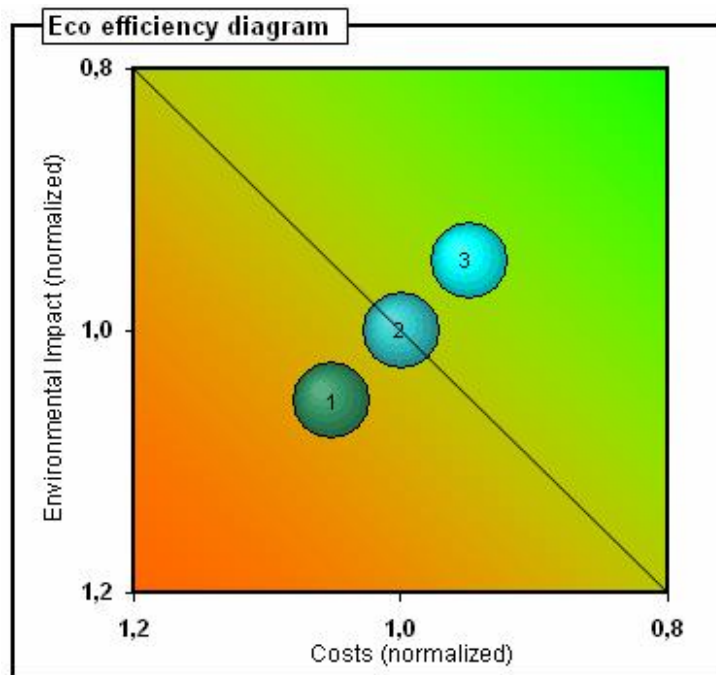


Implementing and using Eco-Efficiency within AkzoNobel

How to incorporate sustainability in financial decisions



Master Thesis Max Sonnen

Industrial Ecology:

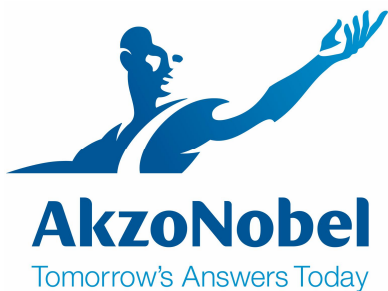
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Industrial Ecology



Preface

When I was looking for a place to do my masters thesis I wanted to work in a company, so that I would have immediate feedback from practice, and somewhere abroad to get some experience living and working in another country. My personal goal on the content was to integrate the economists / business perspective, which I have learned in my bachelors of economics, and the systems and modelling perspective, which I have learned in my bachelors of System Engineering Policy and Management, into the sustainability perspective taught in my masters of Industrial Ecology. So when in January 2008 I got the offer: "Do you want to go to Sweden for half a year to do you thesis with AkzoNobel Sustainable Development?" I had to take that chance and settled for the company abroad, hoping it would be possible to work on my personal goals.

I am happy that I got a lot of space within the SD-group and from my supervisors from the university to achieve my personal goals in the thesis work. Whether or not I have succeeded you can judge yourself by reading this report. Due to the different perspectives there are a number of different topics discussed in this thesis. I hope that it is clear how they are connected and that they add something to the overall story.

I would like to thank my supervisors Rene and Gijsbert for the relaxed atmosphere that you created during my thesis work while being critical and sharp at the same time. You gave me a lot of freedom but still had high expectations from my work. This motivated me to fulfil all these expectations. You have reminded me not to think too lightly about sustainability while at the same time you were able to understand my point of view.

I would also like to thank everybody within the AkzoNobel Sustainable Development Group for giving me a very pleasant environment to work in and good discussions during the fika. More specifically I want to thank my supervisors Karin and Karin for your guidance and advice on my work and thought processes; both in a completely different but very pleasant way. Kjerstin: Thanks for inviting me to Sweden and Klas: thank you for your sharp and inspiring ideas on sustainability. Tobias: Thank you for the good discussions we had, especially on the methodology developed in my thesis. Through your sharp comments, questions and suggestions I was forced to express my ideas more clearly and come to new insights, this has helped a lot to improve the quality of the thesis.

Finally I would like to thank my parents for all their support during the years that I have been studying.

Summary

Eco-Efficiency (EE) is a concept that looks at the impact of a certain system on society using environmental factors and economic factors. AkzoNobel is one of the companies that have adopted the Eco-Efficiency concept to put their sustainability goals into action. They have been working with it since 2004. They use Eco-Efficiency Analysis (EEA) by offering the services of their Sustainable Development (SD) group to their business units and have implemented EEA by promoting it throughout the company. They developed the following definition of EEA: *"A methodology that compares the economic and environmental performance of two or more alternatives over their life cycles, based on their customer benefit"* [AkzoNobel Sustainable Development November 2008]. The full introduction and background can be found in chapter 1 and 2.

The main goal of this study is to:

Review and improve the EEA methodology as used within AkzoNobel.

This thesis consists of four sub-studies:

- An EEA (case) study for sub Business Unit (sBU) Cellulosic Specialties (CS): "filler in paper"
- A project review with the SD-analysts, describing and analyzing the old EEA projects
- An investigation into the decision making structure of sBU CS
- An investigation into the economic part of the EEA methodology

There are four results from these studies:

- There is a first indication that increasing the amount of filler in paper production is financially and environmentally beneficial
- Three recommendations are given on improvement opportunities in the approach of the EEA study
- Life Cycle Costing (LCC) is a suitable method for the economic methodology within EEA in AkzoNobel
- A method is developed to link EEA to the (financial) project valuation used within AkzoNobel

EEA study "filler in paper"

The main goal was to gain insight in EEA and describe the "base case" in order to make clear what the improvements are. The case study was performed on the "high filler in paper concept" that is being developed by AkzoNobel CS and AkzoNobel pulp and paper. The results are that the new concept is better on the environmental axis as well as the cost axis, as compared to the base case. See Figure 1 below. You can find more information about the case study in chapter 3.

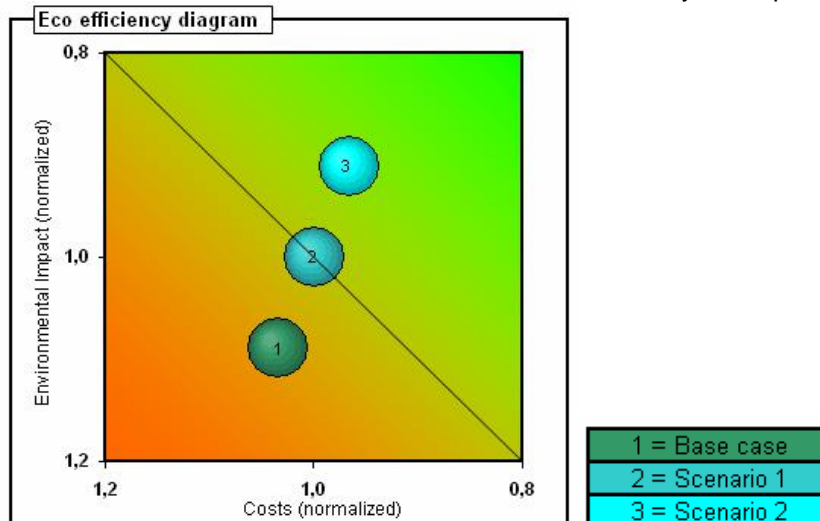


Figure 1: Eco-Efficiency Result: Electricity from the Chinese power grid and heat from coal

EEA review with the SD-analysts

The experiences with EEA of the SD group during the last three years are reviewed via a standardized evaluation interview with one of the SD-analysts for every EEA project. The conclusion of the review is

that the EEA adds value to the AN organization, the current method works. No major problems were identified. The results of the review are described in chapter 4.

Decision making structure

The decision making structure of sBU CS was studied via a series of interviews with managers of CS. The goal was to find the structures that are used in decision making and the elements that play a role in these decisions. Three decision making steps were identified and in a description of the bonus system as used within AkzoNobel. The full results can be found in chapter 5.

Three recommendations on the approach to the EEA study

The three recommendations on the EEA studies in the SD-practice are based on the three sub studies mentioned above. The full recommendations can be found in chapter 6

1. EEA inventory / pre-study:

A number of EEA studies and customers could benefit from an EEA inventory / EEA pre-study. This does not have to be very extensive, but a qualitative investigation of the "EEA system" to see where the main opportunities are.

2. Evaluate the studies:

Currently there is no consistent evaluation of the EEA studies. What were the experiences of the people in the project team working with the SD-Group and EEA? What did the decision maker plan do with the results? How were the results actually used and what information was missing?

3. Investigate and quantify expectations:

This recommendation is mainly meant as a structured way to find out who wants what and why? Spending some time on this before the project starts is mainly important to make sure that things will go smoothly during the project and to provide a "backup plan" in case things go wrong. There are three main actors (groups) who need a different approach:

- **Decision maker / Customer**

The use of the results depends on the decision maker. Are the results useful and do they fulfil the information need of the decision maker? The decision making model is used to find the decision maker's needs:

The decision maker has identified a need

The decision maker has identified a need and thinks requesting an EEA will help him investigate it. Try to find out what the need is and how the EEA will help him in his investigation.

The decision maker investigates the need

The decision maker has decided that the EEA study will give him (part) of the information that he needs to make a good decision. Is this the only resource he uses to make his decision or are there others? There might be an opportunity to share knowledge or insights.

The decision maker makes a decision.

When the decision maker will make a decision, he assesses the impact of his decision on his targets. The decision maker will expect information in a number of the categories presented in Table 1 below:

	Company targets		Personal targets	
	Financial	Non financial	Financial	Non financial
Long term	Goals	Goals	Future salary	Personal needs
Medium term	action plans	action plans	Bonus	Personal needs
Short term	Budgets	Working orders	Bonus	Personal needs

Table 1: Decision maker information need

- **Project team**

The success of the project is mainly dependent on the relation of the analyst with the project team. The project leader has a big role in the communication with the customer and the people involved in data gathering. The main goal should be that everybody in the project team has enough time available

and at least some interest in doing the project. Try to involve the project team as soon as possible and make sure that they know what to expect, especially from the data collection phase.

- **Analyst**

Different people in the project want to get different things from the project. The decision maker usually has an information need. The project team usually wants to work together in a nice way, learn something and feel appreciated and taken seriously. The analysts also want to get something out of the projects. They usually want to have a good cooperation with the project team during the project, make people enthusiastic to work with sustainability and try to spread environmental thinking within the company. This means that for the analyst to have a successful project he will have to satisfy these needs. Try to work on these needs during the project. This is also a good checklist to see what you should highlight in the final presentation.

Economic part of the EEA methodology

The economic methodology used in EEA is studied via information from literature, SD- practice and the decision making structure. Life Cycle Costing (LCC) (perspective) is used and it is a good method for the economic methodology within EEA in AkzoNobel. Besides the LCC, AkzoNobel has other economic indicators, for example the Economic Value Added (EVA). AkzoNobel will always use these indicators as a financial decision making tool and not LCC. The LCC (in the EEA) should not be competing with these economic indicators in decision making but should be used complementary as a means to look at sustainability. The main advantage of accepting that LCC is not used for (financial) decisions is that there is no need for discounting in the LCC methodology. This results in the insight that the sustainability score, that can be derived from the EEA, could be used to set the criteria in the financial decision making structure as used in AkzoNobel. The full results of this part of the study can be found in chapter 7.

Sustainable Project valuation

The sustainability score that could be used to set criteria in the (financial) decision making within the AkzoNobel organization is described. Also, the way the sustainability score should influence the decision making is described. The AkzoNobel organization and individual manager should have different types of targets in their financial structure based on the sustainability score.

Sustainability for the AkzoNobel organization

Sustainability for the AkzoNobel organization is the real sustainability score (impact on society). This score should be used to reprioritize investments with set rules. If an investment is sustainable it should be easy to invest; if an investment is unsustainable it should be hard to invest. This is a good way to communicate internally what "sustainability is worth according to AkzoNobel". This is done without missing out on very profitable but unsustainable opportunities. This system also sets a clear limit where unsustainability cannot be compensated by high profits. This is used to give a strong statement and it is also used as a quantified conscience that cannot be ignored.

Sustainability for the manager:

Sustainability for the manager means improvement on the current situation. If he can find an investment with the new investment rules he should be rewarded for a big improvement in the sustainability, while he should be punished if he does not make an improvement.

From these two concepts the sustainable project valuation diagram follows:

			Effect on bonus manager		
			Improvement by manager versus current project situation		
Sustainability score of the product	Sustainability	Investment	Lower than 5%	Between 5 and 20%	Higher than 20%
Too High	Phase out	Not possible	-	-	-
Much higher than normal	Very Unsustainable	Very Difficult	Penalty	Nothing	Bonus
Higher than normal	Unsustainable	Difficult	Penalty	Nothing	Bonus
Normal	Business as usual	Normal	Penalty	Nothing	Bonus
Lower than normal	Sustainable	Easy	Penalty	Nothing	Bonus
Much lower than normal	Very sustainable	Very easy	Penalty	Nothing	Bonus

Table 2: Sustainable project valuation

The full explanation of the sustainable project valuation model can be found in chapter 8. There are a number of advantages and disadvantages in using sustainable project valuation:

The analyst:

- The decision makers will be more involved in the EEA score and will do their best to provide all the information that is needed.
- The difficult discussion about the need to discount the LCC is avoided
- The results of the EEA study have to be used and taken into account.
- By having an earlier involvement in Appropriation Request (AR) there is more time to find the right information and also to make more improvements.

The decision maker

- By giving a very general rule it is easier to plan and start sustainable projects.
- The rules will be implemented on a very high level while still giving the decision makers the liberty to decide on the direction they want to take; it will just be more profitable to go in the sustainable direction.
- A manager in the unsustainable business will not be severely punished, he will have a harder time to find investments, but if he finds improvements he will be rewarded for it.
- It is a signalling instrument; if you are in an unsustainable business it is better to actually know that and try to do something about it than to find out when it is too late.

The company

- It is easy to communicate, not only internally but also externally. This could be the first time a company would be putting stringent financial targets on sustainability like this. This can give great publicity.
- It is good for the company on the long versus short run struggle. This is done by reallocating resources from managers that do unsustainable business in the short run to managers that can find sustainable solutions for the long run.
- There will be a lot of sustainable business whilst the small amount of unsustainable business will be very profitable. For the company the future is uncertain, the only thing that is certain is that sustainability will become a bigger issue in the future, especially in the western world. AkzoNobel has already acknowledged this in its business strategy. So having a large part of the revenues coming from sustainable business can never be bad.
- It is a steering instrument that does not need a change in the organization; the systems are already in place. It will also steer using those things that the board controls.
- It formalizes the role of the EEA in the Appropriation Request. Where the EEA is currently without (visible) consequences there is now a real added value of the EEA in the AR.

Disadvantages / opportunities

- Right now there is a certain status quo in the organization. The status quo could be turned on its head. Some parts of the organization might go from the winner right now, to the loser. Even while this is actually the goal of the system (to change the success factors) it could give struggle within the organization.
- It takes time and money to implement and it is an extra step in project evaluation, additional calculations are needed to find the costs.
- There has to be a uniform EEA calculation methodology. EEA is very specialized work and it is hard to check if it was done correctly, only by looking at the results. Therefore a strict methodology should be designed and an organ should be appointed that can give out officially valid EE scores. They have to check the figures for consistency with the method.

Conclusions

In chapter 9 the conclusions are presented:

EEA connects economy and environment

Life Cycle perspective

EEA is a good way to connect economic and environmental thinking within a company. By adding the economic dimension to the environmental analysis there is a higher willingness to listen to the results. The main value that is added by the EEA is the life cycle perspective. By looking through the life cycle

to find all the up- and downstream impacts of the products produced by AkzoNobel, valuable opportunities can be identified. By acknowledging the fact that the company needs to make money one way or the other and taking the economy into account in the analysis it becomes easier to talk about sustainability and environmental impacts.

Motivation and opportunity

There are a lot of people in the AkzoNobel organization who have a personal motivation to work “more sustainable”, but they have limited knowledge and budget to become “more sustainable”. By showing them how projects could be financed (for example in the “filler in paper” case) and at the same time saying something about the sustainability improvements, they start to realize that sustainability is not always something that will cost money or is very complicated. Therefore it is very important that also in cases where there are obvious environmental and economic benefits (over the life cycle) these improvements should be acknowledged as sustainable solutions. They should not be dismissed as standard yield improvements or energy savings. The sustainability label should not only be attached to big, complex, timely and (maybe) costly projects that make huge (environmental/sustainability) improvements. It is important that people feel that they are going in the right direction, that they are motivated to be more sustainable and can see that sustainability works. This does not mean that the AkzoNobel organization as a whole should not set high goals on sustainability, but it is important that individuals remain motivated.

Long term strategy and risk

EEA is a very useful instrument if you want to see whether you are going in a sustainable direction or not and if you want to invest money in sustainable business. Doing EEA can reduce the risk of going into an unsustainable direction. In other words: the company will be prepared for changes such as higher raw material and energy prices, environmental taxes and stricter rules and regulations. By moving in the right direction the continuity of the business is ensured. The EEA can be described as a strategic long term (more than 3 years) decision making instrument, looking at “the long term right” a company has to keep on doing business from the perspective of society.

EEA is not the only decision making criterion

Other criteria

Within AkzoNobel, the EEA is always part of a bigger picture. Just looking at the results of the EEA is never enough to take a major decision. A number of other elements are taken into account: the impact on the EVA, the short, medium and long term goals and the way the alternative suggested by the EEA fits in the company strategy. It is important to recognize this when looking at the way the EEA is used in the company. This insight can be used to present the EEA within the company in such a way that it is clear what information it adds to decision making.

Just LCC is not enough

The LCC (as used in the EEA) does not give enough insight in the economic reality of AkzoNobel to be used as the only element in economic decision making. LCC is different from the project valuation /EVA calculations as used by AkzoNobel in decision making. The project valuation tries to measure the future profitability and makes sure that the company can earn back its investment. LCC is a very good tool to look at economic aspects in a qualitative way and discover new insights but AkzoNobel can not use the LCC for (final) project valuation or investment decisions. Therefore it is good to say something about project valuation in the EEA study, for example by calculating the EVA. This way the analyst acknowledges the need to look at other indicators and shows that he understands the difference between LCC and project valuation/EVA.

Measure and put targets on sustainability

The final conclusion is that AkzoNobel has the opportunity to take the next step towards sustainability. This can be done by integrating the sustainability scores into the project valuation process, or using the well known saying: “What gets measured gets managed”. The concept of “sustainable project valuation” developed in this thesis could be used to do this. The most important benefit of taking this step will be the strong signal within the company: “We believe that sustainability is of great importance. Sustainability is of such importance that we incorporate it in our financial decisions”.

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1 Introduction

1.1 Problem description

Almost every large firm in the western world has a corporate statement with something in it on sustainability. They use this in their yearly report and sometimes they have a special report addressing sustainability issues. But how are these words put into action? Can these statements be used in everyday decision making?

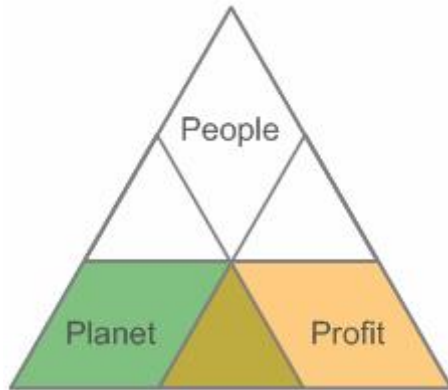


Figure 2: Sustainable development

Since sustainability is a very broad topic this thesis focuses on one specific part of it: the Eco-Efficiency Analysis (EEA). This is an analysis where alternatives are compared on the basis of environmental factors and economic factors. The results of an EEA are often shown in a diagram like figure 2. The economic score is on the horizontal axis and the environmental score is on the vertical axis.

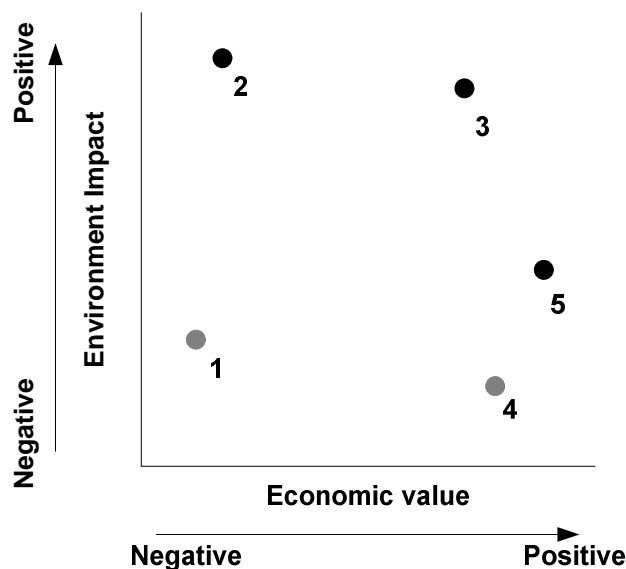


Figure 3: Eco-Efficiency diagram

In the diagram above 5 alternatives are compared. In this case there are three alternatives which can be chosen depending on the preference¹ of the decision maker: the black dots. If the decision maker would go for the most positive economic or environmental option he would respectively choose number 5 or number 2. If he would want a little bit of both he could go for option 3. In this case alternatives 1 and 4 should never be chosen because there are alternatives that are better on both axes.

¹ The decision is of course depending on what is on the axis and how the points are calculated. But the goal here is to explain the general idea.

Why measure Eco-Efficiency?

Why are we measuring the Eco-Efficiency? Kuosmanen has a very useful answer to this question: *“To begin with, it is worth asking why quantification of Eco-Efficiency is important. According to an oft-repeated mantra from the business world, “what gets measured gets managed.” This line of reasoning applies to Eco-Efficiency as well. Many policy makers, business managers, and consumers are keen to make environmentally friendly decisions, but they simply lack the necessary information resources to compare different alternatives. The function of Eco-Efficiency measures is to guide decision making by politicians and managers, as well as consumers, by facilitating systematic comparisons of products and production technologies in a way that comprehensively accounts for various criteria and their tradeoffs.” (Kuosmanen 2005)*

This will be used as the main reasoning line in this thesis:

Use quantified Eco-Efficiency as a way to communicate the impact of a decision on “the sustainability”².

Eco-Efficiency in AkzoNobel

AkzoNobel is one of the companies that have adopted the Eco-Efficiency concept to put their sustainability goals into action. They have been working with it since 2004. They use it by offering it to their business units through the services of their Sustainable Development (SD) group and have implemented it by promoting it through out the company. This thesis will study the experiences of the SD-group with Eco-Efficiency since 2004 and try to find opportunities to better adapt the (use of) the EE concept to the AkzoNobel Organization. There are three reasons for the SD-group to look into this:

Find improvement opportunities

By studying the experiences working with EEA so far improvement opportunities could be identified.

The EEA does not contain the economic information needed for the decision

The decision makers are usually trained in economic analysis and know a lot about it. They will often need a separate economic analysis for their decision since they need to have standardized calculations. EEA often uses other economic methods and have normalized results. Therefore the EEA does not always deliver the economic information that is needed. This could be a reason to disregard the economic elements presented in the EEA since an economic analysis is done separately.

Understanding of EEA by decision maker

EEA is a relatively new concept and decision makers are not used to it. EEA originated from environmental science and the analyst who makes it (usually) has an environmental background. When the results are presented as in figure 2 it is easy to understand. But the EEA itself is not easy to understand. It contains an environmental analysis that is complex and time consuming to understand for people who are not familiar with it. Is there a need to make a better explanation? What does the decision maker expect from the EEA? Could the decision making structure be used as blueprint to adapt the EEA (results) in such a way that the decision maker has more use of the results?

1.2 SD-practice and case study

As already briefly mentioned, this study uses the current practice of EEA in AkzoNobel as a case study for the research. In the problem description it became clear that in decision making the role of the analyst who makes the EEA is important. This case study will take place at AkzoNobel Sustainable Development and will have the goal to develop structures for the analyst to deliver better services to the decision maker.

The analysts

Within AkzoNobel the group Sustainable Development (SD) is working on a daily basis with EEA, we call this SD-practice. They are specialized analysts whose main product is EEA. They do the analysis as well as explaining the results and giving advice on further action and implementation. They are responsible for their own turnover and can also sell their products to other companies and

² Sustainability is defined as the environmental and economic consequences of a decision.

organizations. They can be seen as an independent economic-environmental consultancy firm with AkzoNobel as their main client. The SD-practise will be studied in two ways:

- By working with the SD-group for half a year and doing a case study as an analyst for sub-BU Cellulosic Specialties (CS). The results of the case study are presented in Chapter 3.
- The current SD-practice will be studied through a review finished EEA projects by interviewing the SD analysts. The results of the interviews with the analysts about SD-practice are presented in Chapter 4.

The decision makers

The customers of SD are mainly (the people in) the different Business Units (BU) of AkzoNobel. They ask for the EEA to use it as input on certain decisions for themselves when they are also the decision maker or as input to a decision on another level. The sub-BU Cellulosic Specialties (CS) has agreed to participate in this study in two ways:

- A case study for CS so that I will be able to gain insight in EEA as an analyst as well as the (interaction) processes with the customer. The results of the case study are presented in Chapter 3.
- The management team of CS will be interviewed to collect information about the decision making process in CS. The results of the interviews with the CS management team about decision making in CS are presented in Chapter 4.

1.3 Goal and scope

1.3.1 Goal

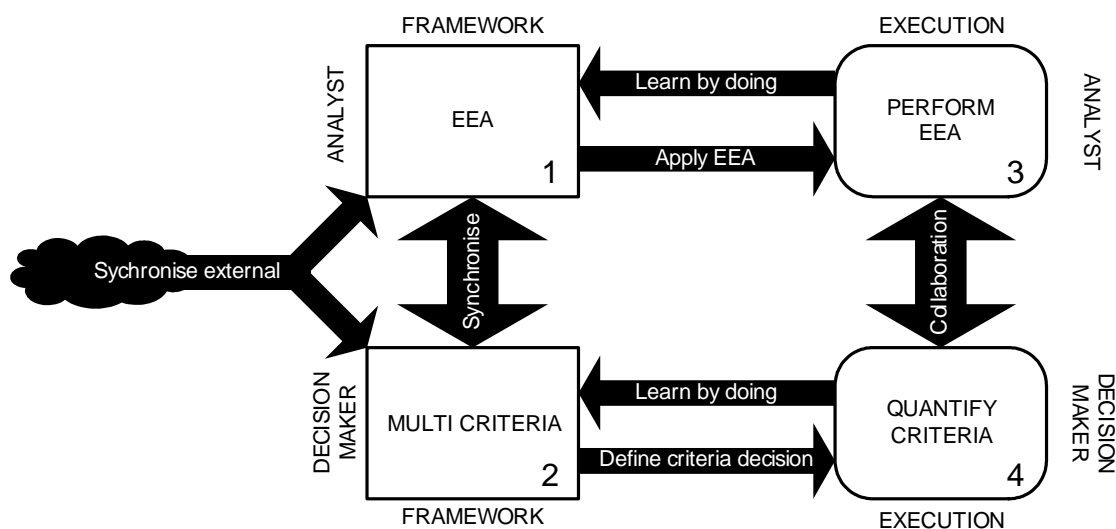


Figure 4: Framework decision make- analyst interaction

The goal of the study is captured in Figure 4 above. It shows the interaction between the analyst's and the decision maker's needs and way of thinking. The main focus is to use the needs/multi criteria framework of the decision maker to update the EEA theory and practise. The figure is used throughout this thesis at the beginning of a chapter in different variations to highlight the elements that are the main topics of that specific chapter. On the left hand side of Figure 4 we find the theoretical frameworks that we will look into:

1: EEA, the theoretical framework of the analyst

The theoretical framework of the analyst is EEA there are other types of analysis that could also be done in order to give information to the decision maker. In this thesis the main focus is on EEA, so that is why we assume that the EEA is the framework for the analyst.

2: Multi Criteria, the theoretical framework of the decision maker

This is the theoretical framework that the decision maker uses. This is filled in as "multi criteria"; we will go into the criteria and also look where the EEA fits in and how this multi criteria approach should be seen or used in EEA.

On the right hand side of Figure 4 we find the execution of the frameworks that we will look into:

3: Perform EEA, projects of the analyst

This box is about the execution of the EEA theory into practice. While something looks logical and straight forward in theory, the practice can be more complex. We will look into the EEA as it is performed by AkzoNobel Sustainable development.

4: Quantify criteria, investigation for information by decision maker

This box is about the execution of the multi criteria analysis of the decision maker. It is the way the decision maker collects the information he needs in order to make his decision. Also, the way he decided on the criteria that he needs.

The arrows in-between the boxes show the different adjustment mechanisms between theory and practice as well as between decision maker and analyst. The adjustment is usually going on in the projects. Therefore this thesis is mainly focussed on the way the analyst's EEA framework could be synchronised with the decision maker's multi criteria framework.

Continues change

The criteria for the decision maker will change based on their own learning, external influence and their synchronisation with the analyst. The same is true for the analyst. During the project the (EEA) method is fixed, but for every new project the newest insights will be used. The exact content will be updated all the time.

Economic elements in EEA

Within this framework a specific goal is to look at the economic elements used in EEA. The methodology that is used and the way the decision maker looks at it.

1.3.2 Scope

The scope of this thesis is the EEA, so social aspects used in sustainability fall out of the scope of this thesis and will not be discussed in detail. Another thing that not will be discussed in detail is the environmental weighting factors and environmental methodology. This would make this thesis to broad.

Environmental weighting factors and methodology

One of the difficult elements of EEA is that it adds up indicators for a lot of different environmental problems together. Things like climate change, land use, resource depletion, sour rain, toxics in water and air etc. These problems are very different in different parts of the world and also very different depending on the person you ask, the Zeitgeist and system you look at. BASF has provided a method to do this and AkzoNobel has developed its own weighting factors. I have chosen to use this in as given since this thesis is about the actual use of EEA in practice. Discussion about environmental weighting factors and methodologies fall out of the scope of this thesis.

Therefore I assume:

- Environmental Method we use the LCA methodology
- EEA method we use the BASF Framework
- Weighting method we use the AkzoNobel method

1.4 Research questions

This thesis research will be conducted in two parts. The first part will discuss improvement opportunities in EEA by looking at the needs of decision makers in companies. The second part will discuss the economic analysis as a part of the EEA methodology.

1.4.1 Improvement opportunities EEA

The question here is: **How can the approach of the EEA study be improved so that the results are more useful in decision making?**

This question will be answered by answering the following sub questions:

1. What is the current approach of the EEA study?

First we define the current approach to EEA. This is done by interviewing the SD-analysts about their experiences with EEA and by doing a case study.

2. What can be improved in the EEA study?

During the interviews and the case study we will also look into improvement options for the EEA. Elements in the current approach that have room for improvement will be identified.

3. How does the decision-making process work?

A number of decision makers will be interviewed to investigate the general processes used to come to a decision. Which factors play a role and why do the decision makers choose alternative A over B?

4. What is the information need of the decision maker?

Using the decision making process described under sub-question three, the information that the decision maker expects to be delivered from the EEA will be identified.

1.4.2 Economic analysis and EEA

Based on the results from we will now try to answer the following question.

The question is: **Can EEA be used to integrate sustainability considerations into (day to day) decision making?**

This question will be answered by answering the following sub questions:

1. What should the economic analysis that is used in EEA in SD-practice look like?

This is done by recommending an economic approach based on the current economic approach in SD-practice. As input, information found in previous research questions and literature will be used.

2. How does the day to day (financial) decision making in AkzoNobel work?

This question will be answered by describing the systems that are used in the day to day decision making and in deciding when to invest.

3. What are the differences between these two approaches?

We describe the differences between the economic method that is applicable for SD-Practice and the (economic) method that is used by AkzoNobel in decision making.

4. How can the information obtained so far lead to new insights on how to use EEA in day to day decision making?

This last question will look at the possibilities to integrate sustainability into the day to day decision making within AkzoNobel.

2 Background

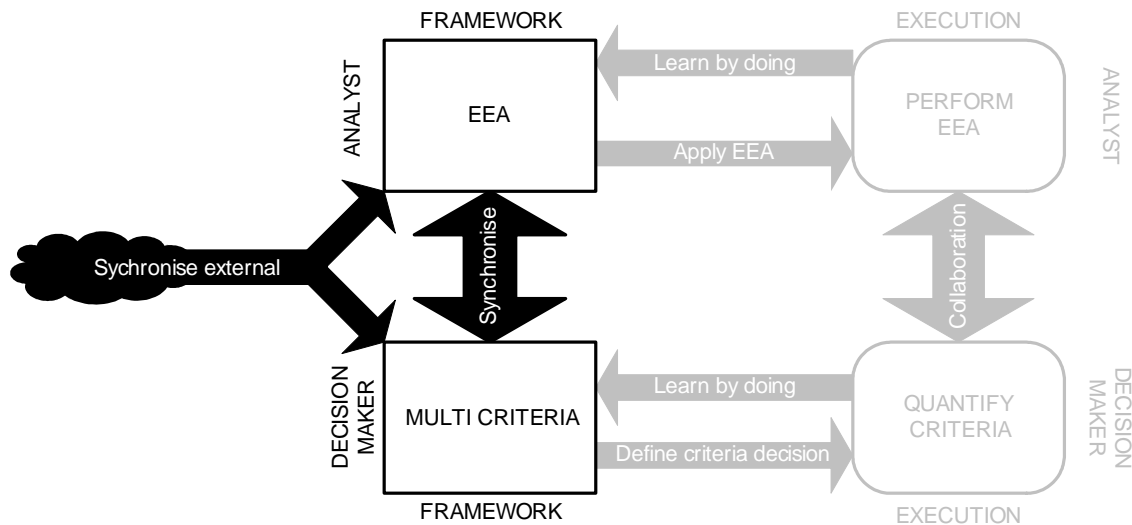


Figure 5: Main topics from framework chapter 2

The goal of this chapter to give a good overview of EEA, starting with the external influences: The general concept of EEA. After that an overview is given of the organization structure of AkzoNobel and the use of EEA. This is the framework use as well as how it has been applied in the organization.

2.1 Eco-Efficiency Analysis

This paragraph 2.1 is about the concept of EEA, how it was developed, what it is about. It gives an overview of the external influences that caused the EEA to develop the way it did within AkzoNobel and gives some first insights in the analyst framework.

2.1.1 The Concept

The Eco-Efficiency Analysis concept is based on Eco-Efficiency (EE). The definition of Eco-Efficiency that has been formulated by the World Business Council for Sustainable Development (WBCSD) in 1992 is: *"Competitively priced goods and services that satisfy human needs and bring quality of life while progressively reducing environmental impacts of goods and resource intensity throughout the entire life-cycle to a level at least in line with the Earth's estimated carrying capacity."*

This is the original vision of EE and also contains a goal: the impact & resource intensity should be at least in line with the Earth's estimated carrying capacity. In practice this is very hard to achieve because of two reasons. First of all it is unclear/debatable what the Earth's carrying capacity is. It ranges between 2 billion people based on the consumption of a typical American up to 40 billion people based on the minimal needs for a person to survive (McConeghy 2007). Considering there are over 6,5 billion people and still increasing it is easy to see that staying within the carrying capacity would mean less people or less resource use by the people who inhabit the earth. If there was an agreement on the carrying capacity there would be a second problem: In order to keep in line with the capacity, it should be divided in equal parts and everybody in the world (country / company / consumer) would have to agree on this division and adjust his resource use accordingly. Obviously this would be an unreachable goal³.

Therefore in practice Eco-Efficiency is used like this:

"In most cases, Eco-Efficiency is taken to mean the ecological optimization of overall systems while not disregarding economic factors" [Eco-Efficiency Analysis by BASF: The Method (Saling, Kicherer et al. 2002)] AkzoNobel, a large chemical company who have applied the BASF method in their sustainable development department, is using it on a daily base. Based on their work with the BASF method they developed this definition: *"A methodology that compares the economic and*

³ At least in the world we are living in right now

environmental performance of two or more alternatives over their life cycles, based on their customer benefit" [AkzoNobel Sustainable Development November 2008]

In this thesis the definition of EEA methodology reflects the way it is used in business practice: "A methodology that simultaneously looks at all the relevant environmental & economic impacts of a certain quantified performance"⁴. This definition is based on the BASF framework and definition of AkzoNobel. To make sure that possible solutions don't fall out of the scope of the thesis the definition is broad. What is good to notice is that the definition as used in this paper does not exclude any of the definitions stated above that are used for EEA, but is not as specific.

There are two main differences between the definition of EEA used by companies and the original definition of Eco-Efficiency by the WBCSD:

The first is that there is no absolute but a relative reference in the EEA. This means that two products will be compared to each other and not to (the carrying capacity of) the earth.

The second is that there are no normative elements in this definition of EEA (Huppes and Ishikawa 2005). Therefore an EEA can never say which production method is good or bad for the environment or economy. This is of course an advantage since normative discussions are avoided. Some say it is not enough to use this definition ((Brattebø 2005; Ehrenfeld 2005)) to make large steps and you have the risk of choosing a product that is less bad but still bad. This is true from an environmental perspective, but from a business perspective it is not possible to reach these goals as one company. Only with a joint effort of companies (changing the production), governments (by changing legislation) and consumers (by changing their consumption patterns) this change can be achieved. So this definition is better than no definition at all (Gabriel and Braune 2005). Using this concept will not only have the direct benefit of making a better decision, but also as a first step to incorporate non-obligatory environmental elements into the decision making.

2.1.2 EEA the method

When we look at the methodology of EEA it is good to look at Life Cycle Assessment (LCA) first. This is an environmental analysis. In business practice, like the BASF framework and AkzoNobel, LCA is often used to fill in the environmental part of the EEA.

LCA

LCA is a method to measure and compare a quantified performance based on environmental data. This basis is the total environmental impact (in different categories) over the total life cycle for one Function Unit (FU). The FU is defined as a quantified performance. When comparing milk packaging the functional unit would be something like "A packaging that can hold one liter of milk"⁵. When comparing different raw materials that can be used to create a chemical product X, then the FU would be "one ton of chemical product X". A good way to explain LCA is by this example:

We want to compare the environmental impact for different types of soda bottle caps: plastic versus aluminum. They have the same functional unit, in this case: "Close one bottle containing soda air tight". When comparing the two caps we look at the environmental impacts in all the steps of the life cycle. So for the aluminum cap that would mean: Mining of the aluminum ore, refining the ore, transporting it to the cap factory, production of the cap, the use phase and finally disposal of the cap. For all the steps there can be energy, material and waste flows. What LCA does is keep track of all these flows. So for example in the production phase the electricity used was generated by burning coal. The emissions of the coal that was burned for that cap are added to the waste flows. This will result in a system that has all the total waste flows, resource and energy use. In other word the complete environmental impact over the life cycle. Based on the flows, the scores on different impact categories like Global warming or Ozone depletion are calculated. These scores are then compared and the best alternative can be chosen, or the scores could be used for example to state the carbon footprint of the bottle cap.

EEA

EEA is developed to assess environmental and economic impacts in the same framework. It uses LCA and adds economic data for the same system. It calculates using the environmental impacts and the economic impacts. It can be calculated in two ways:

⁴ The quantified performance is the same as the functional unit.

⁵ Of course some additional conditions would be used here for example regarding the quality of the milk.

Eco-Efficiency ratio (E/E)

Commonly calculated as: Product or service value/ Environmental influence = Eco-Efficiency ((Brattebø 2005)Ch.12 p 23). We can see in the table below that option A, which is better for the environment (influence is lower), is less Eco-Efficient because the value created is only 1. Option B is more efficient because the value created per unit of environmental impact is higher. The main principle behind this efficiency is that we should create the most value out of the impact we are making on the environment. When thinking about sustainability there is a need for both the planet and the profit, it is best to get one with the lowest cost / most benefit to the other.

