policy and objectives
A strategy for the environmental work 2005-2007 has been adopted and the environmental policy has been updated. The policy is clearer and easier to follow up; Duni environmental objectives are also connected to the policy.

Indicators
We have selected environmental indicators based on the environmental policy. The indicators are chosen from already existing environmental assessment methods. Some but not all of Duni environmental aspects is connected to an environmental indicator.

Data management / environmental aspects
We have made environmental reviews at all sites and by that we started our program of introducing formal environmental management systems (EMS) at all manufacturing sites. Local action plans to improve certain environmental conditions were agreed upon. These action plans were followed up and on reviewing 2003, we can say that a number of environmental improvements some small, some more extensive were achieved during the year 2003
We have established a Duni common global environmental information system to improve the possibility of efficiently control the environmental impact of our operations, thus also improve data quality.
We have collected and documented data from all sites.
We have established a procedure for environmental reporting at group level.

Assessment
At one site (Halmstad):
We have used the environmental assessment method EPS to measure the sites environmental status and identify significant environmental aspects.
The results have been used to set environmental objectives

Company name: SCA Hygiene Products

Unit: Environmental Competence Centre

Application: Environmental Policy and key figures

Description:

The company:

Hygiene Products is a business group within SCA. SCA is an international paper company that produces absorbent hygiene products, packaging solutions and publication papers. Based on customer need, new products are developed for consumers, institutions, industry and the retail trade. Net sales approximately SEK 85 billion (EUR 9.4 billion) annually. At the beginning of 2004, SCA had about 46,000 employees in some 40 countries.

Hygiene Products, with the three parts Personal Care, Away From Home Tissue and Consumer Tissue, contributes to half of the net sales and operating profit of SCA. The average number of employees is 18,500 and it has 48 production plants in 43 countries all over the world.

Background:

The environmental policy of SCA is an integral part of the sustainability policy of the company. The business groups within the hygiene area have broken down this policy into "Aspirations" which lead to the environmental objectives.

Two major tools are used in the work with environmental issues, environmental management systems and life cycle assessments. To have arguments for the efforts and work done in the environmental area some substantial work has been put into analyzing the environmental aspects of the company.

Finding out Impact Indication Principle:

The work started by small group work done by the core team of ECC, with experiences learnt from the A20 project as well as complementary literature studies. This lead to preparations and a workshop for the whole ECC group, carried through on a group meeting 23-24 February. The group consisted of 12 persons. The task of the group was to identify and define the different environmental aspects along the products' value-chain in the form of a brain storming exercise. Lessons learnt from this work are the difficulties in terms and definitions, as well as the ability to see environmental aspects on the right level. Almost all production units within Hygiene have implemented an environmental management system. The aim of the workshop was therefore not to map the aspects and effects of a production unit as such, but to have the view of the aspects of the company's products. The identified aspects were of course a mixture of the aspects of a production unit with the aspects of raw material acquisition, manufacturing of raw material and product, use and disposal. After mapping the aspects along the value chain the result was documented and used as input for further work.

After this first part was done, the work was brought home and elaborated further.

Firstly, work was done to find and learn about the impacts and effects caused by the aspects.

Secondly a deeper discussion took place, analysing the aspects and their part of the value chain. Only relevant aspects were to be defined and the aspects taken care of in the local environmental management systems were discarded in this compilation.

What has come out of these discussions is among other things that we know too little

about the effects of the aspects. The decision is then made to not go further than the analysis of the impact categories and to find the category indicators.

LCA has been used in two steps to strengthen the findings from the start-up workshop. Firstly, old LCA's for tissue paper products were checked for two things:

- Were the chosen impacts of the defined aspects about the same as found in the LCA's?
- How was the impacts distributed along the value chain? Within each impact category, how was the contribution to the single steps of the value chain?

For the first question the finding was that the impact categories of the LCA's were in principle the same as those found in the work so far.
A pattern for how the single impacts were contributing to different steps could be seen.

Secondly LCA's for the different product types (diapers and tissue paper) were re-run, updated with the latest data, both site specific and up-streams. The site specific data came from the Hermes system, i.e. a system collecting data from all producing units regarding energy, emissions, transports from supplier to production unit, flow of materials and water. For supplier data averages from the supplier database and some generic datasets were used. By having the results from these LCA's the actual distribution of the impacts could be determined.

What has not been done so far is to set any type of prioritization of the impacts and their effects. In addition to this "science-based" mapping of important areas to work with, also other external factors such as legislation, customer demand and image has been mapped along the value chain. The combination of the different points-of-view will give the Impact Indication Principle for Hygiene Products.

On-going now are efforts to document the principle, the impact categories with their indicators etc in the tool WWLCAW.

Mölndal 1 July 2004

Björn Spak, Ellen Riise
for the A20 project

Company name: Stora Enso
Unit:
Application: Skutskär mill
Description: A small project group (3 persons) was established in Stora Enso to develop new methods for identifying environmental aspects and determining which are to be regarded as significant. Experience from CPM was regarded as important. Coordination between this SE project group and the CPM project A20 was conducted by Ola Svending. The new methods are still lacking...

Company name: Volvo Car Corporation (VCC)
Unit: Research & Development (R&D)
Application: Valuation of environmental aspects
Description: Since the end of 1999 R&D have been certified acc. to ISO 14001. By the end of 2002 the whole VCC organisation was certified in what is called a "multi-site" certificate. From the start the Environmental Policy has been the guide for the environmental work and the policy that is rather detailed can be described as the "Environmental objectives" for VCC. In that sense we can say that we already have a Policy Controlled Environmental Management Work. Topics that has been interesting for us on VCC and which can be used in the future development of our environmental system is the valuation of environmental aspects and the tool developed. Gothenburg 2004-06-28 Lars Lindkvist Environmental Manager R&D

Appendix III
Policystyrt miljöledningssystem