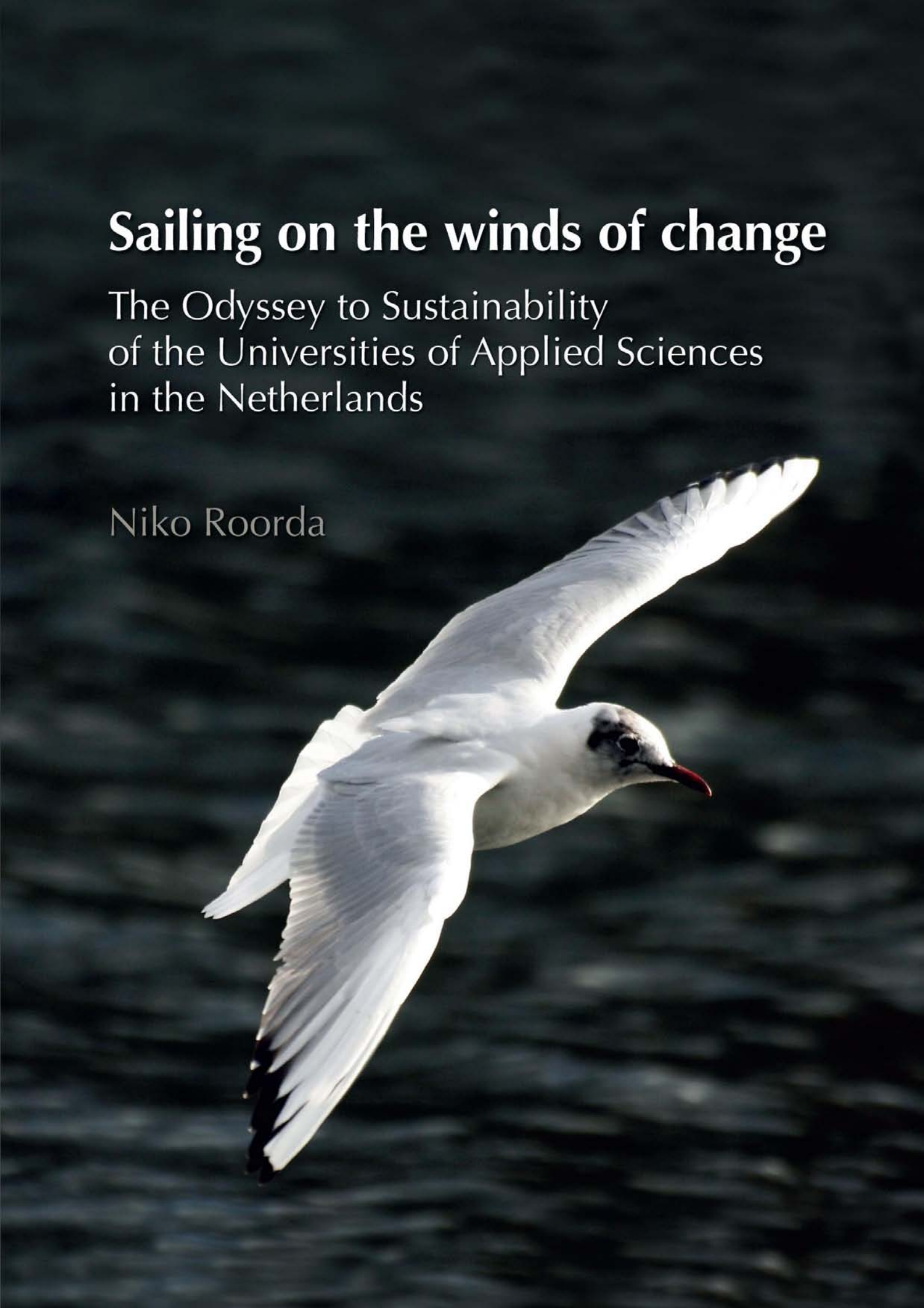
Sailing on the winds of change

The Odyssey to Sustainability of the Universities of Applied Sciences in the Netherlands