Option	Product or service value	Environmental influence	E/E score
A	1	2	0,5
B	3	4	0,75

Table 3: Example Eco-Efficiency E/E calculations

Eco-Efficiency sum (E+E)

It is calculated like this: Give a weight to the environment and the value. In this case we value them equally thus: 1 & 1. Then it would look like this:

Option	Product or service value	Environmental influence	Total sum (E+E)
A	1	2	-1 (-2*1 + 1*1)
B	3	4	-1 (3*1 -4*1)

Table 4: Example Eco-Efficiency E + E calculations

Now they are just as good or bad. We still have the same construct but express in a different way: We say economy and environment are equally important and for every unit of value we accept one unit of environmental influence. Thus making both alternatives equally bad since they have one more unit of environmental influence then is compensated by the unit of value. This is the way as it is done in the BASF method even though it is not explicitly presented like this (Heijungs, Kleijn et al. to be published).

2.1.3 EEA and Industrial Ecology

This paper and the thesis that will follow is part of the master program Industrial Ecology. This paragraph explains why this thesis is relevant for the field of Industrial Ecology (IE). What IE is, is best explained using the words from the IE master program's website:

"Industrial Ecology (IE) is a relatively new field of research that is rapidly emerging on a global scale. IE aims at a sustainable co-existence of the technosphere and the environment. The analogy between natural and technical systems and processes is a core concept. Processes in nature, where cycles are closed and waste from one process is input for another, are models for socio-technological processes."

"The scientific field Industrial Ecology focuses on the sustainable development of the industrial society, through the interaction of various scientific fields like environmental sciences, economics, policy sciences, and technology. In practice, Industrial Ecology is an interdisciplinary field, where engineers, natural scientists, and social scientists cooperate together in finding solutions for environmental problems and shaping sustainable development." (industrialecology.nl 2008)

When an Industrial Ecologist looks specifically at the interaction between economics and environmental sciences, EEA is a useful tool to have in your toolbox. The concept of Eco-Efficiency is therefore one that falls directly under IE. IE looks at the relation and interaction between technosphere and biosphere. The environment is part of the biosphere and the economy is part of the technosphere. Thus EE⁶ is a concept that is part of Industrial Ecology (IE) (Huppel and Ishikawa 2005). EEA is specifically mentioned in the textbook on IE (Brattebø 2005) under the section "methods and indicators".

⁶ Industrial Ecology uses the original EE definition, including the absolute reference and the normative criteria.

2.2 Application of EEA in AkzoNobel

This chapter gives an overview of the introduction to AkzoNobel and to the use of EEA in AkzoNobel. It starts with the EEA framework used by the analysts. How and why it developed the way it did, what the strong points are and where the problems arise. After that the company structure of AkzoNobel. This is needed to understand the framework the decision maker uses.

2.2.1 Introduction EEA in AkzoNobel

This description of EEA in AkzoNobel is based on a number of interviews with Klas Hallberg, the manager of AkzoNobel Sustainable Development (SD). It is based on his ideas and feeling, but where possible facts & argumentations were added.

LCA:

At the Swedish Business Unit (BU) now named Surface Chemistry they started to work with LCA in 1993. This work was started by Klas Hallberg's predecessor Peter Lysell. He started out as a thesis worker on this topic and by the year 2000 they had ~1.5 FTE. In 2002 they got funding from the European funded project DANTES; Demonstration and Assess New Tools for Environmental Sustainability and a separate group on LCA was formed. Through this funding 2,5 more people could be hired and expertise could be built up. This can be seen as the start of the SD-group; ~5 people working on sustainability (related) topics based mainly on LCA around 2003. One of the research projects at that time, done by thesis students from Chalmers⁷, was a combined LCC/LCA study. BASF had introduced a method and tool to do Eco-Efficiency analysis. The tool was studied as a part of the LCC/LCA study, there was a participation in a course given by BASF about their method and tool in 2003.

Interest from AkzoNobel

In 2004 there was more or less separate from the SD group an interest in the BASF EEA tool & method. The people from BASF were invited to come to talk to the Corporate Social Responsibility (CSR) director of AkzoNobel who reports directly to the Board of Management. At a certain point the SD group was asked to join in. At this point the CSR-director found out that it is very important to have people involved who really understand the life cycle thinking, and the decision was made that the SD-group would be responsible for introducing EEA in AkzoNobel.

This concept was first tested by using EEA in three existing projects. This was done by three different consulting companies, mainly because the SD group did not have enough people. These tryouts resulted in the decision to evaluate the opportunities Eco-Efficiency Analysis has for AkzoNobel. A number of pilot projects were done and evaluated after which the decision was taken to implement EEA within AkzoNobel end of 2005. This decision was mainly based on the idea that EEA is a good way to get figures and goals to make more efficient solutions for the future.

Goals & results

The main goals for the implementation were on Strategy and R&D. The first idea was also to use EEA in marketing, but this is very hard to do since there are no uniform structures in marketing. Therefore the implementation goals that were chosen are:

- Introduce EEA in the different parts of the AkzoNobel
- Implement EEA in the strategic decision-making process
- Implement EEA in the R&D process

The first goal, the introduction of EEA, was achieved by visiting many of the BU managers and talk about EEA. Part of the strategy was to always talk about EEA with all the services that were offered by the SD group. The goal was to get people familiar with the concept and the name, and mixing it up with other names like LCA, LCC, EPD or Carbon footprint would give too much confusion.

The second goal, the implementation of EEA in the strategic decision making process has been achieved by making an EEA study an obliged part of the Appropriation Request. This is the official investment procedure where the board has to give its approval for all investments over 2,5 million euro in AkzoNobel. This means that for large investment there will always be an EEA, mainly to give a good

⁷ The technical university in Göteborg

idea of the effect of that decision during the life cycle and to compare it against alternative investments to make sure the best choices are made.

The third goal, the implementation of EEA in R&D has not yet been achieved, mainly due to the fact that there have been a lot of changes in the management of R&D in AkzoNobel since the integration with ICI. The work on this will continue, and even though there are no formal rules regarding EEA, roughly 80% of the R&D projects are somehow focused on Eco-Efficiency issues, e.g. lowering the environmental impact, or improving the energy and raw material efficiency in production.

Success factors

There are a number of factors that have played an important role in the realization of EEA in AkzoNobel.

Organizational factors

- **The strong support from the top of the organization.**

This is the main success factor and there are 2 people who are important to mention here. This is first of all the CSR director, Andre Veneman. He has been a very strong supporter of EEA, and the driving force behind EEA on the top level. His background is physician and from a personal level he is very involved with sustainability. Even though he had very little knowledge about how EEA works he felt that this was the way to go for the future for AkzoNobel and has left the realization to the SD-group. The second person is the CEO, Hans Wijers. He supports EEA and for the implementation it has been very important to be able to say: "I come to talk about Eco-Efficiency, on behalf of Hans Wijers", instead of "I come to talk about Eco-Efficiency".

- **There was an LCA group**

The fact that there was a group of people, the SD-Group in place when the actual questions about EEA came from the board has helped a lot. If there would have been only one person or people with no experience in LCA and lifecycle thinking, it would have been very hard to implement EEA in the organization.

Methodological factors

- **It is a quantitative method.**

There are two reasons why this is a success factor. First of all there are a lot of technical people working with AkzoNobel. They are familiar with working with figures and making decisions based on them. Second of all it turns a qualitative discussion about sustainability into a more concrete discussion and makes it much easier to implement in a uniform way.

- **EEA is linked to economic elements**

Because EEA is linked to economic elements the results of the study is more interesting if there is also a potential economic benefit. It is also a positive approach, it (often) shows that environmental and economic gains can go hand in hand.

- **EEA gives direction**

EEA is always a comparison and gives a direction, you don't just present the results but give advice, tell what it means and what to do with it. The fact that the EEA is always a comparison helps in the explanation of the result, since there is always a "better" alternative, which makes it easier to act upon.

Societal factors

- **The increased awareness**

The awareness regarding sustainability issues and especially global warming have been increased very much for example due to amongst other things the movie by Al Gore. Due to this reason there is more personal involvement and support within AkzoNobel to talk about these issues and act upon it. For people working in the environmental field it is hard to imagine, but some people know very little about climate change, sustainability etc⁸.

⁸ To the point where somebody asked Klas (the manager of SD) in a meeting where he was invited to speak about sustainability: "Did you know that the temperature of the earth is rising? I saw this movie from Al Gore..."

Use in the organization

The fact that the organization is familiar with the term EEA and it is officially implemented in the (Appropriation Request) AR does not mean that everybody can do it and understands the specific considerations. Here are some of the common problems that arise when working with EEA.

- **People have very little understanding of the concepts**

Very often people who have not worked with LCA have very little real understanding of the concepts of EEA. Especially the life cycle thinking is not used often in people's day to day dealings and relatively few people have had a education on this topic. Therefore it would be good to give all people involved an education in LCA. Since the way of thinking in LCA is very different from usual business thinking and misunderstandings about what is what exactly are easily made. A good example here is somebody who called asking: "I would like to have an EEA for my AR and I heard you have it." Not realizing how much effort and time it takes for the SD-group as well as the customer.

- **People try to simplify reality to much**

People should make a reality check and look at the data before assuming and simplifying too much. A typical conversation could be: "To be efficient we focus right now on the 80% that is important", "Ok, and what is the full 100%?", "We don't really know...", "How do you know that that 80% is not 5% then?" The idea to focus on 80% itself is not bad as long as you know what the full picture is. Another example is that people tend to ask for "a simplified tool". Not realizing that the tool is not the problem but getting the correct information and analyze it. After that simplification could be made.

- **Terminology**

The choice made with the implementation to call everything Eco-Efficiency, is now starting to become a hindrance in way. Depending on the part of the company different elements are becoming more important. For one BU this will be the CO2 output, for another it is solvents. They are still not aware that EEA covers the whole range so that an EEA study also covers a Carbon footprint. This has also to do with the little understanding that people really have about the specifics of EEA.

2.2.2 The AkzoNobel organization

The AkzoNobel organization consists of different elements

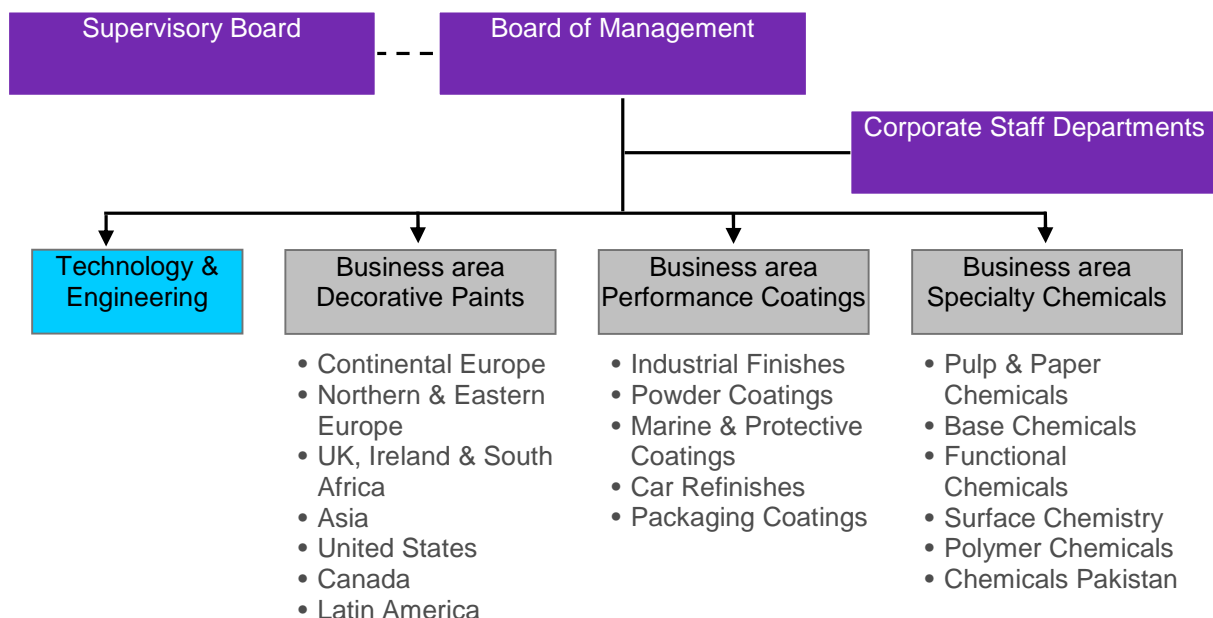


Figure 6: Organizational overview (AkzoNobel 2008)

As we see in Figure 6 there are 3 business areas where AkzoNobel is active. Under each business area there are a number of business units. The Business area Decorative Paints area is mainly the former ICI organization bought in 2007. Under each Business area there are a number of Business

Units (BU's) as you can see in the figure above. The Board of management consists only of four people. This is relatively small. The reason is that the BU's operate relatively independently, a lot of the decision are made by finding a base for consensus between the BU's and then it is decided on by the top management. The BU's have a lot of power to make their own planning as long as that is within the vision of the AkzoNobel organization. The procedures by which this is done will be explained extensively in chapter 5, Decision making process. The Technology & Engineering (T&E) organization is a service organization and Sustainable Development (SD) is part of it.

2.2.3 Place Sustainable Development Group in organization

As said in the previous paragraph the Sustainable Development Group is part of AkzoNobel Technology and Engineering see Figure 6. The SD-Group itself is a part of the SHERA (Safety Health, Environment and Regulatory Affairs) group of T&E. SHERA is a collection of groups who have specialized knowledge on certain (SHERA) topics.

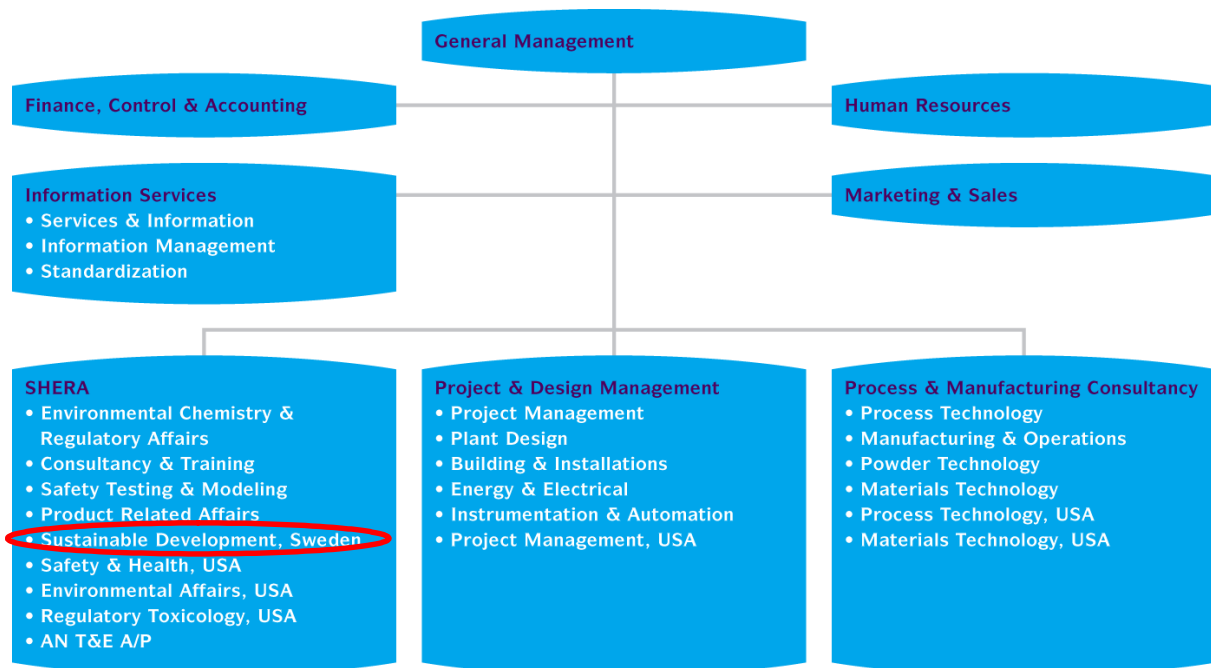


Figure 7: Organization Chart Technology and Engineering

The organization chart of the T&E organization is shown in Figure 7. Due to the specific knowledge that is present with the sustainable Development group it sells its services to all the business areas throughout the world where AkzoNobel is active. The SD-Group has one office in Göteborg in Sweden and has around 10 employees.

3 Case study

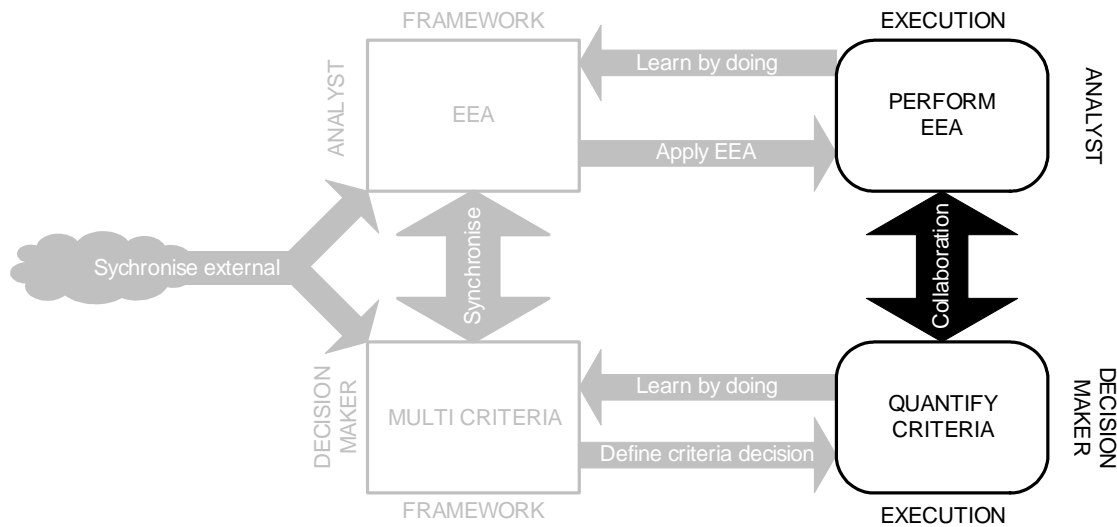


Figure 8: Main topics from framework chapter 3

This chapter is about the case study performed for Cellulosic Specialties and their customer AkzoNobel Pulp and Paper. The main information that this chapter should deliver is on the execution axis. There is a description of the EEA case study and the results from this study.

3.1 Description Case study

3.1.1 The Pre study “High filler in paper”

The case study that is performed as a part of this thesis is an EEA pre study of the production of copy paper. Copy paper is using three main raw materials: pulp, filler, and chemicals, this is mixed, dried & pressed and made into paper. One of the chemicals that BU Pulp and paper uses they buy from sBU CS. The drying and pressing consumes a significant amount of energy.

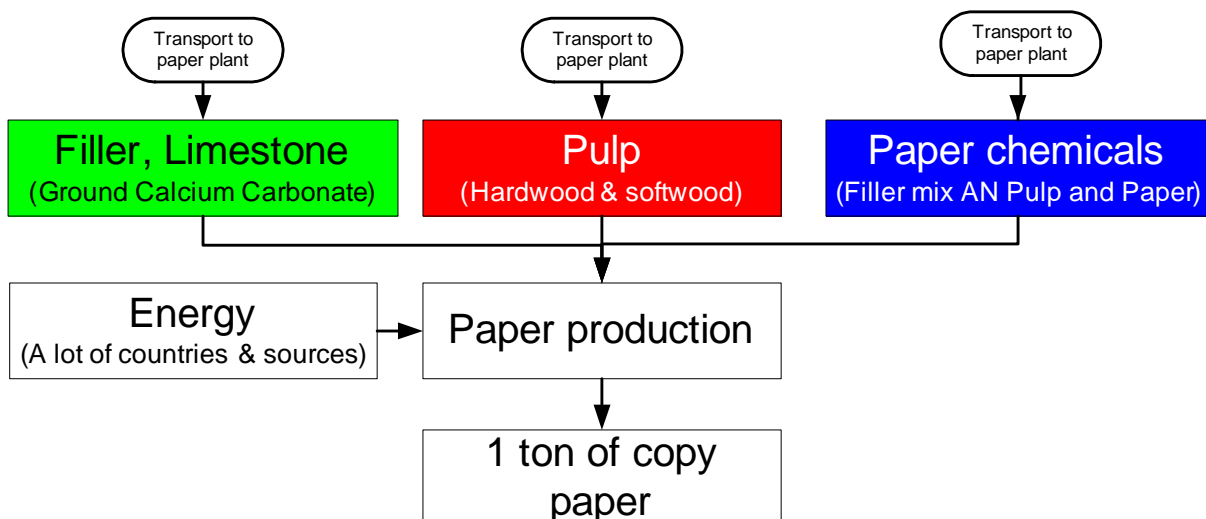


Figure 9: System pre study “Filler in Paper”

AkzoNobel pulp and paper chemicals, one the BU's of AkzoNobel have developed a new technology that gives the possibility to use more filler in paper when using certain different paper recipes. There are three main reasons to look into this:

- Filler is cheaper than pulp. So higher filler content means saving money

- Water is only retained by pulp not by filler, so less energy is needed in drying the paper to get the water out during production. Lower energy use gives financial & environmental benefits.
- Filler can raise the brightness of the paper (so better quality or less bleach used) (excluded from the pre study)

The reasons to do this pre-study are:

CS

- To give AN pulp and paper a good marketing tool that they can use to sell more of CS's products
- Gain insight in the use phase of their products

AN Pulp and paper

- To gain insights for the main study, to see what (if any) the main (environmental & financial) benefits for the improved production processes are
- To make people working in the main study enthusiastic for the project (by showing potential results)

Thesis

- Get experience with EEA by working on a case study
- Get experience in working together with decision makers and data collection people

As we see the reason to do this case study is mainly to get a good insight into the financial and environmental impacts of the higher filler content, but more importantly have a medium to communicate the potential gains internally, to the personnel to get them motivated, and externally to the customers to show them potential savings.

EEA manager

This is done by making an interactive EEA Manager (a software based spreadsheet tool) where you can, due to a very flexible setup, choose of your production facility. This gives within a chosen framework a good approximation of the impacts.

Data

Test trails

There have been test trails to produce paper and the energy use has been measured. Also, the technology is proven on a test scale. These tests have been the basis for the heat requirements in the paper production.

General data

In this study Life Cycle Inventory (LCI) data from general sources used by the SD-group and data available in the Eco-invent and Gabi databases have been used. In this pre study the data is not specific and is thus only valid to give an order of magnitude for the differences between the scenarios. The quality of the LCI data as such found in the databases has not been checked as part of this thesis; the focus is on the methodology. In the main study all the data will be checked and updated for the specific scenarios.

After the pre-study

The SD-group will follow-up on this pre-study with the main study. This is excluded from the thesis work, because if it was included this part alone could have been a full thesis study. The elements that will be looked into later are presented below. These are at the same time the elements that are missing from the pre-study.

Make a specific and real life scenario

- A number of real cases have been defined and for that the specific LCI data on the raw materials and energy will be collected.

Data

- The LCI data currently used will be checked and updated for the specific scenarios.

Broader system boundaries

- More types of chemical mixes to get the higher filler
- Include more types of filler
- Include the pulp production phase (since this is sometimes done in the same plant as the paper production, so additional energy saving could be possible)

3.1.2 EEA Manager

The EEA manager is a software based spreadsheet tool used to customize, modify and access an EEA study. The EEA-manager used in this study is developed specifically using the BASF EEA-tool as a basis and customized to fit the specific customer needs in this study. How the EEA manager was made is explained in more detail in annex II.I.II. This paragraph will explain the setup of the EEA manager.

The concept that is used for the EEA manager is simple⁹ and robust: It is made in such a way that the user can change all the variables he can influence and are easily available. Then there are 2 ways of using it.

- Choosing one of the predefined energy and woods mixes defined in the manager.

This way you have immediate results. The goal is to give an indication of the potential savings for a paper plant in general.

- Customizing with user defined economic data & quantities.

This will take the user more time but will give a more accurate idea of the possible environmental and economic profit in the specific situation of a paper plant.

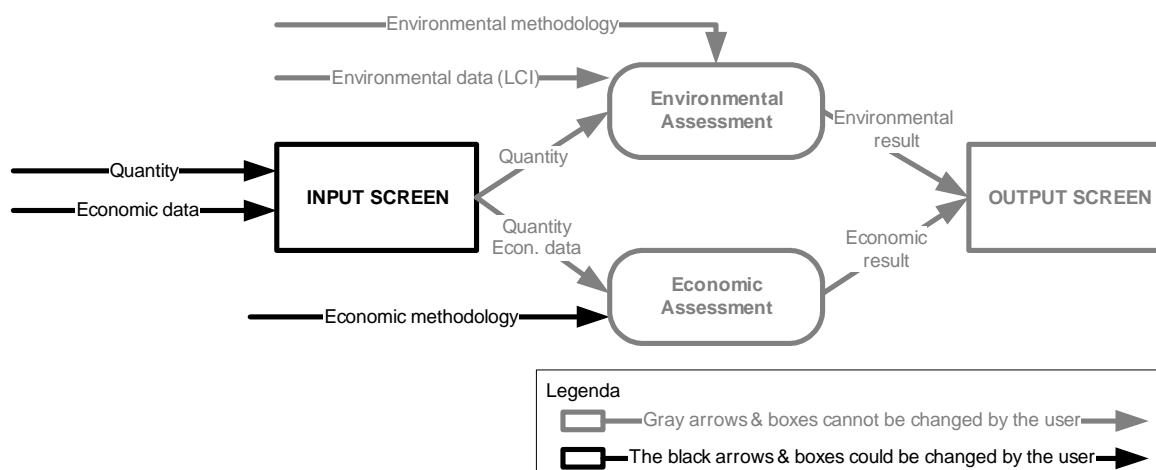


Figure 10: Setup EEA Manager

Therefore the main goal of this specific manager is to make the system flexible where needed, in a correct framework and easy to use. This way it is easily model a paper plant based on the quantification of the flows in the system.

Input screen

The data that can be modified by the user is presented here.

Quantity

This is the amount of the materials used per ton copy paper. This is for example the number of kWhs electricity per ton copy paper. All information is based on assumptions and test trails with a number of scenarios. It can also be overwritten manually within certain boundaries to customize to specific situation.

⁹ A very simple concept does not mean that the manager is simple to make of course.

Economic data

The economic data is defined per standard unit. So for example for 1 kWh of electricity this would be the price in euro per kWh. Other economic data valid for the whole system can be defined here as well as the investments needed to change to the new production method.

Environmental Assessment

In this block the Environmental results are calculated.

Environmental data (LCI)

Here the environmental data is added to the system. In this case the Life Cycle Inventory (LCI). Per standard unit is predefined in the manager. For example nuclear power:

Standard unit = 1 kWh

Per standard unit the LCI data would be:

x gram CO₂

x gram SO₂

x m² land use

etc.

Quantity & environmental data

In this block the quantity is multiplied by the environmental data for the quantity flows.

LCI of the functional unit for different scenarios is calculated based on LCI's of all the separate elements. We know the impact of each separate flow and the amount of each separate flow used in one ton of copy paper. This information is used to calculate the environmental impact of the scenario using LCA. LCA is explained in more detail in the next paragraph.

Economic assessment

In this block the Economic results are calculated.

Based on the economic data and the economic methodology the economic results are calculated.

Output screen

In this screen were the user can see the results. These are the separate economic and environmental scores as well as combined scores in the EEA diagram.

Input : Output

Since the EEA manager is an excel tool and can recalculate the results immediately if something is changed. Therefore there is a preview of the results (output) on the input screen to give the user a better idea about the impact of certain choices.

3.1.3 Environmental assessment

The focus in this thesis is on the economic methodology and the use of the results of the EEA study. But to get a good EEA study (with useable results) the environmental assessment is an important fundament. In this study an LCA is made for the environmental assessment. The LCA is a specification of the case shown in Figure 9 according to the LCA standard ISO 14044 and is available in appendix II.I.III. It is important to know that there are limitations to the environmental results caused by the choices to use certain LCI data.

LCI Data

Data

One of the limitations of the setup is that it is not a site specific study but site specific data has been used. This means that you are and American paper producer using only Coal Power in your production. Then you can choose to use 100% coal power as you energy mix. It will use specific environmental impact data for Coal power but the environmental impacts will be shown as if it was coal power produced in Sweden by Vattenfall, instead of the actual supplier (with his own yield power in the plant, transport of fuel to the plant, exhaust gas cleaning etc).

Limited dataset

The data that has been used have a limited number of impacts due to two reasons: first of all the BASF framework uses a limited LCI data set to calculate the impact on the environment. The second reason is that part of the sources that were used were partial LCI data sets for example not reporting on land use. These parts were excluded from the scope of the LCA studies that these LCI's are derived from. This makes that the data less useful to give a full overview of different environmental impacts or the total environmental impacts in absolute terms.

Data sources from different studies:

It was not possible to find data for all the energy sources from one study so different sources have been used. This means that Coal power is from Swedish Vattenfall data and Biogas CHP from Swiss data. Since the data has not been checked or altered this could mean that one study has excluded water use while another has included it. This could give differences if looking at some specific flows. In this case this would not matter since the energy mix is equal for all scenarios. So the relative changes between the scenarios would be based on the same data. There are consequences that there might be strange results if base cases with different energy mixes are compared on the life cycle results¹⁰.

3.1.4 Economic analysis

The economic analysis that is used is life cycle costing using the real costs for the customer. This is described in chapter 7 economic methodology.

3.2 Results Case study

3.2.1 Results from pre-study filler in paper

The results presented in this study are approximations of the real values. They will be investigated more in-depth in the main EEA study. So the carbon footprints presented here could be more or less and the recipe will probably change. The main thing that we can learn from it is the differences between the base case and the scenarios and how important the country of production is in the environmental impact.

Starting point

As a starting point we use the three scenarios for one ton of copier paper using different filler/pulp proportions.

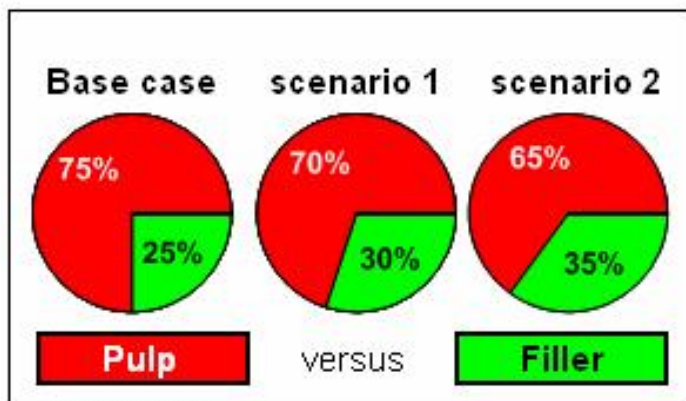


Figure 11: Scenario's in case study

Now we look at the differences in making this one ton of paper in China or in Sweden. Both are realistic scenarios with the side comment that almost all new paper mills are built in Asia and South America. Partly due to lower production cost partly due to increasing demand for paper in these regions.

¹⁰ This will not be possible in the manager without looking into the raw data.

Eco-Efficiency of Paper produced in China

In China most energy is made from coal. The electricity is produced from: 80% coal, 16% hydro power 2% oil and 2% nuclear. Therefore we assume that the energy used to dry the paper is also coal, which will be the case most of the times.

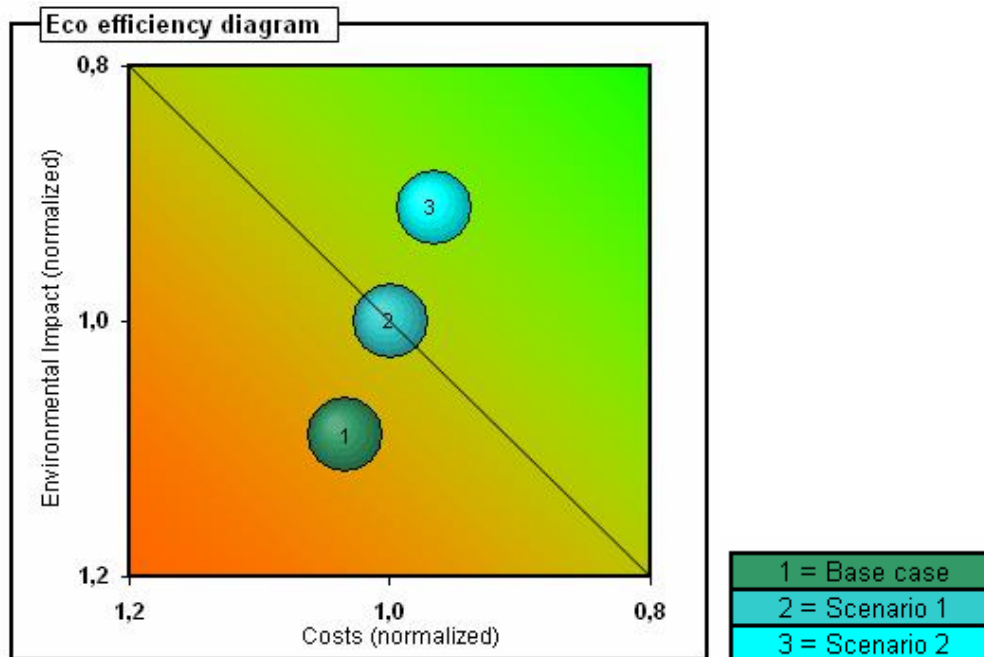


Figure 12: Eco-Efficiency Result: Electricity from the Chinese power grid and heat from coal

The results are as predicted: When more filler is added, the production of paper becomes more Eco-Efficient.

- The environmental improvement is due to the lower energy use in drying the paper and the filler having a lower environmental impact than the pulp.
- The cost improvement is due to the filler being cheaper than the pulp and lower energy costs.

Actual figures from diagram:

	Normalized Cost score	Normalized Environment score	"Eco-Efficiency" (E+E)	% of Base case
Base case	1,03	1,09	2,12	100%
Scenario 1	1,00	1,00	2,00	94%
Scenario 2	0,97	0,91	1,88	89%

Table 5: E+E scores case China

We see is that the base case has an Eco-Efficiency of 2,12 and it is reduced to 1,88. We could say that the Eco-Efficiency will be increased with 11% if we go from the base case to scenario 2.

Environmental criteria

The next thing we look at one of the environmental criteria, the carbon footprint. CO₂ causes climate change and is one of the big issues right now in the world. There are a number of other environmental issues that are important but CO₂ (equivalent¹¹) will be used as an example, since it is easy to grasp what it means for everybody.

¹¹ These are all the different green house gasses expressed in one unit (as if it where CO₂)

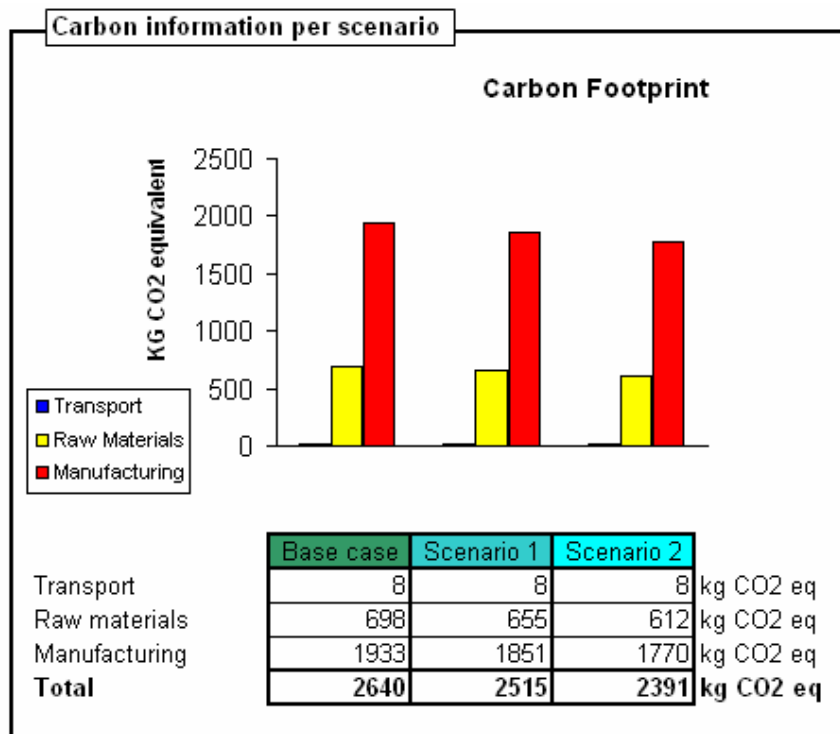


Figure 13: Carbon footprint of paper: Electricity from the Chinese power grid and heat from coal

In Figure 13 you see the Carbon footprint of paper produced in china. This is the CO₂ equivalent that is produced during the different steps in the life cycle. First of all the transport of the materials to the factory, then the CO₂ emitted while making the raw materials for the paper (pulp, chemical & filler). Included in this figure is the CO₂ used to make the materials for the raw materials, like harvesting the forest, the chemicals that where used, in short the whole life cycle from cradle to gate.

End of life

Note that the end of life is not included in this system. This is one of the things that will be investigated in the main study especially since there is a good chance that the filler will emit more CO₂ than the pulp when incinerated. This means that you need to look at the end of life: what would happen when you burn this paper in the waste incineration? Would the paper be recycled? If so how many times? What would happen to the filler in recycling? How would the total comparison look then?

Eco-Efficiency of Paper produced in Sweden

Now we look at the same system for Sweden and compare it to China. The pulp that is used in Sweden has the same environmental impact as the pulp use in China in the previous example. But the electricity and heat have a different source: The electricity is 46% hydro power, 46% nuclear, 4% biomass and 1% for wind, waste, coal and oil. The heat that is to dry the paper is coming from biomass. Again there are the same benefits: Filler is cheaper and has a lower impact. Also, the environmental impact of production is lower due to lower energy use.

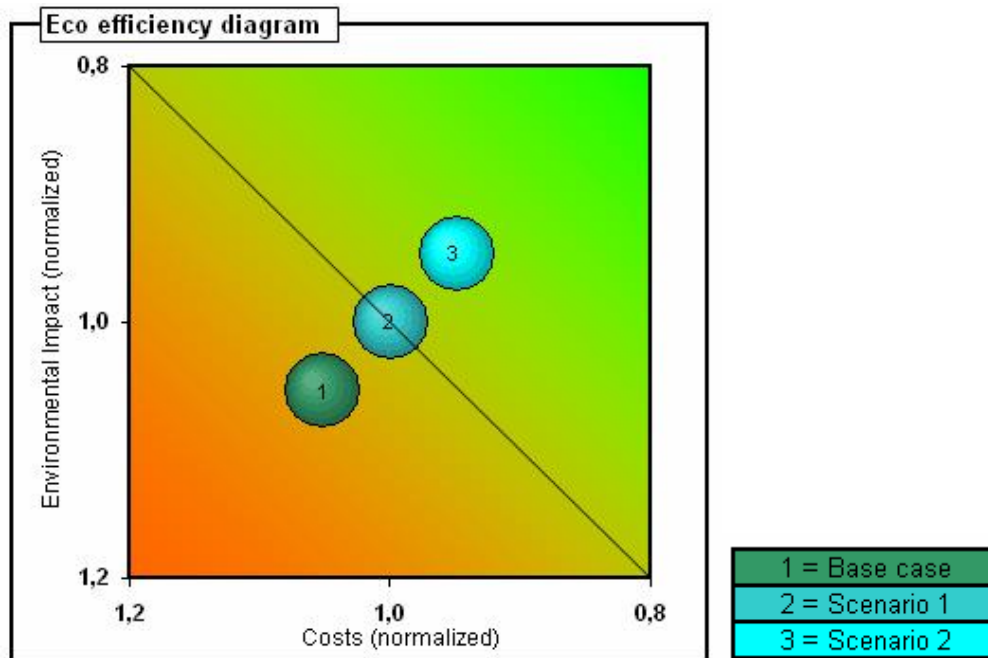


Figure 14: Eco-Efficiency Result: Electricity from the Swedish power grid and heat from biomass

	Normalized Cost score	Normalized Environment score	"Eco-Efficiency" (E+E)	% of Base case
Base case	1,05	1,05	2,10	100%
Scenario 1	1,00	1	2,00	95%
Scenario 2	0,95	0,95	1,90	90%

Table 6: E+E scores case Sweden

When looking at the Eco-Efficiency diagram it is very similar to the diagram for the China scenario. The Eco-Efficiency changes from 2,1 to 1,9, an improvement of 10%.

