



# Definition of relevant environmental aspects

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## Summary

This report belongs to the project DANTEs that is supported by the EU Life Environment Program. The aim of this report is to identify and define relevant environmental aspects. The identified aspects and areas to include in this report should be used in the next step in the DANTEs project. This report should be seen as a part of the work in connecting environmental aspects with tools for environmental sustainability, as well as in the establishment of the DANTEs web platform.

In this report the concept of Environmental aspects have been clarified. The international standards ISO 14001 and 14042 is together used to technically define the concept, including how to identify aspects for e.g. an organisation or product, and how to find analysis methods needed to assess performance based on these aspects, and how to improve the performance in terms of these aspects. The relation between tools and environmental aspects is also discussed.

This report suggests that companies explicitly identify their relevant environmental aspects. A company's list of significant environmental aspects defines the scope of responsibility of the environmental management system for the company. The relevant aspects shall be considered when setting targets, educational need, production routines, requirement of suppliers, routines for supervision and measurements. Therefore the identified environmental aspects are important for a company's environmental management work.

Identification of the environmental aspects within ABB, Akzo Nobel and Stora Enso are presented. The method for identification of environmental aspects was interviews of employees at different departments at the companies.

The next step in DANTEs should be to connect identified, well-defined and prioritized aspects with usable tools. In some cases the scope of the aspects needs to be defined and documented.

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# 1. Introduction

The concept of 'Environmental aspect' is a key component in environmental management. An environmental aspect describes the relevant issue(s) that a management needs to address, irrespective of level of abstraction e.g. waste management, global warming, resource extraction, lack of knowledge about process emissions, toxic material management, and biodiversity. Ideally, a list of environmental aspects defines the identified scope of the responsibility of an environmental management system (EMS) as well as gives input to other actions, e.g. in sustainability strategy development. The aspects on one specific company's list are the ones that the company has identified, and are therefore also the only ones that the company can focus the environmental work on. The environmental aspect concept is well established in companies using an EMS. In other companies an explicit list of environmental aspects might not exist, and therefore the company might lack transparency in the priority settings of their environmental work. It is suggested that all companies explicitly identify their environmental aspects. This report is intended to show how environmental aspects are dealt with today, in practice, and how a more transparent and practical way can be implemented.

Environmental aspects is the term that can on the one hand be used for the important issues in the environment that an organisation should take into consideration in their environmental work, things that we care about due to individual human aspects (e.g. noise, smell) laws and regulations, complaining neighbours etc. Environmental aspects on the other hand can also be a product's or production process's environmental impact, e.g. emissions to a nearby river and use of energy. Other examples of aspects are emissions of a chemical, waste generation, production leakage, recycling, different materials, hazardous materials, electromagnetic fields, impact on flora and fauna etc.

According to an investigation performed by IRIS<sup>1</sup>, industrial research institutes in Sweden and IIIEE<sup>2</sup>, the international environment institute in Lund, small and medium large companies work with a limited number of environmental aspects. The following aspects are prioritised:

- Minimising of waste
- Recycling
- Energy consumption at production site
- Emissions from the production site

According to the investigation actions to minimise waste at site are more frequent than energy efficiency activities, but both minimising waste and energy consumption have been economical beneficial. Typically, transport of materials, personal transportation,

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<sup>1</sup> IRIS is a joint organisation of about 30 industrial research organisations. Its objectives are to improve knowledge of industrial research, to protect the common interests of the institutes and to create good relations with decision-makers and, finally, to serve as a link between industry and universities of technology. [www.irisresearch.a.se](http://www.irisresearch.a.se)

<sup>2</sup> [www.iiiee.lu.se](http://www.iiiee.lu.se)

choice of raw material, as well as minimisation of the products' impact during the use- and end-of-life phases are not considered.

