CHALMERS

Policy Controlled Environmental Management Work

Problem Inventory Report

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Summary

The problem inventory is a part of the CPM project "Policy Controlled Environmental Management Work".

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 that was developed in the pre-study. The interviewed company representatives identified the areas where they meet the most difficulties in their work.

Four main problem areas were identified;

- the environmental impact assessment method
- the environmental indicators
- the environmental policy
- the processing of quality data

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 find the features that help policy implementation in the quality management.

The policy is a mean to create a common shape and focus of the daily work in an organisation, which will help the different parts to move in the same direction. The policy deployment is facilitated by employee participation in the process to break down the policy to objectives and targets. It is important to quantify the targets to enable feed-back on the measures taken, "what is measured is improved". The controllability of a management system depends on the rate of the feed-back loop, and of the accuracy of the information communicated.

In the environmental management system, the lack of credibility of the information is a key issue. Reproducibility of the results of an assessment of environmental aspects is important for the credibility. The key to stringency and transparency and hence to reproducibility is structured and detailed documentation. The CPM/SSVL methodology, developed within CPM, offers quality assurance of data management.

Sets of environmental indicators have been developed by many organisations. The contents range from a handful of general indicators to hundreds of specific ones. The advantage with general environmental indicators is that they are relevant to nearly all organisations 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 organisation's performance.

The assessment of environmental aspects contains a subjective valuation. The guidance in literature on how to weight different forms of environmental impacts against each other is vague. The subjective choices can be made with reliability if they are based on the values that are expressed in the environmental policy and also transparently documented.

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1 Part I - Interviews with Participating Companies

1.1 Introduction

During August 2003, interviews with the companies participating in the CPM project, “Policy controlled environmental management work” were performed. The purpose was to inventory:

- The parts of the EMS that are experienced as the most problematic
- The parts of the EMS on which most effort is put in the company today
- The tools and methods used within the EMS

The interviews were based on the structure for policy controlled environmental management work that was developed in the pre-study, as seen below:

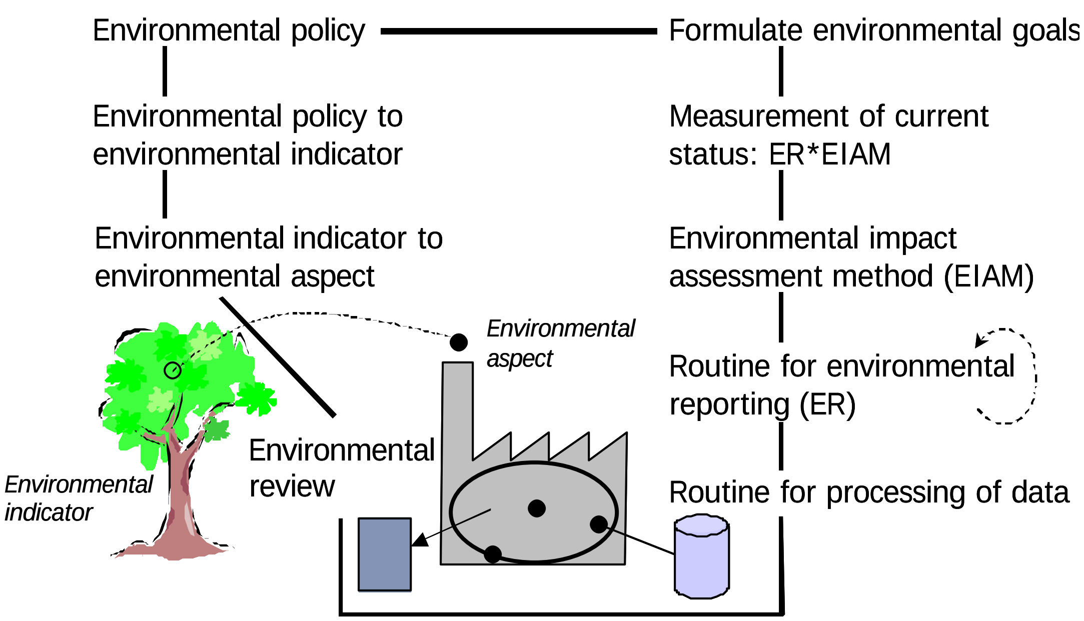

Figure 1.1. Structure of policy controlled environmental management work from the pre-study.

1.2 Interviewed Companies

The interviews showed that the participating companies are at different levels of maturity in their environmental management work. Some have had EMS for years while others are in the beginning of a structured environmental work. There are also many differences in the company product portfolios, company structures and the significant environmental impacts.

Participating companies:

- ABB
- Bombardier Transportation
- Cementa
- Duni
- SCA Hygiene Products
- Stora Enso
- Volvo Car Corporation

1.3 Effort Areas

Many of the participating companies are working internally with their environmental policy as this project begins. The interviews also gave the general picture that it is hard to find environmental indicators and assessment methods that suit the organisations. Since they are seen as important tools, a lot of effort is put on this work. Other effort areas are the implementation of the CPM/SSVL method of data documentation at the moment, and environmental reviews. Outside the EMS area, many companies are performing LCA, EPD or similar analyses for their various products.

The areas in the EMS where most effort is put today can be summarised as:

- Implementation of EMS in all parts of the organisation
- Developing useful environmental indicators
- Developing method for impact assessment
- Formulation, implementation and follow-up of the environmental policy
- Processing of data

1.4 Problem Areas

The environmental management work is difficult to follow up. This is due to many different factors; a vague environmental policy, the subjectivity of assessment methods, ill-fitting indicators, a rigid EMS in a variable world etc. Another problem is the inconsistencies of the methods used in different units of the companies. There is also a lack of trust, both to the way the impacts are valuated and to the reliability of the information that forms the ground for decisions.

Four main problem areas were identified:

1. The environmental impact assessment method

The demands of the impact assessment method that were felt as not met were; relevancy of the method's trade-offs for the company, comprehensibility, transparency and consistency. A less dependence on individuals is also critical to make the method reliable. The interviews showed that there was a low reliance to and perception of the common impact assessment methods[1] available.

[1] The methods available for impact assessment include a subjective weighting step. The EPS method is based on a monetarisation of environmental impacts performed by OECD citizens. The Eco-indicator method is based on questionnaires to a Swiss expert panel and the EDIP in turn is based on the distance to political environmental targets in Denmark. These viewpoints do not always agree with the one of the company.

2. The environmental indicators
Indicators that are useful in a general context are difficult to find. They have to be both relevant to the company and able to use for comparisons.

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.

4. The processing of quality data
The measuring and processing of data need to be reviewed to assure the quality of the data. There is no need to make the system processing the data more precise if the input to the system is measured in a non-satisfying way. The CPM/SSVL method is working well but is laborious to implement.

The need of English as project language was also expressed.

1.5 Tools

A variety of tools and methods are in use at the companies today within the EMS:

- ISO standards
- GRI format and indicators
- Impact assessment tools: EPS, EDIP, Eco-indicator
- Environmental indicators
- Expert panels
- LCA software: LCAiT, EcoLab
- Data reporting manuals
- Key factors
- PHASETS
- Environmental Product Declaration or similar
- Environmental guide lines
- WWLCAW

1.6 Comments

The environmental work is process related for some of the companies and product related for others which creates differences in views. In both cases, the system boundaries are sometimes diffuse.

Ideas of how a better assessment method can be constructed appeared. The most urgent matter to correct with the existing ones is the 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. Another function that is requested is to make company adapted classifications and characterisations to make the performance data more accessible for decisions.

Generally, the environmental policy and objectives are a result of the aspects found at the environmental review. The review is often done by a consultant, who may also make the valuation of the found aspects. The views of what aspects are most significant come sometimes from traditions.

The software platform WWLCAW does not function well enough and needs to be updated.

2 Part II – Literature Study

The literature in the area of environmental and quality management system is extensive. This study has therefore concentrated on the deployment of the environmental policy, linking the environmental policy with environmental indicators and aspects, environmental data management and comparison with quality policy deployment.

2.1 Implementation of Environmental Policy

The environmental policy is a statement by the organisation of its intentions and principles in relation to its overall environmental performance. It provides a framework for action and for the setting of its environmental objectives and targets[2].

2.1.1 Thomas Zobel; Environmental Policy Deployment in an Environmental Management System Context – Experiences from Swedish Organisations

Licentiate Thesis[3], Luleå University of Technology, Sweden

Zobel states that little is known on the subject of environmental policy deployment and the general aim of his thesis is to contribute with knowledge that can form the basis for development of better methodology.

46 organisations in Norrbotten, Västerbotten and Jönköping with environmental management systems (EMS) implemented were subjects for multiple case studies between November 1999 and May 2000.

14 business units within Stora Enso participated in the study between February and July 2000. Handbooks, routines and the environmental review were studied, supported with questionnaires and personal contact.

Environmental policy deployment is identified as being the heart and the most important part of the EMS as it determines the shape and focus of the process. Despite this, Zobel has found that environmental policies are formulated very vaguely, the contents are often similar, and it is often hard to see directly from the policy what kind of activities the policy is related to. The policy is mostly just a starting point for the system implementation and is not used within the organisation.

Before policy deployment, most companies in the study start with an environmental review where environmental aspects are identified and assessed. The significant aspects form the basis for the organisations objectives and for the policy. Some do however start from the other direction with establishing the policy as a first step towards the implementation of the EMS. The environmental objectives are sometimes mentioned in the policy, this is especially common in smaller organisations.