Niko Roorda



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This PhD research was carried out in cooperation with the International Centre for Integrated assessment and Sustainable development (ICIS), Maastricht University

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PROEFSCHRIFT
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aan de Universiteit Maastricht
op gezag van de Rector Magnificus,
Prof. mr. G.P.M.F. Mols
volgens het besluit van het College van Decanen,
in het openbaar te verdedigen
op donderdag 21 oktober 2010 om 14.00 uur
door

Niko Roorda

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Summary

Sustainable development cannot be thought away anymore from society. It has become a major process giving shape to the future of mankind and of our planet. Education has to contribute to this process in a major way, as it builds this future as no other sector of society. The central question of 'Education for Sustainable Development' (ESD) is: "Which strategies can be used in order to make education contribute effectively to sustainable development?" The present PhD study is an attempt to discover fruitful strategies for ESD.
In thcourse of the dissertation, a hypothesis will be tested, stating that a successful strategy is one of 'sailing on the winds of change', i.e. following and using change processes that are already occurring in higher education, on condition that such change processes do occur, and are heading in a suitable direction.

In the last decades, the subject of ESD has become a new field of scientific study, which is described in **chapter 1**. It makes use of recently developed or improved methods and paradigms of science like case study research, action research, mode-2 science, postnormal science and transdisciplinary research. Together they form the fundament for the research that is presented in the dissertation. An important principle of case studies is that of 'triangulation', which enables the researcher to combine empirical information from different kinds of sources. This principle will be used intensively.
The research was indeed an action research, performed as a chain of case studies that took place between 1991 and 2009. All of them followed the above strategy of 'sailing on the winds of change'. Some of them were more successful than others. In order to understand the successes and failures, several theoretical models are used that describe change processes. The main models for this research are: a model by Sterling for the level of change; a model by De Caluwé & Vermaak for the types of change processes; and a model by Bridges describing the natural development of organizations.

Chapter 2 describes the concept of sustainable development, defining and describing it in a way that is sufficient for the purposes of the present research. The impact of education on sustainable development is discussed, both on a global scale, including the United Nations Decade of Education for Sustainable Development (DESD), and in the Netherlands, including the Dutch national strategy for sustainable development. The inverse, i.e. the impact of sustainable development on education, is studied in some detail, as this impact is essential for the research presented in the dissertation. Several sources in the literature are consulted, among which Agenda 21 and a series of publications by ESD investigators, which leads to an overview of characteristics that are typical for education that effectively contributes to sustainable development. This overview is used throughout the dissertation as a checklist in order to assess a main aspect of the several experiments.

Chapter 3 is dedicated to the selection of the field of study. This is the sector of HBO ('Hoger Beroepsonderwijs'), the sector of Dutch Universities of Applied Sciences, which forms about two thirds of all of higher education in the Netherlands. In the last two decades, the same period in which the chain of experiments of the present study took place, this sector has gone through a series of intense change processes. These processes are described briefly in chapter 3, as they will be described in more detail in the later chapters.
Next, chapter 3 describes the experiments that were performed. Five of them have been completed, each lasting on average about four years. Three more experiments started only a few years ago, and they are not yet finished.
The chapter ends with a description of the way in which the results of each of the experiments is systematically assessed. A series of success criteria is developed that is used for all experiments, and it is proved that these criteria together meet the demands of validity that the applied type of research requires.

The next five chapters each are dedicated to one of the completed experiments. They all have the same structure. In the first of them, **chapter 4**, first the context is described in which it took place, i.e. the change processes within HBO that occurred at that time, e.g. a wave of mergers between HBO institutions, and an avalanche of new study programs. In this context, a suitable ESD strategy was followed between 1991 and 1994, i.e. the development of an entirely new study program dedicated to sustainable technology in a University of Applied Sciences in the south of the Netherlands. Its philosophy, its development and the resulting curriculum are described in the second part of chapter 4, followed by an assessment of the results, which finally leads to a conclusion about the strengths and weaknesses of the used ESD strategy.