Whether these results are based on explicit and conscious assessments, decisions, or prioritisations is not known. Without knowing this it is impossible for e.g. customers or other stakeholders of the company to assess the relevance and the quality of the selected aspects. Therefore, to simplify explicit handling of identification and prioritisation of environmental aspects, there is a need for better understanding and handling of the aspects. In consequence, a better handling of environmental aspects and prioritisations should improve the environmental performance of organisations, production sites and products.

## **2. Environmental aspects**

### **2.1. Different types of environmental aspects according to ISO standards**

This section aims to define the concept environmental aspects through showing that there are different types of aspects in ISO standards. The EMS, ISO 14001 and other international standards are therefore used to find a common definition for the DANTES project.

Implementation of an EMS, like ISO 14001 includes defining environmental policy, planning and implementing of an environmental program, checking measures according to goals and reviewing by management. ISO 14001 is characterised by demands for continuous measurements and an EMS is business focused. [Ritzén, S.]

#### **Aspects and indicators according to ISO 14001**

Environmental aspects are “elements of an organization’s activities, products or services that can interact with the environment” according to the international standard ISO 14001:1996. The environment is defined as “surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation”. Additionally, environmental impact is “any change of the environment, whether adverse or beneficial, wholly or partially resulting from an organization’s activities, products or services”.

Annex A to ISO 14001 state “The process to identify the significant environmental aspects associated with the activities at operating units should, where relevant, consider:

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

Significant environmental aspects are the most important environmental aspects which cause the highest environmental impact or are important due to legislation and other requirements (environmental policy, customer demands). Significance equals the prioritising (not relative) between chosen environmental aspects at a company.

The definition of an environmental indicator is a quantifiable aspect according to ISO 14001:1996.

It should be noted that this report refer to ISO 14001:1996 and a new version of ISO 14001 is under developing, ISO/DIS 14001:200X which was not published when this report was written.

## ***Aspects and indicators according to ISO 14042***

In ISO 14042 the term ‘aspect’ is not used, however, the term ‘Impact category’ is defined as a class representing relevant environmental issues to which LCI results may be assigned, i.e. the aspects of the environment that will be regarded when performing the impact assessment of the LCI result. Intuitively therefore, the impact categories in the ISO 14042 terminology is here considered semantically equivalent to environmental aspects in e.g. ISO 14001. Category indicator is a quantifiable representation of an impact category.

In ISO 14042 the term weighting is described as “the process of converting indicator results of different impact categories by using numerical factors based on value-choices.” The application and use of weighting methods shall be consistent with the goal and scope of the LCA study and it shall be fully transparent. Weighting is to quantify the significance i.e. to prioritize specific, significant aspects, according to ISO 14042.

The term characterization is also used in ISO 14042. Calculation of category indicator results is often referred to as characterization. The calculations involve the conversion of LCI results to common units and the aggregation of the converted results within the impact category. This conversion uses characterization factors and the outcome of the calculation is numerical indicator result. The method of calculating indicator result shall be identified and documented, including the value-choices and assumptions made, according to the standard.

### ***2.2. Generalizing environmental aspects***

The international standards ISO 14001 and ISO 14042 define the concept of “Environmental aspects”. ISO 14001 provide a way to find and name relevant issues and ISO 14042 provides support for analysis of environmental impact assessment i.e. a structure way of working when finding the aspects. In this report the two standards are handled in the described way, but other standards e.g. ISO 14041 are handled analogues and in line with these.

### ***2.3. Environmental aspects in DANTES***

In DANTES we regard both environmental aspect in ISO 14001 and Impact category in ISO 14042 as environmental aspects, and we refer to them interchangeably. From the ISO 14001 perspective the impact categories are relevant issues for the environmental management system, and from the ISO 14042 perspective, they may be associated with both a characterising description of how the environment is impacted, as well as with a causal description of how e.g. a product or process gives rise to this impact.