Zobel’s results from studies of identification and assessment of environmental aspects and comparison with quality policy deployment are referred in section 2.3.7 and 2.5.1 respectively.

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[2] ISO 14001:1996 (1996): Environmental management systems – Specifications with guidance for use, European Committee for Standardization, Brussels

[3] The thesis is based on the following papers (all published in Journal of Cleaner Production):

I. Zobel T, Almroth C, Bresky J, Burman J-O, 2001; Identification and Assessment of Environmental Aspects in an EMS Context: An Approach to a New Reproducible Method Based on LCA-Methodology.
II. Zobel T, Burman J-O, 2001; Environmental Policy Deployment.
III. Zobel T, Burman J-O, 2001; Factors of Importance in Identification and Assessment of Environmental Aspects in an EMS Context: Experiences in Swedish Organisations.

2.1.2 Neil Hawke; Environmental Policy: Implementation and Enforcement

De Montfort University, UK

Hawke has studied the process of environmental policy setting and implementation of the European Union. In the European community, the environmental policy is like a pre-step to environmental legislation many times. It "crystallises" to law. The author is concerned of the arbitrariness in the style, extent and emphasis of their transposition into Community law, made by the member countries.

A policy originates in objectives. Factors included in the creation and shaping of policy are; science, technology, economics, risk and geography. Science does not deliver the certainty that policy-makers hanker after. Its limitations should be more explicit. Information management that provides accurate, timely and transparent data is needed. The EEA has the function of generating uniform scientific data across the community.

Policy making throughout the EU is a top-down process, therefore it is important that it is integrated in all parts of the companies. The environmental policy is according to Hawke most integrated in the manufacturing sector and least in the agricultural and tourism sector.

2.1.3 Cary Coglianese, Jennifer Nash; Regulating from the Inside, Can Environmental Management Systems Achieve Policy Goals?

Harvard University's John F Kennedy School of Government

The ISO 14001 standard is less ambitious than the US Responsible Care Program ("move towards no accidents, injuries or harm to the environment") or the American Forest and Paper Association's Sustainable Forest Initiative ("meet the needs of the present without compromising future generations") in that it only makes a commitment to regulatory compliance and continual improvement. In contrast it requires consistency between what the managers say that they will do and what they actually practice. The documented procedures are most certainly the actual ones if the EMS is credibly certified. The only environmental information that must be publicly disclosed for ISO 14001 certification is the environmental policy.

Traditional government regulations are often either over inclusive or under inclusive. Uniform standards sometimes require firms to do too much in areas where the cost of regulation exceeds the benefits, or opposite, too little where the benefits would out-weight the costs. Internal controls give flexibility and organisations can choose the most cost-effective way instead. Coglianese and Nash are of the opinion that traditional regulations might therefore with benefit be substituted with third-party reviewed environmental management systems. Some empirical studies have found that market-based approaches (e.g. emission trading) maintain a fixed level of environmental quality at substantially lower costs than traditional regulation.

2.1.4 Implementation of Environmental Policy - Overall Conclusions

The environmental policy is the central part of the EMS. It determines the shape and focus of the process. Despite this is it very seldom actively used but is merely a starting point for the EMS. The policy must be integrated throughout the whole company to be practically operative.

The significant aspects found in the environmental review most commonly form the basis for the policy, even though some companies start their implementations of an EMS with establishing the policy.

Information management that provides accurate, timely and transparent data is needed.

2.2 Environmental Indicators – Selection and Definition

Organisations all around the world are working to define environmental indicators that are universal and admit comparison between companies in different sectors. Here is a presentation of the work made by ISO, OECD, EU, GRI, WEF and WBCSD.

2.2.1 ISO 14031 – Environmental Performance Evaluation (EPE)

All indicators (Appendix A) are divided into Management Performance Indicators (MPIs), Operational Performance Indicators (OPIs) and Environmental Condition Indicators (ECIs).

- Management Performance Indicators (42 examples) describe the organisation's capacity and effort to realise environmental decisions.
- Operational Performance Indicators (63 examples) describe the environmental performance of the organisation's activities.
- Environmental Condition Indicators (48 examples) describe the environmental condition in a local, regional and global perspective.

ISO imply that the choice of indicators shall be reviewed so that they are consistent with the environmental policy.

2.2.2 Organisation for Economic Co-operation and Development (OECD)

In 1999 OECD developed a set of fourteen agro-environmental indicators (Appendix B). OECD states that the indicators shall be policy relevant and chosen due to the need of certain information and not due to easy available information.
Problems with finding suitable indicators according to OECD:

- Different size of system boundaries; e.g. an agriculture, an eco-zone, a nation
- Different time boundaries; e.g. acute damage, sustainability
- Link to economic and social tasks

2.2.3 World Business Council for Sustainable Development (WBCSD)

WBCSD made a two-year project to create a common framework for assessment and reporting of eco-efficiency relevant to all industrial sectors. The framework was tested during one year at 22 different companies in 15 countries. The conclusion made was that the seven general indicators developed in cooperation with GRI (Appendix C) were relevant to all test companies. Company-specific indicators were concluded to be more important for the measurability of environmental performance and were recommended to be chosen from the ISO 14031 standard.

2.2.4 Global Reporting Initiative (GRI)

The GRI indicators are divided in Core indicators and Additional indicators. Core indicators are the general indicators developed in cooperation with WBCSD. Additional indicators are company-specific.

2.2.5 2003/532/EC – Commission Recommendation

This recommendation was published the 10 of July 2003 and contains guidelines for choice of environmental indicators. The document divides indicators into MPIs, OPIs and ECIs (see Appendix D) just as ISO, gives examples of each group, and states that environmental indicators should be chosen in a cost effective way with regard to the organisation's character, needs and priorities.

Important features of indicators:

Indicators should…

- … give an accurate appraisal of the organisation's performance
- … be understandable and unambiguous
- … allow for year on year comparison
- … allow for comparison with sector, national or regional benchmarks
- … allow for comparison with regulatory requirements

2.2.6 World Economic Forum (WEF)

WEF has constructed a Pilot Environmental Performance Index (EPI)[4] designed to measure current environmental results at the national scale. The EPI derives from a collection of data sets aggregated into four core indicators that gauge air quality, water quality, greenhouse gas emissions, and land protection. These indicators provide measures of both current performance and rates of change.

2.2.7 Environmental Indicators - Overall Conclusions

The advantage with general environmental indicators like the set developed by WBCSD and GRI is that they are relevant to nearly all organisations 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.

In the ISO 14031 standard there are 153 examples of different environmental indicators. They can serve well for guidance when a company develops their own indicators, but it is of highest importance for the utility of the indicators chosen that they give an accurate appraisal of the organisation's performance.

2.3 Assessment of Environmental Aspects

In general the environmental aspects originate from an environmental review. An aspect can be defined in different ways, for example as an activity. If only the activity is documented, then it may not be clear whether it is pollution, energy consumption, noise etc. that is the issue. If only the aspect is documented it will make it difficult to understand how and why the aspect arises, it is therefore recommended to document both.

The aspects are in general identified in the initial review which is sometimes documented, sometimes not. Many organisations seem to identify as many aspects as possible, instead of using resources and time to quantify the ones already identified[5]. When the organisations document their aspects, they do not always document their original sources of information

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[4] http://www.ciesin.org/indicators/ESI/

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

and information of data quality. It will therefore not be possible to form an opinion of the quality of the data. Lack of information about original sources and data quality affects the transparency of the identification. Employee participation in finding aspects can increase the awareness and competence, and perhaps reduce the subjectivity that way.

2.3.1 ISO 14001 - EMS - Specification with Guidance for Use

The standard requires that the organisation determines its significant environmental aspects and consider these when setting its environmental objectives. Legal and other requirements, technological options, financial, operational and business requirements and views from interested parties shall also be considered when setting environmental objectives.
Annex A of the standard, the informative guidance for use, recommends that organisations without a functioning EMS should start by doing an environmental review to find environmental aspects. The process to identify significant aspects should consider:

- Emissions to air
- Releases to water
- Waste management
- Contamination of land
- Use of raw material and natural resources
- Other local environmental issues

No other guidance on the assessment of environmental aspects is provided.
The standard will be updated very soon.

2.3.2 ISO 14004 - EMS - General Guidelines on Principles, Systems and Supporting Techniques

The organisation's environmental policy should be based on knowledge about its environmental aspects and significant environmental impacts.
The standard provides a "practical help" for identification and assessment of environmental aspects in four steps:

- Step 1 – Select an activity
- Step 2 – Identify as many associated environmental aspects as possible
- Step 3 – Identify environmental impacts
- Step 4 – Evaluate significance of impacts

The evaluation of impacts may consider:

- environmental concerns
  - The scale of the impact
  - The severity of the impact
  - Probability of occurrence
  - Duration of impacts
- business concerns
  - Potential regulatory and legal exposure
  - Difficulty of changing the impact
  - Cost of changing the impact
  - Effects of change on other activities and processes
  - Concerns of interested parties
  - Effect on the public image of the organisation

2.3.3 ISO 14015 – Environmental Assessment of Sites and Organisations (EASO)

The criteria against which gathered information will be assessed may include:

- Legal requirements
- Client-defined requirements
- Claims of interested parties
- Technological considerations

The standard does not mention how to handle subjective judgements.