The second experiment took place in a context in which a range of new educational methodologies made its entrance in HBO, e.g. problem-based learning and project education. The focus of the second strategy, described in **chapter 5**, is the application of such methodologies for the purposes of ESD. For this goal, the study program that

was described in chapter 4 was redesigned between 1994 and 1998, trying to realize goals like: more active attitudes of the students, and a more multidisciplinary curriculum. Again, after a description of the context and the redevelopment of this study program, the results are assessed, and conclusions are drawn about the effectiveness of the followed strategy.

Chapter 6 describes an experiment in which an attempt is made to integrate sustainable development within the 13 study programs of a Faculty of Technology, most of which paid no or hardly any attention to sustainability-related aspects until then. This was an ESD strategy that made sense at that time, 1998 – 2002, as efforts were made to restructure HBO and decrease the number of study programs, in order to improve the clarity and the quality. The Cirrus Project was supported by a range of companies, national and local government organizations, ngo's, and by the HBO Council, i.e. the association of HBO institutions. Just as the former chapters, the successes and failures of the experiment are assessed using the management theories described in chapter 1.

In **chapter 7** the development is described of an instrument to assess the rate of success of the integration of sustainable development into the curriculum of study programs, in a quality management style. The instrument, 'AISHE', was developed in 2000 – 2001. Between 2002 and the present, it was applied through a consultancy offered to the Dutch universities by DHO, the Dutch Foundation for Sustainability in Higher Education. Based on AISHE assessments, a Certificate of Sustainability in Higher Education is awarded to successful study programs or university departments. The policies and methods of this consultancy are described and assessed. A fundamental principle, 'system integration of sustainable development' (SISD) is defined and made operational, after which case studies are used to prove that SISD is achievable, and indeed has been achieved.

The experiment of **chapter 8** took place in a context in which HBO was part of an internationalizing higher education, e.g. the Bologna process, with more and more flexible learning routes, and with an increasing role of ICT. As investigation showed a need for educational materials about sustainable development, a strategy was followed in which an instrument was developed for the introduction of sustainable development, both for teachers and for students. The core of the instrument is a study book called 'Basic Book on Sustainable Development', which was published in 2006. Besides, a range of other tools have been developed, all available through a website. The SD introduction instrument has been applied between 2006 and the present in HBO institutions, and the extent to which it satisfied the needs of teachers and students is assessed.

Chapter 9 describes the three experiments that are being performed at present. The structure of this chapter differs from the earlier ones, as no result assessment is yet possible, and so no conclusions are drawn.
Again, first a description is given of the context, i.e. of a relevant change process. In this case, this was the introduction of competence based education.
The first of the three unfinished experiments concerns the design of an instrument for the development or improvement of the competence profile of a study program from a sustainability perspective. The 'SD Competence Cards' are based on a model for sustainability competences called 'RESFIA+D', which is described in a book that was developed for this goal.
The second current experiment focuses on the curriculum contents. The 'SD Curriculum Scan' is used by educational developers to compare a curriculum with a list of themes and subjects, enabling them to discover strengths, weaknesses and 'white spots' related to sustainable development.
The final current experiment describes the redevelopment of the AISHE assessment instrument, this time by an international team. The aim is to expand the field of investigation of AISHE, which in its first version focused on the educational role of a university, to the other roles: research, operations, and community activities.

In the final **chapter 10**, all lines come together. The first section has an analytical character, as the various experiments are compared, trying to draw some general conclusions about why certain strategies were successful and others were less so.
The second section brings a full synthesis of all results, based on a 'grand triangulation'. Here the conclusion is drawn that each of the development processes in HBO in the last twenty years, when taken separately, were no more than an accommodation or a reformation process; but nevertheless, together they form a coherent and deep transformation of higher education. However, until system integration of sustainable development (SISD) is realized throughout HBO, this transformation will be incomplete.
Based on the conclusions about whether or not the various applied strategies of the PhD research were successful, the final question will be answered with the conclusion that the basic principle behind all experiments, 'sailing on the winds of change', was indeed proved to be successful.