The first step is to identify, name and define the list of aspects. There should be no unclarity about what an aspect includes. After prioritisation of the aspects, a list of significant aspects is obtained and future work in DANTES shall focus on these aspects. With help from the philosophy of the ISO 14042 framework, a cause-effect chain (characterisation method) is used to trace the relationship between an

environmental impact and an aspect of e.g. an organisational behaviour or a product. For example, avoidance of killing fish might imply avoidance of emitting cadmium from a production facility, and especially from the unit where batteries are installed in machines. The simple logic of this reasoning is in fact a *backtracking* of the methods described in the framework of ISO 14042, and it results in a logic description, and an understanding of the company's potential environmental cause-effect chains.

### **3. General overview of activities to date**

To be able to sketch some map, a brief and general overview of actual and typical ways of working with environmental aspects has been performed. This information has been used as background when analysing the results from the interviews performed at ABB and Akzo Nobel.

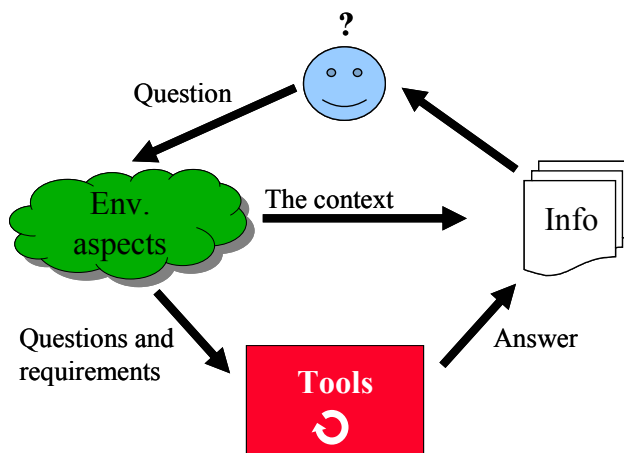
In public environmental information from different companies, mainly in the form of Environmental Management Declaration (EMD), information about the company's environmental policies, environmental performance and action plans is described. After study of a number of EMDs a specific pattern have been found; the area of environmental impact for each company and its list of environmental aspects differ from the action plan and environmental goal set up for the organisation for the next years. In fact only a small fraction of the listed aspects are handed and improved. In appendix 2 an example can be found to illustrate this, more examples can be found on [www.miljostyrning.se](http://www.miljostyrning.se).

There seem to be a lack of consistency, the companies regard a number of aspects as important and have knowledge about their own impact on the environment, but they do not take it into consideration in the daily work.

## 4. The importance of identifying and defining environmental aspects

An employee at a manufacturing company, e.g. a factory has one or more environmental aspect that he/she cares about, or is obliged to get information about and monitor. A certain amount of information is needed to control and minimize the impact of this aspect. The first step is to find out which information needed, an engineering task we here call backtracking (see also 2.3. Environmental aspects in DANTES). The backtracking results in a number of required analyses. For example the information about dose and scope of a toxic chemical, this task might be performed through an exposure analysis.

The figure below illustrates the relation between the employee at the company and connected aspects which he needs different tools to manage. The aspect tells us why and for what we need the tools. The information obtained from tools requires a context. The aspect gives the context and connects the information with the user.



*Picture 1:* The relation between a question or problem, information needed to solve the problem, environmental aspects (which shall give the information a context) and tools used to facilitate when solving the problem.

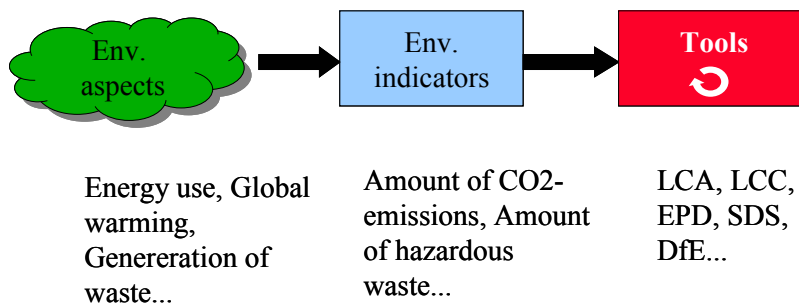
An activity closely connected to the identification of relevant aspects, is to define these aspects. The definition need to explicitly explain the included parts of the aspect. The importance of defining environmental aspects in detail is often forgotten which might cause misunderstandings etc. One perspective of the question how far the aspects should be broken down and described is that one should aim to make the environmental aspect quantitative, based on the same calculation basis e.g. company year. This enable comparison and ranking between companies' environmental aspects. [Zackrisson, 2002] Furthermore, each environmental aspect needs to have a defined owner. The relation aspect and owner is important because someone has to be