2.3.4 ISO 14031 – Environmental Performance Evaluation (EPE)

The identification of an organisation's environmental aspects is thoroughly described in the ISO 14031 standard. It proposes that:

- Potential impacts be identified both from the inside and out perspective and from the outside and in perspective
- Risks, external views, laws and regulations and the life cycle be considered
- A judgement of which the most significant aspects are be made

There is less guidance on how to assess the significance of the environmental aspects. EPE focuses on the valuation of an organisations environmental performance. There are two paragraphs in the standard that treat environmental aspects are somewhat inconsistent;
"The information generated by EPE can assist an organisation to identify significant environmental aspects."(§ 3.1.3)
"An organisation should base its planning of EPE on the significant environmental aspects that it can control and over which it can be expected to have an influence." (§ 3.2.1)
Then the standard refers to ISO 14001 and ISO 14004 if the organisation has an EMS. For those organisations that do not have an EMS there is a "practical help box" with approaches to identify environmental aspects and their relative significance in the context of EPE:

- Identify activities, products and services of the organisation, the specific environmental aspects and the relative significance associated with them, and the potential impacts related to significant environmental aspects.
- Use information about the condition of the environment to identify activities, products and services of the organisation that may have an impact on specific conditions.
- Analyse the organisation's existing data on material and energy inputs, discharges, wastes and emissions and assess these data in terms of risk.
- Identify the views of interested parties and use this information to help establish the organisation's significant environmental aspects.
- Identify activities of the organisation that are subject to environmental regulation or other requirements, for which data may have been collected by the organisation.
- Consider the design, development, manufacturing, distribution, servicing, use, re-use, recycling and disposal of the organisation's products, and their related environmental impacts.
- Identify those activities of the organisation having the most significant environmental costs or benefits.

In short:
Identify potential impacts both from the inside and out perspective and from the outside and

in perspective, consider the risks, external views, laws and regulations and the life cycle and then make a judgement of which the most significant aspects are.
The standard states that LCA is a tool that can be used to valuate activities of the organisation. Other than that there is no guidance on how to valuate environmental impacts.

2.3.5 ISO 14042 – Life Cycle Impact Assessment (LCIA)

Weighting of different environmental impacts is a voluntary part of LCIA together with normalisation and grouping of impacts. Both weighting and grouping is dependent on a subjective valuation which means that they cannot be made scientifically. The standard does therefore recommend the use of several different weighting methods. Weighted results are not to be used for external comparisons and the decisions and trade-offs made should be accounted for together with the results.

2.3.6 J. Noh, Kun Lee; Effect of Different Weighting Methods on the Identification of Key Issues in LCA

Environmental Engineering, Ajou University, Korea
Noh and Lee has studied five different environmental impact assessment methods and the results were presented at the International Conference & Exhibition on Life Cycle Assessment of April 25 – 27 in year 2000.
The investigated methods were:

- IEF (no info on the abbreviation);
  Finnish method based on expert panel judgement.
- EPS (Environmental Priority Strategies in Product Development);
  Swedish method based on interviews with OECD citizens where their WTP (Willingness to Pay) for certain safe guard objects is investigated.
- Eco-indicator 99;
  Netherlands method based on a quest sent to the members of The Swiss discussion platform on LCA.
- EDIP (Environmental Design of Industrial Products);
  Danish method based on Danish political targets, developed in 1996 with year 2000 chosen as the common target year, while 1990 was chosen as the common reference year. A new version expected beginning in 2002.
- Korean;
  Korean method based on a combination of critical load level and expert panel judgements.

Noh and Lee made a case study on LCA of printed circuit boards with impact assessment performed with each of the five different methods. The conclusions were that the results with IEF, Eco-indicator 99 and Korean methods resemble each other while they differ to a large extent to EPS and EDIP. The last two give in their turn very similar results.

2.3.7 Thomas Zobel; Environmental Policy Deployment in an Environmental Management System Context – Experiences from Swedish Organisations

Licentiate Thesis, Luleå University of Technology, Sweden, see section 2.1.1 for more information.

Elements in which environmental aspects are identified and assessed are a central part of the EMS and determine the shape and focus of the environmental work.

Common method and tools for assessment:

- Brainstorming process;
  usually performed by the environmental manager and the executive committee.
- Matrix model;
  for every aspect, each assessment criterion is assigned a value and the sum or the product is calculated. It is common among the studied companies to make the assessment in three levels of significance.

Many aspects remain the same year after year and if new aspects arise it is often due to some change in operation or incident. The assessment criteria may change more often due to new legislative requirements, new knowledge of the environmental impacts, measures taken to the aspects etc. Assessment is often based on previous knowledge and this impairs the transparency.

Common assessment criteria:

- Quantities
- Extent of the environmental impact
- Probability of environmental impact
- Seriousness of the environmental impact
- Permanence of impact damage
- Public and neighbour attitudes
- Regulatory environmental permit
- Consequences of not fulfilling laws and regulations
- Technical or organisational problems
- Employees attitude and suggestions from employees
- Cost for environmental impact change
- Customer attitude
- Conflicts with other activities and processes

ISO 14004 contradict ISO 14001 that says that business considerations should not be taken into account when assessing environmental aspects. Most companies do. When establishing objectives, the business considerations are there anyway, and it can be seen as different ways to the same destination.

Inconsistencies in the methods for identification and assessment of aspects will complicate comparisons between departments and between units in the organisations, and the decisions of where resources should be applied. Also, the system boundaries are often not defined clear enough.

Problems with the assessment:

- The routines are too person-dependent
- Not reproducible
- Method differs between units

The general opinion among the studied companies was that the assessment would not be reproducible; the results would always be somewhat different from the initial assessment, no matter who performs it. Reproducibility is important for the credibility of the EMS. The key

to stringency and transparency and hence to reproducibility is structured and detailed documentation.
In some cases, aspects are only documented in the initial review document, and it seems then as a one-occasion process. If an external consultant performs the review, the competence is then lost and the aspects will probably not be updated very soon.
Six improvable areas:

- Definition of environmental aspects
- Procedures for updates of aspects
- Aggregation of aspects
- Exclusion of business considerations
- Employee and stakeholder participation
- Competence of involved people

2.3.8 Marilyn R. Block; Identifying Environmental Aspects and Impacts

There are as many schemes for evaluating environmental impact as there are companies with evaluating procedures. Block is of the opinion that each organisation should choose or modify a method for evaluation that is appropriate for them.
The impacts are evaluated according to different criteria; severity, frequency, likelihood etc. Most evaluation criteria employ a three- or five-point rating scale. The drawback to such scales is the tendency for evaluators to select the mid-point. A solution to this problem can be to create a four-point scale and force evaluators to either the harmful or harmless side. When an impact has been given a rate for all the criteria, the results can either be added or multiplied, with very different outcome as seen below:

Impacts	Likelihood	Severity	Significance
Addition:			
Impact 1	3	3	3 + 3 = 6
Impact 2	5	1	5 + 1 = 6
Multiplication:			
Impact 1	3	3	3 * 3 = 9
Impact 2	5	1	5 * 1 = 5

Block suggests that if the values assigned to the measured attributes are unrelated to each other, as in this example with likelihood and severity, then the scores should be multiplied. Scores should be added when the values are related to each other.
The book does also contain examples on procedures to assess aspects from six companies in the United States.

2.3.9 Assessment of Environmental Aspects - Overall Conclusions

There is little guidance on how to assess the significance of the environmental aspects in the literature. In the ISO 14031 standard the methodology of LCA is suggested to be used. Assessing the significance, i.e. weighting, of different environmental impacts is a voluntary part of the ISO 14042 standard for Life Cycle Impact Assessment (LCIA), as it is always a subjective act.
Reproducibility of the assessment of environmental aspects is important for the credibility of the EMS. The key to stringency and transparency and hence to reproducibility is structured and detailed documentation.

The significant aspects can both be identified with assessment tools, expert estimations and/or due to legal requirements. The environmental objectives and policy are both consequences of which environmental aspects that are identified as significant.

2.4 Environmental Data Management

One of the main problems identified in the interviews in Part I was the processing of data in a structured way so that the quality can be assured. The CPM/SSVL methodology described below is the proposed routine for data processing in the structure of Policy controlled environmental system work.

2.4.1 An Industry Common Methodology for Environmental Data Management

Platform presentation at SPCI 2002, 7th International Conference on New Available Technologies, June 4-6 2002, Stockholm

Ten Swedish forest industries and Chalmers University of Technology cooperated in a two-year project where a common methodology for environmental data handling was created and implemented in the forest industry. The project was initiated and funded through the Swedish Forest Industries Water and Air Pollution Research Foundation (SSVL).

The goal was to increase the quality of environmental information without increasing the costs. This was to be done through simplification and co-ordination of data at the sites, facilitation of environmental communication between different stakeholders and quality assurance of the data management. The project also aimed to set an industry standard for environmental information management through a common language and a common way of working within the forest industry.

The project result was a practical methodology, commonly named the CPM/SSVL methodology, which consists of:

- A common view of documentation based on SPINE[6] and ISO/TS 14048[7]
- A structured work procedure based on the PHASETS model[8]

A common view of documentation assures the quality of the information that is acquired. A structured work procedure supports efficient handling and documentation of environmental data. Together the documentation and the work procedure supply quality assurance of data. The methodology was shown to have several advantages at the six different sites where it was implemented; control and overview of the environmental information, knowledge of how data is handled and credibility and reusability of collected data. It is also flexible enough to allow for different levels of ambition and detail. The methodology deals with both product and process related environmental information.