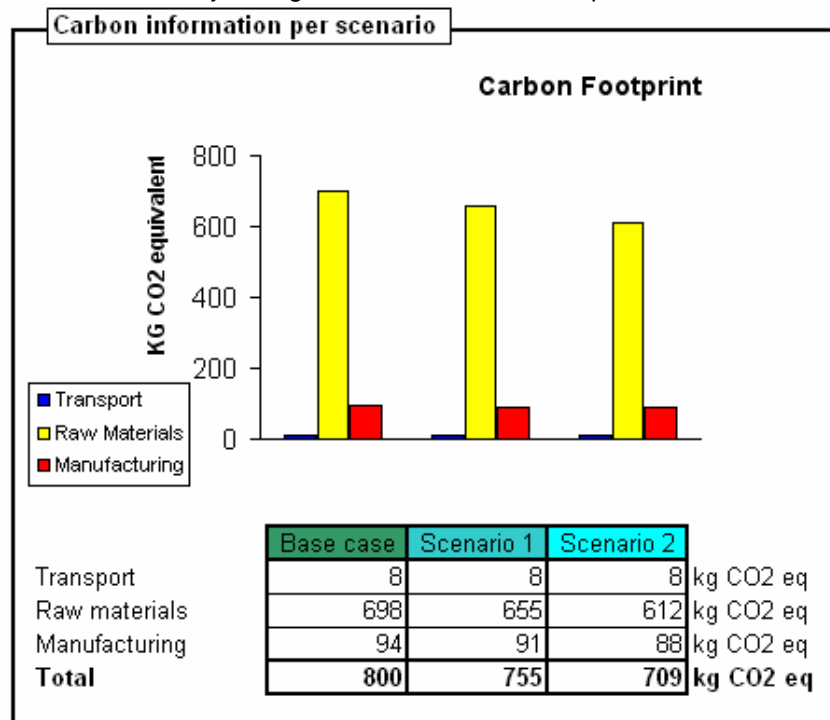


Figure 15: Carbon footprint paper Electricity from the Swedish power grid and heat from biomass

Here we can see that the CO₂ (equivalent) output in the manufacturing phase is not an important factor in this case. The reason for this is that the energy that is used in Sweden is mainly nuclear and hydro. These types of energy have a very low CO₂ output per kWh, as compared to the (mainly) coal power used in China. The main element that is important is the CO₂ output during the production of the raw materials.

Comparing the Chinese and Swedish results

Total environmental impact

The first observation is that the total environmental impact in China is (much) higher than in Sweden but that the Eco-Efficiency scores are about the same. The reason for this is that it is a comparison to the other alternatives. The score (and the balls diagram) only gives an indication of the improvements compared to the other alternatives that chosen.

The second observation has to do with this. The normalized cost scores are different while the actual economic improvements behind it are exactly the same. The reason is that the BASF methodology will weigh the environment as important in the Chinese case (before normalizing), because the actual environmental impact of the ton paper is higher. Which was also shown in the example of the Carbon footprint, due to this the environmental impact is valued around 2. In the Swedish case the absolute environmental impact is not that high so it is weighted at ~0.9 based on the BASF methodology and the cost will play a bigger role in the Eco-Efficiency.

The conclusion is that the BASF Eco-Efficiency is a “relative Eco-Efficiency”, it is only “as compared to other alternatives”. The best way to show this is to add the Chinese and Swedish scores in one EEA diagram. Now the difference is clear immediately that paper produced in Sweden is better than paper produced in China from an Eco-Efficiency perspective.

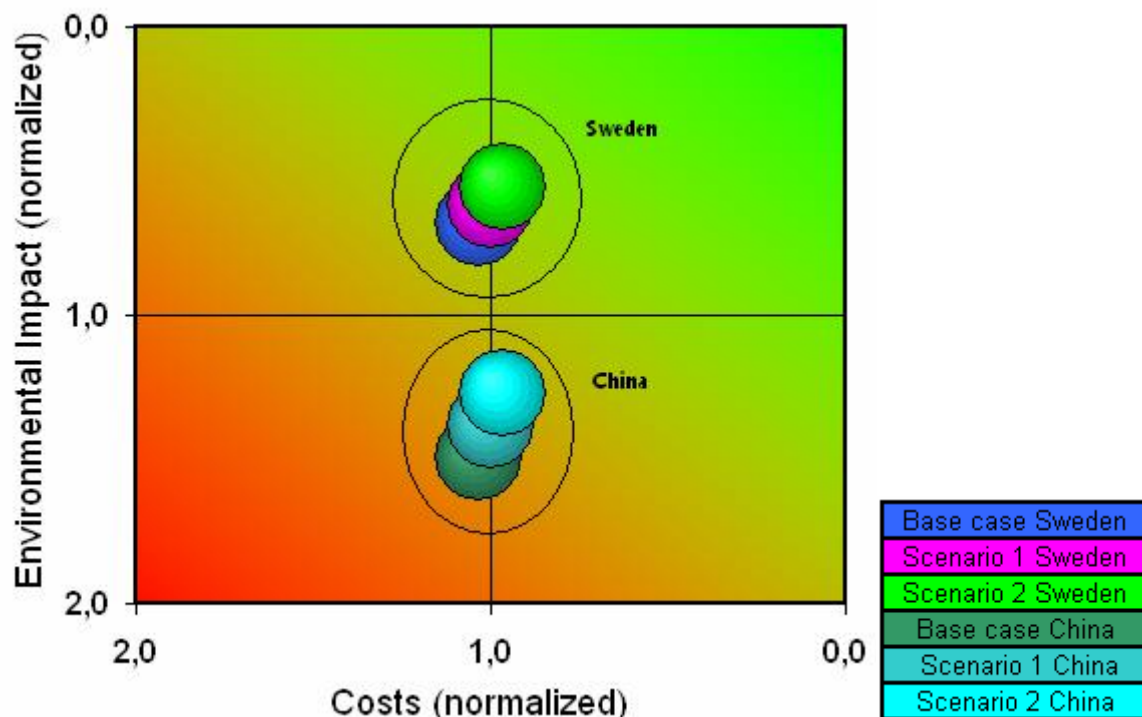


Figure 16: Result Eco-Efficiency, China and Sweden

Now we clearly see that all the Swedish alternatives are better than the Chinese alternatives, but that the relative gains on the environment are better in China.

	Normalized Cost score	Normalized Environment score	"Eco-Efficiency" (E+E)	% of Base case China
Base case China	1,03	1,49	2,53	100%
Scenario 1 China	1,00	1,38	2,38	94%
Scenario 2 China	0,97	1,27	2,23	88%
Base case Sweden	1,03	0,68	1,71	68%
Scenario 1 Sweden	1,00	0,62	1,62	64%
Scenario 2 Sweden	0,97	0,56	1,52	60%

Table 7: E+E scores case China and Sweden together

Conclusions

The BASF Eco-Efficiency is useful to compare different alternatives, but it is not suitable if you want to compare the Eco-Efficiency scores of one study to the Eco-Efficiency scores of another study, since it is relatively bad or good. It does not say anything about the actual environmental impact. This is very important to realise when looking at the results, because if we had just looked at the separate BASF scores we might have chosen China since it seems more Eco-Efficient.

For this reason the Eco-Efficiency diagram is in the SD-practice always accompanied by some kind of real environmental impact like the carbon footprint.

3.2.2 Personal Experiences during Case study

Doing EEA

My personal experience is that the Eco-Efficiency is a good way to look what the relation is between Economy and Environment. Therefore it is unfortunate that there was no trade off in this case. Both the environmental and the economic scores improve, the more filler you add. Therefore it is a nice showcase but the difficult discussion about: "What is more important: Money or nature?" was avoided. It would have been interesting to be involved in that discussion.

Assumptions and knowledge

During the project new information would surface all the time. For example in the presentation of the final EEA manager I found out that while I assumed to have soft wood and hard wood pulp, there is in fact a (more or less) standard mix of soft and hard wood pulp that has to be used in all cases to get the process to work. Also after 1 month in the project I talked about soft wood and hard wood and thought we were talking about actual trees (or parts of it) while in fact the people from AN pulp and paper were talking about pulp. My total lack of knowledge to start was no problem since nobody assumed that I knew it but it would have helped also in collecting the right data from the start¹².

Working with customers

My contact people were very interested in the case study, it could mean a lot for their business if the high filler concept will be applied. They are also genuinely interested in the environmental impact of their product, especially seeing the use of their product in the life cycle. This adds an extra dimension and gives a better basis to discuss with the customer and pinpoint his benefits and understanding his needs. Especially for the people from CS, who are not in the paper production right now, this creates a lot of insight how to interpret the environmental impact of the product that they make. That the environmental impact of the production of their product is important but that they can make a big difference in the use phase of their product. For AN pulp and paper the main added value is the integration of economic factors with the environmental factors. Even though they had the feeling that using the product might be beneficial to the environment they could not find it out themselves. Maybe in a qualitative way like we use less energy, but they did not know how to quantify. Especially looking at economy and environment using the same system and background makes sense. I think the goal to awaken the interest within both organizations and that has been achieved.

¹² I used general sources, but if I had not done that I could have been collecting data from forestry only while I should have been looking at pulp mills as well.

3.2.3 Experiences customers during Case study

I also asked the customer to give a small review of the project:

This is what I asked:

"If you have time I would really appreciate if you could write in a few lines on:

What do you think about the Eco-Efficiency study and manager "Increased filler in paper"?

Any comment, evaluation or reflection is welcome. I will use this in my thesis as "comments from the customer" in my chapter on the case study.

A few lines on what you think of first are more than enough."

These are the replies:

General Manager from CS:

"I was quite impressed by the work done by Max during this project. The way he inquired and quickly understood the different issues that our business is facing really helped to come to significant discussions and pushed us toward further improving our business processes in a way that is more aligned with the company's Eco-Efficiency goals and guidelines. In regards to the Manager tool for "Increased filler in paper" I was very pleasantly surprised and impressed by the quality of the information we can get out of it and also about the flexibility of the tool. The way Max quickly demonstrated all the possibilities of it is an indication of his competence and dedication to this project."

4 Experiences practising EEA

4.1 Introduction

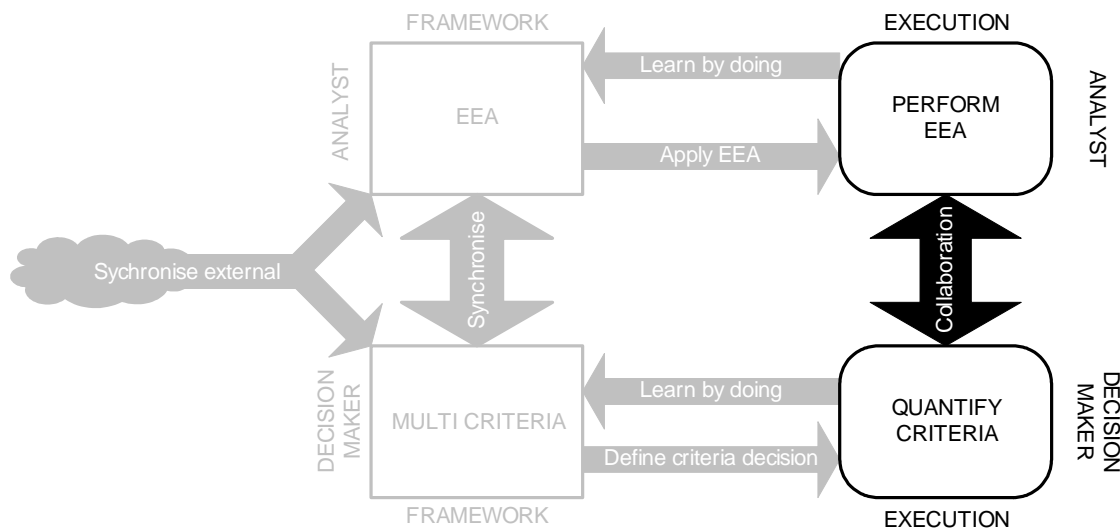


Figure 17 Main topics of the chapter 4

This chapter will give the results of the interviews conducted with the analysts of the SD-group. First the questions are structured according to the information that the questions aimed to retrieve.

Second the information is summarized; this will be useful in two ways:

- For an (aspiring) EEA analyst to get insights into what problems he could face, the goals and results clients ask. In combination with the story told in paragraph 2.2.1 it is a good blueprint of how the EEA practice works.
- For everyone else to get a feeling of the day to day dealings of the EEA analyst.

Third the information is analyzed and the differences between the projects are described: what went very good or very bad in some projects compared to the others (For example enthusiastic customer, neutral customer and negative customer). The projects will be grouped based on these differences if any differences are found.

Finally all the differences are summarized and connected to the use of the results of the EEA. The connections are on a qualitative basis since there are too little projects to do factor or regression analysis and the questionnaire was not setup to enable this.

4.2 General Result of the interviews Analysts SD

4.2.1 Setup

Out of all the projects SD have conducted, 20 different EEA projects have been selected. In September 2008 interviews were conducted, about all of these 20 projects. The projects have been conducted for internal customers (parts of AkzoNobel) as well as external customers. The projects go back to 2005 when EEA was first used by SD until 2008. Within these projects 1 or more EEA studies have been conducted.

The interviews were designed to collect information on a project basis:

- **Projects**
 - Environmental Methodology
 - Economic Methodology
 - Project and Time planning
 - Success factors
 - Improvement options

- **Results of project**
 - Satisfaction
 - Use of results
 - Success factors for use of results
- **Interaction with the customer in the SD-practice**
 - Motivation of clients
 - Knowledge and understanding about EEA of clients
 - Goals of the clients
 - Results for the clients
- **Evaluation of the analysts**
 - Knowledge and improvement options

This can be summarized as a thorough project evaluation, with a focus on the results and interaction.

The interviews were conducted with one interview per project. There were 20 projects and this resulted in 20 interviews that took between 30 minutes and 1,5 hours. This was done by filling in a four page questionnaire about that project by the interviewer. This questionnaire was the same for all projects so questions were interpreted in the same way by the interviewer. The full questionnaire can be found in appendix III.I

4.2.2 Interview setup

These projects are reviewed by having an interview that is used to fill out a standardised questionnaire. There is one questionnaire per project. The projects are divided over the different employees of SD based on their involvement in the project.

The first division of the projects is made so that:

- Every SD-analyst is interviewed about at least one project.
- The SD-analyst who is interviewed has had relevant contact with the DM/customer.

Since everybody in the SD group has had relevant interaction with the DM/Customer in at least one project everybody in the SD group was assigned at least one project.

The rest of the projects were divided in the following way:

- Assign the project to the SD-analyst who had most contact with the DM/Customer in the project.

Before the interviews started we decide on how the results were used. The results will not show who the client, project or the analyst is for three reasons:

- People will be more reluctant to tell negative things if they know it could get back to a client with whom they might have to work in the future.
- The analyst will be able to tell more open about his own practice without having to worry how it will be interpreted.
- The goal of this thesis is not to “name and shame”, but find out what things play a role in the use of the EEA study.

This was communicated to the interviewees in the following way:

The external use (in this thesis)

The external use of the results is a list of numbered projects scored for a number of quantitative elements and anonymous qualitative results. The list is without the name of the decision maker, BU contact, project name, your name or other information that can connect the project number to a specific BU, decision or person. This information will not be published without the consent of SD.

The internal use (in the SD-Practice)

The information is connected to the project / decision makers and to you. In case you feel that you want to make (part) of your comments anonymous I have a separate “comments list” that is not linked to a project so it will not show in the internal results who made that comment.”

Answers not reported in this chapter

Some of the answers to questions in that where apart of the interviews where not reported in this thesis. This is because the information is not public. There are two exceptions:

- 2 projects are not described. These are project that had the goal to implement of the EEA concept in the AkzoNobel organization. This information collected in these interviews is already presented in 2.2.1.
- The questions about “the reward structure of the decision makers” and “the influence the EEA study had on the final decision (in %)” are scraped because they could not be answered by the analysts.

4.2.3 Interpretation of results

The results of the interviews are presented in such a way that it is not possible to connect the rating that the analysts of SD give to themselves or their customers. In a lot of questions this means that the specific comments have to be generalized into general comments, or the topic on which there was a comment. For the people involved it is otherwise easy to see based on that comment which project was his (and how he is rated).

The (generalized) results per project:

This information was collected in a uniform way for all the projects, things like the size of the project, and the ratings for the analyst and the decision maker. Added to this were the questions that had so many comments that were possible to categorize and generalize. These comments were categorized and the category of the comment is reported.

This results in interesting semi qualitative data, but this ignores a lot of specific information that was also collected and could not be presented for example when all the projects had no problems in the start-up phase and one did, it could be possible to give that data and the comment but then it would be immediately clear which project that was. This is a problem. But it is no problem to state the fact that there was a problem in one of the projects and the comment without stating on which project the comment was made.

The results per question:

Every time there was a question that had very little results or very specific results and thus could not be presented in the project list, this information is presented as “a remark made in one of the projects”. The same thing is done for the comments that were categorized: Per category the comments that were put in that category are shown.

This way all relevant information is presented without showing the connection between the specific comments and the ratings of the customers.

4.2.4 Definitions of actors & project elements

This paragraph describes the different roles and project elements that were found in the EEA projects based on the interviews. When these terms are used from now on in the main text of this thesis it is clear what is meant specifically.

Actors

In the questionnaire there are a few actors in the EEA projects mentioned, and while conducting some more were found. They are really clearly defined here, but in reality they are not always as clearly defined like this. This is also a problem in project management, more on that in paragraph 4.3.3.

- **Analyst**

This can be anybody who is performing the EEA study

- **Project leader**

This is the person who is in charge of the project from the SD-group

- **Project member**

This is a person who is working on the project

- **Client**

- **Customer**

This is the person who has ordered the study and is deciding the way to go with the project on a strategic basis, like setting the goals and scope and defining the scenarios. He is ultimately responsible for the project and the success of the study will reflect on his success.

- **Decision maker**

This is the person who will use the study as an input to his decision

- **Project leader**

This is the person who is appointed by the customer to lead the project. Together with the project leader of the analysts he will be in charge of the well being of the project.

- **Project member**

This is a person who works on a day to day basis with the analyst. These are often people who are responsible for the data gathering and specific questions.

- **Project team**

This consists at least of the project leaders and project members from both the analyst and the client.

4.3 Results per topic

Per topic the following information is presented:

Question

The question that was asked to the analyst

Summary of results

The answers that the analysts gave will be presented in the following formatting:

Main topic/conclusion about answer (number project it was mentioned / total number of projects, always 18)

Main differences between projects

Describes (if any) the main differences in the way the projects were handled and approached. The figures given are not intended to be scientifically significant and should not be interpreted in that way. They give a (sometimes strong) indication of the direction and how things are connected. They are meant as an illustration and to give objective results, with a (possible) interpretation and the chance for the reader to draw his own conclusions.

Conclusions

This paragraph describes the main conclusion(s) from the answers on this specific topic.

4.3.1 Projects: Environmental Methodology

For full comments see appendix III.III.I

Question

What environmental methodology was used in the EEA and what were the problems and limitations?

Summary of results

All the projects use LCA as an environmental methodology, sometimes combined with risk & toxicity if that was needed by the client. Here are the specific problems and other comments:

Balance in weighting different of different environmental criteria (4/18)

Especially when there are two environmental impacts this plays a big role: The (local) emissions to water or air, versus the (global) emissions of CO₂ when that waste would be incinerated.

Missed risk & local pollution elements (4/18)

Often risk and local pollution play a role, this is not included in LCA, and therefore sometimes the study was supplemented with ERA (Environmental Risk Assessment) or the risk & toxicity in the BASF system was used.

Problems with availability and collection of data (3/18)

First the availability of data: In the Appropriation Request (AR) phase a plant does not exist yet, so the LCA results will be influenced by a lot of choices regarding specific technology. This information is not always available in this phase of the project.

Second the collection of data: It takes time to collect the data and the data is not always readily available. More about this in the discussion of the time planning in paragraph 4.3.3

A good way to do it (3/18)

The LCA methodology was also specifically mentioned as a good way to look at the system, to make sure that everything was taken into account, to see the trade off with economy (later in the EEA) and to bring the argument of the total system impact into the discussions.

Main differences between projects

There were not really a lot of differences between the projects. In all projects LCA was used sometimes supplemented with an additional risk and/or toxicity analysis. The method is rated mainly good and sometimes ok, no real variation here.

Conclusions

LCA was used in every project. The problems with the projects seem to be normal problems with LCA that were acknowledged and an appropriate solution was found. However, this thesis is not about the environmental methodology. It is not possible to say anything about the methodological choices, setup and whether the LCA's were performed in a correct way. The only conclusion is that LCA has been used in every EEA project and it is a confirmation of the assumption that LCA is the basis of EEA used in SD-practice.

One element that could be important is the fact that there is not a lot of information yet when looking at the LCA of a fictitious plant in an AR. If this is a persistent problem it could be useful to look into other environmental methods.

4.3.2 Projects: Economic Methodology

For full comments see appendix III.III.II

Question

What Economic method was use in the EEA and what were the problems and limitations?

Summary of results

There are two main methodologies that are used, although in contrast to the environmental method where the answer always was LCA, the answers here were: "Yes, we look at the costs and we included this and this and this. But I don't really know the name for it". Therefore it could be that what is interpreted as life cycle costing approach is actually cost for customer and vice versa since this was not checked in the project files.

Life Cycle Costing (perspective) (8/18)

The first method is Life Cycle Costing (perspective), this means taking the costs for the system over the life cycle. Usually from the perspective of the company but in some cases (for example to communicate with authorities) the perspective for whole of society. This means including (the possibility) to add carbon tax in the future or including the costs in the use phase of the product. This method was valued mainly as good.

Cost for the customer (10/18)

This is just the cost for the customer without looking at the whole life cycle as such, usually the production costs of a product, or the sales price when looking at competing products. This method was valued as ok (3) and good (7).

Problems

There was a methodological problem in only one of the projects; this involved the valuation of the current production capacity. The question was whether to include the opportunity cost of having an (old) factory or value it at book value.

From the comments a lot of information can be derived:

The customer knows

First of all the way economics are usually calculated in close cooperation with the customer. Usually they are knowledgeable on this topic and can help a lot. They often have different methods in the different parts of the company and by cooperating the customer gets to put in what he knows and has control over.

Economic figures are strategic

Economic figures can be tricky to talk about and can be very strategic. For example trust issues, where customers ask: Why do you need this? What are you going to do with it? Customers are not always willing to give more than one figure (so the final cost /sales price instead of the elements that define the price). This means that the analyst has to trust his customer on this.

Appropriation Request (AR)

The AR can be seen as a special case, since there is a uniform methodology to calculate it. Here the figures are even more strategic. They will go to the board and the board will make a decision on it. These figures are often only estimations. Letting the analyst get control over these figures and having them question the estimations could mean that another alternative would come out best. This might not be appreciated by the person asking for the AR, since he usually strives for a certain option.

Main differences between projects

There were two approaches discovered: the "Life Cycle Costing" approach and the "Cost for customer" approach. Both worked well and did the job in the project.

Conclusions

The method is good

It seems that the economic method, beside some specific situations, works adequately. Two methodological elements were identified as missing: A name and a formal approach / manual / checklist. There are no problems with or gaps in the methodology identified. The methodology has thus served well in the projects so far.

Economics are sensitive

There is one important conclusion: economic figures are a sensitive subject. When asking for too much information without giving a good explanation on the use of the information the customer could react defensively. He could think that the SD-analyst will draw conclusions contradicting his own work. This means that with a formal economic approach, it might become much harder to get the right information and you would have to start interfering in a strategic subject. You should only do that if it serves a purpose and not just because you want to follow a certain methodology.

More on this topic in chapter 7

4.3.3 Projects: Project and time planning

For full comments see appendix III.III.III

Question

How much time was spent in the different phases and what phase caused a delay?

Summary of results

The phase with the most problems in the time planning seems to be the data collection, most of the hours of the project are put into this phase and also most project are delayed due to problems with data collection.

	Start up	Goal & scope	Data collection	Calculations	Draft results	Final results	Total
Time spent	6,9%	6,4%	36,7%	31,9%	9,7%	8,3%	100%
Delay	22%	6%	56%	22%	11%	17%	44%

Table 8: Time spent in percentage of the total project time and the delay in the time plan.

Time plan

Almost half of the projects were delivered slower than planned, this means after the original deadline. Often due to specific problems in one of the different phases, but mostly due to delay in the data collection. You can read about the reasons for the delay in the different phases in appendix III.III.III. Only the data collection phase is described specifically here.

Data collection phase

This seems to be the most important phase since most of the delay was in this phase. This was the case for two reasons:

The customer has no time, resources or data available (8/18)

Usually the problems come down to the customer / main contact not having the information readily available. Someone has to be found to provide the data one way or the other. This is where almost all of the delay starts since this is unforeseen for the customer, so there are no resources allocated to do this work. Even though the SD group mention this often, it still happens in half of the cases and in almost all bigger projects.

Not clear on demanded data required (2/18)

When the SD group started with EEA there were some problems in defining the right information need. This resulted in some delay during the data collection in 2 projects.

Other observations:

Expectations of customer

The thing that is very often mentioned in all of the phases is that the expectations of the customer are not always in line with the reality of the project. For example the data collection which was mentioned earlier. In the other phases there is a need for better formal agreements on the expectations in projects. For example there are customers who change the whole system after the draft results and then the analyst has to redo all the calculations. Another case is where the goal and scope were too wide and the analyst felt pressured throughout the process to deliver.

Main differences between projects

Bigger project means delay in data collection

Eight out of nine of the projects bigger than the median had delay in the data collection phase. In projects smaller than the median this was only 2 out of 9. The way the time was spent was more or less the same for both groups. The eight projects that described the budget as "too little" all had a delay in the data collection. This means that getting a better control over the data collection phase could give a better control over the financial success of the projects.

Conclusions

The data collection phase had the most problems. Some other problems were found in the other phases. Most of these problems can be brought back into two conclusions.

The customer's expectations have to be clear

It seems to be very important to get the expectations of the customer right in the beginning and break it down in activities and time spent on it. If the customer is asked: "Please allocate a person for 50% of his time for three months to data collection". The person allocated will probably be more prepared for questions. He could try to work in advance, think ahead more or say that he does not know where to start. In the worst case he will ask you to find someone else.

The analyst's expectations have to be clear

Formalizing all these elements before the project start will be very difficult since it will depend on the data available etc. So it will take time in the beginning of the project but it will save time later on, the customer will not change the results after the presentation and if data seems to be very difficult you

can start pushing to get it from the beginning. Especially in the bigger projects that are not so clear sometimes, this can give more control over the projects and make the results more relevant. It will also help to make sure that the budget is sufficient, know when you should charge more and know what you should and should not look at.

If you have done this it will not solve all delays, but it can help to streamline the projects better and release some pressure from the people collecting the data and the analysts and give a clearer end goal that is easier to go for.

4.3.4 Projects: Success factors of project

For full comments see appendix III.III.IV

Question

Give the most important factors why the project was a success (or not)?

Summary of results

This question is only about the success of the project itself, so the cooperation with the customer and the analyst. Which things are important when working together so that the goal will be reached in a nice way, and so that everybody will be happy?

Easy data gathering (6)

Where delays in data gathering is the most important factors in the delay, an easy data gathering clearly helps and is also mentioned as a success factor.

Knowledge base (6)

A strong knowledge base is important, this way the project can be done quickly and good.

Project management (6)

A good project management is also a success factor; it is mostly mentioned when there is a lack of it when there is a need it.

Project team (9)

The cooperation and collaboration with the customer in the project, is very important. Is it mentioned in half of the projects, the ability to make that extra step when needed.

Personal interest (7)

The personal interest of the decision maker or the analyst in the project was mention often as an important factor.

Use / interest method (4)

The usefulness of the method to look at things is also a success factor, the EEA methodology can bring a new way of looking at things and if this is appreciated this will help to make the project a success.

Problems Goal and scope (3)

A problem with the goal and scope is a negative factor in the success of the project. The results will be less useful and also the project will not be so successful.

Closed attitude (3)

A customer with a closed attitude is also a negative factor for the success of the project. This is more or less the opposite of the personal interest. The project will be less successful if the customer does not take an interest in the method and the project.

Main differences between projects

	Average score project	# of projects mentioned
All projects	3,3	18
POS Project team	4	6
POS Easy data gathering	3,8	6
POS Project management	3,7	3
POS Use / interest method	3,5	4
POS Personal interest	3,3	7
POS Knowledge base	3,3	4
NEG Knowledge base	3	1
NEG Closed attitude	2,5	2
NEG Problems Goal and scope	2,3	3
NEG Project management	1,5	2

Table 9: Success factors of EEA studies

The projects where the project team was mentioned as a success factor were scored high by the analyst. While the projects with project management as a negative factor and problems with goal and scope scored low. Even though these results are not statistical relevant it is interesting to see a pattern that the issues related to communication and cooperation have the high and low scores, while interest, knowledge & methodology are scored around the average of all the projects.

Conclusions

These success factors are important to use in setting up the project.

Before focusing on the actual work make sure you have a good project team, clear agreements project management and a good goal and scope. This makes the project more successful at least from the perspective of the analyst of SD. This also comes back to the expectations that were discussed in the previous paragraph.

Make sure the right people are in the project team and also that everybody is involved from the beginning. In these projects Eco-Efficiency / sustainability is often something that people like to work with. It is a positive and new topic for people and if they are interested in learning and trying to make a difference it will positively influence the success of the project.

When it seems clear from the beginning that the customer has a closed attitude it might be more important to find out what you can do for that customer. Make clearer why he is doing the project so spend more time on goal and scope or maybe try to find someone who has that personal drive.

4.3.5 Projects: Improvements options

For full comments see appendix III.III.V

Question

What would you do differently next time and what should the decision maker do differently next time?

Summary of results

The results have a lot of similarities with the problems and challenges identified in the previous paragraphs. This also makes clear communication and cooperation are already an important focus and they are aware of the importance of these issues.

What would you do different next time?

This is more or less the same as the previous paragraph 4.3.4 they will not be discussed here again, but the comments can be read in annex III.III.V.

Communication and cooperation

More visits to customer (7)

Project management (5)

Collecting the data (4)

Time planning (3)

Use and Methodology

Appropriation Request (3)

Use of results (3)

Weighting methodology (2)

What should the customer / decision maker do different next time?

Here again we find comments about communication and cooperation, since this has to come from two sides. But we also see comments on the allocation of time and resources. This is closely connected to the expectation of customers that was also a conclusion in the project planning paragraph 4.3.3. The customer needs to know that it will cost him time and resources to do the EEA project, in 10 out of 18 projects this was mentioned as a point to improve for the customer.

Communication and cooperation

Better involvement (3)

Communication (2)

Expectations effort & resources

Allocate time and money (5)

Better planning (3)

Deliver the data (2)

Conclusions

There were similar connections as the ones found in the previous paragraphs 4.3.3 and 4.3.4. We see a lot of comments about the communication and cooperation with the customer. There are also comments that the expectations of the customer about what will happen (in terms of time, money and people) should be more realistic.

4.3.6 Results in projects: Satisfaction

For full comments see appendix III.III.VI

Question

Were you satisfied with the assumptions & weighing factors and the results?

Was the customer satisfied with the results?

Summary of results

Were you satisfied with assumptions & weighing factors?

Yes (11/18)

In most cases the analyst was satisfied with the assumptions and weighing.

Eventually (2/18)

In two cases the assumptions and weighing was an issue in the beginning of the project but it was worked out during the course of the project.

Open for discussion (5/18)

In five cases it could be open for discussion. These are also the project that had problems with the LCA methodology that were connected to the weighing.

Were you satisfied with the results?

Yes (8/18)

In almost all projects the analysts were satisfied with the results.

Yes, but... (7/18)

And half of those the analysts had some side notes. Mainly on the goal and scope of the study the feeling was that sometime more could have gotten out of a project if the goal and scope was broader, or it was adapted during the project.

No (2/18)

Only in two projects the analysts were not satisfied because of the results or if project did not go as expected.

Was the decision maker satisfied with the results?

Yes (14/18)

Most of the decision makers were satisfied, for different reasons: Because they have learned something from the EEA or because they could use the results.

Would have wanted clearer results (4/18)

Sometimes a more clear answer would have been appreciated. Sometimes there is not a clear black and white, this is good and this is bad. The customer was in these cases looking for an answer that could not be delivered.

Main differences between projects

Satisfaction analyst with results	average score
Yes	3,63
Yes but...	3,38
No	1,50

Table 10: Project Satisfaction analysts and scores

The scores given by the analysts about his satisfaction with the results correspond with the results of the project. When he is not satisfied with the results he will not rate the project high.

Satisfaction decision makers with results	average score
Yes	3,42
Would have wanted clearer results	2,75

Table 11: Project Satisfaction decision makers and scores

For the decision maker it is the same case but less clear. When the decision maker wanted clearer results the average score was lower than when the decision maker was satisfied with the results.

Conclusions

In most of the project the customer and the analyst are satisfied. There are some discussions on the weighting factors. Not that the method that was used was incorrect, mainly that it is constantly open for discussion. It is good that this is sometimes the case since there is not a uniform weighting system available and it show that the analysts are aware of the complexity of the LCA that is behind the EEA.

Then there is the customer who sometimes wants clearer results. It is good to see that the answer is not always clear. Since this means that the analyst will not just write down what the decision maker wants to hear. This is positive since it means that the results will not be changed if it suits the customer. It is also negative since the expectation of the customer was to get clear results; this has to do with the expectations of the customer mentioned also in 4.3.3.

4.3.7 Results in projects: Use of results

For full comments see appendix III.III.VII

Question

Do you know how the (final) results were used?

How much you feel was the influence of the EEA on the choice made by the decision maker?

How were the results taken into account in the final decision?

Summary of results

Only in half (9/18) of the cases it was known how the results of the study were used fully. In the other half, 2/18 projects it was not known and in 7/18 project it was partly known. This means that the intended use was known or only the use of part of the results is known. Also in the cases that the

answer was “yes” it was often “yes: the results were used in discussion, but I do not know to what extend”.

One observation is that even though the use or intended use of the results was known there was very little information in what situation it was used, for what decisions and in what context. Also the question “How much you feel was the influence of the EEA on the choice made by the decision maker?” could not be answered in the projects.

The results are mainly used to put sustainability /environmental aspects in:

- Discussions on (long term) strategy & improvement options
- R&D
- Communication
- Answer specific questions

A more extensive breakdown on the goals and results you can find in paragraph 4.3.11 and 4.3.12 and also the conclusions will be discussed there.

Conclusions

On the one hand it is logical that it is not precisely known how the results are used. Since these discussions are often after the presentation of the results and at this time a new project is already started and the focus is on the new project. On the other hand this should be better known fulfil the customer needs. If you know how the results will be used exactly then it is easier to put the right information in the presentation and in the final report.

How the decision makers actually use the results is not mapped here. There is a big opportunity to try to find out. This way the analyst can improve the quality and maybe find new uses for the results that they were not aware of. It can also be used in selling new projects and explaining how to see the results of the study.

One last remark here is that this question was asked to the individual analyst. This does not mean that the precise use of the results are not known within the SD-group, but at least that it is not known by the individual analyst that worked on the project.

4.3.8 Results in projects: Success factors for use of results

For full comments see appendix III.III.VIII

Question

Give the most important factors why the EEA was used for a decision.

Summary of results

It is unclear how the results were used precisely, but there are a number of factors here why the results were (expected to be) used or not:

Useful concept to look at things (9/18)

By looking at their system from a life cycle perspective the customers get new insights. They can use it as a framework to communicate about the sustainability of their own products.

Favourable results (4/18)

Obviously it is nice if the results favour the product that was investigated.

Did not see use (4/18)

In four projects the decision maker did not see the use of the Eco-Efficiency study and therefore they did not really use the results. In one case the EEA was too late to be used due to last minute changes by the customer.

Formal part of AR (4/18)

AkzoNobel demands to have an EEA as a part of an Appropriation Request. In four projects this was mentioned as a success factor in the use of the results.

Personal interest (4/18)

Personal interest in the EEA and sustainability in general by the decision maker is a factor that was mentioned four times.

Unfavourable or unclear results (4/18)

The fact that the results were not favourable for the customer was mentioned four times as a reason that the results were not used, especially when the goal was to use it in marketing. (More on this topic in paragraph 4.3.12)

Main differences between projects

Since it was not possible to collect figures on the influence of the EEA on the choice made by the decision maker it is not also possible to say how these factors mentioned above influence the use of the EEA study.

Conclusions

In most cases the use was not fully known so therefore there is no complete picture on the use of the results. Here the same remark as in the previous paragraph can be made. It would be good to get this complete picture.

When we look at the information that is available we see that in a lot of projects the concept of the EEA is mentioned as a use factor. We can conclude that there is a real added value to make an EEA study¹³ / use the life cycle concept (in the projects that were looked at). The opposite is also true but fortunately in a much smaller number of cases.

The actual results were mentioned eight times (positive or negative). This means that in the other cases the actual results were not that important but the focus was what can be learned from the results. This should be the goal when working with EEA, even when the results are not positive it should not influence the (internal) use of the results. It is maybe not something to show externally but it should at least be used to adapt the strategy in the future.

Another element that plays an important role is the Appropriation Request. In four cases it was mentioned that this is a reason the EEA was used. This is a good thing, since this means first of all that the strategy of AkzoNobel to make an EEA obligatory in the AR is an effective way to use the results and second of all that an EEA is a useful input in the AR otherwise it would not be used at all.

4.3.9 Clients in SD-practice: Motivation of clients

For full comments see appendix III.III.IX

In this paragraph a lot of questions about the clients will be handled. Like who are they, their position in the organization, in what way were they involved in the project? Finally did this have a result on the success of the project?

Question

Who are the clients?

How is their involvement and interest in the project?

Summary of results

The clients consist of:

The customers

The customer is usually the HSE (Health Safety Environment) manager, technology manager, production manager or project leader (of the project that is studied in the EEA). This responsibility is usually given to somebody with a technical /environmental position in the company. They are often part of the BU or sBU management team. In half of the projects the customer was also the decision maker. In four projects the customer was the main contact person. In two he was the main contact and the decision maker.

¹³ This would be good to get confirmed by the opinion of the customer of course.

The decision makers

The decision maker is usually the customer (as a part of the management team) or the whole management team. The decision maker is usually present at the final presentation. The ultimate decision maker is often the board of management. As will be discussed in chapter 5 the business units have a relatively independent role. In most cases the board will check the figures of the BU and see if everything adds up. The board values the advice of the (s)BU management team, and will usually follow it. Therefore the management team is seen as the decision maker for an EEA study. Since their use of the results will play a very big role. This is confirmed by the analysts that this is the case in most projects.

Comments about the decision maker

Very Interested (3/18)

In three cases the decision maker was very interested in the EEA.

(Very) Low involvement (5/18)

In five projects the decision maker had a (very) low involvement in the EEA study

Don't know decision maker (4/18)

In four cases the decision maker was not known by the analyst who was interviewed on the subject.

Main contact person(s)

These are usually one or two people responsible for the day to day discussion on the project and are reporting to the customer.

Comments about the main contact

Interested / Involved (5/18)

In five cases the main contact was mentioned as very interested and involved.