1. Introduction

In chapter 1 of the dissertation, the characteristics of the research are described. The central question of ESD (education for sustainable development) is introduced, and the scientific theories are described on which the research is based.
For the time being, basic concepts like 'sustainable development' will be used without explanation, as they will be described in some detail in chapter 2.
Preliminary remark: The research described in this dissertation was performed as an action research, in which the PhD candidate actively participated (see §1.4.2). Wherever it is relevant to describe this participation, the PhD candidate will be referred to in the 3rd person, i.e. as 'the *researcher*'.

1.1. Strategies for the development of Education for Sustainable Development

Since the introduction of the concept of 'sustainable development' in 1980 (IUCN et al, 1980), the concept received major attention in 1987 with the so-called 'Brundtland Report' (WCED, 1987) and the first massive sustainability conference in Rio de Janeiro in 1992. Soon it became clear that sustainable development was a very important, arguably the most important program for governments, intergovernmental organizations, non-governmental organizations, local communities, companies and indeed for society as a whole.
One of the vital contributions to sustainable development is to come from education, as was formulated explicitly in 1992 in Agenda 21, offspring of the Rio Conference. The question of how to realize this contribution however is a complicated one. As a consequence, a new field of study has arisen in the last decades, called 'Education for Sustainable Development', or ESD for short.
The central question in the study of ESD may be formulated as:

How can education contribute effectively to sustainable development?

In order to make this question more operational, it can be rephrased as:

Which *strategies* can be used in order to make education contribute effectively to sustainable development?

The current study was performed with the aim to find answers to this question through the application and evaluation of a number of strategies in a series of experiments.

Suitable strategies can be classified in several ways. One way is, to discern the development of new education from the adaptation of existing education.
Another way is to look at the level at which the education is seen, as is shown in figure 1: a simple four-layer model of education.
Combining both views delivers a useful classification of possible strategies. Table 1 shows a number of possible strategies for ESD development, without trying to be complete.

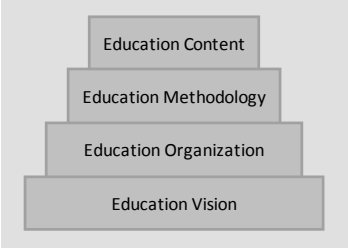


Figure 1. Four-layer model of education

Table 1. Examples of strategies for ESD development

Layer	Develop new education	Change existing education
Education content	• Develop new study program →*X1*	• Integrate SD in study programs →*X3* • Develop education materials →*X5*
Education methodology	• Design new methodology	• Introduce methodologies →*X2* • Introduce Competence Based Learning →*X6, X7*
Education organization	• Design new organization structure	• Relate SD to quality management →*X4* • Introduce interdisciplinary learning
Education vision	• Found new institution	• Redefine institution mission →*X8*

In the course of the research program, between 1991 and 2009 a series of experiments were performed, each focusing on a strategy that is mentioned in table 1, indicated as 'X1' till 'X8'. The numbering of these experiments is in accordance with their chronological order.
The experiments were:

Experiment #1: Development of a new study program on sustainable technology (1991-1994).
Experiment #2: Reformation of this study program, using a selection of educational methodologies (1994-1998).
Experiment #3: Integration of sustainable development in a range of existing study programs (1998-2002).
Experiment #4: Development and use of a system for the assessment and certification of sustainable development in study programs (2000-2009).
Experiment #5: Development and use of an instrument for the introductory of sustainable development, consisting of a book and a series of online accessories (2004 – 2009)
Experiment #6: Development and use of a set of competences for sustainable development, and of study materials consisting of a book and a series of online accessories (2007 – present)
Experiment #7: Development of an instrument to assess a curriculum regarding its sustainability related contents (2007 – present)
Experiment #8: Redevelopment of the assessment & certification instrument to encompass all roles of a university (2007 – present)