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

[7] ISO/TS 14048:2002 (2002): Environmental Management – Life Cycle Assessment – Data documentation format, European Committee for Standardization, Brussels.

[8] Carlson R, Pålsson A-C (2001): "Industrial environmental information management for technical systems", Journal of Cleaner Production, 9 (5): 429-435, Elsevier Science Ltd.

The work procedure is presented in the figure below:

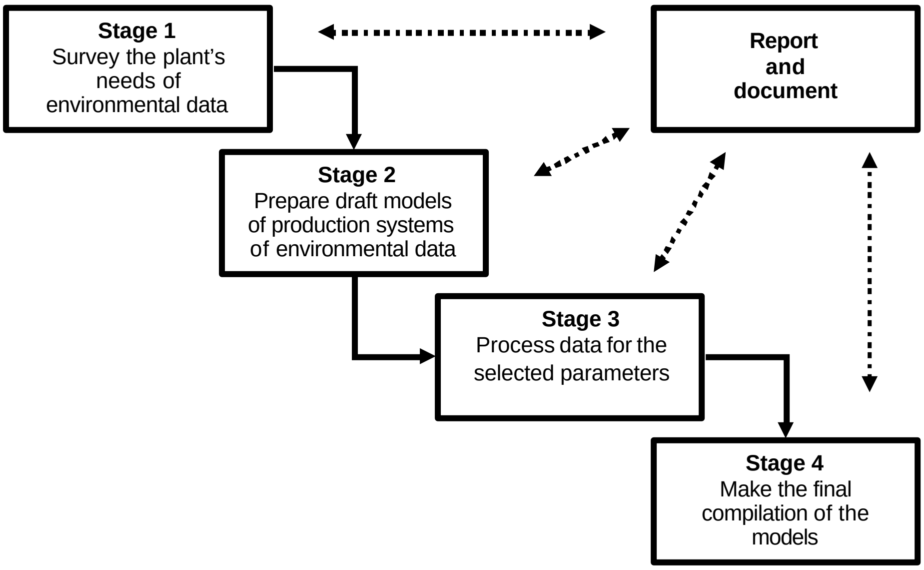

Figure 2.1. The work procedure of the methodology for environmental data handling in the forest industry.

The work procedure begins with identification of the needs and requirements of data. The inclusion of activities and priorities made are based on these needs and requirements. A draft system is modeled and the parameters that should be reported are selected. The processing of data includes specification of parameters and measurement systems, acquisition and compilation of measured values and investigations of allocations. Then the final model is compiled based on the information gathered on the previous steps. The quality assurance of the data handling is assured by documenting and reporting.

2.4.2 Environmental Data Management – Overall Conclusions

A structured work procedure supports efficient handling and documentation of environmental data. A common view of documentation assures the quality of the information that is acquired. Bringing these two together, the CPM/SSVL methodology supplies quality assurance of data.

2.5 Comparison with Policy Implementation in Quality Management

The main role of the quality policy is to communicate the company's commitments and aspirations with regard to quality, and to define principal objectives for the quality management system.

2.5.1 Thomas Zobel; Environmental Policy Deployment in an Environmental Management System Context – Experiences from Swedish Organisations

Licentiate Thesis, Luleå University of Technology, Sweden, see section 2.1.1 for more information.
Policy deployment is just as important in quality management as it is in environmental management. Zobel finds Quality Policy Deployment (QPD) to be a suitable starting point for EMS improvement.

With the background of QPD, four improvable characteristics of environmental policy deployment can be:

1. Make the policy less general
2. Include long-term improvements in the objectives
3. Quantify more of the goals
4. Involve the employees

The theory of QPD gives advice for improvement on the last three problems:

2. Make 10 years horizons; this might be even more advantageous for environmental goals since they are often connected to benefits in the long-run.
3. QPD follows the expression "what cannot be quantified cannot be managed"
4. In QPD an annual policy containing both goals and the means to reach the goals is deployed through the whole organisation.

Zobel is of the opinion that organisations probably achieve a more effective environmental policy deployment process if they focus more on a process characterised by long- and medium-term goals, annual plans and "catchball-type[9]" communication according to QPD, and not so much on ISO 14001's specifications on objectives, targets and programmes. It would therefore be desirable that third-party auditors could focus more on the *ability* of the environmental management system to contribute to continual improvement than on how the environmental management system is structured.
Zobel concludes that in the literature sources he has come across the authors all state that employee participation will increase the probability that objectives will be agreed to and acted upon. Discussions between different levels in the organisation can lead to consensus and motivate the employees to work to achieve the goals.

2.5.2 Camilla Nord, Eva-Karin Olsson; Quality Policy Deployment – Måldialog för Överensstämmelse mellan Visioner och Dagligt Arbete

Master Thesis, Linköping University of Technology, Sweden
Nord and Olsson have studied the quality policy deployment at three divisions at ABB HV Switchgear AB in 1994.
The quality management system aims to make the daily activities contribute to the long term objectives, and to make all parts of the organisation move in the same direction. One of the greatest challenges in the QPD is to break down qualitative objectives to quantitative targets. Nord and Olsson are of the opinion that it is preferable if personnel at all levels are involved in this work. The policy and the objectives will then be known and understood. The targets will be set by the experts in the field, and the personnel will be more motivated and committed to reach the targets. The targets must be set and understood by those who are in a position to influence them. It is important to quantify the targets and to find good measures for them. "What is measured is improved".
There are four factors in an organisation that support the QPD:

- focus on goal
- continual improvement
- flow view
- process view

The flow view defines the flow as the product's way from supplier to customer. It is supposed to be as straight and fast as possible; the obstacles shall be removed. The flow can be divided into steps, all beginning with a supplier and ending with a customer. Process view means to

[9] "Cathball-type" communication is described by the author as discussions between the different levels in the organisation; upper management, middle management, supervisors and line personnel.

look at the world from the PDCA cycle (Plan, Do, Check, Act, see Appendix E). Good results are standardised while checking and corrective actions lead to continual improvement.
The strength of QPD is the fast feed-back. Each organisational level evaluates whether the target is reached and which measures that have been favourable and which have been detrimental. The feed-back will be given at intervals that suit the organisation and be continuously improved itself.
The conclusions made from the studies of the ABB divisions was that there were linguistic barriers that prevented the divisions to benefit from each other's experiences and that animated communication paths both vertically and horizontally are important if the quality policy shall be implemented.
Nord and Olsson compare the QPD with MBO; management by objectives. MBO focuses more on finding the failing link than to understand the origin of the failure and QPD is therefore seen as the most successful in a long term perspective.

2.5.3 Yoji Akao; Hoshin Kanri, Policy Deployment for Successful TQM

Hoshin kanri means "methodology for strategic direction setting" or "policy deployment" and was born as a part of total quality management (TQM). TQM has its roots from the Japanese Deming Prize for quality achievements in the 1950s. The PDCA cycle (Plan, Do, Check, Act, see Appendix E) was developed by Deming and it is a useful item for controlling and for setting the policy.
Hoshin kanri provides management with an opportunity for consensus dialogue about significant system changes. The model is illustrated as:

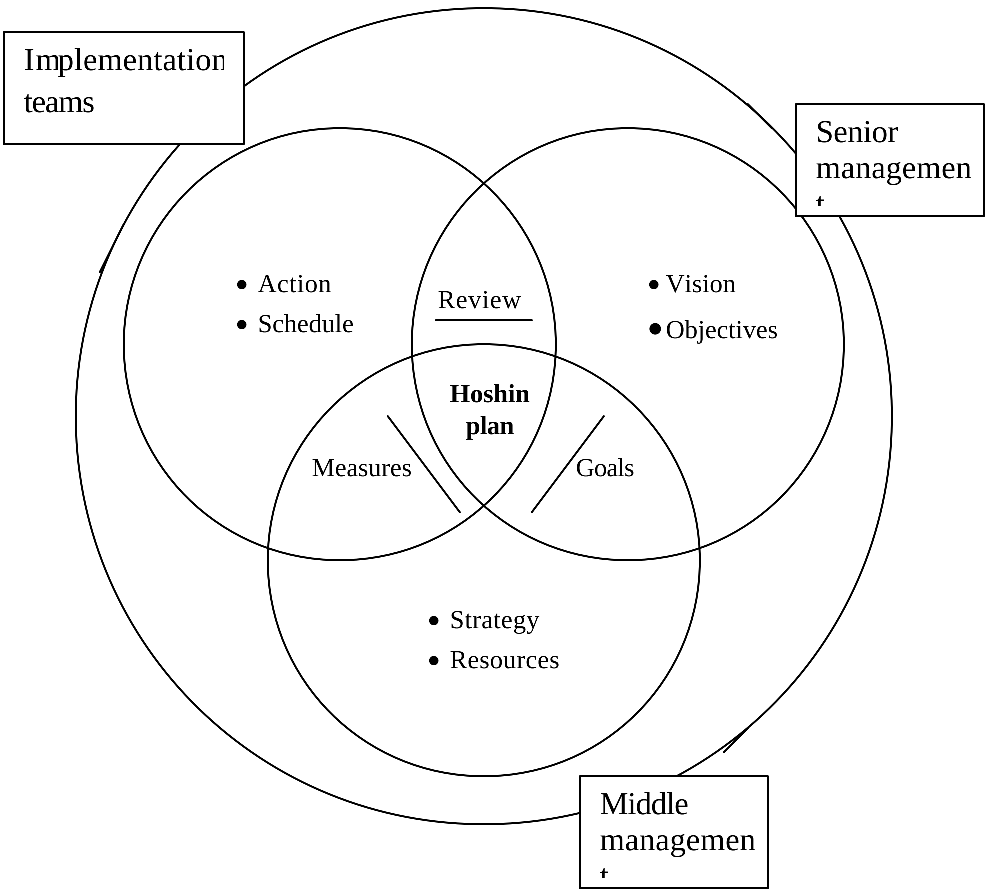

Figure 2.2. Hoshin kanri model for consensus planning and execution process.