responsible for the aspect. The owner should also be responsible for the definition of the aspect.

Identifying and clarifying environmental aspects relevant to an organization also has an educational importance. Education is a prerequisite to be able to change peoples attitudes and increase the awareness of environmental and sustainability issues. When identifying relevant aspects the analysis indicate how an organization can improve in an environmental point of view.

#### 4.1. **Relation between environmental aspects, indicators and tools**

Each environmental aspect should if possible be quantified in terms of an environmental indicator. The indicator can be defined/presented in nominal scale, ordinal scale, interval scale (e.g. the scale on a thermometer) and ratio scale. [Flood et al., 1993] Tools are needed to facilitate the procedure to calculate the indicators. These tools can be both information handling tool e.g. Ecolab, LCAiT, LCAlight etc, and tools describing the working method to achieve answer of the indicator.



Picture 2: The relation between environmental aspects, indicators and tools

## **5. Identification of environmental aspects within ABB, Akzo Nobel and Stora Enso**

### **5.1. Method for identification of environmental aspects in the manufacturing industry**

General perspectives related to sustainability issues as well as more specific user requirements related to sustainability strategies, tools and methods were evaluated by interviewing a number of people at ABB and Akzo Nobel during May and June 2003. In addition to the interviews, information from Stora Enso has been regarded and used as an input for the final conclusions.

The methodology used for the interviews in the two companies was design a little different but in this case it should not have affected the outcome of the identified relevant environmental aspects. A questionnaire was used in both cases and the interviews were conducted as telephone or personal interviews.

The general interview questions in the questionnaire to identify environmental aspects were;

Which environmental aspects (environmental issues) do *you* in your profession find relevant? (Try to get as many aspects as possible, try to focus not only on environmental problems e.g. global warming and acidification but include also energy efficiency etc). Additionally question: Which interested party requests environmental issues at your company?

- Let them develop and explain in detail what they mean with the aspects they have mentioned.
- Present the environmental aspects and let the interviewed person prioritize them (1= very important, 2= important, 3= not important)

An additional question used by ABB was:

What is your consideration about environmental aspects in relation to business?

Among answers of other questions in the questionnaire, environmental aspects were identified as well as how daily work connected to the aspects were performed.

For further information about methodology and results from the interviews about user requirements read the DAN TES internal report User requirements by Arnell, S.

### **Difficulties identified**

One difficulty with the interviews identified were lack of answers from specific areas in the companies and also very brief answers on the questions concerning the environmental aspects. The reason can be lack of knowledge of the person interviewed or lack of understanding of the importance of identifying and working with environmental aspects.

Persons working at the sites, persons responsible for the production sites and R&D have mentioned many environmental aspects which probably reflect the close connection between production and aspects. Market people on the other hand have not the same perception of environmental aspects.

## **5.2. Results at AKZO NOBEL**

Four main environmental aspects relevant for the interviewee and his/her work at Akzo Nobel:

- Environmental impacts from the products and services. Especially impact from the products ecotoxicity.
- Energy use
- Transportation
- Greenhouse gas emissions and other air emissions

Other aspects mentioned were access to fresh water, use of fossil fuels, spill prevention and accidents prevention from transportation, and risks including process safety, occupational safety.

On manufacturing sites, emissions to air and water from the production process is important. The focus has been on emissions to water due to regulations etc. Lots of efforts have been made to prevent emissions to water. Waste and hazardous waste at the site were also mentioned as relevant aspects as well as environmental impact from the products and services e.g. transportation.