Each experiment focused on one or two questions, which are aspects of the central question of ESD:

1. ***New study program:***
   Can education contribute effectively to sustainable development through the development of a separate study program dedicated to (main aspects of) sustainable development?
2. ***Educational methodologies:***
   Can the contribution to sustainable development of an existing study program be optimized through the introduction of a carefully selected range of educational methodologies?
3. ***Reformation of existing study programs:***
   Can existing study programs, not yet giving much attention to (aspects of) sustainable development, be reformed in order to effectively increase their contribution to sustainable development?
4. ***From individual initiatives to mainstream through quality management:***
   Can sustainable development become a part of the mainstream of the educational processes in a university, implementing system integration of sustainable development?
   Can a quality management approach contribute effectively to this system integration?
5. ***Introduction to sustainable development:***
   Can an instrument be developed for the introduction to sustainable development that is applicable in study programs of many different educational sectors?
6. ***Competences for sustainable development:***
   Which competences does a graduate need in order to contribute effectively to sustainable development?
   Can such competences be realized in the curricula of the study programs?
7. ***Sustainable development Curriculum Scan:***
   Can a set of sustainability-related subjects be designed that is applicable to study programs of many disciplines as a checklist for the curriculum, in such a way that each discipline can put its own weights and preferences, making it fit to their needs?
8. ***Integrated assessment instrument:***
   Can an integrated quality management approach be applied to the education, the research, the operations and the societal activities of a university in a coherent way?

For the first five of these questions, the answer will not just consist of a simple 'yes' or 'no', as every time the conditions will be evaluated that appear to be influencing the rate of success.
The questions 6 till 8 cannot yet be answered, as the experiments are still going on.

Reasons for the selection of the experiments
Table 1 shows that, out of several possible experiments, based on a range of ESD strategies, eight experiments have been selected, and other possible experiments were not. Several reasons existed for this selection.

First of all, the experiments were selected simply because the opportunity existed to perform them. Some of the experiments that were not selected, although being theoretically possible, were beyond the practical possibilities that were available. A clear example is the option of founding a new educational institution.
But there were other reasons as well. As the consecutive chapters of the dissertation will show, the realization of each experiment lead to new questions and challenges. These invited in a natural way new experiments. As a consequence, the eight experiments together actually form a chain of research with a logical development through the years. In the final chapter this development will be analyzed.
This natural development was strengthened by the developments within HBO, the sector of higher education in which the experiments took place (as will be explained later). Each of the experiments made use of the developments that occurred at that time, as will be described in §1.2.

1.2. Change processes

From table 1 it is clear that almost all experiments aimed at changing the existing education, instead of developing new education. There is a good reason for this. ESD development might focus entirely or mainly on developing new education, if education in most places was completely absent. All over the world, however, all kinds of education already exist, and so the space for a 'clean installation' of new education is very limited. Consequently, the main task of ESD has to be to change the existing education.

1.2.1. Resistance to change

The disadvantage of this focus is clear, however. In many cases, changing existing structures and methods is much more difficult than developing entirely new ones. Changes will raise all kinds of resistances, based on vested interests, long-term investments, habituation, fear, etc.
This is all the more true when complex structures have been built. For the field of ESD, this is especially relevant, since on the one hand sustainable development itself is a field of study that is complex by its very nature (as will be discussed in the next chapter), while on the other hand the systems of education are also highly complex. So, it is no surprise that ESD development appears to cause many barriers and resistances.
In his work as a consultant for higher education institutions, the *researcher* met a wide variety of these barriers and resistances. Box 1 shows some of the reactions that were received by the *researcher*, each of them several times, in the period of 2000 till 2009.

Box 1. Sixteen reasons *not* to integrate SD in higher education

The concept:
"I don't understand the concept of SD, it is too vague."
"SD is a container concept, it explains nothing."
"SD is not a scientific concept, so education or research in it at a scientific level is impossible."
"SD is a political concept, so it should not be a part of a university curriculum."