The initial considerations in this approach to business system change are as follows:

- Measuring the system as a whole
- Setting core objectives of the business
- Understanding the economic, technical, social etc. surroundings of the business
- Providing resources to perform business objectives
- Defining processes that constitutes the system – their activities, goals, performance measures and performance feedback adjustments

In hoshin kanri the variance between the plan and the actual situation is evaluated and not the value of the results. The cause of such variance is analyzed and the analysis is incorporated into next year's policy. The process that produces the bad results obviously has some weaknesses that need to be discussed and eliminated. The emphasize lies on the process and not the results and improvements are made via improving the process. Companies often bypass the collection and analysis of data and go directly to the countermeasures. In QPD it is essential to fully analyze the causal factors before formulating any measures. If a cause-and-effect diagram is drawn up, measures realized in the past can be re-examined if similar problems arise.

Some organisations set up the means and then assign a goal-value to each mean. The opposite should be done instead. The means should occur only after the current level of achievement in relation to the targets is determined and the reason for any shortfall is identified.

The implementation of the quality policy is facilitated if the employees who are charged with executing a task participate in the planning process according to Akao. Everyone has his/her own parochial view of the "best" way to do something which is most often not optimal for the overall business system. If there is consensus for the core objectives, the business as a coherent whole will focus on them.

2.5.4 Comparison with Policy Implementation in Quality Management – Overall Conclusions

The studied authors all emphasise that the personnel has to be involved and personally engaged if they are going to perform to their best. The targets for the divisions should be set in consensus with the people that will execute the practical work.

Keys to a successful environmental policy implementation:

- Employee participation
- Quantitative and descriptive measures; "What cannot be quantified cannot be managed"
- Easy and regular control of the measures; "What is measured is improved"
- More focus on function than structure at the EMS audition

3 Conclusions

The interviews gave the general picture that it is difficult to find environmental indicators and assessment methods that suit the organisations. Another problem is the inconsistencies of the methods used in different units of the companies. Many of the participating companies are working internally with their environmental policy as this project begins and they experience difficulties with the formulation of an operative policy. The environmental management work is also difficult to follow up. Four main problem areas were hence identified:

- the environmental policy
- the processing of quality data
- the environmental indicators
- the environmental impact assessment method

The policy is a mean to create a common shape and focus of the daily work in an organisation, which will help the different parts to move in the same direction. The policy deployment is facilitated by employee participation in the process to break down the policy to objectives and targets. It is important to quantify the targets to enable feed-back on the measures taken, “what is measured is improved”.

The controllability of a management system depends on the rate of the feed-back loop, and of the accuracy of the information communicated. In the environmental management system, 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. The CPM/SSVL methodology offers quality assurance of data management.

Sets of environmental indicators have been developed by many organisations. The contents range from a handful of general indicators to hundreds of specific ones. The advantage with general environmental indicators is that they are relevant to nearly all organisations 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 organisation's performance.

The assessment of environmental aspects contains a subjective valuation. The guidance in literature on how to weight different forms of environmental impacts against each other is vague. The subjective choices can be made with credibility if they are based on the values that are expressed in the environmental policy and also transparently documented.

4 References

ISO 14001:1996 (1996): Environmental management systems – Specifications with guidance for use, European Committee for Standardization, Brussels

ISO 14004:1996 (1996): Environmental management systems – General guidelines on principles, systems and supporting techniques, European Committee for Standardization, Brussels

ISO 14015:2001 (2001): Environmental management – Environmental assessment of sites and organisations (EASO), European Committee for Standardization, Brussels

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

ISO 14042:2000 (2000): Environmental management – Life cycle assessment – Life cycle impact assessment, European Committee for Standardization, Brussels

2003/532/EC, Commission recommendation of 10 July 2003

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

Marilyn R. Block (1999): "Identifying Environmental Aspects and Impacts", American Society for Quality (ASQ), Wisconsin

Cary Coglianese, Jennifer Nash (2001): "Regulating from the Inside, Can Environmental Management Systems Achieve Policy Goals?", Resources for the future, Washington, DC

Neil Hawke (2002): "Environmental Policy: Implementation and Enforcement", Aldershot, Hants, England

J. Noh, Kun Lee (2000); "Effect of Different Weighting Methods on the Identification of Key Issues in LCA" International Conference & Exhibition on Life Cycle Assessment: Tools for Sustainability, April 25-27, 2000

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

Pålsson et al. (2002): "An Industry Common Methodology for Environmental Data Management", platform presentation at SPCI 2002, 7th International Conference on New Available Technologies, June 4-6 2002, Stockholm

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

Global Reporting Initiative viewed at http://www.globalreporting.org/

Organisation for Economic Co-operation and Development viewed at http://www.oecd.org/

World Business Council on Sustainable Development viewed at http://www.wbcsd.org/

World Economic Forum viewed at http://www.weforum.org/

Appendix A
Recommendations on criteria when assessing environmental aspects

A.1 ISO 14001 - EMS - Specification with Guidance for Use

The standard requires that the organisation determines its significant environmental aspects and consider these when setting its environmental objectives. Legal and other requirements, technological options, financial, operational and business requirements and views from interested parties shall also be considered when setting environmental objectives.

Annex A, the informative guidance for use, recommends that organisations without a functioning EMS should start by doing an environmental review to find environmental aspects. The process to identify significant aspects should consider:

- Emissions to air
- Releases to water
- Waste management
- Contamination of land
- Use of raw material and natural resources
- Other local environmental issues

No other guidance on the assessment of environmental aspects is provided.

The standard will be updated very soon.

A.2 ISO 14004 - EMS - General Guidelines on Principles, Systems and Supporting Techniques

The organisation's environmental policy should be based on knowledge about its environmental aspects and significant environmental impacts.

The standard provides a "practical help" for identification and assessment of environmental aspects in four steps:

- Step 1 – Select an activity
- Step 2 – Identify as many associated environmental aspects as possible
- Step 3 – Identify environmental impacts
- Step 4 – Evaluate significance of impacts

The evaluation of impacts may consider:

- environmental concerns
  - the scale of the impact
  - the severity of the impact
  - probability of occurrence
  - duration of impacts
- business concerns
  - potential regulatory and legal exposure
  - difficulty of changing the impact
  - cost of changing the impact
  - effects of change on other activities and processes
  - concerns of interested parties
  - effect on the public image of the organisation

A.3 ISO 14015 – Environmental Assessment of Sites and Organisations (EASO)

The criteria against which gathered information will be assessed may include:

- Legal requirements
- Client-defined requirements
- Claims of interested parties
- Technological considerations

The standard does not mention how to handle subjective judgements.

A.4 ISO 14031 – Environmental Performance Evaluation (EPE)

EPE focuses on the valuation of an organisations environmental performance. There are two paragraphs in the standard that treat environmental aspects are somewhat inconsistent;

"The information generated by EPE can assist an organisation to identify significant environmental aspects."(§ 3.1.3)

"An organisation should base its planning of EPE on the significant environmental aspects that it can control and over which it can be expected to have an influence." (§ 3.2.1)

Then the standard refers to ISO 14001 and ISO 14004 if the organisation has an EMS. For those organisations that do not have an EMS there is a "practical help box" with approaches to identify environmental aspects and their relative significance in the context of EPE:

- Identify activities, products and services of the organization, the specific environmental aspects and the relative significance associated with them, and the potential impacts related to significant environmental aspects.
- Use information about the condition of the environment to identify activities, products and services of the organization that may have an impact on specific conditions.
- Analyse the organization's existing data on material and energy inputs, discharges, wastes and emissions and assess these data in terms of risk.
- Identify the views of interested parties and use this information to help establish the organization's significant environmental aspects.
- Identify activities of the organization that are subject to environmental regulation or other requirements, for which data may have been collected by the organization.
- Consider the design, development, manufacturing, distribution, servicing, use, re-use, recycling and disposal of the organization's products, and their related environmental impacts.
- Identify those activities of the organization having the most significant environmental costs or benefits.

The standard states that LCA is a tool that can be used to valuate activities of the organisation. Other than that there is no guidance on how to valuate environmental impacts.

A.5 ISO 14042 – Life Cycle Impact Assessment (LCIA)

Weighting of different environmental impacts is a voluntary part of LCIA together with normalisation and grouping of impacts. Both weighting and grouping is dependent on a subjective valuation which means that they cannot be made scientifically. The standard does therefore recommend the use of several different weighting methods. Weighted results are not to be used for external comparisons and the decisions and trade-offs made should be accounted for together with the results.