The question who is responsible (the producer or the customer) for the use of products was also brought up. There is a need for structuring and clarifying this and how to handle this in the future.

Additionally, education, communication and the need to spread knowledge to other employees', suppliers etc regarding environmental work is an important issue closely related to the environmental aspects identified.

Which relevant environmental aspects to work with is often a management requirement at Akzo Nobel.

ISO 14001 is an important management tool that has been implemented on all relevant sites within the company.

### **5.3. Results at ABB**

The most relevant environmental aspect identified at ABB was:

- energy as losses during usage phase or as decreased energy consumptions for the customers

Another aspect mentioned by many of the 27 persons interviewed was:

- materials' toxic properties e.g. brominated flame retardant in plastics, lead in solders etc.

For some products material choice is not a big issue, it is very depending on the type of product.

LCA studies at ABB have also showed that weight and energy losses are important aspects. Furthermore electric and magnetic fields, oil leakage, land use, use of batteries for energy storage and noise emission are identified as relevant aspects.

The whole system aspect was also mentioned meaning that impact from production, usage and end-of-life phase and scrapping should be minimized.

Education and communication of environmental information was also identified as an important issue at ABB.

The EMS, ISO 14001 was introduced at ABB in 1996 and much effort has been put on certifying all production units and this work was almost finished in 2002. The environmental management system is the most important driving force for the every day environmental work

### **5.4. Environmental aspects at STORA ENSO**

Generally the following environmental aspects are prioritized at Stora Enso:

- Emissions to water – including oxygen-consuming substances (e.g. COD), chlorinated substances (e.g. AOX) and in some cases also nutritive substances as nitrogen and phosphorus.
- Emission to air e.g. CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>x</sub>.
- Waste disposal and hazardous waste
- Raw material – wood
- Transports and noise

The focus at Stora Enso is at emissions to water and air as well as waste generation and management.

Depending where in the organization one is situated different types of aspects are considered important. Persons at sales departments often are more focused at the products properties and also at transports.

ISO 14001 is of great importance for handling environmental aspects.

### **5.5. Environmental aspects and the market**

The interviews indicated that environmental aspects are usually not discussed or utilized in the marketing organization. Improved products or systems could therefore be used much more as an argument in marketing to strengthen the competitive edge and contribute to an increase in profit and sales. It is however critical to present and communicate the information in an understandable but still unbiased way. It is therefore critical to implement environmental aspects and considerations in the company's business strategy.

### **5.6. Environmental aspects and the customer**

The requirements from the customers regarding the company's environmental impact are continually increasing but are still relatively limited according to the performed interviews. The lack of interest from customers about the products environmental impact can be one of the reasons why available market information mostly not cover all environmental aspects identified by the company. The cost for acquiring data needed for improvements is high and if few requirements exists efforts are not made. To improve the aspect of e.g. toxic materials impact on environment and humans, all material safety data sheets (SDS) is suggested to consist of sufficient toxicological information including biodegradation, ecotoxicity, accumulation, mobility etc.

## **6. Environmental aspects of research**

Environmental aspects of research are here illustrated by the technical and natural sciences view of aspects. The most important environmental aspect for research at universities and companies are the use of toxic chemicals. Many toxic and mutagen chemicals are handled for research activities and therefore the properties of these chemicals have to be well known. To follow legislation is the driving force concerning the research work with environmental aspects. More information about research and environmental aspects can be found at CODEX<sup>3</sup>, [www.codex.uu.se](http://www.codex.uu.se).

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<sup>3</sup> CODEX- Regler och riktlinjer för forskning, is a co-operation between Uppsala University and Vetenskapsrådet, [www.codex.uu.se](http://www.codex.uu.se)

## 7. Prioritizing environmental aspects

A list of environmental aspects can define the scope of responsibility of an environmental management system, as mentioned in the introduction. The aspects on the list are the ones the company should focus the environmental work on, other aspects are often not considered. Due to economic and practical reasons the chosen aspects needs to be prioritised. Each prioritised aspect, named significant aspect by ISO, requires a specific, well-structured investigation and work.