Lack of time/priority (4/18)

In four cases the main contact was specifically mentioned as someone with little time or priority in the project. The main reason is lack of time due to extra work on top of an already full workload.

A lot of knowledge (4/18)

A lot of knowledge with the main contact person was very helpful in four cases.

Problems with person (2/18)

In two cases there were problems with the main contact on the personal level, this influenced the project one time and the other time it did not.

Main differences between projects

Since there was not a good score for the success of the use of the results we will look at the influence different elements have on the overall (success) score of the project.

Customer

The customer was also the main contact in four smaller projects, never in a bigger project. The size of the project does not seem to be an influence for the customer to be the decision maker. The customer was also the decision maker in 4/9 of the bigger projects and 5/9 of the smaller projects.

	Cooperation with decision maker		Interest decision maker	
	Average overall Score	Times mentioned	Average overall Score	Times mentioned
All projects	3,3	13	3,3	13
Should be much better	-	0	-	0
Could be a bit better	3,0	2	4,0	2
It was ok	4,0	3	3,0	2
Good	3,0	6	3,0	5
Could not be better	3,5	2	3,6	5
Don't know DM	3,3	5	3,3	5

Table 12: Involvement & interest decision maker compared with project score

As is shown in the table above, it does not seem that the involvement or the interest in the day to day process of the decision maker plays a big role during the project. Once the decision has been made to do the EEA study they some times stay involved, sometimes not. There is no indication in the information that was collected that their involvement influences the overall score of the project.

Involvement & interest decision maker compared with success factors

Since the involvement and interest of the decision maker is not connected to the overall success score. There is still the need to know is how this involvement influences the use of the results, since that is the main reason why the decision maker has ordered the study. Since there are no scores on the actual use this is not possible. But we can look what factors pay a role in the (intended) use based on their interest and involvement. To do this we use the factors presented in 4.3.8.

Yes on: Personal interest / good concept

If the analyst mentioned the success factor personal interest and/or good concept to look at things as a "use success factor" this has got a yes. Now the scores on involvement and interest of the DM were grouped by: Up to ok (so 1 - 3 in the scores) Good or better (4 - 5) and no score.

Yes on: the results

Same goes for "The decision maker looked at the results" as a use factor. If the analyst mentioned positive results or negative results as a use factor this has a yes. Again involvement and interest divided in three groups and the number of yes reported.

Involvement DM	Yes on: Personal interest / good concept		Yes on: the Results	
Up to It was ok (1-3)	38%	(3/8)	63%	(5/8)
Good or better (4-5)	100%	(6/6)	33%	(2/6)
No score	25%	(1/4)	25%	(1/4)

Table 13: Involvement and type of expected use of EEA results

Interest DM	Yes on: Personal interest / good concept		Yes on: the Results	
Up to It was ok (1-3)	25%	(1/4)	75%	(3/4)
Good or better (4-5)	80%	(8/10)	40%	(4/10)
No score	25%	(1/4)	25%	(1/4)

Table 14: Interest and type of expected use of EEA results

Both the involvement and the interest scores point into the same direction. If the involvement/interest is rated good or better the personal factor is mentioned as an (expected) success factor (100% & 80%). While the opposite is true for the results; If the results were mentioned as an (expected) success factor the involvement and interest was valued ok or lower (75% & 63%).

Involvement & interest main contact

	Cooperation with main contact.		Interest main contact.	
	Average overall Score	Times mentioned	Average overall Score	Times mentioned
All projects	3,3	18	3,3	18
Should be much better	1,5	2	2,0	1
Could be a bit better	-	0	2,5	2
It was ok	3,7	3	3,3	3
Good	3,3	7	3,2	9
Could not be better	3,7	6	4,3	3

Table 15: Involvement & interest main contact and project succes

The lack of cooperation with the main contact is an important factor in the success of the project. The two projects where cooperation was ranked as: "should be much better" has also received very low scores on the overall project score. When the score on cooperation was Ok or better it does not seem to influence the final score of the project. The relation between the interest and the score of the project

is in the same direction, when the interest is low the score of the project is low and the scores become higher as the interest is scored higher.

Conclusions

General

The idea about the three main roles, the customer, decision maker and main contact, is confirmed in the review of the old EEA projects. These are most of the time different people with different roles. Only in smaller projects these roles are combined. By having confirmed these roles it is now possible to have a different targeting strategy for these people.

Customer

The customer has a mixed role with the decision maker. He is often also the decision maker or the responsible person in the decision making group. What is also good to know that half of the time the customer is not the decision maker; this means that even though he is the person paying the bill there are other people behind him who have asked him to do the study. Their demands on him should be known in order to investigate the right things.

Decision Maker

Interest and success of project

It does not seem that the involvement of the decision maker has a very large influence on the overall success of the project. That is a good thing since the time the decision maker has is often very limited, and sometimes the decision maker is not known at all.

Interest and success of use

When we look at the “expected use factors of the projects results” we can conclude that: The results of the study are more important when there is a low interest and the personal interest and use of method is more important when there is a high interest. This cannot be verified further at this point until the actual use is known. What we could learn if it is true¹⁴ that when the involvement of the decision maker is (expected to be) low he will focus on the results (good or bad). In this case you should make sure that the decision maker sees the use of the method during the projects and to make sure that the results are clear in the end of the project. Both elements should be the goal, clear results and get interest in the project. Next chapter will go into more in-depth into decision making process and the (information) needs of the decision makers.

Project leader / Main contact

In the definition of the roles there is no “main contact person”. In most cases this can be seen as the project leader from the client. But in some projects this was not the case. Since these roles were not so clear before starting the interviews a question about who was the project leader was not included. But the main contact seems to be a key player in the success of the project. Therefore he should be recognised as such, involved in an early stage and give him the “status” of the project leader. It is important to find someone with time and interest in doing it. It also confirms that a problem in cooperation has a very negative influence on the overall success score of the project, mentioned earlier in paragraph 4.3.8.

4.3.10 Clients in SD-practice: Knowledge and understanding about EEA by clients

For full comments see appendix III.III.X

Question

How was the knowledge on EEA by the main contact and the decision maker?

Did the decision maker understand the logic behind the results (weighting factors/economic and environmental criteria) or did he see it as a black box? Was this a problem in making the decision?

¹⁴ There is of course a fair chance that there is wish full thinking by the analyst that if the decision maker is interested and thinks it is a good method he will also use the results.

Summary of results

Knowledge main contact on EEA

The scores were relatively low (11/18) so there is room for improvement. So the analysts at SD are usually working with people who don't know a lot about EEA.

Knowledge decision maker on EEA

The knowledge of the decision maker on EEA was comparable with the knowledge of the main contacts. Five out of fourteen were rated with room for improvement.

Understanding of EEA by decision maker

It was hard to get a good answer on this question since there was not a lot of contact with the decision maker so it is hard to figure that out. Still, in five projects the understanding was low, but that was not always a problem since a lot of times it was reported that they needed to look at the big picture, it was one of the elements for a decision. The only time when it was mentioned as a problem is in the communication with authorities if the decision maker wants to explain the details.

Main differences between projects

Success project and knowledge main contact

	Knowledge main contact on EEA	
	Average Score	Times mentioned
All projects	3,3	18
Should be much better	2,5	2
Could be a bit better	3,1	9
It was ok	3,7	3
Good	3,5	2
Could not be better	4,0	2

Table 16: Knowledge of main contact and success project

There does not seem to be a link between the knowledge of the main contact and the success of the project. The success of the project slightly increases but not a lot. The slightly lower scores of "should be much better" could be explained by misunderstanding (or unwillingness to understand) of the analyst by the main contact person, since in a way you cannot ask the contact to have any knowledge on the topic.

Success project and knowledge decision maker

	Knowledge decision maker	
	Average Score	Times mentioned
All projects	3,3	18
Should be much better	4	1
Could be a bit better	2,75	4
It was ok	3	4
Good	4	5
Could not be better	-	-
No score	3,0	4

Table 17: Knowledge of decision maker and success project

The results are more or less the same for the decision maker. His knowledge level does not seem to affect the results of the project.

Conclusions

Knowledge on EEA

It was not possible to find a strong connection to the success of the project and knowledge and understanding about EEA. It would be really interesting to find out if there is, by asking all the decision makers involved in EEA studies to fill in a questionnaire about EEA and how they used the results to see if there is a connection. But at least there is no need to have knowledge on EEA before starting a project. This is a sign that the analysts from SD are doing a good job. As a consultant you are

expected to bring certain knowledge and if the people you work with need to have that as a pre requisite to do a project you would not be doing a good job.

Understanding of EEA by decision maker

It seems that it doesn't really matter if the decision maker understands the logic behind the EEA or not. When this was reported a low it was also mentioned that the goal is to get the relevant results and that they believe in the results that the analysts have presented. If that is the case they will use the results. This means that it is more important to make sure the results of the EEA are clear and understandable then to try to explain in detail what is behind it. If the decision maker wants to know he will ask for it.

4.3.11 Clients in SD-practice: Goals of the clients

For full comments see appendix III.III.XI

Question

What was the primary and secondary reason to do the EEA / What were the goals of the study?

Summary of results

The goals of the projects were investigated in two ways: First the reason to it based on the six application areas of EEA (as used by the analyst of SD) and after that by asking for the specific goals.

EEA application area's (as used by the analyst of SD)

Strategy	13
Manufacturing	7
R&D	1
Communication	6
Supply chain	0
Marketing	5

Table 18: Type of applications EEA studies

As we see the main reason is strategy, it is mentioned in two thirds of the projects. Then manufacturing, communication and marketing in around a third of the projects. Finally R&D and supply chain they were only mentioned once or not at all.

Specific goals

When the specific goals are grouped we get a more detailed picture on the goals.

Strategic discussions (5)

This is the general strategy of the s(BU) management. What things are important to focus on and where are improvement options.

Learn about EEA (4)

How does EEA work and in what way can it be use is to asses the products. In all projects that mentioned it, to learn about EEA was of at least two goals. So it should not be seen as a goal but as an effect of doing an EEA study.

EEA for AR (5)

One very specific category is the EEA as part of the Appropriation Request. For every big decision and EEA is made to find the most Eco-Efficient solution. This is added to the AR and send to the board.

Specific information (5)

The goals in this category are all about the need to get a specific question answered. For example: How is a product rated compared to other products? Or what is the best alternative to go for?

Communication authorities (5)

This is mainly to show authorities the Life cycle perspective of certain (environmental) demands, instead of looking at local /individual effects.

Marketing (3)

It is used to show the Eco-Efficiency of a certain product in order to sell more products.

Reaching the goals

Most of the goals were reached (23/31). When this was not or partly the case (8/31) it was usually either due to problems finding the data or getting useful results for the customer.

Main differences between projects

Scores per EEA application area

	Main goal EEA		Secondary goal EEA	
	Average Score	Times mentioned	Average Score	Times mentioned
All projects	3,3	18	3,3	18
Strategy	3,7	11	3,5	2
Manufacturing	3,0	1	3,7	6
R&D	-	-	3,0	1
Communication	3,0	4	3,0	2
Supply chain	-	-	-	-
Marketing	1,5	2	4,0	3
No goal	-	-	2,3	4

Table 19: Success and goal of the EEA study

When looking at the goals of the EEA and their effect on the rating of the projects it is very clear from this list that the projects primarily focussed on marketing did not go so well and the projects focussed on strategy were most successful. Also these two marketing projects had no secondary goals. The projects that had marketing as a secondary goal had very good scores.

Scores for grouped goals

	Grouped Goals	
	Average Score	Times mentioned
Total	3,3	25
Marketing	2,3	3
(Learn about EEA)	3,0	4
Communication authorities	3,0	5
EEA for AR	3,6	5
Specific information	3,8	5
Strategic discussions	3,8	5

Table 20: Goals and success of study

Most projects had more the one goal, which is why there are 25 goals for 18 projects. Since there was subdivision in primary or secondary goals they were not presented as such. We see the same thing as in marketing as we did before, lower scores¹⁵. The other scores are not that different from each other. Communication is a bit under average, while specific information and strategic discussions are over average.

Conclusions

Primary goal marketing

EEA should not focus on marketing as a primary goal. The projects were not successful because the mindset of the customer was wrong. If you do an EEA you have to be willing to learn from it. If you just do it to get nice results to show in marketing and are not willing to learn from it and maybe use it in your strategy EEA is not a good tool.

On the other hand there is nothing wrong with investigating your product try to learn from it and if there are nice results tell people and use it in marketing. If there are not Eco-Efficient, change the strategy and focus on the right thing to make sure that the products will become Eco-Efficient. Therefore in this thesis marketing is not considered as a goal, but more as a potential nice by-product of an EEA study.

¹⁵ Less clear since the secondary goals are now included in the

Reaching goals

Goals that were not reached was usually due to the fact that there was no answer to be found (within in time available for the project). This means that the goals were not reachable or that the question was not the right one. Sometimes this is no problem since the answer that something cannot be answered is also useful information. Again the expectation of the customer and the goal and scope that was mentioned earlier in paragraph 4.3.3 and 4.3.4 is very important here in being able to reach the goals that you have in the start of a project.

Grouped goals

Marketing and learning about EEA are both extra opportunities of results of doing the EEA. The real goals are: Communication authorities, EEA for AR, getting Specific (product) information and Strategic discussions.

4.3.12 Clients in SD-practice: Results for the clients

For full comments see appendix III.III.XII

Question

What were the results and did it match the assumptions regarding the results the decision maker had on before hand?

Summary of results

The specific results are grouped into three result types

Comparison (8)

In eight cases there was a comparison between a number of products. Of course the EEA usually makes a comparison, but in these cases the comparison itself was the result for the client.

Life cycle insights (10)

Life cycle insights are mentioned ten times as an important result for the customer.

Specific results /information (13)

Specific information or a specific piece of information from the results was mentioned as the desired result. This is for example the EEA diagram for an AR or the environmental scores of a specific product.

Assumptions of results

Half of the cases the results matched the assumption on beforehand. In the other half it did partly (7/18) or not (2/18). In most cases this was not a problem since it was more or less the goal to test the assumptions and lead to useful insights. In a few cases it was seen as negative by the customer that their assumptions were not right.

Main differences between projects

	Specific results /information		Life cycle insights		Comparison	
Total	3,3	18	3,3	18	3,3	18
no	3,3	8	3,1	10	3,3	13
yes	3,3	10	3,5	8	3,2	5

Table 21: Project success and type of results

When looking at the result of the project, there does not see to be a connection to the type of results that are achieved and the success of the project.

Conclusions

The results

Even though the EEA is always a comparison the actual comparison is not always the main goal of the study. The actual results, or specific information is also very important and the general learning for the products and processes.

Assumptions

The fact that the assumptions were proven (partly) wrong in half of the cases is a very good thing since this means that doing an EEA can reveal new insights and new information. If this was not the case there would not be a (real) need for an EEA. On the other hand it is good to make sure that the customer knows that their assumptions might be wrong and that the results might be different than expected. Again also this is part of the expectations of the customer mentioned above.

4.3.13 Evaluation of the analysts: Knowledge & Improvement options

For full comments see appendix III.III.XIII

Question

Rate your:

Knowledge of processes & considerations client

Involvement in project

Knowledge of environmental analysis

Knowledge of economic analysis

How can any of these be improved?

Summary of results

Knowledge of processes & considerations client

There was an average score of 3,0 on the Knowledge of processes & considerations client, this means it was ok. If the knowledge could be better it took a little more time to understand everything. When the processes are known it is easier to make the goal and scope and ask the right questions immediately.

Involvement in project

There was an average score of 3,9 on the involvement in project, this is the highest of the four scores. It means that the involvement is high on average.

Knowledge of environmental analysis

There was an average score of 3,6 on the knowledge of environmental analysis. This is also the speciality of the people in the SD-group. In the cases where it could or should be better the comments were made that it was due to inexperience of the people who just started with LCA.

Knowledge of economic analysis

There was an average score of 2,9 on the knowledge of economic analysis, which mean that is was ok. There were a lot of comments here and most of them had to do with the lack of specific understanding of the language economist use. By not knowing this there is some insecurity to talk about it even though it we saw in 4.3.2 that the economic method itself did not give a lot of problems. What was also mentioned as missing was "the method" or standard approach to hold on to.

Main differences between projects

	Results as expected		Average success Score
	Times yes	Times mentioned	
All projects	50%	18	3,3
Could be a bit better	83%	6	2,8
It was ok	60%	5	3,8
Good	14%	7	3,3

Table 22: Knowledge of processes and results for customer

In the previous paragraph we saw that the in half of the cases the assumptions of the customers were not correct. It seems logical to compare this to the knowledge of the analyst on the processes of the client. And as is shown above, it seems to have a big influence on the results and the things that were found during the projects. When the knowledge was good there was only one out of seven projects where the results were as expected. When the knowledge could be improved there was only one out of six where the results were not as expected.

Involvement in project

The two projects where the involvement was rated below “it was ok” have a low success score (see explained in 4.3.11).

The knowledge on economic and environmental analysis does not seem to influence the success of the project or the delay during the project.

Conclusions

Knowledge of processes

This knowledge is not really important to do a successful project, but it is very important to find things that are “hidden under the surface”. When the analyst has knowledge on the products and processes he will be able to find more results that were not expected. Now there are a number of explanations for this. First of all: the analyst can ask better questions and knows where to look and also dares to question the assumptions. Second of all: The analyst has gained this knowledge by doing EEA studies, has more experience so is better trained to find the unexpected results. Third of all: Due to knowledge on processes the important elements for that customer are already known. Therefore it is easier to make sure that the study has the right goal and scope and really look at those things. Most likely it is a combination of these three explanations. I think it is ok to say that “proving assumptions wrong” is an indicator of the quality or added value of the EEA. The conclusion is that having more knowledge will increase the quality / added value of the EEA study, and should therefore be a goal to have before the project start, even if it will not influence the success of the project itself.

Involvement in project

The involvement is very good except for the two marketing projects; this means that there was low motivation with the analysts to work on these projects.

Knowledge of environmental analysis

The knowledge on the environmental methodology is good. This is the background of the analysts and when there is a lack of knowledge or experience on a certain topic it is filled in.

Knowledge of economic analysis

The knowledge of economic analysis is good enough, but there are improvement options. Not so much in the methodology itself, but more on the communication. As we concluded in 4.3.2 the economics are often sensitive to talk about. Therefore communication is very important, the goal is to collect enough information and explain very clearly why the information is needed and maybe even more important how it will be used. If they are (still) reluctant to give the information or the client has the feeling that this is not the way he looks at economics. Then how to proceed? Another aspect is communicating in a way that the client will take you seriously, by using the right terminology and asking the right questions, more on this topic in chapter 7.

4.4 Conclusions

This chapter was mainly a manual of EEA, what is important and what can go wrong. There are a lot of different elements that were discussed and conclusions drawn. Sometimes there might have been a lot of emphasis on the problems, but these are the things that we can learn most from. The main conclusion is that the EEA's are useful to do and the way it is performed right now works and there are no problems with that. There are some opportunities for improvement; they are presented in chapter 6 where an updated approach for EEA studies is discussed. Before going into the project approach we have to see if what input we can get from the decision makers in the next chapter.

5 Decision making process

5.1 Introduction

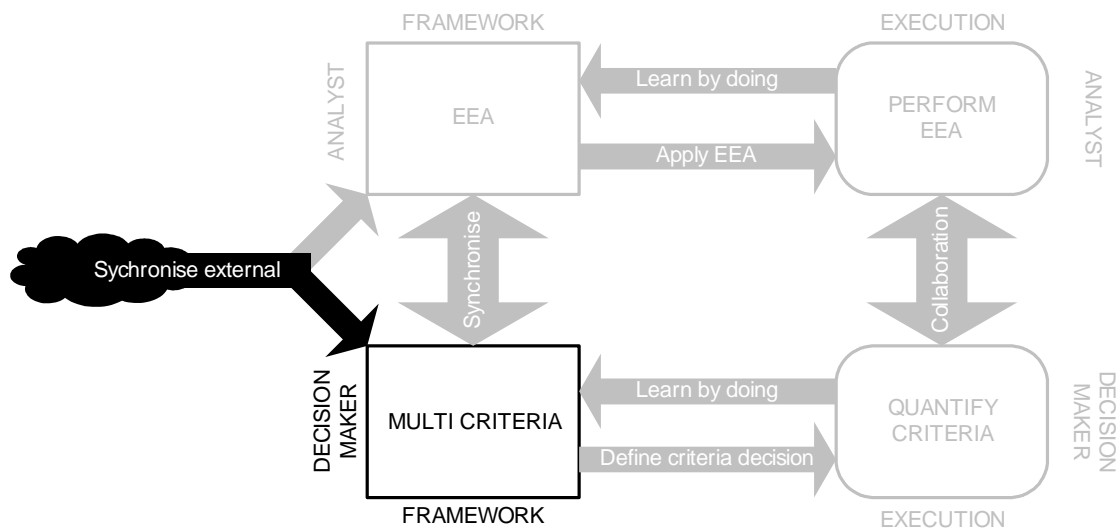


Figure 18 Main topics of the chapter 5

In this chapter the decision making as encountered in the AN-practice is described. This consists of the decision making in the AkzoNobel sub Business Unit Cellulosic Specialties. The DM-process is described based on interviews with the management. The focus is to describe the way the decision making process works. This goes from general goal setting to the translation into action plans. Based on this the information need of the decision maker is described.

5.2 Result of the interviews management CS

5.2.1 General results

To look at decision making in AkzoNobel the management of the BU Cellulosic Specialties (CS)¹⁶ was interviewed to ask them about the way they make decisions and what criteria play a role. Six managers were asked to cooperate and give two interviews¹⁷. The selection of these managers was based on the six application areas of EEA. The first interview was to tell about the decision making process and the criteria that are important and the main drivers in their organization. The second interview was used to reflect on the results of the first interview. An overview of the full transcript with an introduction and the full setup can be found in annex IV. There were different questions for the different managers who were interviewed the results are qualitative and mainly to get a good overview of what the aspects that influence the decision making are. Therefore this chapter is a summary restructuring the interviews based on the different elements that were mentioned as having an influence on the decision making in CS.

5.2.2 Validity to whole AkzoNobel organization

What is important to note is that sBU Cellulosic Specialties is a part of the Business Unit (BU) Functional Chemicals (FC) AkzoNobel. FC can be seen as the BU where activities are collected that are distinctly different but not large enough to be an independent BU. Therefore the way the sBU CS works is comparable with the way a lot of BU's work (where the strategy, R&D etc is controlled on BU level and the sBU's are mainly focused on the specific sales regions, for example the BU Pulp & Paper Chemicals). The planning & budgeting procedure and bonuses system is the same in all the parts of

¹⁶ This is the same BU for whom the Case study was performed.

¹⁷ This was the setup, but for one manager only one interview has been conducted due to long travel distance.

AN. So the planning & budgeting procedure and bonuses system in other sBU's and BU's of AkzoNobel are in general terms comparable to the ones presented in this chapter¹⁸.

5.3 Drivers decision making

This paragraph explains the how the multi criteria framework the decision making is build up. When are goals included and into the planning and how a decision is made.

The three elements that were found in CS that have an influence on decisions making are:

- Relation with stakeholders
- Planning and budgeting system
- The bonus system

These three are not equally important, the relationship with stakeholders, is the basis for the two others.

5.3.1 Relation with stakeholders

The strategy of CS revolves around its stakeholders they are equally important in the sense that attention & effort has to be put in each of them and one cannot be seen without the other. Together they are the main drivers in decisions & for changes. Therefore there are goals to manage all four categories:

- **Owner (Board of AkzoNobel as representatives of the shareholders)**

Have a good relation with the AkzoNobel Organization, where there is a good (long term) yield on the money invested.

- **Customers**

Listen to the needs of customers. Have a good long term relationship with customers and act on their questions, demands & complaints.

- **Society**

Work with the authorities and community, be aware of role and be a good (corporate) citizen

- **Employees**

Create a safe, pleasant & stimulating working environment

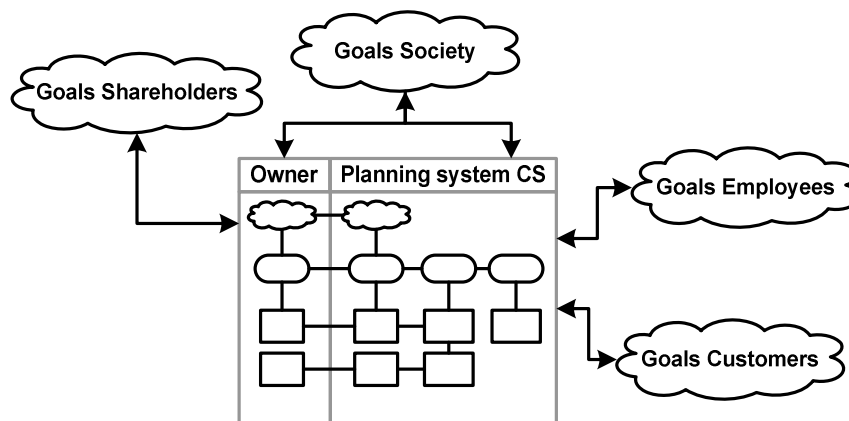


Figure 19 Relation CS with stakeholders

The overall goal is to have a sustainable relation with all the four stakeholders. They all try to influence the company in one way or the other to try to fulfil their own needs. This concept comes back in all the different parts of the organization.

For example this means for R&D this means that it focuses on the development of products that: Fulfills the customer needs, have a good potential profit for the owner, don't pollute the society and can be produced in such a way that it is not dangerous for employees.

¹⁸ At least the description is representative to the way it should be setup.

Types of goals

To satisfy all the needs of the stakeholders there CS organization needs goals:

- Financial goals
- QHSE (Quality, Health, Safety and Environment) goals
- Personnel development goals
- Customers satisfaction goals
- Communication goals

In every step of the planning process these goals are specified put into action plans and into the bonus and motivation system. Depending on the place in the organization there will be a stronger focus on some of the goals and less on the others. Two things are important to note about the goals:

Competition for resources in practice

All these goals are constantly competing for attention and resources so even when there is a goal that could be financed and is on the target list and is reachable there should be focus on it. For example in manufacturing the main drivers are safety and health in the plant and then the yield of the plant (a financial goal). Then the production quality needs to be good. After that there are a lot of regulatory requirements regarding HSE-issues. After all these issues are taken care of there is place to focus on the other goals.

Financial goals are not equal to the other goals

Financial goals are special goals since every decision on any topic will have an influence on the financial goals¹⁹. The financial goal is also a measuring instrument of the effectiveness of the implementation of a non financial goal.

5.3.2 Planning system CS

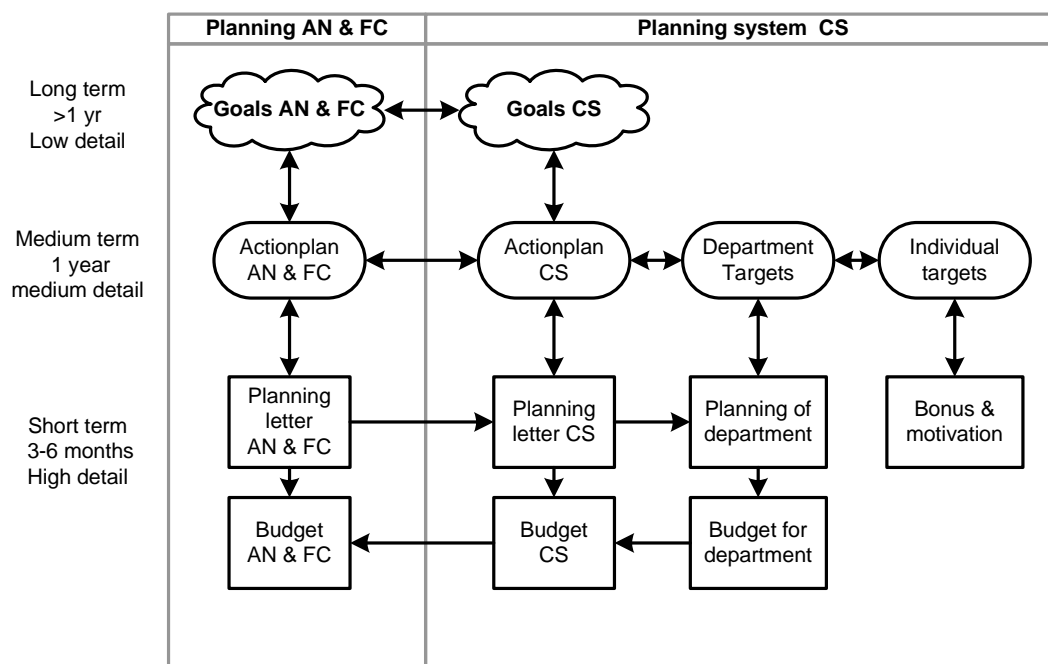


Figure 20 Planning system CS

Goals and action plans

The goals are decided on in the Management Team (MT) based on the four drivers presented in the previous paragraph. These general goals can arrive bottom up, from within the organization, top down from Corporate or from developments outside the organization. Therefore there is a lot of

¹⁹ It could be that the influence is nil but that is required information.

communication with the employees before and after the MT meetings, to get input from the employees, or explain about the decisions that were taken. The (long term) goals are specified into (one year) action plans that describe the actual actions that will be taken to fulfil the goals. These action plans are usually yearly and are updated around the turn of the year. The score cards & bonuses are based on the goals.

5.3.3 Bonus system

When talking about drivers for decision making it is good to know in what way the people who are making the decision are rewarded. This helps to understand motivations why certain decisions were taken. As was told earlier the financial goals are a measure of effectiveness of non financial goals, as well as goals. About the bonus system is good to know that the categories for which there were goals are translated into indicators.

The bonus and motivation system that is in place is applicable for all managers within AkzoNobel; the other employees usually have group goals, with a collective bonus.

The (management) bonus system has three main elements:

- Own unit performance (in this case sBU, CS). This part accounts for ~50% of the bonus and it is measured with financial indicators.
- One level up performance (in this case BU, FC). This part accounts for ~20% of the bonus and it is measured with financial indicators.
- Personal goals. This part accounts for ~30% of the bonus and it is measured with non financial indicators.

The financial goals are based on the EVA (Economic Value Added) which starts with profits but also takes into account taxes to the corporation and the cost for the invested capital. The bonus is calculated based on the improvement desired versus the previous year versus what was achieved. For instance if 2007 EVA was 6 M€ and the desired improvement was 2 M€ and the performance at the end of 2008 is 7 M€ then the bonus is 50% which is an improvement of 1 M€ over the desired 2 M€.

The non-financial goals are mostly function related, so a safety manager could have a goal: 5% less (near) accidents compared to last year (or base year). These goals are agreed upon by the employee with his manager. Some are given to him, some are own interest of employee. Half way the year the goals are reprioritized, evaluated and sometimes adjusted if they are unfeasible or too easy. The main target is to have reasonable goals that are attainable so that they are motivating and give an extra drive.

In the case of the safety manager he could have the reward based on 5% less accidents. The amount of the bonus he will get is based on his review from his manager on that goal. So when he achieves a reduction of 4% he will probably still get a large share of the bonus.

The total share in the salary of the bonus is anywhere between 5% for managers in the sBU and up to 60% or 70% for the members of the board.

5.4 Decision making procedure

Based on the previous paragraph we define the decision making procedure as used in CS practice. This happens in three steps. The first two steps are based on the needs and how these are handled. The way it is described is the formal how they should be followed, and also will be done for big decisions, and that should be done in the case and EEA is made.

While for smaller decisions and needs the same steps are followed but maybe some will do step one and two in his head, tell his colleagues about it and they will be enthusiastic. But still they will use the framework in step 3 to evaluate the decision.

1. Identify need

A stakeholder with a need

(At least) One of the four main stakeholders has to have a need that has to be strong enough to consider.

Consider the need

Consider and decide if the need is important enough to investigate. There could be opposing needs from other stakeholders.

2. Investigate need

Quantify the need in scenarios

What do you have to do to fulfil this need?

Quantify impact of the need in financial and non financial indicators

Calculate what the expected effect of scenarios is.

3. Make a decision

The decision maker has to decide what it will mean for his goals and action plans that we defined in the previous paragraphs. And what the impact on his targets will be.

	Financial targets	Non financial targets
Long term Goals		
Medium term action plans		
Medium term Bonus		
Short term budgets		

Table 23: Decision making goals as described in CS practice

This is basically the framework the decision maker optimizes for him personally. So it could be the case that the decision maker has very tight budget restrictions for a certain year and will take a decision only on those grounds.

5.5 Conclusions

This chapter was to clarify the decision making structure that the decision maker uses. This was fulfilled:

- Identify need
- Investigate need
- Make decision

Now we connect this to the practice of the SD-practice.

- Identify need
- Order an EEA with the SD-group
- Make decision

The analyst now knows that when he gets a question to do an EEA he needs to identify the need and figure out on what grounds the decision maker will make his decision. This way he can provide the decision maker with more relevant information, or give more focus when presenting the results, for example by showing what will happen to the medium or short term results. These three steps will be used in the next chapters to identify different EEA situations.

Validity

This has been a face validation by the decision makers, this means that this chapter was read by the people who where interview and they agree with the content, and the conclusions drawn in this chapter.

6 Opportunities to improve EEA

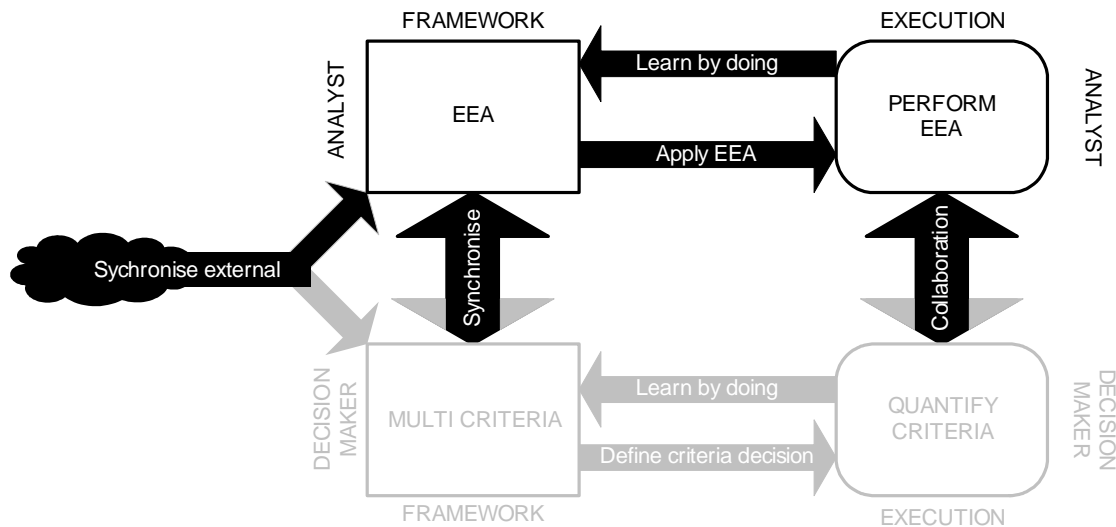


Figure 21: Main topics of the chapter 6

This chapter connects the conclusions that were found in the three previous chapters and integrate them into three recommendations to improve EEA in the SD-practice. This way future EEA studies can be more effective and successful. The first recommendation is to start offering “EEA pre-studies”. The second recommendation is to investigate and quantify the expectations before starting a project. The last recommendation is to have a structured project evaluation.

6.1 EEA inventory / pre-study

It would be interesting to start offering an EEA inventory / EEA pre-study. This does not have to be as extensive as the pre-study performed in this thesis, but a qualitative investigation of the “EEA system” to see where the main opportunities are. There are four reasons to do the pre-study:

Right goal and scope

The EEA inventory can help to start the EEA study with the right goal and scope. This way the work can be done more efficient. When it is not really clear for the customer what he wants this would be especially helpful. The customer most likely does not realise what he needs because he does not know so much about EEA. Finding the right goal and scope is done by specifying the information demand. It will be useful to walk through the steps of the life cycle with the customer and ask what really happens in the different life cycle steps.

Knowledge analyst and customer

The analyst can learn about the processes, so that he is able to ask the right questions in order to find more than only the expected results. It will also help to identify whether or not there are any differences between the alternatives that will be compared. If there are no differences the goal and scope should be updated. At the same time the customer can find out how EEA works and how he should interpret it.

Project team

The analyst can get to know the customer and vice versa. This way the analyst can try to find people in the customer’s organisation that are interested in EEA. They might be good people for the project team and are able to provide the information needed. At the same time the customer can get used to the concept of EEA, the type of questions that will be asked and thus think about who would be the most suitable person to put in the project team.

Expectations analyst and customer

This pre-study process can help to synchronise the expectations of the customer and the analyst. The customer might just want to have the EEA diagram but the analyst wants to teach the customer something. By doing the pre-study the customer might become more interested in EEA and the

analyst might realize that the customer just needs the results and someone to tell him how to interpret the results.

6.2 Investigate and quantify expectations

This recommendation is mainly meant as a structured way to find out who wants what and why? Spending some time on this before the project starts is mainly important to make sure that things will go smoothly during the project and to provide a “backup plan” in case things go in the wrong direction. In the EEA project there will most likely be a lot of people involved. There are at least two people involved in the project (one analyst and one person from the customer) but usually a lot more than two. There are often 2 or 3 analysts, 1 or 2 decision maker(s) / customer(s)²⁰, 1 or 2 main contact(s) and 2 to 7 data contacts. So there will usually be between 5 and 14 people involved in the project. All these people have needs and want to get something out of the project. This paragraph will discuss these actors and what they usually expect.

Actors:

- **Decision maker / Customer**

The roles of customer and decision maker are often shared; if this is not the case the customer usually represents the decision maker(s). There is a need to check what information the decision maker wants and to have a good plan to deliver this information. The decision maker / customer is willing to pay for the EEA study because he has a lack of information to make a decision on a certain topic and expects to receive this information by ordering the EEA study. It is good to try to quantify the underlying question and the information need. This can be done by using the model presented at the end of chapter 5:

1. The decision maker has identified a need

The decision maker has reacted on something and thinks requesting an EEA will help him investigate it. Try to find out what that is and how the EEA will help him in his investigation.

2. The decision maker investigates the need

The decision maker has decided that the EEA study will give him (part) of the information that he needs to make a good decision. Is this the only resource he uses to make his decision or are there others? Maybe there could be an opportunity to share knowledge or insights.

3. The decision maker makes a decision.

When the decision maker will make a decision, he assesses the impact of his decision on his targets. These can be personal or company targets and financial or non-financial targets. The decision maker wants to know the impact on the short run, medium run and long run. It will depend from person to person which targets are important and which are not. These targets written down in a structured way can be found in Table 24. It is based on the model presented at the end of chapter 5. It has been rephrased to give more space to personal targets, since in chapter 4 it became clear that the personal reasons are a strong driver within the EEA projects. This means that the decision maker will expect information in a number of the categories presented in Table 24:

	Company targets		Personal targets	
	Financial	Non financial	Financial	Non financial
Long term	Goals	Goals	Future salary	Personal needs
Medium term	action plans	action plans	Bonus	Personal needs
Short term	Budgets	Working orders	Bonus	Personal needs

Table 24: Decision maker information need

It is very important for the analyst to find out what information he should deliver.

First of all, if the decision maker just wants to know how the decision will affect his short term targets, then he does not want an EEA study that shows what his opportunities are in the long run.

Second of all, if the information that the decision maker needs is not presented by the analyst, the decision maker will make his own assumption. This means that he could make the wrong assumption and come to the wrong conclusions because the analyst was not aware of the information need of the customer. This is especially important in an EEA study: Since it is about sustainability and

²⁰ This role is often shared

environment, the most Eco-Efficient alternatives can be (incorrectly) associated with expensive alternatives or as only profitable in the long run. By including calculations on the short term effects of the decision, the decision maker will have the correct information. This means that for example an EVA calculation could be added.