A.6 Thomas Zobel; Environmental Policy Deployment in an Environmental Management System Context – Experiences from Swedish Organisations

46 organisations in Norrbotten, Västerbotten and Jönköping with environmental management systems (EMS) implemented were subjects for multiple case studies between November 1999 and May 2000.

14 business units within Stora Enso participated in the study between February and July 2000. Handbooks, routines and the environmental review were studied, supported with questionnaires and personal contact.

Common assessment criteria in the studied organisations:

- Quantities
- Extent of the environmental impact
- Seriousness of the environmental impact
- Public and neighbour attitudes
- Regulatory environmental permit
- Consequences of not fulfilling laws and regulations
- Technical or organisational problems
- Employees attitude and suggestions from employees
- Probability of environmental impact
- Cost for environmental impact change
- Customer attitude
- Permanence of impact damage
- Conflicts with other activities and processes

A.7 Marilyn R. Block (1999): Identifying Environmental Aspects and Impacts

There are as many schemes for evaluating environmental impact as there are companies with evaluating procedures. Block is of the opinion that each organisation should choose and/or modify a method for evaluation that is appropriate for them.

The impacts are evaluated according to different criteria; severity, frequency, likelihood etc. Most evaluation criteria employ a three- or five-point rating scale. The drawback to such scales is the tendency for evaluators to select the mid-point. A solution to this problem can be to create a four-point scale and force evaluators to either the harmful or harmless side. When an impact has been given a rate for all the criteria, the results can either be added or multiplied, with very different outcome as seen below:

Impacts	Likelihood	Severity	Significance
Addition:			
Impact 1	3	3	3 + 3 = 6
Impact 2	5	1	5 + 1 = 6
Multiplication:			
Impact 1	3	3	3 * 3 = 9
Impact 2	5	1	5 * 1 = 5

Block states that if the values assigned to the measured attributes are unrelated to each other, as in this example with likelihood and severity, then the scores should be multiplied. Scores should be added when the values are related to each other.

The book does also content examples on procedures to assess aspects from six companies in the United States.

Appendix B
A presentation of indicators

B.1 ISO 14031 indicators

B.1.1 Management performance indicators

General overview

Management efforts to improve environmental performance may include implementation of policies and programmes, conformity with requirements or expectations, financial performance, and community relations. Depending on the significant environmental aspects of the organization, and the organization's environmental performance criteria, it may choose some or none of the following examples of MPIs for use. This subclause provides examples of MPIs that can be chosen to measure the management efforts of an organization.

B.1.2 Examples of MPIs

Implementation of policies and programmes

If management's interest is in evaluating the implementation of environmental policies and programmes throughout the organization, possible MPIs include:

_ number of achieved objectives and targets;

_ number of organizational units achieving environmental objectives and targets;

_ degree of implementation of specified codes of management or operating practice;

_ number of prevention of pollution initiatives implemented;

_ number of levels of management with specific environmental responsibilities;

_ number of employees that have environmental requirements in their job descriptions;

_ number of employees participating in environmental programmes (e.g. suggestion, recycle, clean-up initiatives or others);

_ number of employees who have obtained reward and recognition in comparison to the total number of employees who participated in the programme;

_ number of employees trained versus the number that need training;

_ number of contracted individuals trained;

_ levels of knowledge obtained by training participants;

_ number of environmental improvement suggestions from employees;

_ results of employee surveys on their knowledge of the organization's environmental issues;

_ number of suppliers and contractors queried about environmental issues;

_ number of contracted service providers with an implemented or certified environmental management system;

_ number of products with explicit "product stewardship" plans;

_ number of products designed for disassembly, recycling or reuse;

_ number of products with instructions regarding environmentally safe use and disposal.

Conformance

If management's interest is in evaluating the effectiveness of management systems in achieving conformance with requirements or expectations, possible MPIs include:

_ degree of compliance with regulations;

_ degree of conformance of service providers with requirements and expectations specified by the organization in contracts;

_ time to respond to or correct environmental incidents;
_ number of identified corrective actions that have been resolved or that are unresolved;
_ number of or costs attributable to fines and penalties;
_ number and frequency of specific activities (e.g. audits);
_ number of audits completed versus planned;
_ number of audit findings per period;
_ frequency of review of operating procedures;
_ number of emergency drills conducted;
_ percentage of emergency preparedness and response drills demonstrating planned readiness.

Financial performance

If management's interest is in evaluating the relationship of environmental performance to financial performance, possible MPIs include:

_ costs (operational and capital) that are associated with a product's or process' environmental aspects;

_ return on investment for environmental improvement projects;

_ savings achieved through reductions in resource usage, prevention of pollution or waste recycling;

_ sales revenue attributable to a new product or a by-product designed to meet environmental performance or design objectives;

_ research and development funds applied to projects with environmental significance;

_ environmental liabilities that may have a material impact on the financial status of the organization.

Community relations

If management's interest is in evaluating its programmes in local communities with respect to environmental issues, possible MPIs include:

_ number of inquiries or comments about environmentally related matters;
_ number of press reports on the organization's environmental performance;
_ number of environmental educational programmes or materials provided for the community;
_ resources applied to support of community environmental programmes;
_ number of sites with environmental reports;
_ number of sites with wildlife programmes;
_ progress on local remediation activities;
_ number of local cleanup or recycling initiatives, sponsored or self-implemented;
_ favourability ratings from community surveys.

B.1.3 Operational performance indicators

General overview

This subclause provides examples of OPIs that may be appropriate to measure the environmental performance of an organization's operations. An organization's operations may be logically grouped, based on inputs to and outputs from the physical facilities and equipment of the organization. The organization's operations also include the organization's physical facilities and equipment, as well as the supply to and delivery from them.

B.1.4 Examples of OPIs

Materials

If management's interest is in environmental performance related to the materials it uses in its operations, possible OPIs include:

_ quantity of materials used per unit of product;

_ quantity of processed, recycled or reused materials used;

_ quantity of packaging materials discarded or reused per unit of product;

_ quantity of auxiliary materials recycled or reused;

_ quantity of raw materials reused in the production process;

_ quantity of water per unit of product;

_ quantity of water reused;

_ quantity of hazardous materials used in the production process.

Energy

If management's interest is in environmental performance related to the total energy or the types of energy used by, or the energy efficiency of, the organization's operations, possible OPIs include:

_ quantity of energy used per year or per unit of product;

_ quantity of energy used per service or customer;

_ quantity of each type of energy used;

_ quantity of energy generated with by-products or process streams;

_ quantity of energy units saved due to energy conservation programmes.

Services supporting the organization's operations

If management's interest is in environmental performance related to the services supporting its operations, possible OPIs include:

_ amount of hazardous materials used by contracted service providers;

_ amount of cleaning agents used by contracted service providers;

_ amount of recyclable and reusable materials used by contracted service providers;

_ amount or type of wastes generated by contracted service providers.

Physical facilities and equipment

If management's interest is in environmental performance related to the organization's physical facilities and equipment, possible OPIs include:

_ number of pieces of equipment with parts designed for easy disassembly, recycling and reuse;

_ number of hours per year a specific piece of equipment is in operation;

_ number of emergency events (e.g. explosions) or non-routine operations (e.g. shut-downs) per year;

_ total land area used for production purposes;

_ land area used to produce a unit of energy;

_ average fuel consumption of vehicle fleet;

_ number of vehicles in fleet with pollution-abatement technology;

_ number of hours of preventive maintenance to equipment per year.

Supply and delivery

If management's interest is in environmental performance related to the supply of inputs supporting, and the delivery of outputs resulting from, the organization's operations, possible OPIs include:

_ average fuel consumption of vehicle fleet;

_ number of freight deliveries by mode of transportation per day;

_ number of vehicles in fleet with pollution-abatement technology;

_ number of business trips saved through other means of communication;

_ number of business trips by mode of transportation.

Products

If management's interest is in environmental performance related to its products or by-products (e.g. materials other than main products, including recycled and reused materials, that are generated and retained for further commercial purposes), possible OPIs include:

_ number of products introduced in the market with reduced hazardous properties;

_ number of products which can be reused or recycled;

_ percentage of a product's content that can be reused or recycled;

_ rate of defective products;

_ number of units of by-products generated per unit of product;

_ number of units of energy consumed during use of product;

_ duration of product use;

_ number of products with instructions regarding environmentally safe use and disposal.

Services provided by the organization

If the organization provides a type of service, and management's interest is in environmental performance related to the service, possible OPIs include:

_ amount of cleaning agent used per square metre (for a cleaning services organization);

_ amount of fuel consumption (for an organization whose service is transportation);

_ quantity of licenses sold for improved processes (for a technology licensing organization);

_ number of environmentally-related credit risk incidents or insolvencies (for a financial services organization);

_ quantity of materials used during after-sales servicing of products.

Wastes

If management's interest is in environmental performance related to the wastes generated by its operations, possible OPIs include:

_ quantity of waste per year or per unit of product;

_ quantity of hazardous, recyclable or reusable waste produced per year;

_ total waste for disposal;

_ quantity of waste stored on site;

_ quantity of waste controlled by permits;

_ quantity of waste converted to reusable material per year;

_ quantity of hazardous waste eliminated due to material substitution.

Emissions

If management's interest is in environmental performance related to the emissions to air from its operations, possible OPIs include:

_ quantity of specific emissions per year;

_ quantity of specific emissions per unit of product;

_ quantity of waste energy released to air;

_ quantity of air emissions having ozone-depletion potential;

_ quantity of air emissions having global climate-change potential.