All organizations have to choose the aspects the most relevant and important for them. For example magnetic fields can be more strategic to decrease than leakage of oil. One reason could be that the public opinion about magnetic fields is very strong since high magnetic fields may cause negative effects on humans. If leakage of oil occurs, the customer can take care of it easily, through filling the application with more oil.

It is important that the prioritizing of aspects in different sections in a company is made on common basis. This facilitates the communication of aspects to customers, public etc.

Energy savings and ecotoxicity are two sides of the same sustainability. To acquire sustainability a trade-off is required. Trying to work with both energy savings and ecotoxicity aspects at the same time, often leads to a situation of optimization. For example a more energy efficiency solution during usage phase is achieved through a higher consumption of cadmium or a more energy efficient production process uses the toxic and mutagen solvent Trichloroethylene.

## 8. Methods for identifying and prioritizing significant environmental aspects

There are many methods for identifying and prioritizing significant aspects, only a few of them are documented in public available documents. They are often built on estimations of environmental impact of different environmental aspects. IVF<sup>4</sup> presents a method for environmental assessment of environmental aspects. An example of the first step of this method is presented below. For further information please read Zackrisson, Miljöaspekter – identifiering, bedömning, prioritering, 2002.

<b>Environmental aspect</b>	<b>Climate change</b>	<b>Depletion of ozone layer</b>	<b>Acidification</b>	<b>Use of land</b>	<b>Biodiversity</b>
Transportation	3	1	2	2	1
Use of energy	3	2	2	1	1

Explanation: 0= no impact, 1= minimal impact, 2= impact, 3= large impact on the present area.

*Table 1:* Environmental aspect in relation to impact categories [Zackrisson, 2002]

<sup>4</sup> IVF Industriforskning och utveckling, [www.ivf.se](http://www.ivf.se)

## 9. Summary of identified environmental aspects

The interviews showed that consumption of energy - both consumption during use and during production, and environmental impacts from the products in terms of toxicity are the most significant environmental aspects. Additionally, emissions to water and air, waste management, transportation and energy use in general are identified prioritized aspects. The complete list can be found in appendix 1.

The relevant environmental aspects identified from the interviews are in some cases similar but in many cases they very much depend on the product and the business situation. Each department/business unit at a company has their own priority list on aspects. Some aspects are ignored and some all efforts are used to improve to obtain a more sustainable product. Requirements from different customers are a small driver since these requirements are few. Legislation is on the other hand the major driving force, therefore the environmental aspects are closely connected to the legislation.

Often the identified aspects are vaguely defined. The aspects should be divided into several well-defined fractions which can be developed into quantifiable indicators. The aspect "Energy use" for example can include both energy consumption during production of the product, the end-of-life phase or during use of the product. Economic aspects and energy use during transportation can also be included as well as suppliers' use of energy. If the meaning of the aspect energy use is very broad the required amount of information is tremendous.

For the aspect toxicity there are a range of toxicity parameters that can be considered e.g. ecotoxicity, biodegradation etc. Even the term ecotoxicity could be defined further. The term ecotoxicity might include not only the results from eco-toxicological tests but also the public opinion about hazardous chemicals etc.

Energy consumption in the usage phase is an aspect close related to economic aspects. If the customer learns how to evaluate their whole system (different machines etc) in which a purchased machines are going to work, energy consumption will probable play a larger role and this could be an advantage for the company selling the machine.

Transportation to and from the production site is a relevant aspect due to the impact on global warming. There is a need to specify transportation more to improve understanding about e.g. emission of carbon dioxide. Suppliers close to the factory could be used to minimize transports according to the interviewed persons. The price is nevertheless the most important factor to date. To be able to measure the environmental impact on different transports and compare different alternatives in a structured way both the environmental aspect and economical aspect could be taken into account. A first step could be to define a set of environmental aspects relevant for each company's transportation.