The power:
(Board member:) "I am in favor of SD, but my middle managers think differently."
(Middle manager:) "I am in favor of SD, but it is against the vision / strategy of the Board."
(Middle manager:) "I am in favor of SD, but my teaching staff does not support the idea."
(Teaching staff:) "I think SD is important, but my manager does not give me any support or facilities."

The priority:
"SD is not relevant for my discipline / program / faculty / school."
"The curriculum of my discipline / program / faculty / school is too full already."
"This is a bad time to start with SD: presently we are in the middle of a change process."
"This is a bad time to start with SD: presently we are not in the middle of a change process."

Every day life:
"I don't have the money to invest in SD at the moment."
The staff is too busy with other things."
"Too many staff members are ill / absent at the moment, and there are vacancies too."
"The national / sectoral regulations for the education in my discipline / program / faculty / school limit my options."

Source: private conversations with the *researcher*

Many of these and other reactions are illustrated by Peet & Mulder (2002), who gave an overview of problems and resistances they met in their efforts for ESD in the Delft University of Technology:

Barriers between departments:

> "In the university organization with its sharp divides between departments and sections, the various courses are 'owned' by the separate units. Changes in curricula affect the balance between these units. Integrating SD into a course is therefore tricky: it might trigger discussions regarding credit points of courses etc. that are hard to solve. To avoid the risk of internal conflict and the extra costs of changes, departments are generally very reluctant to change curricula. Moreover, the teaching staffs of the university hardly have the means to improve the quality of the course that they offer."

Academic independence:

> "University lecturers are expected to be specialists in their discipline. They are supposed to be active scientists, working on the scientific frontline. The scientist can only make his own choices and only needs to take into account the remarks of (more senior) colleagues. This implies that disciplinary divides are perceived as essential, as they determine who is allowed to be involved in discourses on specific subjects. Interdisciplinary work is only perceived as important for applied projects, not for scientific progress as it does not contribute to the conceptual core of the discipline. This creates a barrier for the introduction of sustainable development in the academy."

The personal pride of the expert when dealing with staff development on SD:

> "When a specialist in sustainable development tries to teach a scientist about sustainable development and how it should be integrated in his discipline or his courses, the typical academic lecturer resists. (…) The general attitude is that the scientist is the specialist and that he or she does not accept training regarding his own discipline by someone who is ignorant of his or her discipline."

The perceived vagueness and unquantifiability of the SD concept:

> "Engineers tend to consider only those aspects as worthwhile that can be included in the 'program of demands' for a design. Designs should therefore not only be cost efficient, long lasting, safe, etc. but also sustainable. However, very often SD questions the design as such. The question then is not whether we should design a sustainable tyre, but what a sustainable transport system should look like. Another point is that in order to be included in the program of demands, SD should be quantifiable. Only in that way, it can be optimized vis-à-vis other demands. However, no SD indicator exists, and it is highly questionable if such an indicator could exist at all. If it turns out that SD cannot be included in the program of demands for a design, SD is often considered to be too vague. Normative aspects cannot be dealt with in the clear-cut way that engineers deal with problems. Therefore, these issues are generally regarded as only of interest for politicians, not for engineers."

A monodisciplinary vision on SD:

> "Scientists and lecturers often interpret sustainable development too narrow. Without interaction with an SD specialist the interpretation of the concept is often too specifically focused at only one of the three elements of SD, mostly the environmental aspect in the case of technical disciplines. Although we do not want to deny the value of this work, examples of this narrow focus can be found in various works on ecodesign, emission control technology (sometimes only preventing emissions by creating different emissions)."

Other causes and examples of resistances to change towards sustainable development are discussed by Lozano (2006), who describes a relation between them and the well-known Maslow Pyramid (Maslow, 1954), and by several authors in Holmberg & Samuelsson (eds., 2006).
A recent international investigation into successes and failures of the development and implementation of ESD showed that nothing much has changed over the years. The following remarks were made:

Spain (Benayas et al, 2008):

> "The biggest handicap is the traditional resistance to change in HE institutions and the high degree of 'irrationality' in the decision-making process in discussions on curriculum (re)design, based ultimately on the curriculum as a tool of power in the university structure."