Project team

The success of the project is mainly dependent on the relation with the project team. The project leader has a big role in the communication with the customer and the people involved in data gathering. The main goal should be that everybody in the project team has enough time available and at least some interest in doing the project. Try to involve the project team as soon as possible and make sure that they know what to expect, especially from the data collection phase.

- **Project leader**

The project leader is usually the day to day contact of the analyst in the project. Sometimes the decision maker will stay involved but most of the times not too much involvement can be expected from the decision maker. A good cooperation with the project leader is the key to a successful project.

- **Project members**

The other project members have a less prominent role, but are very important in the data collection phase. Try to get them involved, enthusiastic and make them feel a part of the project. This way they are more likely to prioritize the data collection and potential problems can be spotted in an earlier stage.

- **Analyst**

Different people in the project want to get different things from the project. The decision maker usually has an information need. The project leader and members usually want to work together in a nice way, learn something and feel appreciated and taken seriously. This means that for the analyst to have a successful project he will have to satisfy these needs. The analysts also want to get something out of the projects. They usually want to have a good cooperation with the project team during the project, make people enthusiastic to work with sustainability and try to spread environmental thinking within the company. This is a good thing, but it can also be dangerous if it is not appreciated by the customer. Therefore the most important thing for the analyst is to adjust his ambition level to the ambition level of the client. If the decision maker just wants to have the EEA diagram and the project leader has got very little time then it might be better to just deliver that result, and not bothering the project leader too much. It might be nice to add one or two really helpful insights for the decision maker. The analyst should not try to teach everybody how EEA works and keep coming back to the project leader with new requests for information. This will result in an unwanted report.

The analyst will be frustrated that the client doesn't care about the results of the EEA, while the client doesn't understand why he has put in all that money and effort to end up with something that (he thinks) he doesn't need. He will be less likely to be interested in the results or order a follow-up study. He might be more interested in EEA if he got the information he needed in a very efficient way, maybe with one or two additional conclusions that he can really use.

This scenario is especially applicable for the appropriation request. These are projects where the decision maker is making an investment plan, usually under a lot of time pressure. If he has not worked with EEA before he does not understand how it works and why it is needed. He could see it as another hoop to jump through to get his investment approved. If the analyst recognises this, the strategy could be to show what EEA can actually add to get the decision maker interested in future use of EEA.

Form a project team

To avoid trouble and misunderstandings it is good to formally form a project team with one project leader from the customer. Also, it is good to find out who will be collecting data on the different topics. Try to involve the people that will collect the data as soon as possible because delays while collecting data are very common. This could help to make sure that you have the right person to provide the data, they know that they will have to do x days of data collection and that the data is expected on a certain date. If that is an unrealistic scenario it is better to change the plan at the beginning of the project. If the client still expects fast results he knows that he should allocate more resources to data collection. The best thing is to meet everybody who is involved in the project at the beginning of the project.

Quantify the needs

A good method to quantify the needs of everybody involved in the project is to ask them what they expect, what they really want to get out of the project and what they would like to get out. Write this down, but also make sure that the expectations are realistic. Based on that add one or two goals for yourself that you would really like to achieve in the project. Try to work on these goals during the project. This is also a good checklist to see what you should highlight in the final presentation.

6.3 Evaluate

Currently there is not a consistent evaluation of the EEA studies. What were the experiences of the people in the project team working with the SD-Group and EEA? What did the decision maker do with the results? How were the results used and what information was missing? It would be best to split the evaluation in 3 parts:

The project team evaluation

The main reason is to give everybody the opportunity to give feedback on the project and the cooperation. That should be done just after the project has ended.

Individual evaluation analyst

The analyst should also evaluate the project, first of all to see what could be improved next time and second of all to see if there are any methodological difficulties that he encountered, or nice solutions that he came up with in order to share this with his colleagues. This way the quality of the EEA studies can be improved.

Evaluation Decision maker

After two to six months the way the EEA study is/was used is clearer. This would be a good time to ask the decision maker for his opinion on the project and the way he has used the results. It is also a good time to see if he would need more services from the SD-group in the (near) future.

7 Economic Methodology

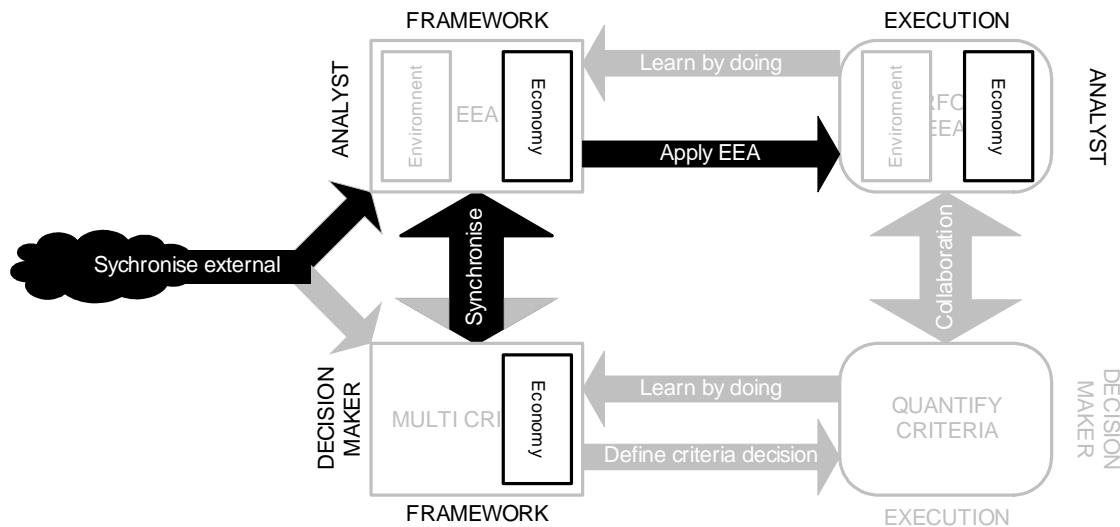


Figure 22: Main topics of the chapter 7

This chapter connects the different demands on the economic methodology identified in the last chapter together and gives recommendations on the approach of the economic part of the EEA.

7.1 Introduction

As we saw during the different chapters there are a lot of demands on the economic analysis. The decision maker wants to know what the impact on his EVA is. The analyst wants to get the right terminology to be able to talk to the customer and answer all his questions, while at the same time trying to give the life cycle perspective and look at the whole life cycle according to the EEA methodology. In this chapter these two worlds will be brought together.

The goals of this chapter are:

- **Check the economic / LCC methodology available in literature and compare that to SD-practice**

The main goal is to see if anything is missing in the current approach that is used in the SD-practice, are there any big things missing and are the choices that are made correct.

- **Describe an economic approach, using the different demands encountered within AkzoNobel.**

How to integrate the information needs of the decision maker into the EEA methodology.

7.2 Overview methodology

When talking about economic methodology you can do this in two ways:

The specific execution

This is the set of specific rules which elements are valued in which way, based on that general concept. For a concept there can be different set of calculation rules giving different outcomes. Often the same methodology name can mean different things for different practitioners. To describe all the different executions variants is not relevant since the question is which execution method is best for the SD-Practice. A good example of this is a study about the usefulness of LCC in building (Glucha and Baumann 2004). Ten variants of LCC were described, some with different names meaning the same and some with same names meaning something different. Probably they could have found more variants if they would have included articles not relevant to building.

The general concept

This is about the system that is addressed. So which elements are included and which are excluded. What are the system choices that have to be made in order to have a good and consistent methodology? Based on that we will have a methodology and then the most appropriate execution method can be chosen for the SD-practice.

First we discuss some concepts and ideas brought forward in literature and see how they add to the needs found in the SD-practice and the DM-practice.

7.2.1 Input from literature

This paragraph contains a number of sources mainly looking at Eco-Efficiency from an application / quantification perspective. How do you work with it and in what way can you make a methodological framework so that the results are correct.

BASF framework, Saling

The Basf Framework leaves the discussion quite open, but they look at the life cycle.

“5 Total Cost Calculation

The Eco-Efficiency analysis draws up the balance sheet for the ecological impacts all-inclusively over the entire life cycle. Similarly, total costs are likewise totaled over the life cycle. The costs in question are the real costs that occur and the subsequent costs, which will occur in future. Eco-Efficiency analysis by BASF does not utilize the avoidance costs or other costing approaches in order that ecological and economic impacts may be separately computed and assessed. Real costs having an ecological aspect, for example water treatment plant costs, are likewise included in the overall calculation. The costs incurred are summed and combined in DM or EURO amounts without additional weighting of individual financial amounts. This helps to identify and, in certain circumstances, to optimize particularly cost-intensive areas. The use of different costing models is likewise possible. This is particularly important, for example, when capital investments are to be protected into the future or country-specific depreciation models are to be reflected” **Eco-Efficiency Analysis by BASF: The Method** (Saling, Kicherer et al. 2002)

It comes down to “real (current and future) cost over the life cycle” but if that is not applicable use another costing model in order to include depreciation etc.

Input for SD practice

Saling says basically, you can put any kind of cost calculation of the economic axis as long as you use a method that is applicable to the case and that is valid for the life cycle. This comes down to the life cycle costing concept. This is also the way it has happened in the SD-practice in the last years. (See chapter 4.3.2)

Huppess and Ishikawa

They also point in the direction of the life cycle concept and give options to apply it.

“Economic Score

In the process of arriving at Eco-Efficiency ratios, the market part is to be quantified in one term, as cost or value, and the environmental impacts are to be aggregated into one score as well. Value and cost aggregation are well-established subjects in two main domains, cost-benefit analysis (CBA) and life-cycle costing (LCC), both developed in the middle of the 20th century. Cost-benefit analysis has a broad societal point of view, disregarding transfer payments and correcting market values for market imperfections (for classics on this topic, see Mishan 1971, and Dasgupta and Pearce 1972). Like LCC, it takes a full systems point of view, covering “the life cycle.” Life-cycle costing, as developed for public procurement by the Rand Corporation in the United States—see, for example, the work of Fisher (1971)—and by management accountants for application in firms—see, for example, the work of Dhillon (1989)—takes a budget point of view, including transfer payments such as taxes and subsidies, and accepting the actual functioning of markets, including capital markets. Though for each approach different aggregates are possible, for example, as related to value-added or cost concepts, the underlying reasoning is well established and will not be much discussed in this volume. Both CBA and budget-related LCC express cost or value as a discounted present value. In the realm of LCA,

discussions on how to align cost accounting to steady-state LCA modeling, directly related to the Eco-Efficiency subject, may give rise to steady-state cost or value as a third approach to LCC (see work by Rebitzer and Seuring 2003 on the LCA-related SETAC Working Group on LCC and the survey by Huppes and colleagues 2004)

Some conventions on specifying cost and value might come in handy, though, at least in specifying which approach is followed, how empirical effects are modeled, and which aggregation method is applied. For example, when Eco-Efficiency is analyzed from a broad societal perspective, as in analyzing climate-change policy measures, the logic would indicate a CBA type of cost and value analysis, such as the Intergovernmental Panel on Climate Change (IPCC) does in its publications (IPCC 2001). In CBA, though, economists tend to express market value and external effects as referring to the same value concept. This final integration step of external effects with market-related magnitudes may better be postponed and, if done, be made as a recognizable last step, for several reasons. These reasons relate to, for example, the uncertain nature of environmental effects; the impossibility of specifying all effects in terms amenable to subjective evaluation by consumers; the lack of agreement on discounting when long time horizons are involved; the Brundtland principles of intra- and intergenerational justice and equity; and the divergence in stringency of actual environmental policies. So, in CBA for Eco-Efficiency analysis, the environmental external effects are kept distinguishable from market-related effects, avoiding at least some of these issues of contention. In budget LCC and LCA-related LCC, cost and value refer to market-related items only. For a given cost and value concept, numerous empirical issues must be resolved, especially if long time horizons are involved. In their comparative study on Eco-Efficiency trends, Dahlström and Ekins (2005) encounter the problem of changing market values of steel and aluminum, directly influencing the Eco-Efficiency scores. Historical studies may solve such issues by giving time series of prices as well. For future-oriented studies for decision support, historical values are proxies for expected future prices. Especially for abiotic resources, which have shown substantial long-term price decreases and volatility, expected prices may be highly disputed, and hence the ecoefficiency of decisions involving such resources as well. Uncertainties concerning the future cannot be avoided, apart from scenario development on main uncertainties."

A Framework for Quantified Eco-Efficiency Analysis:

(Huppes and Ishikawa 2005)

Then they continue about the environmental score and they conclude:

"Economic Score

For the economic part of the Eco-Efficiency ratio, there are three basic approaches available, all based on life-cycle costing: market-cost related values, as in management accounting and budget cost analysis; cost-benefit analysis, for the market-related cost and benefits; and a steady state type of cost, conceptually best linked to steady-state models for environmental analysis such as LCA. Establishing the economic score raises no fundamental problems, but several practical ones, for example, as related to discount rates and to mechanisms to take into account in the analysis."
(Huppes and Ishikawa 2005)

The first thing that is good to notice that they talk about the E/E ratio this means one combined score for the environmental and economic value. Secondly they talk about the full societal costs over the life cycle and not about the cost to one single actor. Thirdly they offer three approaches all based on life cycle costing. Fourthly they mention there are some practical problem like the use of discounting and what to take into account in the analysis. Fifthly they mention is that taxes and subsidies are included in the LCC in company situations.

Input for SD practice

The practical problems have indeed been encountered already in a number of SD-studies and are the ones that have to be addressed in this study. Next to this an approach based on life cycle costing is recommended. It is good to know that even when not a specific LCC method is chosen at least the life cycle thinking is applied in the economic methodology.

Kuosmanen

"The ultimate purpose of the Eco-Efficiency measure should be borne in mind in its design and specification. Because the needs of different users (politicians, business managers, consumers) differ quite dramatically, there is no "one size fits all" solution. For example, consider the treatment of labor and capital costs. In the system of national accounts, the value added by a firm is defined as the total earnings (revenue) minus the value of the intermediate goods (materials) used up. The total value

added by all firms represents the gross national product (GNP). The GNP comprises wage/salary-payments for labor, interest/rent for capital, and profits for firm owners. Policy makers are usually mainly interested in the total GNP, not in its functional distribution to wages, rents, and profits. By contrast, the firm management is usually only interested in the profit. Thus, the economic value added may include or exclude the labor and capital costs, depending on the purpose of the Eco-Efficiency analysis."

"Assessment of economic impacts is often considered a relatively simple task. But a sound economic assessment is more than just a trivial accounting exercise. In particular, economists argue that decisions should be based on opportunity costs, referring to the value of the best alternative to a given choice, or the value of the resource in its next best use. In contrast to accounting costs, opportunity costs arise even when no money transaction takes place. For example, if a city builds a waste incineration facility on vacant land that it owns, it does not pay rent for the land. Still, the land has an opportunity cost that is equal to the value of land in the best alternative use (e.g., when rented out for private business), which should be taken into account in comparing alternative waste management options. On the other hand, the cost calculations should exclude any sunk costs: costs that have been incurred and cannot be recovered. For example, suppose a city had hired consultants to investigate waste incineration technology in the past. The consultant's fee is a sunk cost and should not be counted as a cost of the incineration option in comparing it with other waste management possibilities. In conclusion, the relevant economic costs are not always immediately obvious; identifying the true economic benefits and costs may require considerable investigation of alternative resource uses. In my view, assessment of economic impacts deserves more attention in Eco-Efficiency analysis."

Measurement and Analysis of Eco-Efficiency, An Economist's Perspective: (Kuosmanen 2005)

"In many applications, economic costs and benefits and environmental damages occur over long time-spans, which may result in a need to discount future cost and benefit streams into net present values. The art of discounting has recently attracted a lot of debate in environmental economics (see, e.g., Arrow et al. 1996). The economic rationale for discounting is closely related to the opportunity cost: one dollar today is more valuable than one dollar ten years from now. This is because the former option enables one to invest the dollar productively to increase its value over a ten-year time horizon. Conversely, the net present value of one dollar after ten years is less than one dollar: if one borrows money today to pay back the debt after ten years, one gets less than a dollar because of the interest. In addition to the opportunity cost, some economists point to human impatience—or time preference of money—as a rationale for discounting future money streams. Reasons for impatience include uncertainty about the future and the chance of mortality before future payments realize. Such time preferences would also imply that one should discount physical environmental damages by assigning higher weight on damages that occur today than to those that occur in the future. But whereas individuals prefer the present to the future, many economists consider time preferences for the society as "ethically indefensible" (e.g., Ramsey 1928). Thus, the social discount rate may differ from the consumption discount rate, but there are no clear-cut rules for how the discount rate should be specified. The ultimate objective of an Eco-Efficiency study should be borne in mind when choosing the discount rate."

Kuosmanen does not give a specific method, but tells that we should focus on the real costs that (should) influence the decision, so opportunity costs should be included but sunk cost excluded.

Input for SD practice

As seen in the results of the SD-practice this is very relevant for example when talking about investments. The opportunity costs of money currently invested in old plants should be included and not taking the book value of a plant to compare with a whole new factory. Especially since AkzoNobel has an interest rate on invested money the opportunity costs of the old plant should be included.

Conclusions:

There are not a lot of direct references to business. What they all seem to agree on is that it should be costing model, preferably based on the life cycle. What is also important is that there are a number of ways to do it and that there is not one "right way" to look at the costs. It will depend from situation to situation. What is important is that the economic methodology that is chosen has the same system boundaries as the whole of the EEA. The specific inputs for SD-practice are discussed during the rest of the chapter.

7.2.2 Input from decision making

Use EVA in project valuation

The EVA is important for the decision maker for three reasons

1. The EVA shows the impact of a decision on the company's and personal financial situation.
2. The discounted EVA is used to select and value projects.

What is EVA?

The Economic Value Added (EVA) and is used in investment decisions. It was designed by Stern Stewart & Company and is used to measure performance of companies as well as the people within the company. It is directly related to shareholder value, but can be calculated to a very detailed level. (Berk and DeMarzo)

The question it tries to answer is how much value is added by doing a certain activity. The formula is $EVA = \text{Net Operating Profit after Tax} - (\text{Cost of capital} * \text{Capital invested})$

So the total profit after tax is calculated and from that the opportunity cost of having capital invested in that project is deducted. What is left is the added value. This is the main unit of measure in AkzoNobel when calculating bonuses and project values, but also as a value of the company as a whole. This way it is easy to track down improvements in EVA to an individual project /department. If you can increase the EVA of you part of the company it you will get rewarded for this via the bonus system. This way the EVA is used in the incentive scheme so that the company makes sure that employees that create shareholder value (EVA) get rewarded.

Project valuation

In project valuation within AkzoNobel the present value of the EVA is calculated. This means that the future EVA is discounted to get the Present Value of the (expected) EVA of a project. The discounted EVA is also (one of) the main financial project parameters in the AR. If the discounted EVA is positive according to certain rules the project will have a good chance if it is not, it will have a (very) low chance, much more on how the EVA calculation and project valuation actually works in the next chapter.

7.2.3 Input from SD-practice

We saw in paragraph 4.3.2 that there are currently 2 methodologies used in the SD practice, Life cycle costing (perspective) and Cost for the customer. Both of them just look at the costs for AkzoNobel, not any costs for the society as a whole.

Involve the customer

Economic can be very sensitive and often discussed a lot also by the customer. Involve the customer and make sure that he has a say in the economic figures that you use. If there are differences of opinion explain why you make certain decisions or in- / exclude certain costs.

From the perspective of the analyst it is also good to show the EVA:

1. The customer will also be able to relate more with EEA and see that it is the real economics and only that it has to do with the environment.
2. The decision maker will put more effort in getting you the right economic figures and be more involved since incorrect information will lead to the wrong EVA.

Look at the cost for AkzoNobel

If the EEA is for a decision within AkzoNobel is not possible to look at other costs then the costs for AkzoNobel as direct decision making information. If you would include cost to the society or something like that it will not be taken into account in the decision and it will not be used. There is one side note though: The risk on other (future) costs should be taken into account in the AkzoNobel costs. So if there is a large cost for the society and there is a risk that AkzoNobel will be taxed for it somewhere in the future it should be included in some way since it is a real potential cost (Maybe as a scenario, what would the economics look like if they decide to tax it).

Use a life cycle costing approach

The methodology that was used so far the life cycle costing or the cost for the customer. This works and adds information for the decision maker. It gives a bigger picture and adds the life cycle perspective.

What are the life cycle costs in SD-practice?

Before looking at life cycle costs, we look at the general variant of costs, what are the costs for the customer? This sound very simple but in fact it is not: As Png says in his book on managerial economics (Png 1998): *"The principle is **relevance**: managers should consider only the relevant costs and ignores all others. There is no simple definition of which costs are relevant. Which costs are relevant depends on the alternative course of action for the decision at hand."*

This paragraph will give an overview of costs elements that could be relevant when trying to find the costs for the customer / life cycle costs.

Cost elements

Real costs for the company could include actual costs like:

- Production factors
 - Invested Capital (machines)
 - Labour
 - Raw Materials
- Actual future costs like:
 - Site clean up
 - Demolition
 - Etc
- Potential future costs like:
 - Regulatory affairs (stricter rules, investments to follow rules)
 - Legal affairs (law suits, claims)
 - Etc

On top of these costs that are straight forward costs there are two types of costs that deserve special attention: Sunk & opportunity costs and Taxes and subsidies.

Taxes and subsidies

Taxes and subsidies are treated in the same way as any other cost: This means that they are included in the LCC if they are relevant to the decision. A subsidy on renewable materials will be relevant and a tax on CO2 should also be included.

Sunk & opportunity costs:

Sunk costs are the costs that are spent and cannot retrieve. The opportunity costs are the costs of investing the resources in a different way. An example makes clear what the opportunity and sunk costs are. A customer draws the following picture regarding his economics:

Old plant

The base case is a plant with a revenue (annual sales) of €5.000.000 and operating costs of €4.000.000, making a profit of €1.000.000. The book value of the old plant is €0.

New plant

The alternative scenario is that the plant can be closed down and be sold for €5.000.000 (Selling the machines will pay for the site cleanup). The people now working in the old plant will be working in a new plant and they can make a revenue of €8.000.000 and expenses of €5.000.000. There is also a €20.000.000 investment in the new plant and working capital of €5.000.000. This money can be borrowed from AkzoNobel at a 10% interest per year. There is also R&D cost for the new processes that have been developed for the new plant. The cost is €5.000.000 and has to be paid back in 10 years.

		Old plant	New plant
Revenue	Annual sales	€ 5.000.000	€ 8.000.000
Expenses	Operating costs	-€ 4.000.000	-€ 5.000.000
	Capital costs		-€ 2.500.000
	R&D		-€ 500.000
Profit		€ 1.000.000	€ 500.000

Table 25: Setup sunk and opportunity costs

So his conclusion would be that it does not pay to make a new plant.

But there are two things he forgot:

Opportunity costs

The annual fee on the working capital was not included in the old plant. The book value of the old plant is 0 but there should still be an annual fee on the capital that is invested and could have alternative use. This way the assets are priced in the same way, the book value is not of importance. The value in this case would be the € 5.000.000, that for which the factory could be sold and the working capital that is also € 5.000.000. This means that the € 10.000.000 in the old plant also needs to be charged with a 10% capital costs. This means an addition cost of € 1.000.000 per year for the old plant. This is cost that AkzoNobel charges to have € 10.000.000 invest in a plant²¹. Note that this is a different from the EVA statement; they would only use the € 5.000.000 in working capital and the book value of the plant of 0 as the capital costs²².

Sunk costs

In the example there is a sunk cost that should be excluded. These are the R&D costs for the new plant. What would happen if the new plant would not be build? Would the money now spend on R&D be given back? The answer is no, what ever the decision is the 5.000.000 is spend. So it should be removed as a variable to take the decision.

The new picture is now different:

		Old plant	New plant
Revenue	Annual sales	€ 5.000.000	€ 8.000.000
Expenses	Operating costs	-€ 3.500.000	-€ 5.000.000
	Capital costs	-€ 1.000.000	-€ 2.000.000
Profit		€ 500.000	€ 1.000.000

Table 26: Example sunk and opportunity costs

It is now favouring the new plant over the old plant, by looking well at the system. AkzoNobel is using the EVA system, which included the opportunity cost of capital, so in all cases the opportunity costs should be included in the EEA to give a representative overview of the relevant costs.

Conclusions:

The main conclusion is that like Kuosmanen (Kuosmanen 2005) said it is easy to make a mistake in calculating the costs. When looking at sunk- and opportunity costs difficult situations could be encountered, especially when the customer has a different view on how to take this sunk and opportunity cost into account. Especially opportunity costs are difficult; it is dependent on an alternative way of using the resources. It can be a lot of work to find alternative use for the resources. This means that when we reflect this to EEA that it will be up to the analyst, preferably with the customer, to decide what the cost picture looks like depending on the alternatives.

²¹ AkzoNobel has to get its money somewhere, either borrow it from the capital market or get it from shareholders. Both want a payback.

²² The difference is that all opportunity costs are included in this example and the EVA just uses the opportunity costs of the capital that is invested.

7.3 Conclusions economic methodology

The conclusion is that on the one hand there is a need to use the life cycle costing to make a meaningful EEA and look at the economic elements from the same perspective as the environmental analysis. On the other hand the EVA information would be missing that (could be) needed by the decision maker. So why not work with more indicators to evaluate a project then just the Eco-Efficiency? The EVA will be calculated anyway and used to choose project so why not place it in the bigger picture?

This is the way it works:

1. Calculate the EVA.

The first indicator is the discounted EVA. AkzoNobel will not start a certain project if the discounted EVA is negative since this would mean that they would lose money. This means that there is already a filter, lets say the reality check for a project.

2. The EEA using Life Cycle Costing.

Now we have the second indicator: the Eco-Efficiency diagram and score using life cycle costing and LCA. The way it has been used so far, with all relevant costs for AkzoNobel included. This gives an indication which project is better from an EEA perspective and gives the opportunity to look at the costs along the value chain and not just within AkzoNobel. The actual environmental performance of the alternatives should also be shown. A number of different indicators could be used for this, for example the environmental impact per ton product in the scenarios.

This way the Eco-Efficiency and connected directly to the EVA, the most managed score within AkzoNobel, without losing the Life cycle perspective. This approach open the door to start to put targets on Eco-Efficiency scores in a quantified way, much more quantified then just the diagram that says A is better then B. But there is one last step left.

Re-evaluate the discounted EVA

What if we go back now to step 1 the discounted EVA is there a chance that we want to say: If we have a very Eco-Efficient measure or the Environmental impact per ton product can be reduced with X%. Should we still use the same discount factor on the EVA? Why not discount with a lower factor or have lower target on the required EVA? Should it not be promoted to invest in real environmentally friendly solutions? Maybe it is even possible to make an indicator calculate the "Environmental Impact Avoided" and based on a trade of lower the requirements on discounted EVA. A project that has a higher environmental impact should maybe have a higher discount rate making it less attractive to invest.

By showing the actual financial and environmental impact of a decision it becomes possible to put measurable targets on the main financial indicator based on Eco-Efficiency performance.

This would change the order of the steps:

1. The EEA using Life Cycle Costing

Calculate the EEA using Life cycle costing and LCA both from a societal perspective.

2. Sustainable project valuation

Based on the EEA decide on the economic parameters needed to value this project

This model and the design of the framework and an approach for sustainable project evaluation will be shown and discussed in the next chapter.

How to do the economic part of the EEA?

The conclusion is besides going to a model of sustainable project evaluation is:

The way it is done right now is good. It works and as long as there is no need for a more meaningful use of the EEA you should not complicate the LCC. The focus should be on the extra things that LCC delivers for the decision: Find the costs that are related to the use of the product by the customer and look at the value that the activities deliver to society. The LCC cannot be done instead of the normal project valuation done by the manager. Use the LCC to get addition insights. It is more important to show the actual figures. In the form of a few meaning full indicators like the CO2 per ton and the price

per ton product produced to educate the decision makers on the impacts. On top of that you could calculate the EVA. This would give a lot of benefits. Not only will the decision maker feel that you are really looking into it, it will also help to gain knowledge and the terminology to the analyst on how the economic side works. That can also be used when looking into the LCC and be creative when it comes to finding alternatives that would be used to calculate opportunity costs. The next chapter has a lot of information how the EVA is calculated what it means and what other terminology means that you can expect when looking into EVA.

8 Sustainable project valuation

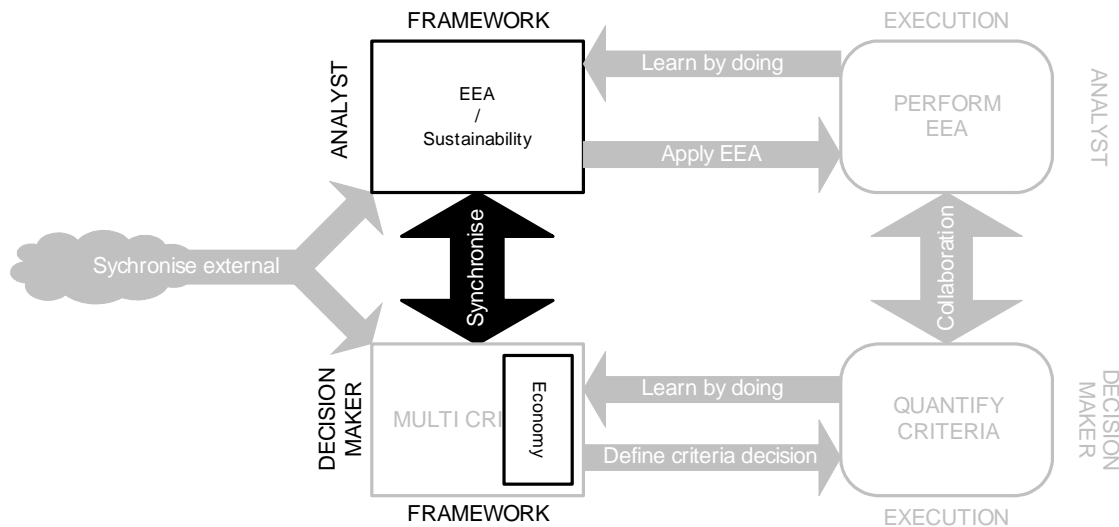


Figure 23: Main topics of the chapter 8

This chapter discusses the EVA calculation / the financial project evaluation. The reason is that we need to get acquainted with the model and way of thinking. As was concluded in chapter 7 we could add the EVA to the EEA calculation. This is something that could be done immediately without changing much to the current approach of AkzoNobel. By doing this the connection between environmental impact and investment will be made clearer to the decision maker. The concepts will also be connected into a model of sustainable project valuation in the end of the chapter.

8.1 Financial Project valuation

If we want to make a sustainable project valuation, we first need to know how normal project valuation works. In AkzoNobel the EVA is used, so this paragraph will explain the different elements used in EVA calculation. At the end this will be connected to the EVA.

8.1.1 What is IRR?

The easy explanation is that the IRR means "Internal Rate of return". It is the fictional interest rate that is charged by AkzoNobel to their business units to see if they will do a project or not. Take for example this project:

If I borrow 100 euro from you and I promise to pay back 30 euro for 5 years starting from next year. What is then the IRR? It is the "fictional" interest you would be getting from me. It is exactly the same as a mortgage from the bank. Part of the money is used to pay back the loan and part is interest on the main sum. In this case the IRR is 15,24% or in other words I would be paying 15,24% interest on my loan.

Year	0	1	2	3	4	5
Interest rate (IRR)		15,2%	15,2%	15,2%	15,2%	15,2%
Payment (cash flow)		30,0	30,0	30,0	30,0	30,0
Interest		15,2	13,0	10,4	7,4	4,0
Deduct from main sum		14,8	17,0	19,6	22,6	26,0
Main sum	100	85,2	68,2	48,6	26,0	0,0

Table 27: Example IRR

The formula for the IRR as described above is:

$$100 = \frac{30}{(1+r)^1} + \frac{30}{(1+r)^2} + \frac{30}{(1+r)^3} + \frac{30}{(1+r)^4} + \frac{30}{(1+r)^5}$$

Starting sum = yearly payments discounted at the IRR

The value of the IRR can be approximated for example in excel.

Note that if we would have assumed that I would have paid back 30 euros for 10 years the IRR would have been: 27,3% and if I would have paid back indefinite it would have been 30%²³. This shows that the number of years a payment is made is also very important in calculating the IRR.

8.1.2 What is Cash flow and NPV?

Cash flow diagram						
Interest rate you want	10%					
Year	0	1	2	3	4	5
Cash flow	-100	30	30	30	30	30
Discounted cash flow	100%	91%	83%	75%	68%	62% *
	-100	27,3	24,8	22,5	20,5	18,6
NPV of discounted cash flow	13,72					
IRR =	15,2%					

Table 28: Cash flow and NVP

We can also make a cash flow diagram now:

Year 0 you borrow 100 euro. => Cash flow -100

Year 1 to 5 you get back 30 euro => Cash flow 30 each year.

Now we say: You want to have at least 10% interest when you lend out money. How do you evaluate if you want to lend it to me at these conditions?

This is done by making the cash flow scheme and calculating the Net Present Value (NPV) of the cash flows. We do this by discounting the cash flows so that we get today's value of future earnings.

When we look at the example in Table 28 we see that when we want the 10% interest and we use the 5 x 30 euro as a payment there is a net present value of 13,72. This means that by making this deal we have earned 13,72 of today's euros extra, on top of the 10% interest.

The total value borrowing money would be the same if you put the 113,72 in the bank with an interest rate of 10% starting from year 0. Or as if you would put the 30 euro you would receive from me every year in the bank also with 10% interest.

on bank in t = 0	113,72	125,1	137,61	151,4	166,5	183,2
To bank every year		30	30	30	30	30
Interest in year			3	6,3	9,93	13,92
In bank end of year		30	63	99,3	139,2	183,2

Table 29: Example NPV

This means that if the sum of the NPV of your discounted cash flows is positive you are making money compared to the required interest rate and when the sum of the NPV is negative you are losing money compared to the required interest rate. If the sum of the NPV is 0 it doesn't matter what you do. Both options are equally good.

8.1.3 What is WACC?

The WACC (Weighted average cost of capital), is the price that AN pays for money (either by borrowing it from the bank or they get from share holders who demand dividend on it). Again an easy example to clarify:

²³ It would be a 30 euro interest payment yearly; the main sum would not get smaller. So then the IRR would be: yearly payment/ main sum (30/100)

$$r_{\text{wacc}} = \frac{E}{E+D} * r_E + \frac{D}{E+D} * r_D \text{ (Berk and DeMarzo 2007)}$$

Operating Revenues			
(1) Net Sales	100		
Operating Expenses			
(2) Cost of goods sold	50		
(3) Depreciation and Amortization D&A	10	+	
Total expenses	60		
(4) Operating income (Revenues - expenses)	40		
(a) Non operating income	0	-	
(b) Earnings Before Interest and Taxes (EBIT)	40		
Taxes	12	-	
Earnings Before Interest and Taxes (EBI)	28		
Net interest expenses	7	-	
Net Earnings	21		

Derive NOPAT	
Net Operating Profit After Taxes	
(4) Operating Income	40
(5) Tax charge (1- tax rate = 28%)	11,2 -
(6) NOPAT	28,8

Derive EBITDA	
Earnings Before Interest, Taxes, Depreciation and Amortization	
(b) EBIT	40
(3) Depreciation and Amortization (D&A)	10 +
(c) EBITDA	50

reduction of value of our factory in this year). This gives us the operating income (4). Then we subtract the tax charge²⁵ to get the NOPAT (Net Operating Profit After Taxes) (5)

8.1.5 What is EBITDA?

The AkzoNobel organization uses its EBITDA in external reporting (to the shareholders) therefore it is good to show how to go from the NOPAT to EBITDA and show how they are related.

The book "Corporate Finance" gives a short explanation of what EBITDA is and how it is used:

"EBITDA: Financial analysts often compute a firm's Earnings Before Interest, Taxes, Depreciation and Amortization or EBITDA. Because depreciation and amortization are not cash expenses for the firm, EBITDA reflects the cash a firm has earned from its operations." (Berk and DeMarzo 2007)

Calculate the EBITDA

As shown in Table 31 we start with the operating income (4) and add the no operating income (a). Then we have the EBIT (b). To the EBIT we add the depreciation and amortization (3) that was removed earlier to get the EBITDA (c)

8.1.6 Calculate EVA

After defining and explaining some investment and finance topics we can finally start to calculate the EVA. A quick reminder from paragraph 7.2.2: $EVA = \text{Net Operating Profit after Tax} - (\text{Cost of capital} * \text{Capital invested})$.

When a manager would calculate his yearly EVA he would do it like this:

1. Calculate the capital that AN has invested, this is the value of his plant and the working capital
2. Ask AN for the cost of the capital in that year (they charge him the WACC)
3. Calculate his NOPAT

And use this formula:

$$EVA = NOPAT - (r_{wacc} * \text{Capital})$$

For example:

NOPAT	1600
Capital	10000
r_{wacc}	8%

Table 32: Variables use in EVA example

$$1600 - 10000 * 8\% = 800$$

His EVA is 800

We can calculate something else; his rate of return:

Return on Invested Capital (ROIC) = $NOPAT / \text{Capital}$

$$1600 / 10000 = 16\%$$

So every year he makes 16% with the money that AN has trusted to him. They borrow the money for 8% (WACC) so there is an 8% profit on every euro capital invested. This money is used to reinvest to grow etc. It is not pure profit or something like that.

8.1.7 Deciding to invest or not

Now we have enough information to ask: What happens if we want to invest in a project in AN?

They basically say we will approve your project if you have an internal rate of return of 16%. Please show us the EVA calculations using the WACC of 8%

²⁵ Note that the tax *charge* is something different from the *taxes*. This has to do with the tax regime (theoretical tax charge) and not with what is actually paid.

Another example:

The manager has a project where he can invest 1000 euro that has a NOPAT of 0 in year 1, 90 in year 2 and 150 in year 3, 4 and 5. We assume that there is a depreciation of 200 each year (this is also paid and "included in the NOPAT statement) and that after 5 years the project will end. What are his EVA and IRR?

EVA Diagram						
Year	0	1	2	3	4	5
Capital		1000	800	600	400	200
WACC		8%	8%	8%	8%	8% *
Capital charge		80	64	48	32	16
NOPAT		0	90	150	150	150 -
EVA		-80	26	102	118	134
Discounted rate (8%)		93%	86%	79%	74%	68% *
Discounted EVA		-74	22	81	87	91
NPV of discounted EVA	207					

Table 33: EVA diagram example 5 years.

Cash flow diagram						
Year	0	1	2	3	4	5
Cash flow	-1000	200	290	350	350	350
Discounted cash flow (8%)	100%	93%	86%	79%	74%	68% *
	-1000	185	249	278	257	238
NPV of discounted cash flow	207					
IRR =	14,9%					

Table 34: Cashflow diagram example 5 years.

The NPV of the cash flow is 207, so we make 207 euro today if we invest, so it seems the smart thing to do. But the IRR is only 14,9 so < 16% so even though the EVA is positive and we actually make money the project will not be accepted. So in fact the EVA is not really important for the decision and the IRR is the most important.

Note that the NPV of the discounted EVA is the same as the NPV of discounted cash Flow. The reason for this is that the EVA is based on the same data but the money invested is smoothed out over the actual years when it is paid back instead of a large minus in the beginning and then paid back during the years after.

One more year

It matters a lot that we calculated for 5 years. In fact if we assume that the exact same operation as in year 5 can continue for one more year, then the IRR would go to 19,3% and the NPV of the EVA will almost double.

EVA Diagram							
Year	0	1	2	3	4	5	6
Capital		1000	800	600	400	200	0
WACC		8%	8%	8%	8%	8%	8% *
Capital charge		80	64	48	32	16	0
NOPAT		0	90	150	150	150	300 -
EVA		-80	26	102	118	134	300

Discounted rate		93%	86%	79%	74%	68%	63% *
Discounted EVA		-74	22	81	87	91	189
NPV of discounted EVA	396						

Table 35: EVA diagram example 6 years.