The customer does not always value environmental aspects and he or she is mostly not paying a premium on that. The ranking is price, maintenance fee, safety,

automated, environmental friendly. There is one example at ABB when discussions about the environmental aspect on a toxic substance have lead to increased sale.

The interviews indicate that the public opinion in some cases affects the prioritized environmental aspects. The aspect noise for example could be prioritized based on the public opinion due to neighbors close to the site. On the other hand, emission during use as leakage of glycol and oil is only considered when legislation requires measurements. Public opinion is more focused on material issues (lead, SF<sub>6</sub>, cadmium etc) and the recycling of materials than environmental impact of energy loss.

A general comment is that the EMS, ISO 14001 seems to be of great importance in handling and identifying environmental aspects. Prioritizing between them on the other hand does not appear to follow a certain pattern (see section 7. Prioritizing environmental aspects).

## **10. Discussion - Consequences of the results**

As discussed before a company's list of significant environmental aspects ideally defines the scope of an EMS. The aspects on the list are the ones the company can focus the environmental work on. In practice, the scope is often set first by a managerial group and the aspects are identified within the scope. Furthermore, an explicit list of environmental aspects might not always exist within a company, and therefore the company might lack transparency in the priority settings of their environmental work. This report suggests that companies explicitly identify their environmental aspects. Due to economical and practical reasons all relevant aspects are not dealt with simultaneously and with the same priority. It is also suggested that the prioritisation of the handling of environmental aspects are also made explicitly, on the basis of the list of relevant environmental aspects. This would result in a transparent view of companies' prioritised environmental aspects, the significant aspects, and it will result in well-structured way to work.

Furthermore, the identified environmental aspects have to be well-defined. The person responsible for the investigation of a certain aspect has the responsibility to find out exactly what is meant to be included in the aspect. When using the term ecotoxicity or biodegradation, the meaning of this term should be clear.

Another important conclusion is that there is a need to talk about the product from a holistic perspective, including production, use and end-of-life, often named the life cycle perspective. The information and environmental aspects from the life cycle of a product are both comprehensive and complex and has to be structured in a systematic way. Several types of environmental management tools have been develop to support the measurement, control and calculation of environmental aspects over the whole or specific parts of the life cycle. Different tool for environmental sustainability should however be well defined in their scope as well as in their role in the companies that should be explicitly defined. For example for Life Cycle Assessment the role needs to be defined and the procedure of how to perform an LCA study should be well known. Additionally knowledge of how to interpret the results is crucial. Analogous for material specifications and transport studies the role, how to make, how to interpret should be well-known and explicitly defined.

The consequences of the list of significant aspects also need to be discussed. Consequences in terms of competition with other companies are one important issue. Furthermore, reducing energy consumption both for the production process and the customer, when using a specific product, leads to changes in both the production and end-of-life phase of the product. Scrapping costs, choice of materials etc, are influenced. Therefore an environmental aspect that seems limited and well defined can be broader and have consequences on the products total environmental impact. There is a risk to limit the view of an environmental aspects because the company might not see how customers apprehend the improvement of an aspect e.g. energy efficiency.

Summarizing the environmental aspects in the companies indicate that control of the production is the most important aspect. The below picture can be used as example to facilitate the understanding and control of an industrial system. To be able to navigate a system towards the target, the responsible person need perceivable information about the goal and the current status of the system he/she is controlling. Based on this information targets are being set to steer the system towards better performance. Information and facts about the present situation is therefore crucial. A feedback loop of knowledge will be established when aiming to reach the target. To reach this the person, the controller, responsible for the process is very important.