If management's interest is in environmental performance related to the effluents to land or water from its operations, possible OPIs include:

_ quantity of specific material discharged per year;

_ quantity of specific material discharged to water per unit of product;

_ quantity of waste energy released to water;

_ quantity of material sent to landfill per unit of product;

_ quantity of effluent per service or customer.

If management's interest is in environmental performance related to other emissions resulting from its operations, possible OPIs include:

_ noise measured at a certain location;

_ quantity of radiation released;

_ amount of heat, vibration or light emitted.

B.1.5 Environmental condition indicators

General overview

This subclause provides examples of ECIs.

Development and application of ECIs is frequently the function of local, regional, national or international government agencies, non-governmental organizations, and scientific and research institutions rather than the function of an individual organization. For purposes such as scientific investigations, development of environmental standards and regulations, or communication to the public, these agencies, organizations and institutions may collect data and information on:

_ the properties and quality of major bodies of water;

_ regional air quality;

_ endangered species;

_ resource quantities or quality;

_ ocean temperatures;

_ concentration of contaminants in tissue of living organisms;

_ ozone depletion;

_ global climate change;

_ and many other parameters.

Some of this information may be in the form of ECIs which could be useful to an organization in managing its environmental aspects or indicating specific issues that an organization should consider in its implementation of EPE.

Some organizations that can identify a relationship between their activities and the condition of some component of the local environment may choose to develop their own ECIs as an aid in evaluating their environmental performance as appropriate to their capabilities, interests, and needs.

B.1.6 Examples of ECIs

Regional, national or global ECIs

If management's interest is the organization's contribution to the regional, national or global condition of the environment, the organization can use indicators being investigated and developed by government agencies, nongovernmental organizations, and scientific and research institutions. Examples of such indicators include thickness of the ozone layer, average global temperature, and the size of fish population in oceans.

Local or regional ECIs

Examples of areas for which ECIs can be developed are air; water; land; flora; fauna; humans; and aesthetics, heritage and culture.

Air

If management's interest is in information on the condition of local or regional air, possible ECIs include:

_ concentration of a specific contaminant in ambient air at selected monitoring locations;

_ ambient temperature at locations within a specific distance of the organization's facility;

_ opacity levels upwind and downwind of the organization's facility;

_ frequency of photochemical smog events in a defined local area;

_ weighted average noise levels at the perimeter of the organization's facility;

_ odour measured at a specific distance from the organization's facility.

EXAMPLE

a) A specific situation

An organization located in a remote non-industrial area may wish to monitor odours in an adjacent residential area as an indicator of its success in controlling air emissions.

b) A possible related ECI

Odour measured at a specific distance from the organization's facility.

Water

If management's interest is in information on the condition of groundwater or surface water, such as rivers or lakes, in the local or regional area, possible ECIs include:

_ concentration of a specific contaminant in groundwater or surface water;

_ turbidity measured in a stream adjacent to its facility upstream and downstream of a wastewater discharge point;

_ dissolved oxygen in receiving waters;

_ water temperature in a surface water body adjacent to the organization's facility;

_ change in groundwater level;

_ number of coliform bacteria per litre of water.

EXAMPLE

a) A specific situation

A local government that manages a sewage treatment plant may wish to monitor coliform bacteria upstream and

downstream of its sewage discharge to determine whether there is a health risk requiring action.

b) A possible related ECI

Number of coliform bacteria per litre of water.

Land

If management's interest is in information on the condition of land in the local or regional area, possible ECIs include:

_ concentration of a specific contaminant in surface soils at selected locations in the area surrounding the organization's facility;

_ concentration of selected nutrients in soils adjacent to the organization's facility;

_ area rehabilitated in a defined local area;

_ area dedicated to landfill, tourism or wetlands in a defined local area;

_ paved and non-fertile area in a defined local area;

_ protected areas in a defined local area;

_ measure of the erosion of topsoil from a defined local area.

EXAMPLE

a) A specific situation

An organization may be concerned about the loss of soil from its land.

b) A possible related ECI

Measure of the erosion of topsoil from a defined local area.

Flora

If management's interest is in information on the condition of flora in the local or regional area, possible ECIs include:

_ concentration of a specific contaminant in tissue of a specific plant species found in the local or regional area;

_ crop yield over time from fields in the surrounding area;

_ population of a particular plant species within a defined distance of the organization's facility;

_ number of total flora species in a defined local area;

_ number and variety of crop species in a defined local area;

_ specific measures of the quality of habitat for specific species in the local area;

_ specific measure of the quantity of vegetation in a defined local area;

_ specific measure of the quality of vegetation in a defined local area.

EXAMPLE

a) A specific situation

An organization whose air emissions include fluoride may conduct vegetation surveys in the vicinity of its facility to

monitor improvements in air emissions control.

b) A possible related ECI

Specific measure of the quality of vegetation in a defined local area.

Fauna

If management's interest is in information on the condition of fauna in the local or regional area, possible ECIs include:

_ concentration of a specific contaminant in tissue of a specific animal species found in the local or regional area;

_ population of a particular animal species within a defined distance of the organization's facility;

_ specific measures of the quality of habitat for specific species in the local area;

_ number of total fauna species in a defined local area.

EXAMPLE

a) A specific situation

A land management company may wish to evaluate the relationship between its operations and biodiversity within its region of influence.

b) A possible related ECI

Number of total fauna species in a defined local area.

Humans

If management's interest is in information on the condition of human populations in the local or regional area, possible ECIs include:

_ longevity data for specific populations;

_ incidence of specific diseases, particularly among sensitive populations, from epidemiology studies in the local or regional area;

_ rate of population growth in the local or regional area;

_ population density in the local or regional area;

_ levels of lead in blood of the local population.

EXAMPLE

a) A specific situation

An organization that uses lead in its products may wish to monitor the relationship of lead released in its emissions with the local population.

b) A possible related ECI

Levels of lead in blood of the local population.

Aesthetics, heritage and culture

If management's interest is in information on aesthetic factors or the condition of historically or culturally significant structures and places in the local or regional area, possible ECIs include:

_ measure of the condition of sensitive structures;

_ measure of the condition of places considered sacred in the vicinity of the organization's facility;

_ measure of the surface integrity of historical buildings in the local area.

EXAMPLE

a) A specific situation

An organization may be concerned about the effect of its air emissions on historical buildings in the local area.

b) A possible related ECI

Measure of the surface integrity of historical buildings in the local area.

B.2 Organisation for Economic Co-operation and Development (OECD)

In 1999 OECD developed a set of fourteen agri-environmental indicators. OECD states that the indicators shall be policy relevant and chosen due to the need of certain information and not due to easy available information.

Problems with finding suitable indicators according to OECD:

- Different size of system boundaries; e g an agriculture, an eco-zone, a nation
- Different time boundaries; e g acute damage, sustainability
- Link to economic and social tasks

The indicators:

1) Contextual Indicators: Covering land, population and farm structures, including changes in agricultural land use and land cover; numbers of full time farmers; and numbers and type of farms.
2) Nutrient Use: Soil surface balances of nitrogen and phosphorous; farm gate nutrient balances; nutrient use efficiency (technical/ economic).
3) Pesticide Use: Index of pesticide use; pesticide use efficiency (technical/ economic); pesticide risk
4) Water Use: Water use intensity (proportion of water resources diverted to agricultural use); water stress (proportion of rivers subject to diversion); water use efficiency (technical/ economic); policy and management response to water stress.
5) Soil Quality: Risk of soil erosion by water and wind; inherent soil quality (agricultural areas where there is a mismatch between the soil capability and actual or impending use).
6) Water Quality: Nitrate and phosphorous concentration in water vulnerable areas; risk of water contamination by nitrogen and pesticides.
7) Land Conservation: Water buffering capacity (quantity of water stored in soil, on the land and by irrigation facilities and the relationship to downstream flooding); off-farm sediment flow (and the relationship to sedimentation of rivers, lakes and reservoirs).
8) Greenhouse Gas Emissions (GHG): gross agricultural emissions (methane, nitrous oxide and carbon dioxide); agriculture's contribution to renewable energy (biomass production); net emissions of carbon dioxide from agricultural soils; economic efficiency of agricultural GHG emissions.
9) Biodiversity: Genetic diversity of domesticated livestock and crops; wildlife species diversity (related to the quality and quantity of species diversity).
10) Wildlife Habitat: Intensively farmed, semi-natural agricultural habitats and uncultivated natural habitats; habitat heterogeneity and variability; impact on habitat of different farm practices/systems.
11) Landscape: Land characteristics (including natural features, ecosystem appearance; and land type features), cultural features (such as stonewalls); management functions of agricultural landscape; landscape typologies; monetary valuation of societal landscape preferences.
12) Farm Management: Farm management capacity (standards for environmental farm management practices; expenditure on agri-environmental research, educational level of farmers); on-farm management practices (adoption of environmental practices related to nutrients, soil, pesticides, water and whole farm management).
13) Farm Financial Resources: Public and private agri-environmental expenditure; farm financial equilibrium between net farm operating profit after tax and the cost of capital.
14) Rural Viability: Agricultural incomes; entry of new farmers into agriculture; social capital in agricultural and rural communities (strength of social institutions, voluntary organisations, etc.)