The reason is that all the capital had been paid back and the NOPAT will increase a lot. Since we can still use the same machines to make money one more year, is profitable. As we also see in the NOPAT calculation of year 5 & 6 below.

NOPAT year 5 & 6		
Year	5	6
Sales	1000	1000
Cost	600	600 -
A+D	200	0 -
Operating profit	200	400
Tax (25%)	50	100 -
NOPAT	150	300

Table 36: NOPAT calculation year 5 and 6

Cash flow diagram							
Year	0	1	2	3	4	5	6
Cashflow	-1000	200	290	350	350	350	300
Discounted cashflow	100%	93%	86%	79%	74%	68%	63% *
	-1000	185	249	278	257	238	189
NPV of discounted cashflow	396						
IRR =	19,3%						

Table 37: Cashflow diagram example 6 years.

To get the IRR we calculate the cash flow diagram again.

8.1.8 Summary and conclusions

The capital

This is the amount of money that is needed to do a certain activity.

Internal Rate of Return (IRR)

The IRR of a project is a benchmark for the company to value whether they are willing to invest or not. If it is over x% it is a good plan. It is only used in the decision to go for a plan or not.

Return on Invested Capital (ROIC)

The ROIC is the “**actual** Internal Rate of return”, or the actual money that you make on the investment. This means that if everything goes exactly as projected and you use the same time period, then the ROIC is equal to the IRR.

The Weighted Average Cost of Capital (WACC)

The WACC is the average interest rate that is charged to the company to get capital.

The EVA

The EVA is the difference between the WACC and the ROIC times the Capital invested. It is the extra money you earn from performing a certain activity after you pay the capital charge, tax, depreciation and all costs.

NPV of EVA / Cash Flow

This is the same as the EVA, but now the future earnings are discounted so that they resemble today's earnings. The discount rate is the WACC. This is used to evaluate how much value a project actually adds to the company.

Conclusions

It is easy to make an EVA calculation but explaining the details of the different concepts can take some time. There are a number of important variables that will decide on how high the EVA and the IRR are. This is very important in deciding if a project will be started.

Both elements are influenced by the discount rate, the WACC, and the number of years you look into the future.

The main thing that you should remember from this chapter:

When we have a **basic investment**: (one expense in year 0 and then continuous cash flow to pay it back)

If the WACC goes down:

EVA goes up.

If the number of years to pay back the investment goes up:

The IRR goes up and the EVA goes up. And vice versa of course

8.2 Sustainable project valuation

This paragraph will give a setup to connect sustainability to the financial decision making criteria shown in the previous paragraph. To work more sustainable we should decrease the financial requirements if the product that we are making is sustainable. This would mean longer payback time of the money invested or lower requirements on the IRR or lower WACC or a combination of both. In this paragraph I assume that Akzo Nobel normally values projects with a WACC of 8%, a 10 year time horizon and a minimum IRR of 16%. I thought of two ways to change the way project are valued, based on the Eco-Efficiency of the project, by taking a longer time period and by changing the WACC.

8.2.1 Longer time period

A simple way to change project valuation is to change the time period in which the project has to be paid back. The reasoning is simple and easy to explain:

The only business that will survive in the long run is sustainable business. So any investment made in sustainable business can have a longer payback period, but if we have unsustainable business we should have a shorter payback period, because we want our investment back as soon as possible.

This would give the following picture for the EVA and other variables.

Year	IRR	EVA NVP	EVA	NOPAT	Depr.	EVA /year	Cash flow (CF)	CF as % of CF(y10)	Invested Capital
5	16%	219	287	105	200	57	305	148%	1000
6	16%	255	349	105	167	58	271	131%	1000
7	16%	289	413	105	143	59	248	120%	1000
8	16%	323	482	105	125	60	230	111%	1000
9	16%	356	554	106	111	62	217	105%	1000
10	16%	388	629	107	100	63	207	100%	1000
11	16%	420	708	108	91	64	199	96%	1000
12	16%	450	789	109	83	66	192	93%	1000
13	16%	480	874	110	77	67	187	90%	1000
14	16%	510	964	112	71	69	183	89%	1000
15	16%	536	1052	113	67	70	179	87%	1000
16	16%	562	1144	114	63	72	177	85%	1000
17	16%	586	1237	115	59	73	174	84%	1000

Table 38: EVA and Cash flows for different years with IRR 16%

But what does it mean for the IRR of the same project at year 10?

Year (IRR = 16%)	IRR (year 10)
5	27,9%
6	24,0%
7	21,1%
8	19,0%
9	17,3%
10	16,0%
11	15,0%
12	14,1%
13	13,4%
14	12,8%
15	12,3%
16	11,9%
17	11,6%

Table 39: IRR in year 10 for different situations from Table 38

For the 5 year alternative the IRR is much higher while for the 17 year alternative the IRR is much lower. The conclusion is that it is the same to demand a 6 year time period with a 16% IRR as a 10 year time period with a 24% IRR.

The two advantages of taking a longer time period are:

1. It is easy to explain that sustainability is looking into the future; the longer time period automatically follows from the sustainability concept.
2. It will make sure that there are less chances to invest in unsustainable projects, while there are more chances to invest in sustainable projects

There are two disadvantages:

1. It takes a lot of calculations to calculate the EVA and a lot of plants will be built for 10 or 15 years at least so it might feel strange when calculating for a longer or shorter time period than that.
2. Once the project is given an ok and it will continue longer than the planned time the decision maker will get a very high EVA, so even if the chances are smaller to find such a project, the reward will be bigger, so there is less incentive for the decision maker to try to find sustainable projects.

8.2.2 Change the WACC

The second way to make sustainable investments is to look at the capital charge AkzoNobel asks, the WACC. Of course when we change the WACC it is not the weighted average anymore, but just the capital cost by AkzoNobel. If the charged "WACC" would be lower for sustainable projects and higher for unsustainable projects this would give a great incentive for the decision maker to invest in sustainable projects.

The reasoning would be:

If you invest in an unsustainable project there is a higher risk for the company (that society will not tolerate it), so then they charge a higher capital cost (since part of the capital cost is determined by risk)

When we look at the numbers (as an example) it is really easy:

	Sustainable	Normal	Unsustainable
Investment	1000	1000	1000
"WACC"	6%	8%	10%
IRR	16%	16%	16%
"EVA"	100	80	60

Table 40: Example changed WACC

While the decision maker is now looking for sustainable projects he still needs to meet the same requirements of the IRR. This means it is not easier to invest in sustainable opportunities. We have to adjust the IRR for that:

	Sustainable	Normal	Unsustainable
Investment	1000	1000	1000
“WACC”	6%	8%	10%
IRR	15%	16%	17%
“EVA” (DM)	90	80	70
“EVA” (AN) (IRR-WACC)	70	80	90

Table 41: Example changed WACC adjusted IRR

Now we have the motivation for the individual decision maker (maximize EVA to get good results bonus) and the whole organization: demand a lower return on investment for sustainable projects.

Advantages

1. It will actually favour sustainable projects over unsustainable projects
2. The calculation mechanism is really easy
3. It provides an opportunity to measure the money invested in sustainable projects and possibility to start a “green investment fund” with all the potential tax benefits.
4. There is a lower incentive for the AkzoNobel organization to start unsustainable projects, since they have increased the requirements on unsustainable projects.

Disadvantages

1. It disconnects the WACC to the actual capital costs of the company.
2. There are variable IRR and WACC for projects.
3. The EVA will be a fictional EVA and not the real one. So there is a need for two measuring systems (only when you have a variable WACC)

8.2.3 Conclusions

It is easy to change the time perspective from a communication standpoint. It means that the filter for unsustainable projects will be stronger but the profit of finding these projects will be higher than sustainable projects. From a communication and sustainability point of view it would be best to choose the change in capital cost (desire a new “WACC”) combined with a changed IRR. The benefits are easy to calculate and it gives motivation to both the decision maker and helps the whole organization to go into the right direction. Therefore we continue this chapter with the assumption that we will change the WACC and IRR, depending on the sustainability of the project.

8.3 What are sustainable projects?

Now we know how to value a project. If we want to know whether it is sustainable or unsustainable, we have to define what a sustainable project is. Before doing that we consider what we have said in the previous paragraph.

8.3.1 What does it mean for EEA?

In the previous paragraph we have quantified what it means to say: we would like to do sustainable projects and we will settle for less money. If we can make a lot of money we will do unsustainable projects. This means first of all that there is no need to take the company perspective in the LCC used in EEA. The question “is it good for the company?” is answered in a separate analysis, the usual project evaluation, with a different set of parameters for sustainable projects and unsustainable projects.

Look at everything

If we do an EEA we should use the full societal viewing point on the Economic part (LCC) and Environmental part (LCA). It is also wise to include social impacts.

Do not discount

In the financial project evaluation we already discount the future financial impacts. This means that we should not discount again when performing the EEA. There is no actual decision based on the EEA, it sets the system parameters. We can ignore the financial risk and other elements connected to discounting because it will be done in the project evaluation. So any future costs from pollution or benefits that are still far away will be fully included against current prices. The only argument for discounting would be inflation, but since we can easily assume that the yearly increase in price level equals the inflation, we can keep a constant price level.

Quantify sustainability in financial parameters

We have now quantified sustainability in financial parameters i.e. we have put a price on a sustainable future.

Conclusion:

We should go for full societal Eco-Efficiency²⁶ without any discounting, so don't take the business perspective on the costs, since we take that perspective in the project valuation. Now we have to formulate the Eco-Efficiency (EE) score in such a way that we can give the verdict: sustainable /unsustainable.

8.3.2 Sustainable, relative to....

Sustainability is always relative to something, either to another alternative (like the EEA described in this thesis) or maybe relative to the earth's carrying capacity. This is the benchmark for the score, the EE score itself can be expressed as a relative figure to the other alternatives (x% better) or as an absolute figure ("environmental impact of X").

Relative EE

An EE-score²⁷ of X percent of the current situation would be a relative EE-score. This score does not say anything about the real impact. See the example of the case study in chapter 3.2.1. The alternative is better but we don't know if the situation is sustainable or unsustainable to start with. On the other hand you can also say: as long as the right alternatives are included it doesn't matter since an X% improvement versus the current situation is always better regardless of the actual height of the impacts. It is relatively sustainable if there are no viable alternatives.

We define the sustainability according to relative EE as:

X% of the current situation

Not better then viable alternatives

We would then have:

	Sustainable	Normal	Unsustainable
EE score	< 90%	90% to 100%	>100%
"WACC"	6%	8%	10%
IRR	15%	16%	17%

Table 42: Relations EE relative scores to IRR and WACC

Since we will always expect an improvement in a new situation the normal case should be a small improvement and the sustainable case a big improvement.

EE absolute

This is for example the E/E score (See paragraph 2.1.2) of X (per functional unit). Based on this we could say X or lower is sustainable and above Y is unsustainable. But we need some kind of reference to define what X and Y are. For example the average impact of AkzoNobel.

Say that the whole of AkzoNobel has an average E/E score of 6 per function unit. Then we could say: Smaller than 3 is sustainable, between 3 and 9 is business as usual and over 9 is unsustainable.

²⁶ I leave the social impacts for what they are in this thesis, but you can read it as Full eco efficiency including social impacts.

²⁷ The score based on the full societal eco efficiency

	Sustainable	Normal	Unsustainable
E/E score	< 3	3 to 9	>9
“WACC”	6%	8%	10%
IRR	15%	16%	17%

Table 43: Relations EE absolute scores to IRR and WACC

We define the absolute benchmark as:

Under the absolute score X is sustainable and over score Y is unsustainable

What to use as a benchmark?

It is good to look at the real impact, since improving the EE with a large % in an unsustainable business, as shown in situation 1 Figure 24, should not be promoted as a sustainable investment. When we look at situation 3 we see that a sustainable business could move to the border and could become less sustainable and still get the profitable WACC.

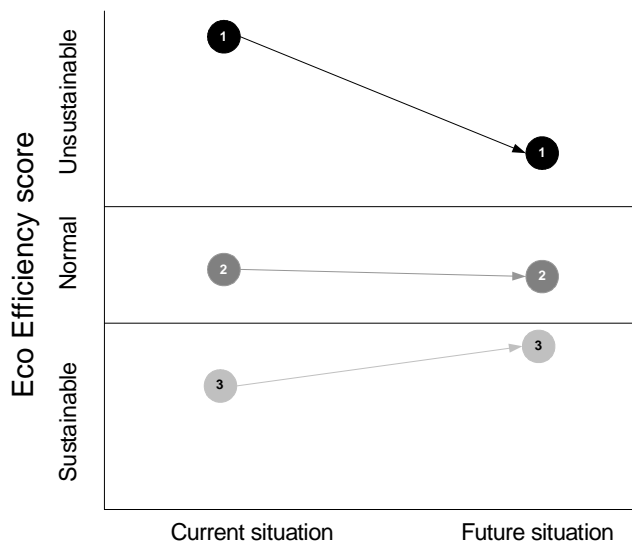


Figure 24 Possible situations with different type of benchmarks

There should be a grouping with a reference to the absolute Eco-Efficiency, and then a demand on the relative improvement. It could look something like this:

	Sustainable			Normal			Unsustainable		
EE score	< A			A-B			>B		
Improvement %	>X%	Y-X%	< Y%	>X%	Y-X%	< Y%	>X%	Y-X%	< Y%
WACC	6,5%	7%	7%	7%	8%	9%	8%	9%	10%
IRR	15%	15%	15%	16%	16%	16%	17%	17%	17%
Motivation manager	9%	8%	7%	9%	8%	7%	9%	8%	7%

Table 44: Setup Sustainable project valuation

Some AN products will be unsustainable and some will be sustainable. This system should not punish the decision maker (directly) for being in charge of the wrong department. They get equal opportunities to earn their EVA. AkzoNobel on the other hand will find fewer opportunities to invest in unsustainable products (due to the higher IRR requirements) and in that way invest less in the unsustainable products. Therefore we break the system down into two elements: The sustainability for the organization and the sustainability for the manager

8.3.3 Sustainability for the organization

The system should make sure that the sustainability score of the whole of AkzoNobel is going into the right direction. There are a number of ways to do this based on the ideas presented above. One way is worked out, one that can be easily tuned with a number of simple parameters and elements. This way nothing is fixed, but the structure is clear.

The reference line

We have to define the reference line. This could be any real score that represents the Eco-Efficiency that is the "normal score" This is the most important variable for the organization as a whole since it will represent the ambition level, if the ambition level is too low there will not be any real improvement. Adjusting the reference line every x (number of) year(s) is a great steering instrument in order to improve the sustainability of the company.

In this example we will use the weighted average of the absolute EE score of all the processes of AkzoNobel.

Company reference line = Weighted average of absolute EE scores for all products. This is an internal benchmark and by doing this you stimulate improvement over the actual situation. We call this variable "Ref" and set it at 10 in this example.

Improvement

Now we compare the investment project to the reference line. For example there is a project that has a E/E score of 7,5.

$$\frac{(E/E)_{\text{project}}}{(E/E)_{\text{ref}}} = \text{Sustainability Project (Sp)}$$

$$\frac{7,5}{10} = 0,75 \text{ (or 75\%)}$$

It is fair to assume that an improvement from 2 to 1 can be considered equally difficult as an improvement from 10 to 5²⁸. For this reason we will assume that there is a logarithmic connection between the scores. So we calculate the times it is better or worse than the base case.

$$LOG_2(Sp) = \text{Times better or worse than the base (negative is better, positive is worse)}$$

In this case: $LOG_2(0,75) = -0,42$ So this is an 0,42 times improvement.

This improvement we use to calculate the new IRR, we call it the Sustainable Rate of Return (SRR):

We could require an X% lower IRR if the new situation is twice as sustainable as the base case. This means that the SRR formula would be:

$$IRR + (X * LOG_2(Sp)) = SRR$$

Where x = lower IRR requirement

If we take IRR =16% and x = 1:

$$16\% + (1\% * -0,42) = 15,58\%$$

What if the project would have an EE score of 25?

It would give an SRR

$$LOG_2\left(\frac{25}{10}\right) = 1,32$$

$$16\% + (1\% * 1,32) = 17,32\%$$

So indeed the SRR will go up if the project is less sustainable.

While this is a fair way to do it from a mathematical perspective it is not so practical or educational. There are some calculations to be done and then a number comes out. We do not give a verdict on

²⁸ This will depend from situation to situation, but this is a better than saying that from 2 to 1 is just as easy as from 10 to 9.

the actual sustainability. It seems better to use this concept and make different levels that are easy to communicate and then decide how the calculations fit in.

It would be good to divide the business into 6 categories:

No investment, Very Unsustainable, Unsustainable, Business as usual, Sustainable and very sustainable. It is like the situation discussed before but now three categories are added. Two of them are to add more details, and "No investment" is to give the level at which AkzoNobel says: This is so unsustainable no matter how much money we make we will not invest.

It could look like this:

	Impact of Proj/ref (base 2)	Level	Impact of Proj/ref (base 3)	Impact of Proj/ref (base 1,5)
Phase out	8	3	27,0	3,4
Very Unsustainable	4	2	9,0	2,3
Unsustainable	2	1	3,0	1,5
Business as usual	1	0	1,0	1,0
Sustainable	0,5	-1	0,3	0,7
very sustainable	0,25	-2	0,1	0,4

Table 45: Categorization sustainability with different bases

Suppose that we say business as usual is equal to the impact of 1 (100%) or level 0. Then half of "business as usual" is sustainable, while double of "business as usual" is unsustainable, etc. If the impact is eight times the average score it is so unsustainable that you should not invest at all. Maybe we should say we need to be 3x as good or bad (so an improvement of 200%) to be considered more sustainable (and go to the next level) or an improvement of 50% would be good (giving a base of 1,5). The formula of the impact is $\text{Base}^{\text{Level}}$. This means that different number of levels can be chosen and different bases but the main thing is to determine: When should something be phased out and what is the lowest level needed to stimulate sustainable business. In between these two extremes should be meaningful categories.

We continue with the base of 2 and the 6 levels that were shown above and fill in the full schema with the formula's and the corresponding real figures.

Name	figure	Description
Base	2	Improvement required to go to next level (% +1)
X	1%	Reduction on the IRR requirement to be sustainable
IRR	16%	Current required Internal rate of return
Ref	10	Benchmark
Lvl		The level of sustainability
SRR		Sustainable rate of return based on sustainability

Table 46: Example figures levels of sustainability

The scheme in formulas:

Lvl	Level name	Lower limit	Middle	Upper limit	SRR
3	Phase out	$\frac{\text{Base}^{(\text{lvl}-0,5)}}{\text{Ref}}$	-	-	-
2	Very Unsustainable	$\frac{\text{Base}^{(\text{lvl}-0,5)}}{\text{Ref}}$	$\text{Base}^{\text{lvl}} * \text{Ref}$	$\frac{\text{Base}^{(\text{lvl}+0,5)}}{\text{Ref}}$	$\text{IRR} + (\text{X} * \text{lvl})$
1	Unsustainable	$\frac{\text{Base}^{(\text{lvl}-0,5)}}{\text{Ref}}$	$\text{Base}^{\text{lvl}} * \text{Ref}$	$\frac{\text{Base}^{(\text{lvl}+0,5)}}{\text{Ref}}$	$\text{IRR} + (\text{X} * \text{lvl})$
0	Business as usual	$\frac{\text{Base}^{(\text{lvl}-0,5)}}{\text{Ref}}$	$\text{Base}^{\text{lvl}} * \text{Ref}$	$\frac{\text{Base}^{(\text{lvl}+0,5)}}{\text{Ref}}$	$\text{IRR} + (\text{X} * \text{lvl})$
-1	Sustainable	$\frac{\text{Base}^{(\text{lvl}-0,5)}}{\text{Ref}}$	$\text{Base}^{\text{lvl}} * \text{Ref}$	$\frac{\text{Base}^{(\text{lvl}+0,5)}}{\text{Ref}}$	$\text{IRR} + (\text{X} * \text{lvl})$
-2	Very sustainable	-	-	$\frac{\text{Base}^{(\text{lvl}+0,5)}}{\text{Ref}}$	$\text{IRR} + (\text{X} * \text{lvl})$

Table 47: Formula's levels of sustainability

The scheme in figures:

Lvl	Level name	Lower limit	Middle	Upper limit	SRR
3	Phase out	56,6	-	-	Do not invest
2	Very Unsustainable	28,3	40	56,6	18%
1	Unsustainable	14,1	20	28,3	17%
0	Business as usual	7,1	10	14,1	16%
-1	Sustainable	3,5	5	7,1	15%
-2	very sustainable	-	-	3,5	14%

Table 48: Example levels of sustainability

Now we see that the middle column is not really needed to give a score on the IRR, so if we remove the middle column and the level and rephrase the scheme looks like this:

EE score of project	Sustainability	SRR
Above 56,5	Phase out	No investment possible
Between 28,3 and 56,6	Very unsustainable	18%
Between 14,1 and 28,3	Unsustainable	17%
Between 7,1 and 14,1	Business as usual	16%
Between 3,5 and 7,1	Sustainable	15%
Below 3,5	Very sustainable	14%

Table 49: Example Link EE score and sustainability

This is a clear framework that, based on a number of indicators, gives a verdict on the sustainability of the project and also on the required IRR for that project.

8.3.4 Sustainability for the manager

Now we calculate the new WACC; we call this the Sustainable Cost of Capital (SCC), for the manager, so that he can still earn his EVA.

The formula for SCC is:

$$WACC + (X \cdot Ivl) = SCC$$

Now we can rewrite it into the original EVA formula.

$$Capital * (SRR - SCC) = EVA$$

$$SRR = IRR + (X \cdot Ivl) \text{ \&}$$

$$SCC = WACC + (X \cdot Ivl)$$

So:

$$Capital * (IRR + X \cdot Ivl) - (WACC + X \cdot Ivl) = EVA$$

Rewrite:

$$Capital * (IRR - Wacc) + (X \cdot Ivl - X \cdot Ivl) = EVA$$

$$(X \cdot Ivl - X \cdot Ivl) = 0$$

So:

$$Capital * (IRR - WACC) = EVA$$

Now we add the incentive for the manager to find improvements:

We have three levels here and use the same principle as shown above:

We compare the new situation and the current situation and calculate the percentage of improvement.

We assume that there should always be an improvement in a new investment.

If the improvement is lower than a certain percentage it will be considered unsustainable. We call this Unsustainable Line manager, Um. The manager should get a penalty on his EVA if he invests in this project. If the percentage of improvement is higher than a certain percentage it is considered sustainable. We call this Sustainable Line manager, Sm. The manager should get a bonus for this.

So we can fill in:

	Capital Cost (CC)
No Improvement or improvement lower than Um%	SCC - Incentive
Improvement between Um and Sm %	SCC
Improvement higher than Sm %	SCC + Incentive

Table 50: Improvement and Capital Cost.

When we fill it in of the different levels we have

					Capital cost Project (CC)		
					Improvement versus current project situation		
Lvl	Level name	Lower limit	Upper limit	SRR	Lower than U	Between S and U	Higher than S
3	Phase out	$\text{Base}^{(\text{lvl}-0,5)} * \text{Ref}$	-	-	-	-	-
2	Very Unsustainable	$\text{Base}^{(\text{lvl}-0,5)} * \text{Ref}$	$\text{Base}^{(\text{lvl}+0,5)} * \text{Ref}$	$\text{IRR} + (X * \text{lvl})$	SCC - inc	SCC	SCC + inc
1	Unsustainable	$\text{Base}^{(\text{lvl}-0,5)} * \text{Ref}$	$\text{Base}^{(\text{lvl}+0,5)} * \text{Ref}$	$\text{IRR} + (X * \text{lvl})$	SCC - inc	SCC	SCC + inc
0	Business as usual	$\text{Base}^{(\text{lvl}-0,5)} * \text{Ref}$	$\text{Base}^{(\text{lvl}+0,5)} * \text{Ref}$	$\text{IRR} + (X * \text{lvl})$	SCC - inc	SCC	SCC + inc
-1	Sustainable	$\text{Base}^{(\text{lvl}-0,5)} * \text{Ref}$	$\text{Base}^{(\text{lvl}+0,5)} * \text{Ref}$	$\text{IRR} + (X * \text{lvl})$	SCC - inc	SCC	SCC + inc
-2	very sustainable	-	$\text{Base}^{(\text{lvl}+0,5)} * \text{Ref}$	$\text{IRR} + (X * \text{lvl})$	SCC - inc	SCC	SCC + inc

Table 51: Sustainable project valuation diagram

Now calculate and rewrite for

inc= 0,5%

U = 5%

S = 20%

WACC = 8%

So we see:

			Capital cost Project		
			Improvement versus current project situation		
EE score of project	Sustainability	IRR	Lower than 5%	Between 5 and 20%	Higher than 20%
above 56,5	Phase out	No invest	-	-	-
Between 28,3 and 56,6	Very Unsustainable	18%	10,5%	10,0%	9,5%
Between 14,1 and 28,3	Unsustainable	17%	9,5%	9,0%	8,5%
Between 7,1 and 14,1	Business as usual	16%	8,5%	8,0%	7,5%
Between 3,5 and 7,1	Sustainable	15%	7,5%	7,0%	6,5%
Below 3,5	very sustainable	14%	6,5%	6,0%	5,5%

Table 52: Example of Sustainable project valuation diagram filled in.

This is all the information that will be needed to get the Rate of Return and Capital Cost for every project, the 2 variables that are needed to evaluate a project.

8.3.5 Examples using sustainable project valuation

Now we evaluate the methodology for three projects:

Project 1

Project one has an EE score of 18. This is an unsustainable situation; therefore the required IRR is 17%. The EE score in the current situation is 23. So the improvement = $1 - 18/23 = \sim 22\%$ and there are no alternatives with a lower score.

This is over the 20% required to have a sustainable project

So the manager has to use the Capital cost of 8,5%

His EVA is $17\% - 9,5\% = 8,5\%$ of the invested capital

The actual EVA For AN = $17\% - 8\%$ (real WACC) = 9%

Project 2

Project two has an EE score of 6. This is a sustainable situation so an IRR of 15% is required.

The EE score of the current situation is 7. However there is a better alternative that has an EE score of 5,5 so this is not a sustainable project. Therefore the manager should use the capital cost of 7,5%.

His EVA is $15\% - 7,5\% = 7,5\%$ of the invested capital

The actual EVA For AN = $15\% - 8\%$ (real WACC) = 7%

Project 3

Project three has an EE score of 70. This is over 56,5 so there should not be an investment.

8.3.6 Conclusions

The system designed gives a clear and understandable approach how to do sustainable business, link it to project evaluation and the financial figures commonly used in the company. The things that are missing are the actual numbers to fill in the framework. This will strongly depend on the situation in which it will be used. In the next paragraph I will fill it in for the current situation in AkzoNobel using elements that are available. The two concepts of "Change the IRR" and "Change the WACC" can also be used separately.

Change the IRR

The change in IRR based on a real "sustainability score" is a smart way to reprioritize investments with set rules. It is also a good way to communicate internally what "sustainability is worth according to AkzoNobel". This is done without missing out on very profitable but unsustainable opportunities. This system sets a clear limit where unsustainability cannot be compensated by high profit. This is used to give a strong statement and it is also used as a quantified conscience that cannot be ignored.

Change the WACC

This concept is mainly to motivate managers to find sustainable solutions; they will get rewarded for sustainable solutions while being punished for unsustainable ones. This concept could also be used separately even without any costs to the company. Just put a penalty on the business as usual and a larger penalty on unsustainable solutions. Then they have to be more sustainable to keep their full EVA.

8.4 Sustainable project valuation in AN-Practice

The concept presented above can be easily used and implemented quickly. The main problem for implementing the concept in AkzoNobel is that there are no full societal EEA scores available for all AkzoNobel application areas, and most likely there will never be.

To implement this system my personal suggestion is to start using the LCA scores that can be derived from the EEA studies done so far. Use a methodology to add them up to get one environmental score. This can be done in different ways, but this thesis will not go into this.

Now we have the total environmental impact scores over the life cycle per functional unit for a number of products. Then we have to find out the value of that product (to the consumers). A full LCC for all projects would be preferable but this will suffice to get an indication of the value of the product. Now divide the LCC Cost score over the LCA score over to get the E/E scores that are comparable between products.

The maximum of the E/E scores found in the old EEA studies can be used to determine what a reasonable "Phase out" score is. The goal is not to say that 80% of the business should be phased out. It is better to start with a model that will rule out the most extreme cases and move into the right direction from there on. The goal is to get it incorporated in decision making first and then slowly increase the demands during the years afterwards.

The (weighted) average of the score could function as the reference score that is used. The weighted score will better resemble the actual situation so without giving small but very sustainable or unsustainable products a large weight. It should be weighted with the number of tons of the product sold for that application by AN. The difference between the maximum and minimum E/E scores can be used to determine the number of levels that are needed or to set the base for the levels. In any new Eco-Efficiency project that is done afterwards the following elements should be calculated on top of the current information:

1. The full LCA /LCC for the whole life cycle

This data is needed to start the real sustainable project valuation later on.

2. Value of the product

Use this together with the LCA and put in the model directly and fill in the E/E score to find the verdict on the sustainability of the project.

8.5 Conclusions

Based on the demands of the decision makers we have found a model to let a score on the sustainability of a product decide on the parameters used in project valuation.

Advantages

First we discuss the advantages for the three actors involved, and after that some disadvantages

The analyst:

- The decision makers will be more involved in the EEA score and will do their best to provide all the information that is needed.
- The difficult discussion about the need to discount the LCC is avoided; therefore there is no disturbance between the way the value is calculated in the LCC and the environmental impacts in the LCA. It is possible to look very far into the future to get the right sustainability perspective.
- The results of the EEA study will always be used and taken into account.
- By having an earlier involvement in AR there is more time to find the right information and also to make more improvements. The reason for this is it is not possible to write the economic chapter of the AR without having the E/E score.

The decision maker

- The company will "put its money where its mouth is", to say it popularly. Everything has to be sustainable but at the same time the profit requirements do not change. By giving a very general rule it is easier to plan sustainable projects and logical to allocate R&D resources to sustainable projects since that is where the EVA is easiest to obtain. It is easier to plan and start sustainable projects.
- The rules will be implemented on a very high level whilst still giving the decision makers the liberty to decide on the direction they want to take; it will just be more profitable to go into the sustainable direction.
- A manager in the unsustainable business will not be severely punished, he will have a harder time to find investments, but if he finds improvements he will be rewarded for it.
- It is a signalling instrument; if you are in an unsustainable business it is better to actually know that and try to do something about it than to find out when it is too late. It is like an early warning sign: "Last exit, this is a dead end road"

The company

- It is easy to communicate, not only internally but also externally. This could be the first time a company would be putting stringent financial targets on sustainability like this. This can give great publicity.

- It is good for the company on the long versus short run struggle by reallocating resources from managers that do unsustainable business in the short run to managers that can find sustainable solutions for the long run.
- There will be a lot of sustainable business whilst the small amount of unsustainable business will be very profitable. For the company the future is unsure, the only thing that is sure is that sustainability will become a bigger issue in the future, especially in the western world. AkzoNobel has already acknowledged this in its business strategy. So having a large part of the money come from sustainable business can never be bad. On the other hand the unsustainable business will be more profitable but smaller, so in case the business environment changes rapidly towards sustainability it is easier to leave these businesses.
- It is a steering instrument that does not need a change in the organization; the systems are already in place. It will also steer using those things that the board has control.
- It formalizes the role of the EEA in the Appropriation Request. Where the EEA is currently without (visible) consequences there is now a real added value of the EEA in the AR.

Disadvantages / opportunities

- Right now there is a certain status quo in the organization. This could be turned upside down. Some parts of the organization might go from the winner (in terms of for example EVA) right now, to the loser because the board indirectly says, sorry you are not sustainable enough, change your business or have a hard time in this company. Even while this is actually the goal of the system (to change the success factors) it could give struggle within the organization. However it is better to discuss it, than to wait until a sharp correction is needed²⁹.
- It takes time and money to implement and it is an extra step in project evaluation. My personal opinion is that implementing a system like this will pay itself back on the long run. But additional calculations are needed to find the costs.
- There has to be a uniform EEA calculation methodology. EEA is very specialized work and it is hard to check if it was done right, only by looking at the results. Therefore a strict methodology should be designed and an organ should be appointed that can give out official valid EE scores. They have to check the figures for consistency with the method especially if the calculations of the EE scores would be done by or paid by the BU's and not the board.

Issues to be addressed

There are some loose ends that have to be addressed here with an approach to them:

Environmental scores

There should not be too many worries about the uncertainty of the underlying environmental scores³⁰ to still give a verdict. Even if it would be wrong some time it will be right most of the times. You should not look at the individual score but at the business as a whole. So it does not matter that the real impact scores might be off by 20% or 30% (in any direction). This will level out over the whole company.

Balance

There will most likely be balancing issues, what E/E is sustainable, what is a reasonable IRR and how will it affect project valuation. The best thing would be to look at the business as a whole, divide it in categories to make some simulations on what the change in IRR will do to the profits etc. How many projects will be sustainable, how much profit will they still make? Is the extra turnover and profit created by these businesses enough to compensate the unsustainable projects that will not be done? The concept is not ready to be implemented but there is a basis to work from.

²⁹ Remember the banks in the world who were also the winners a few years ago?

³⁰ As long as they are not intentionally wrong of course

9 Conclusions and recommendations

This chapter will give the overall conclusions on how EEA helps to connect two of the pillars of sustainability: Environment and Economy. These conclusions can easily be applied to companies who want to move forward with sustainability. Chapter 6 there have been three recommendations for improvement opportunities for EEA in SD-practice, they will not be repeated here. The conclusions and recommendations in this chapter are based on the last two chapters on the economic methodology and sustainable project valuation.

9.1 Conclusions

9.1.1 EEA connects economy and environment

Life Cycle perspective

EEA is a good way to connect economic and environmental thinking within a company. By adding the economic dimension to the environmental analysis there is a higher willingness to listen to the results. The main value that is added by the EEA is the life cycle perspective. By looking through the life cycle to find all the up- and downstream impacts of the products produced by AkzoNobel, valuable opportunities can be identified. By acknowledging the fact that the company needs to make money one way or the other and taking the economy into account in the analysis it becomes easier to talk about sustainability and environmental impacts.

Motivation and opportunity

There are a lot of people in the AkzoNobel organization who have a personal motivation to work "more sustainable", but they have limited knowledge and budget to become "more sustainable". By showing them how projects could be financed (for example in the "filler in paper" case) and at the same time saying something about the sustainability improvements, they start to realize that sustainability is not always something that will cost money or is very complicated. Therefore it is very important that also in cases where there are obvious environmental and economic benefits (over the life cycle) these improvements should be acknowledged as sustainable solutions. They should not be dismissed as standard yield improvements or energy savings. The sustainability label should not only be attached to big, complex, timely and (maybe) costly projects that make huge (environmental/sustainability) improvements. It is important that people feel that they are going in the right direction, that they are motivated to be more sustainable and can see that sustainability works. This does not mean that the AkzoNobel organization as a whole should not set high goals on sustainability, but it is important that individuals remain motivated.

Long term strategy and risk

EEA is a very useful instrument if you want to see whether you are going in a sustainable direction or not and if you want to invest money in sustainable business. Doing EEA can reduce the risk of going into an unsustainable direction. In other words: the company will be prepared for changes such as higher raw material and energy prices, environmental taxes and stricter rules and regulations. By moving in the right direction the continuity of the business is ensured. The EEA can be described as a strategic long term (more than 3 years) decision making instrument, looking at "the long term right" a company has to keep on doing business from the perspective of society.

9.1.2 EEA is not the only decision making criterion

Other criteria

Within AkzoNobel, the EEA is always part of a bigger picture. Just looking at the results of the EEA is never enough to take a major decision. A number of other elements are taken into account: the impact on the EVA, the short, medium and long term goals and the way the alternative suggested by the EEA fits in the company strategy. It is important to recognize this when looking at the way the EEA is used in the company. This insight can be used to present the EEA within the company in such a way that it is clear what information it adds to decision making.

Just LCC is not enough

The LCC (as used in the EEA) does not give enough insight in the economic reality of AkzoNobel to be used as the only element in economic decision making. LCC is different from the project valuation /EVA calculations as used by AkzoNobel in decision making. The project valuation tries to measure

the future profitability and makes sure that the company can earn back its investment. LCC is a very good tool to look at economic aspects in a qualitative way and discover new insights but AkzoNobel can not use the LCC for (final) project valuation or investment decisions. Therefore it is good to say something about project valuation in the EEA study, for example by calculating the EVA. This way the analyst acknowledges the need to look at other indicators and shows that he understands the difference between LCC and project valuation/EVA.

9.1.3 Measure and put targets on sustainability

The final conclusion is that AkzoNobel has the opportunity to take the next step towards sustainability. This can be done by integrating the sustainability scores into the project valuation process, or using the well known saying: "What gets measured gets managed". The concept of "sustainable project valuation" developed in this thesis could be used to do this. The most important benefit of taking this step will be the strong signal within the company: "We believe that sustainability is of great importance. Sustainability is of such importance that we incorporate it in our financial decisions".

9.2 Recommendations

There have been a number on recommendations how to improve the EEA in SD-practice in Chapter 6

9.2.1 Go forward with sustainable project valuation

The main recommendation is that AkzoNobel should go forward with sustainable project valuation. There is a basis, it fits with current EEA approach and there is a group who can make it work. There are some hurdles to take and some specific elements to fill in. But using the current situation the concept could be implemented within a few months. There is no need for complex systems or a lot of money. The concept itself does not (have to) cost money. The only requirement is that there is the will to take this step.

9.2.2 Sustainable project valuation societal uses

This thesis is focussed on the use of EEA in companies, but maybe the "sustainable project valuation" could be use in similar way in EEA's performed for societal project valuation. Is it not so that there are always mechanisms to value a project? More investigation in this field are needed, but in the principle could be applied: Do not discount to look at all the influence of a decision on society on the long run (the direction) and use some kind of financial decision making model to look at the financial feasibility on the short or medium run.

10 Reflection

Perspective

The main goal of this thesis is to integrate the perspective of the decision maker and the analyst so that the EEA is easier to use. To look into this I tried to have a certain distance from both parties and be a neutral observer. Still I spend (much) more time with the analysts and in fact I am (being trained to become) an analyst. Therefore it is very hard to imagine that one does not understand EEA and to imagine how the decision maker sees and experiences the EEA study. This study assumes that the decision maker needs the EEA (otherwise they would not hire the services of the SD-group). What are the real needs of the decision maker regarding sustainability? Not only the needs from the people who have already ordered an EEA (or one of the other SD-services) but also from the others who have not. What are their main questions and needs regarding sustainability and how does EEA fit into this?

Approach

In May 2008 I started with my thesis. The goal was to finish it before the end of November 2008. This worked out well. The start up phase took a bit too. It took time to formulate the right research questions and get acquainted with the subject, especially because this was combined with a Swedish course (4 weeks every morning until 12:30) and moving into a new city. Then I had a vacation and when I came back it was August and everybody else was on vacation. Due to this I did not have enough time to get interviews with people in different layers of the AkzoNobel organization or with customers that had used the EEA (I only found out that this was necessary when I discovered that the SD-analyst have a big knowledge gap on the use of the EEA). Beside these setbacks I am happy with the total progress, since from August on I have been very busy and felt I did useful work moving into the right direction. My original goal of combining different perspectives has been achieved. I almost finished at the end of November; only the thesis presentation is left for December 12th 2008.

Time spent

In total I have worked about 1020 hours on the thesis during my time in Göteborg, excluding my Swedish course and the hours that I will use to make the final presentation and the hours that I already spent before going to Sweden. I expect that in total I will spend about 1100 to 1150 hours on this thesis for a total of 36 credits (ECTS). The workload is 28 hours per ECTS so this thesis has a workload of about 1000 hours. The reason for exceeding (10 to 15%) the official workload is mainly the extra hours spent at the end of the thesis: Until August the workload was about 40 hrs/wk, September and October 50 hrs/wk and November 60 hrs/wk. Exceeding the amount of hours is reasonable; I was very motivated and wanted to put in the extra effort in the end to get a good result. If I would have been able to balance the workload more I probably would have been able to do this thesis within prescribed time.