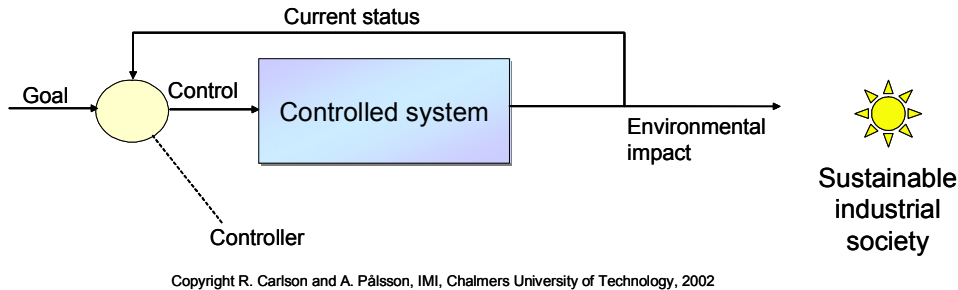


Figure 3: Model that enables navigation of an industrial system towards a dynamic definition of sustainability

## 11. Future work within DANTEs

There is an explicit relation between the aspect and what to measure i.e. which analysis to perform. For example ecotoxicity is closely connected to acute toxicity measurements ( $LC_{50}$ ,  $LD_{50}$ , etc). The work in DANTEs for the nearest future should be to link each of the identified aspects and connected indicators to usable available tools.

First the identified environmental aspects needs to be interpreted as far as possible, and then the tools identified in the report “Benchmarking of WEB-methods and WEB-tools”, written by Dag Ravemark, should be connected to each of the different aspects. Furthermore the map of aspects and tools should be analysed and completed if there are any missing parts. The tools for environmental sustainability should be well-defined and their role in the companies should be explicit.

## **Reference:**

Arnell, Sylva, User requirements, DANTES internal report

CODEX- Regler och riktlinjer för forskning, is a co-operation between Uppsala University and Vetenskapsrådet, [www.codex.nu](http://www.codex.nu)

ISO 14001:1996 – Environmental management systems – Specification with guidance for use

ISO 14042:2000(E) – Environmental management – Life cycle assessment – Life cycle impact assessment

ISO 14041:1998(E) – Environmental management – Life cycle assessment – Goal and scope definition and inventory analysis

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# Appendix 1

## List of identified environmental aspects

- Emissions to water
- Emission to air e.g. CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>x</sub>
- Waste disposal and hazardous waste
- Raw material – wood
- Noise emissions
- Materials' toxic properties e.g. brominated flame retardant in plastics, cables made of PVC and lead in solders
- Electromagnetic fields
- Oil leakage
- Land use
- Use of batteries for energy storage
- Environmental impacts from the products and services, Impact from the products ecotoxicity especially
- Energy use
- Energy as losses during usage phase or as decreased energy consumptions for the customers
- Transportation
- Greenhouse gas emissions and other air emissions
- Access to fresh water
- Use of fossil fuels
- Spill prevention
- Accidents prevention from transportation and risks including process safety, occupational safety.

## Appendix 2

Environmental Management Declarations from different companies have been studied, especially in terms of environmental aspects and the actions connected to the aspects. Below is an extract from an EMD for Zinkteknik AB in Sweden, the full version can be found at [www.miljostyrning.se](http://www.miljostyrning.se).

### Environmental impact

The following environmental aspects have been identified as them that mainly is connected to/affect the company's activities:

- Consumption of energy
- Consumption of raw material (zinc)
- Consumption of water
- Use of chemicals
- Noise
- Emissions to water and air
- Hazardous waste
- unsorted waste
- Transports
- Suppliers and contractors

### Environmental goals and action plan

1. The amount of (volume) unsorted waste shall be minimised by additional 10% through sorting combustible
2. Decrease the energy consumption by 10% till the end of year 2001
3. Replace Freon R22 in air-dryer to compressors and refrigerating (cold-storage) plant with a for the environment better alternative.
4. To impact and assist at least half of our suppliers to improve/start their environmental work.

Translated by Karolina Flemström, the full version in Swedish can be found at [www.miljostyrning.se](http://www.miljostyrning.se)

The example shows that only a small part of the listed prioritized environmental aspects are included in the action program.