B.3 The GRI / WBCSD Set of Generally Applicable Indicators

WBCSD has worked in cooperation with GRI in the course of the creation of this concept and during the pilot exercise to come up with a set of generally applicable indicators that can be used by all businesses and provides a globally accepted description and measurement method for them. This will help for a common understanding. The following indicators meet the three criteria for general applicability and should therefore be used by all companies.

Product/service value

- Quantity of goods/services produced or provided to customers
- Net sales

Environmental influence in product/service creation

- Energy consumption
- Materials consumption
- Water consumption
- Greenhouse gas (GHG) emissions
- Ozone depleting substance (ODS) emissions

There are no generally applicable indicators for the environmental influence of product/service use. All indicators in this group are considered to be business specific.

The following additional indicators could become generally applicable if current efforts to develop global agreement on measurement methods are successful:

Additional financial value indicators

- Acidification emissions to air
- Total waste

WBCSD recommends that all companies collect and report data on the generally applicable indicators. But these indicators alone will not necessarily represent the eco-efficiency performance of a company. They will normally be combined with appropriate business specific indicators and meaningful eco-efficiency ratios to provide a company’s eco-efficiency performance profile.

B.4 2003/532/EC – Commission Recommendation

This recommendation was published the 10 of July 2003 and contains guidelines for choice of environmental indicators. The document divides just as ISO indicators into MPIs, OPIs and ECIs, gives examples of each group, and states that environmental indicators should be chosen in a cost effective way with regard to the organisation’s character, needs and priorities.

Important features of indicators:

- Indicators should give an accurate appraisal of the organisation's performance
- Indicators should be understandable and unambiguous
- Indicators should allow for year on year comparison
- Indicators should allow for comparison with sector, national or regional benchmarks
- Indicators should allow for comparison with regulatory requirements

The indicators:

B.4.1 OPERATIONAL PERFORMANCE: INPUT INDICATORS

Indicator category	Examples of indicators	Examples of measurement units
Materials	Raw materials, operating and auxiliary materials, ground water, surface water, fossil fuels, wood, etc.	tonnes per year tonnes per tonnes of product per year tonnes of hazardous/harmful substances per year tonnes of hazardous/harmful substances per tonnes of product per year cubic metres per year cubic metres per tonnes of product
Energy	Electricity, gas, oil, renewables, etc.	megawatt hours per year kilowatt hours per tonnes of product
Products (to be co-ordinated with functional area ‘purchasing and investments’)	Preliminary products, auxiliary and office products, etc.	tonnes per year kilograms of hazardous/harmful material per tonnes of product number/percentage of products with eco-labels (per year)

Services (to be co-ordinated with functional area 'purchasing and investments')	Cleaning, waste disposal, horticulture, catering, communication, office services, transport, travel, education, administration planning, financial services, etc.	tonnes per year kilograms of hazardous/harmful material per service unit (and year) number/percentage of services with eco-labels (per year)

B.4.2 OPERATIONAL PERFORMANCE: PHYSICAL FACILITIES AND EQUIPMENT INDICATORS

Indicator category	Examples of indicators	Examples of measurement units
Design	Buildings, machinery, equipment, etc.	heat loss of buildings in Watts per square metres and Kelvin percentage of equipment with reusable parts (per year)
Installation	Buildings, machinery, equipment, etc.	percentage of machinery parts designed for reuse (per year) percentage or number of equipment with eco-labels or environmental declarations (per year)
Operation	Buildings, machinery, equipment, etc.	hours per year specific machinery or equipment is in operation tonnes of substances, materials or products per year used for operation
Maintenance	Buildings, machinery, equipment, transport vehicles, etc.	hours per year specific machinery or equipment needs maintenance tonnes of substances, materials or products per year used for maintenance
Land use	Natural habitats, green area, paved area, etc.	square kilometres (per year)

Transport	Fuel consumption, emissions from vehicles, business travels by type of transport (plane, car, bus, train), etc.	fuel consumption in tonnes per year by vehicle fleet greenhouse gas emissions emitted in tonnes per year by vehicle fleet mass or number of fine and ultrafine particles emitted per year by vehicle fleet person kilometres per year

B.4.3 OPERATIONAL PERFORMANCE: OUTPUT INDICATORS

Indicator category	**Examples of indicators**	**Examples of measurement units**
Emissions	Air emissions such as greenhouse gases, volatile organic compounds, fine and ultrafine particles, etc. Effluents such as discharge of specific hazardous substances, process water or cooling water, etc. Waste such as hazardous wastes (1), non-hazardous waste, sludge, heat, noise, etc.	tonnes per year kilograms per tonnes of product cubic metres per year cubic metres per tonnes of product kilograms of substances per cubic metre of waste water percentage of waste recyclable (per year) megajoules per year megajoules per tonnes of product decibels (at specific location)
Products (design, development, packaging, use, recovery, disposal)	Substances in products, packaging material, energy consumption of appliances, etc.	tonnes of hazardous/harmful material per year (and product unit) mass percentage of product parts designed for reuse per year number and percentage of products with eco-labels (2) (per year) tonnes of packaging material per year

Services (design, development, operation)	Cleaning, waste disposal, horticultural, catering, communication, office services, transport, travel, education, administration planning, financial services etc.	tonnes or kilograms of hazardous/harmful substances used per service unit and year fuel consumption in litres per service unit and year number and percentage of services with eco-labels (per year)

B.4.4 MANAGEMENT PERFORMANCE: SYSTEM INDICATORS

Indicator category	**Examples of indicators**	**Examples of measurement units**
Implementation of policies and programmes	Environmental objectives and targets, workplace conditions, data management, etc.	percentage of objectives and targets reached per year percentage of units/workplaces with environmental requirements (per year) percentage of units/workplaces integrated into environmental measurement and data management systems (per year)
Conformance	Auditing, conformance with voluntary environmental agreements, etc.	percentage of units/workplaces audited per year number of targets of voluntary agreements achieved (per year)
Financial performance	Resource savings, etc.	euro per year

Employee involvement	Environmental training, employee consultation, suggestions by employees for improvements, etc.	days of training per employee and year percentage of total training per year number of meetings with employee/employee representatives per year number of suggestions per employee and year number/percentage of suggestions implemented per year

B.4.5 MANAGEMENT PERFORMANCE: FUNCTIONAL AREA INDICATORS

Indicator category	**Examples of indicators**	**Examples of measurement units**
Administration and Planning	Direct and indirect environmental aspects and impacts of planning decisions, policies, land-use planning, engagement in green markets, etc.	number of policy developments for which an environmental impact analysis was made (per year) percentage of land planned to remain or become natural habitats or green areas (per year) total value in euro or percentage of products sold on green markets
Purchasing and investments (to be co-ordinated with input indicators related to products and services)	Environmental performance of suppliers and contractors, etc. Investments in environmental projects, etc.	number/percentage of suppliers and contractors with environmental policies or management systems total value in euro or percentage of capital investments into environmental projects per year

Health and safety of workplaces	Environmental accidents, illnesses, indoor air quality, water quality at workplaces, noise, etc.	number of employee accidents per year sick days per employee and year concentration of harmful substances in milligram per litre or parts per million level of noise in decibels at location
Community relations	Discussions with stakeholders groups (meetings, active participation in events), etc. External requests for the environmental statement, etc.	number of discussions in person days per year number of external request per year number of external website downloads per year

B.4.6 ENVIRONMENTAL CONDITIONS: ENVIRONMENTAL MEDIA INDICATORS

Indicator category	Examples of indicators	Examples of measurement units
Air	Specific substances in the air such as sulphur and nitrogen oxides, ozone, volatile organic compounds, fine and ultrafine particles, etc.	milligrams per litre parts per million
Water	Specific substances in rivers, lakes, groundwater such as nutrients, heavy metals, organic compounds, etc.	milligrams per litre
Land	Natural habitats, protected areas Soil contaminated by heavy metals, pesticides, nutrients, etc.	percentage of area (per year) change in square kilometres per year square metres/cubic metres of contaminated soil per cubic metre (per year)

B.4.7 ENVIRONMENTAL CONDITIONS: BIO- AND ANTHROPOSPHERE INDICATORS

Indicator category	Examples of indicators	Examples of measurement unit
Flora	Extinguished and endangered species	number/percentage compared with natural habitats
Fauna	Extinguished and endangered species	number/percentage compared with natural habitats
Humans	Life expectancy of local population, environmental diseases of local population, concentration of contaminants in blood of local population (lead, etc.)	life expectancy in years percentage of local population with specific (chronicle) diseases milligrams of contaminant per litre
Aesthetics, heritage and Culture	Natural monuments	square kilometres

B.5 World Economic Forum (WEF)

WEF has constructed a Pilot Environmental Performance Index (EPI) designed to measure current environmental results at the national scale. The EPI derives from a collection of data sets aggregated into four core indicators that gauge air quality, water quality, greenhouse gas emissions, and land protection. These indicators provide measures of both current performance and rates of change.

Appendix C

The "Plan, Do, Check, Act" cycle

Many companies are good at planning and acting but forget to follow-up the results. This leads to that a lot of information is never used, and lessons from past experiences are not made. If the PDCA cycle is followed, the work will lead to continual improvements.

If a measure has been found to be especially effective in the checking phase, then the next step is to standardise it in the SDCA cycle. However, a new check may lead to that the measure will return to the PDCA cycle.