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Appendices

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I Abbreviations, terms & list of figures & tables

I.I Abbreviations

AN	AkzoNobel
AR	Appropriation Request
BU	Business Unit
CC	Capital Cost
CF	Cash Flow
CMC	CarboxyMethyl Cellulose
CS	Cellulosic Specialties
DM	Decision Maker
EBIT	Earnings Before Interest and Taxes
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
EE	Eco-Efficiency
EEA	Eco-Efficiency Analysis
EHEC	Ethyl HydroxyEthyl Cellulose
ERA	Environmental Risk Assessment
EVA	Economic Value Added
FC	Functional Chemicals
FU	Functional Unit
HSE	Health Safety Environment
IE	Industrial Ecology
IRR	Internal Rate of Return
LCA	Life Cycle Assessment
LCC	Life Cycle Costing
LCI	Life Cycle Inventory
MEHEC	Methyl Ethyl HydroxyEthyl Cellulose
MT	Management Team
NOPAT	Net Operating Profit After Taxes
NPV	Net Present Value
ROIC	Return On Invested Capital
sBU	sub Business Unit
SCC	Sustainable Cost of Capital
SD	Sustainable Development
SHERA	Safety Health, Environment and Regulatory Affairs
SRR	Sustainable Rate of Return
T&E	Technology & Engineering
WACC	Weighted Average Cost of Capital

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II Background information AkzoNobel

II.I Case study

II.I.I Setup Eco-Efficiency Analysis

This paragraph shows that full setup of the EEA pre study that was done as a case study in this thesis.

CMC in paper production to use more filler

By Max Sonnen

Background & Setup

This Eco-Efficiency Analysis is part of the master thesis I am conducting at AkzoNobel Sustainable Development with a case study for Cellulosic Specialties. For this case study I will conduct the study: Eco-Efficiency Analysis (EEA): CMC in paper production to use more filler.

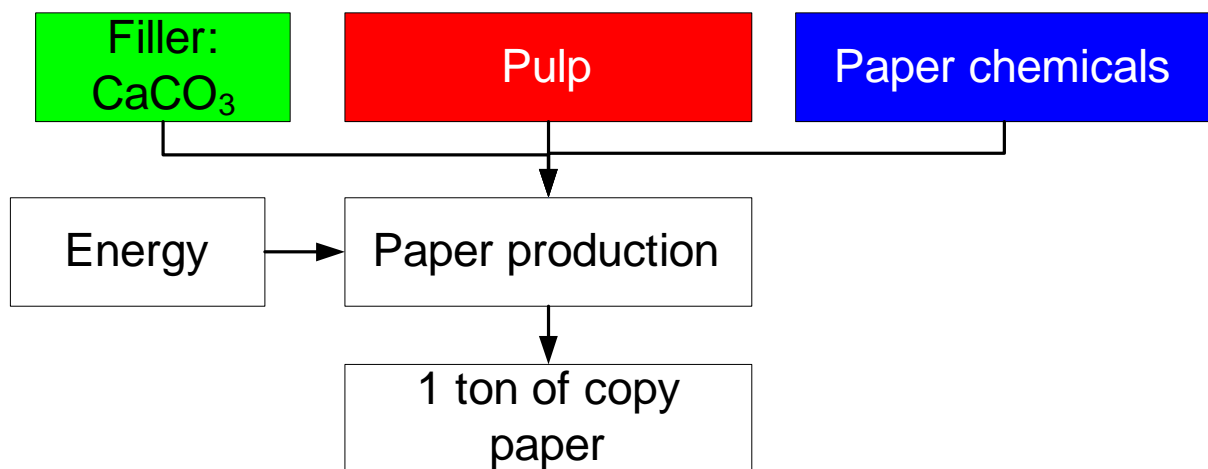


Figure 25 Paper production system

In Figure 25 we see the system that we will look at. We start with the base case: Standard paper production without the use of CMC:

Base case: ~ 20% filler + chemicals + pulp

Then in the two scenarios CMC is added as well as extra Filler.

Scenario 1: ~ 25% filler + chemicals + pulp

Scenario 2: ~ 30% filler + chemicals + pulp

This study is a pre study to a main study that AkzoNobel Sustainable Development is doing for AN pulp and paper.

Goal, Scope and results

Goal:

The first goal of this study is to make an EEA manager that will, based on a limited number of criteria, give a first impression of the possible benefits the owner of a paper mill can have by choosing one of the scenarios. This profit is in terms of financial benefits as well as environmental benefits. This could be seen as a marketing tool for AN pulp and paper, to show all the benefits of the increased filler use. Any further site specific calculations can be made in a later stage to achieve more specific results.

The second goal is to gain insights for the main study, to see where the main (environmental & financial) benefits for the improved production processes are. Where possible the results and data used in this study will be reused in the main study.

Scope:

The results of this EEA study will be delivered mid-October. This means that all the data that will be used has to be available before 1st of October.

There have been test trails using GCC as filler, so the test data (regarding energy use) that is available will be used. Outside of the scope falls the use of PCC as filler (Precipitated Calcium Carbonate) since there are no recipes & test data expected to be available before 1st of October. This can be added later in the main study

Results:

There will be a final presentation and an EEA Manager.

Scenarios, assumptions and variables

Proposed scenarios:

Base case: 20% filler + chemicals + pulp

Scenario 1: 25% filler + chemicals + pulp

Scenario 2: 30% filler + chemicals + pulp

These are the standard scenarios, but can be modified to custom needs

Assumptions:

Functional unit: 1 ton of copy paper at the paper mill.

Type of filler: GCC as filler (Ground Calcium Carbonate)

Variables:

Type of pulp:

Hardwood eucalyptus (from Brazil)

Softwood Spruce (from Sweden/ Finland)

Customize mix between different wood types.

Transport modes

Boat

Truck

Customize the distance & mode based on location of plant

Energy

Be able to choose between some standard energy mixes (based on main location)

Customize own energy mix

Prices

Filler

Chemicals

Wood fibres

Energy

Transport

Customize prices

II.I.II Justification EEA manager

BASF Tool

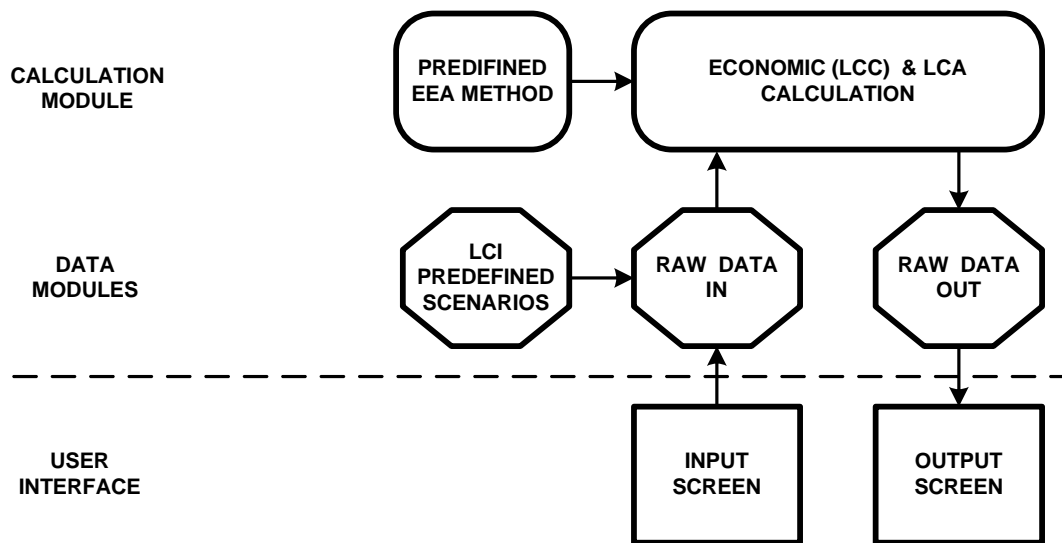


Figure 26 BASF (excel) Tool

The concept of the BASF tool presented in Figure 26 uses three elements:

Calculation module

The EEA method put in is used to calculate the LCA data & Economic data.

Data module

This is where the data is collected and “prepared” for calculation. And also the results are “stored” after calculation.

User Interface

This is the place where the tool interacts with the user. This means for the input screen that the user can make choices the way the data is used, select some predefined scenario's and maybe put in some data himself. In the output screen the EEA diagram and other diagram that could be of interest are presented.

Note: When you look at the BASF tool it is hard to define where for example “raw results out” ends and where “output Screen” starts. It is not strictly divided in this way, but for the concept, and the think about this it is good to divide it this way. The tool is developed by BASF for internal use and not sold as a commercial product by BASF.

EEA Manager

As a basis for the EEA manager developed for this study the BASF Tool presented above is used. It is modified on a number of points. This is shown in Figure 27. The grey blocks are used from the BASF Tool. The black-grey dashed line pattern indicates an update. The black blocks have been added or customized.

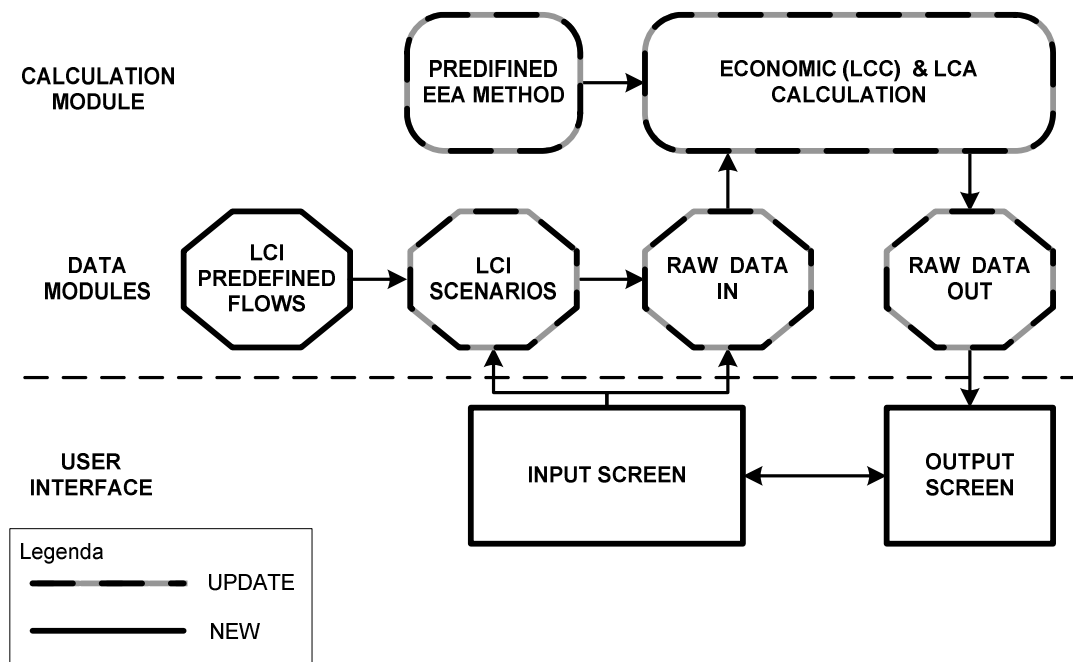


Figure 27 EEA (excel) Manager

Calculation module

- **Predefined EEA method**

Update: to include different economic methodology developed in this thesis

- **LCA calculation**

Old: Nothing changed

- **Economic calculation**

Update: includes different economic methodology developed in this thesis

Data module

- **LCI predefined flows**

New: gives the possibility to make custom scenario's based on a number of choices in the input screen.

- **LCI scenarios**

Updated: It now gets input from the LCI from the flows & the data in the input screen. This replaces manual placed scenario's giving the possibilities to create scenario's very much flexibility.

- **Raw data in**

Small update: includes more customizable more data elements and new economic data elements.

- **Raw data out**

Small update: includes new economic data elements.

User Interface

- **Input screen**

New: Fully redesigned to be able to collect all relevant data, partly integrated with the output screen to get immediate feedback on the implications of choices.

- **Output screen**

New: Fully redesigned, the data that is presented is still (more or less) the same so the Eco-Efficiency Diagram just like some of the graphs. Concept and layout has been completely redone.

II.I.III Setup LCA according to ISO 14044

Goal and scope

Goal:

Look at the differences between the environmental impacts different paper recipes, varying the filler content and the associated energy, raw material and chemical use. It will always be a comparison of a base case versus different filler scenarios. The scenarios are customizable for the main flow types.

Scope:

Cradle to gate, excluding the paper production plant.

Functional unit:

1 ton of copier paper at the gate of the paper producer.

Life Cycle Inventory

Mainly published data sources have been used. The data that has been collected from suppliers is confidential and thus not published in this thesis. The paper production is based on the four main flow types: Chemicals, Forestry, Filler and Energy. For these ingredients Life Cycle Inventory has been collected with the help of databases, earlier studies and the data collected from suppliers.

This is the list of flows & sources used in the LCA that is used in case study

CHP = Combined Heat & Power, this means that some of the environmental flows have been allocated to power and some to heat (always based on exergy)

Flow type	Flow name	Source: amount	Source: environmental LCI data
Energy	Power Wood CHP	Test trial	Wood CHP plant Vattenfall 1996
Energy	Power Wind	Test trial	Wind power plant Vattenfall 2007
Energy	Power Solar	Test trial	electricity_ production mix photovoltaic_ at plant, Sweden. Sachbilanzen von Energiesystemen.(Jungbluth, N. 2006)
Energy	Power Oil	Test trial	Oil condense plant Vattenfall 1996
Energy	Power Nuclear	Test trial	Nuclear power plant Vattenfall Ringhals 2007
Energy	Power Natural gas CHP	Test trial	Natural gas combined cycle plant Vattenfall 1996
Energy	Power Hydro	Test trial	Hydro power plant Vattenfall 2005
Energy	Power Coal CHP	Test trial	Coal power CHP present vattenfall
Energy	Power Biogas CHP	Test trial	electricity at cogen biogas agricultural mix allocation exergy. agricultural plants in Switzerland. (Life Cycle Inventories of Bioenergy, Jungbluth N. 2007)
Energy	Heat wood	Test trial	wood chips from forest mixed burned in furnace 300kW (Holzenergie, 2007 Bauer, C.)
Energy	Heat Oil	Test trial	heat light fuel oil at boiler 100kW nonmodulating (Erdöl, Jungbluth, N., 2007)
Energy	Heat NG	Test trial	natural gas burned in boiler modulating 100kW, (Ecoinvent Database, Emission data from different references.)
Energy	Heat Coal	Test trial	Steam from hard coal (89% yield) Sweden (All relevant flow recorded: PE INTERNATIONAL)
Energy	Heat Biogas CHP	Test trial	heat at cogen biogas agricultural mix allocation exergy agricultural plants in Switzerland. (Life Cycle Inventories of Bioenergy, Jungbluth N. 2007)
Filler	Lime stone	Test trial	Limestone, milled, packed, at plant. Data company in Switzerland (KFN)
Forestry	Soft wood	Test trial	Industrial residue wood, mix, Gabi, Ecoinvent (Switzerland Werner F. 2007)
Forestry	Eucalyptus wood	Test trial	roundwood, eucalyptus ssp. (SFM) Gabi, (Thailand)

Implementing and using Eco-Efficiency within AkzoNobel

Chemicals	Chemical mix	Test trial	Reported by producers & various sources
Transport	Truck	User defined	Truck, 60T, 70%, Sweden" (EcoLab, AN)
Transport	Ship	User defined	Bulk commodity carrier (105000 dead weightt) ocean, (Ecoinvent & PE INTERNATIONAL)

Life cycle impact assessment

The life cycle inventory data is used within the BASF framework for EEA (Saling, Kicherer et al. 2002). Where there are societal weighting factors are defined specifically for AkzoNobel. It is also possible to use the EPS system within this framework.

Interpretation

The LCA is an intermediate result and not presented as a separate. Therefore there is no interpretation of the LCA as such. The results will be used in the EEA and interpreted in that framework.

III Interviews old EEA projects

III.I Questionnaire used in interviews SD-Practice

This is the questionnaire as it was used to interview Analysts of the SD group to talk about their old EEA projects. Since some questions could not be answered, sometimes interpreted a little bit different when actually asking the questions and some of the answers are not publicly available the questionnaire will not be a 1-1 match with the results. But they will be matched as good as possible.

Review of old EEA projects by SD Project

Date:

Interview with:

1. Project information

Year:

Name project:

Project leader SD:

Customer name:

BU & sBU:

Number of scenario's / products:

Budget & hrs spend on the project:

Type of project: **(Internal / External)**

Short description of the project:

1.1 Environmental analysis

Method Type:

Good choice for problem? (Bad / ok / good / na)

Why this choice & problems/limitations:

1.2 Economic analysis

Method Type:

Good choice for problem? (Bad / ok / good / na)

Why this choice & problems/limitations:

2. Customer Information:

Level of customer

(sBU / BU / board / na)

Short description of the customer:

2.1 Decision maker:

Was the customer also the decision maker(s)

(Yes/no), if no who was?

Level of DM

(sBU / BU / board / na)

Knowledge of decision maker regarding EEA

(1 2 3 4 5 na)

Interest of decision maker in EEA

(1 2 3 4 5 na)

Involvement in project

(1 2 3 4 5 na)

Knowledge about own products and processes

(1 2 3 4 5 na)

How did the cooperation work out?

(1 2 3 4 5 na)

Why?

Reward structure DM:

Time span personal incentive scheme based on (financial) results:

(No / Short (3-6 month)/ medium (0.5 - 3 yr) / long (3 to 10 yr / very long (10+ yr))

What are criteria (if known)

Time span personal incentive scheme based on other (HSE) results:

(No / Short (3-6 month)/ medium (0.5 - 3 yr) / long (3 to 10 yr / very long (10+ yr))

What are criteria (if known)

2.2 Main contact person

Was main contact person(s) same as customer? **(YES/NO)**, if no who was?

Level of contact person	(sBU / BU / board / na)
Knowledge of contact person regarding EEA	(1 2 3 4 5 na)
Interest of contact person in EEA	(1 2 3 4 5 na)
Involvement in project	(1 2 3 4 5 na)
How did the cooperation work out?	(1 2 3 4 5 na)
Why?	

3 Analyst

Who worked on the project (mainly)

3.1 Knowledge & involvement

Knowledge of processes & considerations client	(1 2 3 4 5 na)
Involvement in project	(1 2 3 4 5 na)
Knowledge of environmental analysis	(1 2 3 4 5 na)
Knowledge of economic analysis	(1 2 3 4 5 na)

(The knowledge of the analyst how comfortable he/she feels with the role of specialist on that part)

How can any of these are improved?

3.2 Funding & Time planning in different project phases

At what point where you involved by the customer to do an EEA?

(To early stage / right time / late stage / last minute)

Was there enough funding to answer all questions?

(Too much funding / More than enough funding / enough / to little / way to little)

How many people did you involve in the data gathering? (____)

Start-up phase **(%/hrs of project: ____)** **(1 2 3 4 5 na)**

Why & how to improve

Define goal & scope **(%/hrs of project: ____)** **(1 2 3 4 5 na)**

Why & how to improve

Data collection **(%/hrs of project: ____)** **(1 2 3 4 5 na)**

Why & how to improve

Calculations **(%/hrs of project: ____)** **(1 2 3 4 5 na)**

Why & how to improve

Deliver draft results **(%/hrs of project: ____)** **(1 2 3 4 5 na)**

Why & how to improve

Deliver final results (%/hrs of project: ____) (1 2 3 4 5 na)
Why (all) & how to improve (if not 4/5)

Total project (1 2 3 4 5 na)
Why (all) & how to improve (if not 4/5)

4 Results & evaluation:

Primary Use of EEA: (Strategy / Manufact / R&D / Communication / Supply Chain / Marketing)

Secondary use of EEA: (Strategy / Manufact./ R&D / Communication/ Supply Chain / Marketing)

Goals/reasons to do EEA:	Fulfilled?
	(Yes / no / part)
	(Yes / no / part)
	(Yes / no / part)
If no / part why not?	

Results of the EEA:	Fulfilled expectation?
	(Yes / no / part)
	(Yes / no / part)
	(Yes / no / part)

Did the assumptions regarding the results they one before hand match the actual results?

(Yes / no / part)

4.1 Satisfaction with assumptions & weighing factors

You:

4.2 Satisfaction with the results

You:

Decision maker:

4.3 Use of EEA results

Did the decision maker understand the logic behind the results (weighting factors/economic and environmental criteria) or did he see it as a black box? How was understanding of logic?

(Complete /good / little / very little /no understanding)

Was this a problem in making the decision? (Yes/No)

Do you know how the (final) results where used? (Yes / no)

How much you feel was the influence of the EEA on the choice (___ %)

How where the results taken into account in the final decision:

3 most important factors why results where used/ not used.

1.

2.

3.

4.4 Evaluation

Rate overall score you would give the project (1 2 3 4 5)

What would you do different next time in a similar project?

What should you customer / decision maker do different next time in a similar project?

3 most important factors in success/unsuccessfulness project

1.

2.

3.

III.II Information collected in interviews SD-Practice

#	Question:	Type:	Discussed in:
1	project number	pre defined	Not shown
2	Date	open	Not shown
3	Interviewee	open	Not shown
4	Year	open	3.5
5	Name project	open	Not shown
6	Project leader SD	open	Not shown
7	Customer name	open	Not shown
8	BU & sBU	open	Not shown
9	Number of scenario's / products	open	3.5
10	Budget & hrs spend on the project	open	3.5
11	Type of project	options	3.5
12	Short description of the project	open	3.5
13	What Environmental Method did you use?	options	3.4.1
14	Good choice for problem?	open	3.4.1
15	Why this choice and state problems/limitations:	open	3.4.1
16	What Economic Method did you use?	open	3.4.2
17	Good choice for problem?	options	3.4.2
18	Why this choice and state problems/limitations?	open	3.4.2
19	What was the level of the customer	options	3.4.9
20	Give a short description of the customer		3.4.9
21	Was the customer also the decision maker(s)	yes/no	3.4.9
22	If no who was?	open	3.4.9
23	Level of DM	options	3.4.9
24	Knowledge of decision maker regarding EEA	options	3.4.10
25	Interest of decision maker in EEA	options	3.4.9
26	Involvement in project	options	3.4.9
27	Knowledge about own products and processes	options	3.4.9
28	How did the cooperation work out?	options	3.4.9
29	Comments on this question?	options	3.4.9
30	Time span personal incentive scheme based on (financial) results	options	Could not be answered
31	What are the criteria?	open	Could not be answered
32	Time span personal incentive scheme based on other (HSE) results:	options	Could not be answered
33	What are the criteria?	open	Could not be answered
34	Was main contact person(s) same as customer?	yes/no	3.4.9
35	If no who was?	open	3.4.9
36	Level of contact person	options	3.4.9
37	Knowledge of contact person regarding EEA	options	3.4.10
38	Interest of contact person in EEA	options	3.4.9
39	Involvement in project	options	3.4.9
40	How did the cooperation work out?	options	3.4.9
41	Comments on this question?	open	3.4.9
42	Who worked on the project (mainly)?	open	3.4.13
43	Rate your: Knowledge of processes & considerations client	options	3.4.13

Implementing and using Eco-Efficiency within AkzoNobel

44	Rate your: Involvement in project	options	3.4.13
45	Rate your: Knowledge of environmental analysis	options	3.4.13
46	Rate your: Knowledge of economic analysis	options	3.4.13
47	How can any of these are improved?	open	3.4.13
48	At what point where you involved by the customer to do an EEA?	options	3.4.3
49	Was there enough funding to answer all questions?	options	3.4.3
50	How many people did you involve in the data gathering?	open	3.4.3
51	What % of hrs did you spend in start-up phase	open	3.4.3
52	Did this phase go according to plan?	options	3.4.3
53	Give comments on this phase if not according to plan	open	3.4.3
54	What % of hrs did you spend in goal scope phase	open	3.4.3
55	Did this phase go according to plan?	options	3.4.3
56	Give comments on this phase if not according to plan	open	3.4.3
57	What % of hrs did you spend in data collection phase	open	3.4.3
58	Did this phase go according to plan?	options	3.4.3
59	Give comments on this phase if not according to plan	open	3.4.3
60	What % of hrs did you spend in calculation phase	open	3.4.3
61	Did this phase go according to plan?	options	3.4.3
62	Give comments on this phase if not according to plan	open	3.4.3
63	What % of hrs did you spend in draft results phase	open	3.4.3
64	Did this phase go according to plan?	options	3.4.3
65	Give comments on this phase if not according to plan	open	3.4.3
66	What % of hrs did you spend in final results phase	open	3.4.3
67	Did this phase go according to plan?	options	3.4.3
68	Give comments on this phase if not according to plan	open	3.4.3
69	Did the total project go according to plan?	options	3.4.3
70	Give comments on project if not according to plan	open	3.4.3
71	What was the primary reason to do the EEA	options	3.4.11
72	What was the secondary reason to do the EEA	options	3.4.11
73	What where the goals of the study?	Open	3.4.11
74	Did you achieve these goals?	options	3.4.11
75	If not or partly achieved why is that?	Open	3.4.11
76	What where the results of the study?	Open	3.4.12
77	Did this fulfil the expectations?	options	3.4.12
78	Did the assumptions regarding the results they one before hand match the actual results?	Yes/no	3.4.12
79	Was this a problem?	Open	3.4.12
80	Where you satisfied with assumptions & weighing factors	Open	3.4.6
81	Where you satisfied with the results	Open	3.4.6
82	Was the decision maker satisfied with the results	Open	3.4.6
83	Did the decision maker understand the logic behind the results (weighting factors/economic and environmental criteria) or did he see it as a black box? How was understanding of logic?	options	3.4.10
84	Was this a problem in making the decision?	Yes/no	3.4.10
85	Any comments on this?	open	3.4.10
86	Do you know how the (final) results where used?	yes/no	3.4.7
87	How much you feel was the influence of the EEA on the choice [%]	open	Could not be answered
88	How where the results taken into account in the final	open	3.4.7

	decision?		
89	Give the most important factors why the EEA was used for a decision		3.4.8
90	Rate the overall score of the project	options	3.4.6
91	What would you do different next time in a similar project?	open	3.4.5
92	What should you customer / decision maker do different next time in a similar project?	open	3.4.5
93	Give the most important factors why the project was a success (or not)	open	3.4.4

III.III Results per question

In this appendix the actual results & comments of the interviews with the analysts per topic are presented. It uses the same structure a chapter 3.

III.III.I Projects: Environmental methodology

Generalized results per project:

Project #	Method	rating	Categorized Comments
1	LCA	good	-
2	LCA	ok	Balance in weighting different environmental criteria
3	LCA	good	Missed risk & local pollution elements
4	LCA	good	Problems with availability and collection of data
5	LCA	ok	-
6	LCA	good	Problems with availability and collection of data
7	LCA	good	-
8	LCA	ok	Missed risk & local pollution elements
9	LCA	good	Missed risk & local pollution elements
10	LCA	good	-
11	LCA	good	-
12	LCA	Good	Problems with availability and collection of data
13	LCA	good	Balance in weighting different environmental criteria
14	LCA	good	-
15	LCA	good	-
16	LCA	ok	Balance in weighting different environmental criteria
17	LCA	ok	Missed risk & local pollution elements
18	LCA	good	Balance in weighting different environmental criteria

Results per question:

Environmental method: Why this choice and state problems/limitations:

Balance in weighting different environmental criteria

- Tricky to have a good balance between energy and waste water in LCA, very dependant on weighting.
- Problems with the weighting, one of impacts should not have been in the study
- Different opinion on the weighting method the customer demanded. But it gave a complete picture.

Missed risk & local pollution elements

- The emission of dioxin is not included in method. Also use of waste stream, did not expect that there would be any allocation to those streams. (But there is since it has a value)
- Mostly ERA, used a lot of the information from previous study, updated it where needed

- ERA, could have complemented since there was leaching of the preservatives into the environment during the use phase
- Human Health and local pollution is not included, and these things were very important in this case. So used BASF & EPS system

Problems with availability and collection of data

- Not knowing the specific production method will influence on the results. This is hard especially for AR where most is hypothetical and not real specific plans are made.
- Problems with data collection: Data not as easy available as expected. Data people also very busy
- Maybe a sustainability report would also have been useful since it was hard to collect data for plants that did not exist yet

Not categorized:

- The right tool, since it was mainly about greenhouse gas emissions and location is not relevant for that. Also intended use was for authorities so total emissions over life cycle are useful to show.
- Good example for EEA. The study was a good illustration of a trade off between environment and economy that can make an EEA weighting necessary for the decision. LCA is a good choice since it covers the whole value chain and takes into account many different environmental impacts.
- Customer didn't want to include the raw materials and because this is part of LCA it had to be included and in fact was a very important part of the environmental impact. (Although they didn't really want to know that)

III.III.II Projects: Economic Methodology

Generalized results per project:

Project #	Method	rating
1	LCC (perspective)	good
2	LCC (perspective)	good
3	LCC (perspective)	good
4	Cost for customer	good
5	Cost for customer	good
6	Cost for customer	ok
7	Cost for customer	good
8	Cost for customer	good
9	LCC (perspective)	na
10	LCC (perspective)	good
11	Cost for customer	ok
12	Cost for customer	ok
13	Cost for customer	good
14	Cost for customer	good
15	Cost for customer	good
16	LCC (perspective)	good
17	LCC (perspective)	good
18	LCC (perspective)	good

Results per question:

Problems:

- Include opportunity costs of invested capital in current plants (use book value yes or no)

Relevant Comments:

- A lot of different methods are used in different parts of the company. Make sure that you discuss this in the beginning. This way you will have the unity of language and you are sure that you are talking about the same things. Also discuss the actual calculation method. Combine this with the economic information they use in the rest of the AR

- Difficult to see if the figures were correct, due to lack of economic background. Had to believe in them, the customer usually does it the way they want it.
- Best choice at that moment. They have good skills regarding economics themselves.
- The results were mixed, it gave some good insights. One of the results was that the product that was sold was cheaper than the raw materials that were put in. This does not seem very logical.
- Didn't understand that his product was more expensive for customer even though price was 50% higher
- Good case to show that lignite would give financial risk for future due to high CO2 output
- Good to include all elements over life cycle. Straight forward calculations.
- All the main discussion in the study were on the economic part. On the environmental part some questions.

III.III.III Projects: Time planning

Generalized results per project:

	Point in time involved	Funding for project	People involved in data collection	Data collection phase	Reasons	Total plan
1	right time	enough	2	as planned	-	as planned
2	late stage	to little	2	(much) slower	not clear on demanded data required	as planned
3	right time	enough	1	as planned	-	as planned
4	right time	enough	5	(much) slower	People / resources customer	(much) slower
5	late stage	to little	3	(much) slower	People / resources customer	(much) slower
6	right time	to little	4	(much) slower	People / resources customer	(much) slower
7	right time	enough	3	as planned	-	(much) slower
8	late stage	enough	1	as planned	-	as planned
9	right time	to little	3	(much) slower	not clear on demanded data required	as planned
10	right time	enough	7	(much) slower	People / resources customer	(much) slower
11	late stage	to little	4	(much) slower	People / resources customer	as planned
12	late stage	More than enough funding	4	as planned	-	(much) slower
13	??	to little	3	(much) slower	People / resources customer	(much) slower
14	right time	enough	2	as planned	-	as planned
15	right time	to little	6	(much) slower	People / resources customer	(much) slower
16	right time	enough	2	as planned	-	as planned
17	right time	enough	5	as planned	-	as planned
18	right time	to little	4	(much) slower	People / resources customer	as planned

Results per question:

Results start-up phase

4/18 delay

Comments to this phase:

- Very important to get the project
- Some had to come from the other side of the world for kick-off
- Unclear about who was in the project

- Could have got more out of the start-up if there would have been a better goal and scope definition and a more quantified offer (we do this and this, this many meetings etc) Then also the money would have been enough.

Results goal scope definition

1/18 delay

Comments to this phase:

- More questions in the offer than could be answered
- Didn't think they needed the EEA, so took time to find out what questions to answer
- There were too many questions that needed to be answered (according to offer) felt pressure due to that.

Results data collection phase

10/18 delay

People / resources customer

- Expected the customers to have more information. Next time this could be improved by looking into info before and see what you can find without the help of the customers.
- They did not understand what was needed. Changed the figures. There was a collision about the figures between the people in the clients group about the figures to use.
- Data guys didn't have time & right information to give the data. Need to inform customer that Data collection will take time & resources from their organization.
- Failed to get the right data because had been talking to the wrong person. Got data in the end (from a consultant)
- Decided to collect data in January. But the controllers that where suppose to collect it do not have time in January.
- Make sure data collector has time and involve in project from the start
- Asked to hold all data collection since they had negotiations with their customers.
- The data gathering took very long time since the data was not available, since all the decisions on technology had not been made yet.

Not clear on demanded data required

- New method, new questions along the way and not a clear idea on what data was needed from the beginning
- New customer, second EEA project, and data collection was not really standardized

Results calculation phase

4/18 delay

Comments to this phase:

- Learning the programmes and method.
- Customer changed their mind multiple times during the project, also problems with project management due to unforeseen personal issues with SD.
- Waited for the data and data was updated several times
- The data was late, so faster calculations. Due to speed it took more hrs, since working with 3 people on it at the same time. (less efficient and overlap in work)
- First project for one of the analysts. Time needed for calculations and figuring out Ecolab

Results draft results phase

2/18 delay

Comments to this phase:

- Hard to find a good time to present the results in calendar. 2 different presentations.
- Date changed due to demanded by customer, also some problems with the software. Calculations had to be re made

Results final results phase

3/18 delay

Comments to this phase:

- Recalculate and have extra work after the presentations.
- The MT has time only 4x per year. So first date the project was not completely finished so the final presentation was 2,5 months after end of project

- Not date from customer for final presentation
- Redo the calculations after receiving new data & much work.

Results total project

8/18 delay

Comments to this phase:

- It was in time to be used as input for the decision.
- suppose to take 2-3 months took 6 months
- The scope should have been smaller, and the expectations lower. Also first meeting was not very productive since there was no preparation.
- Very small project, not really in phases.
- More or less according to plan since the plan was not really strict with phases etc.
- Simple data collection, and very clear understanding of goal and scope of study
- It was a very fast plan, but worked out good.
- There were a lot of meetings. Organizing and going there took a lot of time.
- Quick until final presentation
- Put in less hrs then available, but was finished after AR was due.

III.III.IV Projects: Success factors

Generalized results per project:

Project #	Reason 1	Reason 2	Reason 3	Score
1	Use / interest method	Easy data gathering	Project team	5
2	Problems Goal and scope	Personal interest	-	3
3	Project management	Knowledge base	-	3
4	Project team	Project team	Project team	4
5	Problems Goal and scope	Closed attitude	Project management	2
6	Knowledge base	Project team	Use / interest method	3
7	Easy data gathering	Closed attitude	Closed attitude	3
8	Problems Goal and scope	Personal interest	-	2
9	Knowledge base	Use / interest method	Personal interest	3
10	Personal interest	Knowledge base	Easy data gathering	4
11	Project team	Easy data gathering	Project management	4
12	Easy data gathering	Knowledge base	Knowledge base	3
13	Project management	Project management	-	1
14	Personal interest	Project management	-	4
15	Project team	Project team	-	4
16	Personal interest	Use interest method	-	3
17	Easy data gathering	-	-	4
18	Personal interest	Project team	-	4

Results per question:

Problems Goal and scope (3)

- Hard to compare different environmental effects
- Bad goal and scope definition by client (due to bad process knowledge) and our involvement too late
- Lack of a relevant EEA question

Closed attitude (3)

- Little incentive to be involved in the project
- Didn't want to show the financial data they had, therefore hard to combine everything.
- Not interested in learning or curious about EEA.

Easy data gathering (6)

- The willingness to help from the people gathering the data

- There were little people involved in data gathering and they had the data and were aware of the processes and interested in helping.
- Fast data collection (mainly Sweden, makes communication easier)
- Quick data gathering.
- The right person to get the data
- Had the right data available

Knowledge base (6)

- Lack of experience with EEA, would have gotten more out of time today
- Knowledge about processes from the start (be able to ask the right questions from the start)
- Good understanding of issues in general
- Availability of research data of competitors (otherwise comparison impossible)
- Customer understood the life cycle thinking
- Knowledge (within SD) of processes on before hand

Personal interest (7)

- Interest of the decision maker
- The people in the project were really interested and involved
- Interest of customer. Not only result but genuine interest in way of thinking.
- Personal interest in Topic by analyst
- Interest of the customer in the EEA
- Positive wanted to learn about EEA, and a clear view on what they wanted to accomplish
- Personal involvement in EEA

Project management (4)

- Internal problems SD with project management
- Good communications with all data people & Customer
- Communication with contact person
- Getting the right people involved to do the project.
- Lack of a firm hand, steering the project
- Prioritization of task within SD group

Project team (9)

- It was a good project team (Analysts worked together very well & the people from the customer were all young and willing to learn about EEA and looking forward to the results)
- Motivated & Enthusiastic customers
- Cooperation between the different analysts to get the job done.
- Put in effort when needed (thus make overtime/be flexible)
- Reference group ready to support project with expertise & their network
- Their involvement in the study and that there where people in organization that could help.
- A lot of fun and had a good time doing the project
- Have a good group of people from SD with different skills.
- Good communication with other analyst

Use / interest method (4)

- The intended use of the study in the AR, positive attitude towards EEA
- Interest in this kind of information and wanting to look at more than just economic elements (where EEA is one of those other elements)
- Be brave enough to question the assumptions and choices made so far.
- Usefulness of the methodology for this case.

III.III.V Projects: Improvements options

Generalized results per project:

NONE

Results per question:

What would you do different next time?

Collecting the data (4)

- Have a higher budget (for data gathering)
- Data collection: make sure that you can do more yourself.
- Better data collection management. Have enough time in the end when work is almost finished to do the analysis
- Go to the data guy in the beginning.

More visits to customer (7)

- Have more meetings with people face to face and validate the data.
- Have much more contact with the customer.
- Go on a site visit
- Involve the data gathering people earlier, have kick-off with them in person.
- Meet the data gathering people in person at least once at the beginning of the project (or sit down with them).
- Go on a site visit if that is possible.
- If possible have a site visit.

Appropriation Request (3)

- Be more aware of existence of less enthusiastic customers (in AR). They see it as a requirement in the AR, not as something that they value. Have a good approach for that.
- Make sure you know about timeframe for AR.
- Find out more how AR works & how EEA in regard of AR works

Use of results (3)

- Make sure right EEA results go to board and that SD sees the actual final results and advise that go to board.
- More communication with decision maker. How and why they do it.
- Have much more contact with the customer.

Project management (5)

- Work together with someone with experience (on first project)
- Start to manage the project earlier (when things are not going into the right direction)
- Stop or change the project after first meeting since results were destined to be useless.
- Taking a more firm lead in the project and try to stop
- Change the offer (for example: define the # of meetings),

Time planning (3)

- Make a good time planning and "enforce" that
- Get the right time frame & the Dutch vacation calendar (since everybody was gone when all the data had to be collected)
- Have a longer time schedule to be really sure of the results.

Weighting methodology (2)

- Find more info & consideration on weighting.
- Make the weighting methodology more representative.

What should the customer or decision maker do different next time?

Deliver the data (2)

- Don't say they have data while they have not,
- Deliver more detailed data and trust the SD department.

Allocate time and money (5)

- Spend more money on a project so that you get better help.
- Give time to and plan time for the data people
- Understand that EEA is needed and devote time & resources to it

- Make sure that they prioritize the project and give time to the data collectors, and let them attend.
- More time for the project /not somebody who is going for another position

Better involvement (3)

- A larger involvement of the decision maker.
- Be more involved in the project.
- Be more enthusiastic & open minded. See opportunities and be open to learn new things.

Better planning (3)

- Don't make last minute changes at the end.
- More patience of DM. Plan ahead bit and don't push to much. This will increase the quality of the study.
- They should make sure the timeframe is followed (for their own use of the study)

Communication (2)

- Have a customer that communicates with everybody
- Speak to each other before starting.

III.III.VI Results of project: Satisfaction

Generalized results per project:

Project #	satisfied weighting	Satisfied results	Satisfied results decision maker
1	yes	yes, but...	yes
2	Open for discussion	yes, but...	yes
3	yes	yes	Would have wanted clearer results
4	yes	yes	yes
5	eventually	no	Would have wanted clearer results
6	yes	yes, but...	yes
7	eventually	yes, but...	yes
8	yes	yes, but...	Would have wanted clearer results
9	yes	yes	yes
10	yes	yes	yes
11	yes	yes	yes
12	yes	yes	yes
13	Open for discussion	no	yes
14	yes	yes	Would have wanted clearer results
15	yes	yes, but...	yes
16	Open for discussion	yes, but...	yes
17	Open for discussion	yes	yes
18	Open for discussion	yes, but...	yes

Results per question:

Satisfied assumption and weighing

Were you satisfied with assumptions & weighing factors?

Yes (11)

- Yes, no real focus on raw materials, but sometimes that is the case and then you should accept that (even though you would want to spend more time, and could do more specific calculations)
- Yes it is discussed often in the studies, but the final assumptions were good. A high importance was given to CO₂
- It was more about CO₂ the EEA, so weighting was not really an issue
- There were a lot of assumptions and estimations, but in the right way, so yes satisfied

Open for discussion (5)

- Hard to get a good weighting between air & water emissions, since the choices are very important for the results.
- Not really, don't know really how to improve, maybe have another weighting method than BASF.
- Steam and electricity allocation were not the most commonly used. Not satisfied with that. Start of discussions about weighting.
- Partly, would like to have used the new weighting factors, but that didn't really change the ranking of the alternatives

Eventually (2)

- Yes, no real focus on raw materials, but sometimes that is the case and then you should accept that (even though you would want to spend more time, and could do more specific calculations)
- Not satisfied with the scenario's since they were not relevant (also reason to make 2 extra scenario's)

Satisfied results

Were you satisfied with the results?

No (2/18)

- No, also not satisfied with the project
- No nothing really useful came out. The EEA should not have been started

Yes, but... (7/18)

- Yes at the time No with the new insights right now.
- Yes, but frustrated that the offer was too vague and general and the consequences that much more work needed to be done than necessary
- Yes (within predefined scope)
- Yes according to their ideas
- Base case not really, the scenario's yes. In total ok.
- No, internally since over the budget, yes on the EEA delivered
- Yes, but not very exciting

Yes (8/18)

- Yes, as expected
- Yes, it was a very nice tool. The customer was impressed and (hopefully) it opens up their eyes
- Yes, conformation of ideas

Satisfied results decision maker

Was the decision maker satisfied with the results?

Would have wanted clearer results (4/18)

- Partly, would like to have a more clear answer
- No, the results were useless
- Partly, would have liked more clear (unambiguous) argumentation that they could use. Explanation needed
- Would have liked a clearer picture

Yes (14/18)

- Yes cheapest alternative came out best
- Yes, they had the idea that they were on the right track with this project
- Yes they used it.
- Yes, the message has spread and they ordered a very big follow-up study.
- Decision maker was satisfied with result, contact person not.
- Yes, mainly. Some questions about water use. And found some errors in their own cost data they provided at the final presentation.
- Yes but there was no focus on EEA in the AR.

- contact person was satisfied

III.III.VII Results of project: Use of results

Generalized results per project:

Project #	know how it was used
1	part
2	yes
3	yes
4	part
5	yes
6	yes
7	part
8	part
9	yes
10	part
11	yes
12	part
13	yes
14	no
15	yes
16	part
17	no
18	yes

Results per question:

Comments/details about the use of the results

- As input in the (long term) strategy planning of BU. The EEA-manager to make comparisons to themselves based on scenarios
- Assume: on future plant investments. Don't know in R&D, think in future projects
- Did follow recommendations but very little influence since in line with ideas
- Discussion on the alternative to choose. Useful tool to do that. Right now more discussions about emissions, new limits from the government?
- In communication with authorities, to what extent not known
- In communication, but not known to what extent
- In internal discussions and to order a follow up project with SD.
- In marketing. All sales people have the results & slides. But no training on it (which is a bad thing)
- Intended use in communication with authorities
- Little actual use, it was a go for the investment or not. Environmental considerations didn't play a large role
- No use
- Optimizations of own processes. Looking into the differences and make a strategy for the future.
- R&D part of study is used in internal discussions
- The results would be used in the discussions not how the results would be used.
- The intended use was known not specific outcome. Large influence since only reason not to choose Lignite was environment
- The main (environmental) issues were put on the agenda; Showed relevance of technology choice (economy & environment)
- They will use the results to increase the Eco-Efficiency of there products
- Used it as a basis of decision

III.III.VIII Results of project: Success factors use of results

Generalized results per project:

Project #	Use factor 1	Use factor 2	Use factor 3
1	Formal part of AR	Personal interest	-
2	Useful concept to look at things	Favourable results	-
3	Useful concept to look at things	Unfavourable or unclear results	-
4	Useful concept to look at things	Favourable results	-
5	Unfavourable or unclear results	Did not see use	-
6	Useful concept to look at things	Personal interest	Formal part of AR
7	Did not see use	Formal part of AR	-
8	Useful concept to look at things	-	-
9	-	-	-
10	Favourable results	-	-
11	Did not see use	Formal part of AR	-
12	Unfavourable or unclear results	Did not see use	-
13	Favourable results	-	-
14	Personal interest	Unfavourable or unclear results	-
15	Useful concept to look at things	Personal interest	-
16	Useful concept to look at things	Useful concept to look at things	-
17	-	-	-
18	Useful concept to look at things	-	-

Results per question:

Useful concept to look at things (9)

- The results were showed in a clear and simple way
- The customer thinks it is a good tool to use.
- Interest in methodology of customer
- They think it is a good way to communicate products
- (positive) Thought it would show the bigger picture with the wider picture
- Demands from their customers
- Show the bigger picture
- The awareness of the un-sustainability of their own energy intensive processes. Decide the best way for the future.
- Been involved in LCA, think it is useful to look from lifecycle perspective

Favourable results (4/18)

- The results were favourable to the environment. (didn't talk about the price of their product anymore)
- Positive results/confirm the expectations
- Results showed what they wanted to see
- Can make money by offering other products.

Did not see use (4/18)

- Not excited, just saw it as a diagram on a checklist.
- Support with what was already decided on
- No real interest from the people involved in the project
- Change of input data due to learning about own process for customer, therefore to late

Formal part of AR (4/18)

- AN demands to have an EEA as a part of the AR
- Positive: fact is was mandatory for AR
- Obligated part of the AR
- The AR is important and had a high profile, thus the results where important to the customer

Personal interest (4/18)

- Personal involvement of the people in the project and the insights they gained in their own processes
- Personal interest of DM in sustainability
- They have a long history of environmental awareness in the company.
- DM's personal interest in sustainability

Unfavourable or unclear results (4/18)

- Not useful results for marketing purpose
- No urgency regarding the use of the results
- The bigger picture was the EEA showed not much clearer
- How the results look like, would have been easier if the differences between alternatives were larger

III.III.IX Interaction with the customer in the SD-practice: motivation of clients

Generalized results per project:

Project #	Customer		Decision maker						Main contact person					
	Level	same as DM?	Level	Interest	Involvement	Knowledge own process	How did cooperation work	Comments:	same as customer?	Level	Interest contact	Involvement contact	How did cooperation work	Comments
1	sBU	no	BU	4	4	-	3	(Very) Low involvement	yes	sBU	5	4	4	-
2	BU	yes	BU	4	4	4	4	Very Interested	No	sBU	3	4	4	Interested / Involved
3	sBU	yes	sBU	5	2	5	5	Very Interested	no	sBU	4	4	5	A lot of knowledge
4	BU	no	BU	5	5	4	4	Very Interested	no	sBU	5	5	5	Interested / Involved
5	sBU	no	sBU	3	1	1	2	-	no	sBU	1	1	1	Lack of time/priority
6	BU	yes	BU	5	3	3	3	-	no	BU	3	4	2	Lack of time/priority
7	BU	no	bu	-	-	-	-	Don't know decisionmaker	no	sBU	4	4	5	Interested / Involved
8	sBU	yes	sBU	4	4	5	4	-	yes	sBU	4	4	4	-
9	BU	no	?	-	-	-	-	Don't know decisionmaker	no	sBU	4	4	4	Interested / Involved
10	BU	yes	BU	5	2	4	4	(Very) Low involvement	no	sBU	3	4	2	Lack of time/priority
11	board	yes	board	2	2	4	2	(Very) Low involvement	yes	board	2	2	2	-
12	sBU	no	sBU	-	-	-	-	Don't know decisionmaker	no	sBU	4	4	4	Lack of time/priority
13	sBU	no	sBU	4	3	3	4	Don't know decisionmaker	no	sBU	2	3	1	-
14	bu	no	bu	2	1	4	-	(Very) Low involvement	no	sBU	4	4	5	A lot of knowledge
15	BU	yes	sBU	5	4	2	5	-	no	BU	4	4	4	A lot of knowledge

16	sBU	no	?	-	-	-	-	Don't know decisionmaker	yes	sBU	4	4	4	-
17	sBU	yes	sBU	3	3	-	3	(Very) Low involvement	no	sBU	4	3	4	Interested / Involved
18	sBU	yes	sBU	4	5	5	4	-	no	BU	5	5	5	A lot of knowledge

Results per question:

Comments:

People who are customer

- HSE Manager
- Technology manager
- Production manager
- project leader

People who are Decision maker

- Management team
- The HSE / technology manager
- ultimately the board

Comments on scores decision maker:

Very Interested (3/18)

- Could not ask for better interest from customer. Lack time made sure that it took more time than expected
- Has worked with LCA for 10 years.
- Very interested in the study & methodology, also read articles about it

(Very) Low involvement (5/18)

- The contact was handed down to main contact
- He ordered the study but not involved during the project
- He was very busy and would change his position afterwards, which was not very good for project. (also left before final results where finished)
- Lack of time and knowledge about the data that was needed.
- The involvement was not very high, but the way that was expected

Don't know decision maker (4/18)

- Don't know who is the decision maker
- Not involved in EEA and not really interested. Just looked at money, results not so interesting, They thought that it is always cheaper in China (added scenario with increase raw material prices where this was not the case)
- No Idea (there was very little time with the DM) also not really clear what demands for AR are. What do they do with the EEA?
- Understood too late that he was the one using the final results.

People who are main contact

- Usually 1 or 2 people: Responsible & knowledgeable about the information mainly, reporting to managers

Comments on scores main contact:

Interested / Involved (5/18)

- Really interested in EEA, read everything send to him. Spend a lot of time on it.
- Good help, no problems or something like that
- Did all he could in the time he had available
- Didn't know anything about EEA, but where interested (especially in results)
- They where very friendly and really interested.

Lack of time/priority (4/18)

- Did not meet in person (except for main contact), did not really know what EEA was about. The data gathering took very long time since the data was not available, since all the decisions on technology had not been made yet.
- They had no one driving the project from their side, and they were not interested and the project was laid upon them. Expected analyst to take the driver seat and manage the project with a firm hand.
- Project took very long time. The questions were not answered in time. He was a very nice guy, but did not make enough time to do the work. He was not at the kick-off meeting
- Knowledge: they don't really know what is needed for the AR especially the EEA part. They look at SD for input. And accept what SD said and not able to ask the right questions to get the right information in the EEA.

A lot of knowledge (4/18)

- Good to have the first hand contact all the way. Worked out very well.
- Very well, knew everything about the site and had all the figures
- They were really interested. It was outside their normal work. Wanted to make a good impression
- Worked on LCA before, has all the knowledge and knows his way around environmental information and competitor's information. He was very important for this study.

Problems with person (2/18)

- 1x influenced the project one time it didn't

III.III.X Interaction with the customer in the SD-practice : Knowledge and understanding about EEA by clients

Generalized results per project:

Project #	Knowledge decision maker	Knowledge contact person	Understanding
1	4	2	good
2	3	2	good
3	4	2	good
4	4	5	good
5	2	1	very little
6	2	2	good
7	-	1	little
8	2	2	little
9	-	2	don't know
10	4	2	Complete
11	3	3	good
12	-	3	don't know
13	3	2	don't know
14	2	3	don't know
15	4	4	very little
16	-	4	good
17	1	2	little
18	3	5	good

Results per question:

Comments

- Not really. The people have very limited knowledge of what EEA and LCA specifically means. They usually either trust the results or try to understand them. Sometimes people think they can manipulate the results.
- They don't care as long as the big picture is good.
- Results were in themselves useless

- Weighting factors and EPS system complex. If you want to (really) explain this to the authorities you would need detailed knowledge
- There was no need to go into all the specifics of the EEA, since it is one of the factors for him (others for example being social, risk financial)
- The people in the project understood
- New decision maker during (end phase of) project. She has a better understanding.

III.III.XI Interaction with the customer in the SD-practice: Goals of the clients

Generalized results per project:

Project #	Main	Secondary	Goal	Achieved?	Goal	Achieved?	Goal	Achieved?
1	Strategy	Manufacturing	EEA for AR	Yes	Specific information	Yes	Specific information	yes
2	Manufacturing	Communication	Specific information	yes	Communication authorities	yes	-	-
3	Communication	Strategy	Communication authorities	yes	-	-	-	-
4	Strategy	Marketing	Specific information	yes	Strategic discussions	yes	-	-
5	Marketing	-	learn about EEA	yes	Marketing	no	learn about EEA	part
6	Strategy	Communication	EEA for AR	yes	-	-	-	-
7	Strategy	Manufacturing	EEA for AR	yes	-	-	-	-
8	Communication	Manufacturing	learn about EEA	part	Communication authorities	part	-	-
9	Strategy	-	Strategic discussions	yes	-	-	-	-
10	Communication	Strategy	Communication authorities	yes	Specific information	part	-	-
11	Strategy	Manufacturing	EEA for AR	yes	-	-	-	-
12	Strategy	R&D	EEA for AR	part	Specific information	yes	-	-
13	Marketing	-	Marketing	yes	-	-	-	-
14	Strategy	Marketing	Strategic discussions	part	Strategic discussions	part	-	-
15	Strategy	marketing	Marketing	yes	learn about EEA	yes	Strategic discussions	yes
16	Communication	-	Communication authorities	yes	-	-	-	-
17	Strategy	Manufacturing	learn about EEA	yes	-	-	-	-
18	Strategy	Manufacturing	Strategic discussions	yes	Strategic discussions	yes	-	-

Results per question:

Strategic discussions (7)

- Decision to continue or stop with the project
- Mainly need of general results as well for the long term strategy
- For R&D in the department
- See influence of energy prices compared to competitors processes
- Choice of investment in the technology
- Input for their future strategy in BU

- Learn about their value chains.

Specific information (6)

- Addition to offer for client for specific question regarding alternative
- R&D: better then competing product with same customer benefit
- Increase the knowledge of subsidy system around the world.
- Understand the different alternatives
- Look how good or bad Lignite actually is
- Compare the three alternatives of waste water treatment

Marketing (3)

- Marketing, Show environmental impact of product
- Insight in the use of EEA (for marketing purpose)
- Get info to use in marketing

Communication authorities (5)

- Discussions with authorities, teach them about life cycle thinking
- As a part of the permit study to the possibility of reducing COD output has to be made. This is part of that. The results where used in discussions with decision makers.
- Have arguments for authorities
- Communication with authorities
- Show Inadequacy (unfairness) of the subsidies

Learn about EEA (5)

- More knowledge on EEA
- Learn about EEA
- Spread knowledge in organization
- Have more knowledge about EEA and some argument in the discussions.
- Corporate said you must do an EEA

EEA for AR (5)

- EEA Diagram for AR
- Must have the EEA for the AR
- Eco efficieny for the AR
- Have material to put in the AR
- Get input for the Appropriation request

Why were the goals not / partly achieved?

- It was tricky to communicate the results. The method was still new. Combining environmental impacts with economic impacts is not always in the interest of the people focussing on permits and only want to decrease on their own goal.
- The results where not useable since there was no difference
- Scope of the study does not fit EEA very well. Results not really clear without interpretation
- Not all investment opportunities looked at could have been a broader view, so more alternatives. Also for R&D would have liked more alternatives.
- Subsidy system in Europe investigated no info about Asia
- Probably too late for the AR

III.III.XII Interaction with the customer in the SD-practice : Results for the clients

Generalized results per project:

Project #	result 1	satisfied	result 2	satisfied	Results as assumed?
1	Life cycle insights	yes	Specific results /information	yes	Yes
2	Comparison	yes	Specific results /information	yes	part
3	Specific results /information	part	-	-	no
4	Comparison	yes	-	-	part
5	Comparison	no	Life cycle insights	no	no
6	Specific results /information	yes	Specific results /information	yes	part
7	Specific results /information	yes	Life cycle insights	yes	yes
8	Life cycle insights	yes	Comparison	part	part
9	Comparison	part	Comparison	part	yes
10	Specific results /information	yes	Specific results /information	yes	yes
11	Specific results /information	yes	-	-	yes
12	Specific results /information	yes	-	-	yes
13	Specific results /information	yes	-	-	yes
14	Life cycle insights	part	Comparison	part	yes
15	Specific results /information	yes	Life cycle insights	yes	yes
16	Comparison	part	-	-	part
17	Life cycle insights	part	Life cycle insights	yes	part
18	Life cycle insights	yes	Life cycle insights	yes	Part

Results per question:

Comparison (8)

- Overview of the three alternatives & their EE.
- No difference between alternatives
- EEA comparison of 3 products
- Compare the three alternatives of waste water treatment
- Scenario 1 is a little bit better then scenario 2
- Overview of how their products came out compared to competitors.
- EEA comparison of the different alternatives.
- All alternatives were very much alike

Life cycle insights (10)

- Methodology not really applicable for case.
- Lignite is bad for the environment but cheaper
- The impact the application phase had on the lifecycle results.
- More knowledge about EEA and info for discussions.
- Influence of manufacturing is of minor role in the environmental impact. The application phase is most important'
- Decision makers found out information about their own processes
- Overview of exposure to energy prices of processes
- Will be used for make changes to increase the EE of the production
- Information for the strategy
- Insights in own production process & importance of raw materials

Specific results /information (13)

- The environmental aspects of the products were good.
- Information for the AR
- Product is good for the environment

- ERA & EEA update
- quantification of impact subsidies on material that was studied
- EEA diagram & text in AR
- Report the most Eco-Efficient solution
- Not in favour of plan
- Have arguments for authorities
- Check environmental impact of investment
- The economic benefits of the lignite alternative did not weigh up for the environmental disadvantage in this EEA.
- Report with an overview of subsidies
- EEA Manager with cost data for raw materials

Comments about the assumptions:

- They made assumptions that were wrong and thought that the scenarios would be the same, but the outcome of the result showed otherwise.
- They had thought about this already before a lot. They were sure that it would come out good. They didn't know that the application phase was so important
- Not so easy to get a clear answer on the question. They underestimated the effect COD would have on the waste water
- The results were so that their solution was not more energy efficient but they still presented their solution as more energy efficient
- Two alternatives, some people expected one, some the other, but they were happy with the results anyway since they viewed it as a learning process.
- Not so much assumptions, mainly to try EEA.
- It fulfilled their expectations after the first round of talks and discussions with SD regarding this project.
- Mainly as expected, some results where surprising.
- Didn't expect that one of their raw material based on a by-product would have an environmental load
- It was even better (more) then expected
- It supported the calculations made by other consultant

III.III.XIII Evaluation of the analysts : Knowledge and improvement options

Generalized results per project:

Project #	Knowledge processes	Involvement	Environmental analysis	Economic analysis		Comments
1	3	4	3	3	Environmental analysis	-
2	4	4	4	3	-	-
3	4	4	3	-	Environmental analysis	-
4	4	4	5	3	Weighting environmental elements	-
5	3	2	5	3	Project management	-
6	4	5	-	2	Economic structure, knowledge & vocabulary	Experience with EEA
7	2	4	4	2	Economic structure, knowledge & vocabulary	-
8	4	4	4	5	Environmental analysis	-
9	2	4	2	1	Experience with EEA	-
10	2	4	4	4	Specific customer information	-
11	3	4	5	3	-	-
12	2	5	2	2	Weighting environmental elements	Economic structure, knowledge & vocabulary
13	2	1	1	4	Project management	-
14	4	5	5	3	Economic structure, knowledge & vocabulary	-
15	3	5	2	2	Project management	Economic structure, knowledge & vocabulary
16	2	3	4	3	Weighting environmental elements	-
17	3	4	4	4	-	-
18	4	5	4	3	Economic structure, knowledge & vocabulary	Weighting environmental elements

Results per question:

Comments

Experience with EEA (2)

- Since it was one of the first projects performed by some analysts well as one of the first EEA studies by SD group, there where a lot of things to learn even though LCA was known.
- The EEA tool was not clear in the beginning, since it was one of the first times used this took a lot of time to figure out especially the manager. With a lot of checks and testing worked it out well in the end.

Economic structure, knowledge & vocabulary (6)

- Increase the knowledge in economic "vocabulary" & knowledge LCC.
- Learn more about mainly the financial things.
- The economic information could have been improved with the actual information and not just the relative differences
- Know more about terminology & know what data they need to provide. Ask for that in a structured and standardized way. And discuss it clearly with customer.
- Knew what was doing, but not full knowledge on (English) terms. Also discuss with customer in earlier stage, and talk open and clear about this topic.

- Learned a lot from working with external consultant. Much better now: more knowledge and more secure. Like to take some courses where you can learn more about the actual theory and the language that economics use. A standard approach for economic part to hold on to.

Project management (3)

- Learn more about handling difficult customers, learn more about project management
- Learn more about mainly the project management. Do that by working with experienced people in a project.
- Have better knowledge about what can go wrong in projects.

Weighting environmental elements (4)

- It would be good to have some more information on water emissions and the impact of water emissions in this type of study.
- Have a uniform weighting system, in SD where everybody is happy with and can be secure about.
- More knowledge and discussions about weighting.
- Difficulties with weighting.

Specific customer information (2)

- Knowledge: study chemistry. Was ok for the project, but communication would be better and more effective and get a better understanding of the consideration the customer has.
- (Production) Processes: very little time in project to learn that. Would be good for own security

Environmental analysis (3)

- A lot about water & COD. For more in depth question we would hire a specialist
- A better spread of plume model & the specific health issues related to ethylene
- Not a lot of experience in LCA at that time. Still putting the theory in practice (now, would rate good) (This had no influence on the final outcome however, as this EEA was straightforward)

IV Interviews with managers of Cellulosic Specialties

In this Appendix you can find the interview reports with the responsible managers of AkzoNobel sub Business Unit (sBU) Cellulosic Specialties (CS). The goal of these interviews was to get a good overview of the way goal setting works in a typical (s)BU.

Setup & Methodology

The interviews with the responsible manager of CS were conducted in two parts.

The first part of the interview has the goal to gain insight in the considerations that are used within Cellulosic Specialties to make decisions. This involves questions regarding the decision making processes as well as the goals and criteria that are used.

The second part of the interview will go into concept of Sustainable Development. This means some questions about the concept, your knowledge about it and the way you would like to see it being used in daily practice & the decision making process.

Interview 1 (15 -30 minutes)

The goal of the interview is to gain insight in the considerations that are used within Cellulosic Specialties to make decisions and identify possibilities to use Eco-Efficiency analysis.

This involves first of all questions regarding the decision making processes as well as the goals and criteria that are used.

Interview 2 (30 - 45 minutes)

Based on interview 1 we will make a (draft) scheme of the goals and criteria. We can discuss the scheme, and will serve as the basis for further discussion about Eco-Efficiency and the possibilities.

The results of the interviews is an overview per EEA application area

The full transcripts of the results of interviews can be found in the next 6 paragraphs. In these interviews the goal was to get a good overview on the actual decision making structure and the way goals are set and what the drivers are for decision making. It also serves as an example per EEA application area to understand how the decision making process works and what specific factors are important.

IV.1 Strategy within CS

Investigation to the goals for and criteria used in decision making

Results of two interviews with the responsible manager for strategy within CS

Conducted by Max Sonnen

AkzoNobel Corporate

The involvement of Corporate has demands in order to create value using all 4 drivers mentioned below. This is communicated through the Reforecast system, with a planning letter from the board that is used for goal setting in the whole organization.

Functional Chemicals

There is very much interaction. Mainly through budget talks, but also through regular contact by the CS manager. He is also in the MT of FC. Besides this, there is a yearly FC conference where 60 to 70 people participate. In this conference a lot of ideas and views are exchanged.

Cellulosic Specialties

The strategy of CS revolves around its stakeholders they are equally important in the sense that attention & effort has to be put in each of them and one cannot be seen without the other.

Together they are the main drivers in decisions & for changes. Therefore there are goals to manage all four categories:

- **Owner (Board of AkzoNobel as representatives of the shareholders)**

Have a good relation with the AkzoNobel Organization, where there is a good (long term) yield on the money invested.

- **Customers**

Listen to the needs of customers. Have a good long term relationship with customers and act on their questions, demands & complaints.

- **Society**

Work with the authorities and community, be aware of role and be a good (corporate) citizen

- **Employees**

Create a safe, pleasant & stimulating working environment

Goals

There are goals for the 4 drivers. The goals are decided on in the MT. These general goals can arrive bottom up, from within the organization, top down from Corporate or from developments outside the organization. Therefore there is a lot of communication with the employees before and after the MT meetings, to get input from the employees, or explain about the decisions that were taken. The (long term) goals are specified into (one year) action plans that describe the actual actions that will be taken to fulfil the goals. These action plans are usually yearly and are updated around the turn of the year. The score cards & bonuses are based on the goals.

The (formal) specification of the goals is closely linked to the budgets. This revolves mainly around the Reforecast system. Every quarter there is a (new) forecast for budgets and revised projections. For the reforecast rounds the AN Corporate organization makes a planning letter with the expected financial goals for Function Chemicals; this letter also addresses all important aspect of the operation of the business such as human resources objectives, safety targets, environmental impact guidelines, business principle compliance expectations, etc. They on their turn make their own planning letter for CS. This way the budgeting directions (and in that sense also the focus of the organization) come top down. This way the different goals are specified. The budgeting directions are specified by making the (planned) budgets. This (more or less) starts at plan level, with the highest level of detail, and is communicated upwards in the organization by combining it into the CS, FC & corporate budget.

Plant/Site Level

The plants have a representative in the MT (manufacturing). They do a lot of the work in the budgeting process.

Bonus system & motivation

The Bonus and motivation system that is in place is applicable for all managers within AkzoNobel; the other employees usually have group goals, with a collective bonus.

The (management) bonus system has three main elements:

- Own unit performance (in this case sBU, CS). This part accounts for ~50% of the bonus and it is measured with financial indicators.
- One level up performance (in this case BU, FC). This part accounts for ~20% of the bonus and it is measured with financial indicators.
- Personal goals. This part accounts for ~30% of the bonus and it is measured with non financial indicators.

The financial goals are based on the EVA (Economic Value Added) which starts with profits but also takes into account taxes to the corporation and the cost for the invested capital. The bonus is calculated based on the improvement desired versus what was achieved the previous year. For instance if 2007 EVA was 6 M€ and the desired improvement was 2 M€ and the performance at the end of 2008 is 7 M€ then the bonus is 50% which is an improvement of 1 M€ over the desired 2 M€.

The non-financial goals are mostly function related, so a safety manager could have a goal: 5% less (near) accidents compared to last year (or base year). These goals are agreed upon by the employee with his manager. Some are given to him, some are own interest of employee. Half way the year the goals are reprioritized, evaluated and sometimes adjusted if they are unfeasible or too easy. The main target is to have reasonable goals that are attainable so that they are motivating and give an extra drive.

In the case of the safety manager he could have the reward based on 5% less accidents. The amount of the bonus he will get is based on his review from his manager on that goal. So when he achieves a reduction of 4% he will probably still get a large share of the bonus.

The total share in the salary of the bonus is anywhere between 5% for managers in the sBU and up to 60% or 70% for the members of the board.

IV.II Manufacturing within CS

Investigation to the goals for and criteria used in decision making

Results of an interview with responsible manager for manufacturing within CS

Conducted by Max Sonnen

AkzoNobel Corporate

The AkzoNobel Corporate level is mainly involved in the strategic part of manufacturing: this means giving permission to large investments through the AR-process. They also ask to keep looking at the market, competitors and future developments. Have long term strategy and improve safety records, the yield and environmental parameters of the plants. Beside this they have requirements regarding the profitability and HSE.

Functional Chemicals

On the FC level there is a lot of awareness and there are a lot of discussions regarding environmental issues, sustainability and efficiencies. They also set specific goals, e.g. the improvement project roadmap to safety.

Cellulosic Specialties

Description: The sBU Cellulosic Specialties is the result of a merger between CMC & EHEC/MEHEC in 2003. The commonalities where cellulose being the main raw material handled and that the type of products and production processes have a lot of similarities. The manufacturing of CS takes place in 3 plants: in Örnsköldsvik (SE), Arnhem (industrialecology.nl) & Novara (Saling, Kicherer et al.).

Goals & drivers: The main drivers in manufacturing are safety, quality and the yield of the plant. Beside this a lot of goals are pursued in manufacturing. These goals are as we see often set by the different levels in the organization and have to be implemented in manufacturing, for example:

- Roadmap to safety
- Profitability requirements
- Meet AkzoNobel HSE requirements
- Meet legal requirements
- Production flexibility
- Reliable deliveries
- Quality/Reduce customer complaints
- Separate environmental targets per site
- Support community projects one per site
- Responsible care
- Process safety improvements

There is a large number of goals and to make sure that there is enough focus on all goals they work with the balanced score card model. The main and most important goal is to have a safe working environment for the employees.

On top of these goals there are a lot of requirements from the authorities regarding QHSE (Quality, Health, Safety and Environment) issues. These are mainly about safety and environmental issues. To fulfil these requirements investments are needed that don't directly increase the yield or profit.

Plant/Site Level

In the plants safety is the main factor. There is a need to investigate about how to further reduce the environmental impact in the long run.

Sustainability

The plants spend a lot of resources on regulatory requirements. The position taken from the plant can be considered as reactive since the demands from the authorities are high and investigations on how to further reduce emissions often are complex and very costly meaning requiring high investments. The awareness regarding sustainability is increasing but still very conceptual instead of practical. It would be good to make sustainability part of the day to day discussions, and take a proactive role. Find Eco-Efficient opportunities, so working on the profitability and environmental impact at the same time. For example alternative uses of waste streams & efficient use of energy and raw materials. Pick a few opportunities and set measurable targets for the future, so that the sustainability goals become visible and part of the day to day reality.

IV.III R&D within CS

Investigation to the goals for and criteria used in decision making

Results of two interviews with responsible manager for R&D within CS
Conducted by Max Sonnen

AkzoNobel Corporate

Corporate has an indirect influence based on the KPI's that Akzo sets for the sBU, like 25% of the Contribution Margin comes from products that have been developed in the last 5 years. Beside this there is a Multi BU R&D program that is focused on process development. This way the level of competence and knowledge base regarding processes within AkzoNobel is sustained at a high level.

Functional Chemicals

There is input in the KPI's from the budgeting procedure as input for the directions of R&D for the next year. Since the BU FC is very heterogeneous there is not a lot of overlap in research fields. The sBU's do share best practices and have brainstorming as inspiration for their own R&D.

Cellulosic Specialties

The R&D strategy is based on the CS strategy. From this the goals are: develop new markets, new products and support.

The R&D strategy is different for the different application areas of the products. The main goal is to have a good product portfolio in the application areas. This is the main goal, so if there is an inferior product or a new need on one of these areas then that will be the top priority. There will be a calculation on the project potential based on production (expected sales) volume, production cost and product price.

The services R&D provides are three different ones:

Programs: These are long term and focused on a development of knowledge in important application areas. This means mainly new products for new markets. These programs are guided by the (long term) R&D strategy of CS. The programs are paid out of the general R&D budget.

Projects: These are short to medium term R&D, focused on a specific commercial application, so to develop a new market for an existing product or a new product for an existing market. These are mainly driven by questions/directions from marketing and the GAT's (Global Application Team). The projects are paid out of the general R&D budget.

Technological support: This is specific support customers or to plants when they have a specific (R&D related) question. This is about existing products for existing markets. These services are sold on hourly basis. Beside this there is cooperation between the R&D departments of other (s)BU's in Akzo when they need specific knowledge that is available at CS. This way they learn from each other.

Sustainability is also an important issue. Sustainability is used in R&D; it is one of the criteria in the gates model that is used. So far there has been one R&D project that focused on a specific environment issue. This was for a product with tin in it. The tin was removed, this was even before there was a high demand for this product, but there was a clear improvement. On the other hand a lot of the R&D programs are focused on yield improvements (resources and energy use) which generally have a positive influence on the environment.

Plant/Site Level

The plants are involved in the later stage of the R&D. Every plant has its separate pilot plant, where new grades can be tested. They also run the full scale trials; to test that then can really produce the new product.

IV.IV Communication within CS

Investigation to the goals for and criteria used in decision making

Results of two interviews with responsible manager for Communication within CS
Conducted by Max Sonnen

AkzoNobel Corporate

The communication regarding: AN Brand image and information sensitive to the stock market and all communication with NGO's is handled by the AN communication department

Functional Chemicals

Functional chemicals has a minor role in (external) communications

Cellulosic Specialties

- **Internal communication**

Medium: Intranet, Quarterly meetings, Paper bulletin (site specific)

Strategy and Goals: Have a sustainable business, well informed and motivated personnel, of high importance for plants; (mainly focused on plant level); avoid spills and dangers to employees and immediate surroundings of plant.

The internal communication differs greatly around the world and greatly depending on the local company culture. For example in Sweden there is a lot of openness towards and communication with the employees, while in Asia and (south) America there is very little openness towards and communication with the employees.

- **External communication**

Medium: Internet, brochures and sales & present at industry fairs.

Strategy and Goals: The main goals for the external communications of the CS products are to sell the products and have a low exposure risk. The product brand names are promoted. Therefore no claims regarding the environmental performance of the products, although the end products are very clean (no REACH registration) especially compared to competing technologies. The reason is that the raw materials used in production are dangerous to handle and pollutants. This means that a small problem in the production or an accident at one of the sites (maybe even of competitors) could ruin the clean image and hurt the sales. To reduce the exposure to this risk the clean image is not promoted. Another reason not to promote the clean image / environmentally friendly image of the products is that survey of the customers have showed that the environmental image of the products is rated good, but the importance to the customers of that image is low.

Also CS has an active role in CEFIC an industry organ, Cellulose ethers group where a more proactive role is chosen, which resulted in environmental evaluation and explosion risk study of the products, industry wide.

Plant/Site Level

Very good relations and open discussions with mainly local authorities and regulators, as a chemical company this is often also required by law. Regulatory issues dealt with almost 100% locally with long lasting relations. Demands differ for different locations; there is no need or benefit for standardized approach for all sites. An active place in local community: have open days, have communication letters. There are environmental reports available for the different plant sites.

IV.V Supply chain within CS

Investigation to the goals for and criteria used in decision making

Result of two interviews with responsible manager for Supply Chain within CS
Conducted by: Max Sonnen

The supply chain is divided in two sub-categories: Transport & Supply

Transport

AkzoNobel Corporate

No direct involvement in transport, but initiates through the NPR (Non Production Related) program cooperation between BU's

Functional Chemicals

A lot of the guidelines that are used in CS are made on FC level, based on the demands of CS. Choice of transporters is based on economics and on the HSE evaluation. Where environment is high rated ~25%

Cellulosic Specialties

Upstream transport, materials to the plants: a lot of dangerous chemicals, so a lot of rules and regulations, Goals reduce the risks. Long term plans to reduce the risks.

Downstream transport, products from the plants: non dangerous chemicals. Easy to handle: pallets in containers.

Plant level

No major involvement in transport purchasing

Supply

AkzoNobel Corporate

Corporate is involved in purchasing of Non Production Related goods. These are centrally purchased and agreements are made for whole regions.

Functional Chemicals

A lot of the guidelines that are used in CS are made on FC level, based on the goals and demands of CS. FC has a central purchasing function, which on behalf of CS buys the main raw materials and packaging

Cost is the main driver in the decision of the raw material supplier. This means, **the actual costs** to use a certain raw material build up by:

Price

Transport cost

Environmental cost

Other elements that increase cost to use

Other driver is **availability of materials**: Goal is to have 2 suppliers of the main ingredients preferably in different currency areas.

Business ethics: The raw material supplier should comply with their authorities, also no child labor etc.

HSE issues: There is an environmental check.

Cellulosic Specialties

The responsibility for raw materials, transports and packaging at CS level is given to the GSS (Global Strategy and Support) manager who together with FC purchasing sets strategies and goals. The execution is the responsibility for the latter.

The purchasing of raw materials done at plant level is all reported (is done on CS level and plant level, but everything is reported) in the same system, therefore it is possible to get a complete overview of all the flows in the plants.

Responsibility of CS regarding HSE & Business ethics:

1st level (supplier of CS) Responsible for actions supplier (Active involvement)

2nd level (supplier of 1st level) CS pay attention to development (Passive involvement)

3rd level (supplier of 2nd level) CS has no opinion (unless crisis) (no involvement)

Plant level

(Most of the purchasing is done on CS level) (See above) Some site specific purchasing is done on plant level mainly spare parts and specific (low volume) ingredients. The HSE requirements for suppliers on plant level depend from site to site and are left to the sites.

IV.VI Marketing within CS

Investigation to the goals for and criteria used in decision making

Results of two interviews with responsible manager for Marketing within CS
Conducted by Max Sonnen

AkzoNobel Corporate

There is no involvement in Marketing and Sales

Functional Chemicals

There is involvement through general train programs like margin management and commercial excellence, but not on the specific sales strategy.

Cellulosic Specialties

CS is selling its products business to business. The market of CS consists of three geographical regions: EMEA, America and Asia. There are sales managers covering different markets, and they also work with agents distributors for markets without an own sales force. Depending on the application type there are a handful customers (mining) or hundreds (paint & food).

Medium: The work with exhibitions, and in new markets (for example, Asia and Eastern Europe) also with seminars and conferences (to teach the client where and how to use the CS products).

Strategy and Goals:

The goal is to increase sales, mainly by growing in the new markets and, have consolidation with some growth in Europe & America.

The goal sell product in a profitable way. While the main targets used to be focused the volume, there has been a shift to the general margin. This way the actual profit can be increased even when the sales do not increase.

There are no general marketing strategies; it depends on the customer, application area and region. Often there is a close cooperation with the customer on specific product grades, to improve the performance of the product so that it works better in their formulation. In the paint business this is difficult since AkzoNobel is a big paint producer and other paint companies would be reluctant to hand over information.

Depending on the application area the discussion and main topics are very different. In general Sales people don't really talk about sustainability /environmental aspects of the products (other then the fact that there is no Reach registration and the product is friendly to handle).The sometimes get requests for information but it is not part of the daily discussions. It is good to be prepared for the future though, since the trend is that this will become more important.

Regarding HSE issues the topics of discussions are very different, a few examples:

In pharmaceutical application the HSE issues play a big role, therefore there is a very close cooperation between the customer and CS. In paint there was a shift from mainly solvent based paints to more water based paints during the last years. While in building the where no real discussions about the environment.

Plant/Site Level

There is not a huge involvement from the plants. Marketing has used some brochures, that where made at one of the plants for the community, to show to their customers.