Sweden (Djurberg et al, 2008):

> "There is no clear definition of SD and there is a discussion about if and to what degree the content can/should be replaced by approach and attitude. This highlights the different traditions and approaches in different disciplines. (...) SD is seen especially by many representing social sciences as a political buzz word and ESD as a political decision without any real life bearing. There is also an idea that the content of education as well as that of re-

search must not be regulated by political decisions and that they must be assessed within science. (...)
Another problem is to assess the students in an examination regarding their competence of SD. Future teachers are expected to have good knowledge and understanding of SD since they will have to be able to teach it further to their students, but they tend to choose other, more important courses when SD courses are optional. (...)
The requirement to integrate several perspectives, for example equality and internationalisation in university education, now including sustainable development, is also a problem. But the possibility of including different perspectives under the SD umbrella is also brought up."

England (Scott & Sterling, 2008):

"Over the last decade, in some respects, quite a lot has been done and achieved, not only in relation to research and development, advanced courses spinning off from this, and undergraduate courses incorporating a range of sustainability issues because of internal interest and external accreditation requirements, but also in relation to environmental management (estates, transport, energy, waste, etc). But, if we examine the extent to which [higher education institutions] have actually reoriented themselves such that environmental and sustainability issues now pervade the vision, ethos, thinking and work of the institution, then the conclusion probably has to be that very little has happened in most cases. "

Belgium (Rottiers, 2008):

"The Flemish higher education is often implementing ESD in its curricula without yet being recognised as such. (...) ESD is still too frequently limited to environmental issues."

Germany (Michelsen & Adomßent, 2008):

"Even when the choice of study options appears to be relatively broad in quantitative terms, there are still few courses that can be characterised in terms of higher education for sustainable development. At the same time, there is a lack of further training options for teaching staff, without which they are unlikely to be capable of taking on the particular challenges of a sustainable learning culture. The fact that responsibility for education policy lies in the hands of the various federal states is hardly propitious to the creation of a unified strategy for a more thoroughgoing integration of sustainability at HE institutions."

Netherlands (Heideveld et al, 2008):

"A teacher says 'yes, it is very important, but I think you can better ask my colleague'. The colleague says 'yes, but I want to have a confirmation of my board. Do they really think this is a priority?' The board wants to know if it is a priority in the ministry (money…). And the Minister says 'the universities and the teachers have to do it themselves. I cannot set priorities'. Everyone agrees, no one is doing something. (...) Every level (board, ministries, teachers, students) has its own reason not to act."

All these problems don't imply that there are no successes. To the contrary: much has been achieved in many universities and countries. What it does mean is that, in order to be successful, it is vital to use clever, well-chosen strategies and policies.
And so, a key question is: what kinds of strategy are possible, and what can be expected of their effectiveness under various circumstances?
This question leads to the hypothesis of the dissertation.

1.2.2. Hypothesis for a successful strategy: Sailing on the winds of change

Roughly speaking, two strategies for ESD development and implementation can be discerned. One is: trying to actively change the education within the universities in a desired direction, e.g. through the use of power or negotiations. This may probably even mean: going beyond the individual universities and trying to change higher education altogether. This would mean a major operation.
The other strategy is: following and using the changes that already occur. This is only possible if such changes do occur; if not, only the first strategy remains. But if a certain sector of higher education is indeed involved in intensive processes of educational and organizational innovation, these processes may be utilized as a kind of 'hitchhiking' for the integration of sustainable development into education. A logical condition is that those innovation processes head in the direction that sustainable development needs. A mix of both strategies may be possible.

On the whole, the major distinction between the two approaches is that the first one implies a confronting role within higher education, a role which means a fight against the existing structures, methods and interests. The second strategy is much less of a threat to the existing situation. This second strategy, following and using the occurring change processes, obviously has several advantages. As it follows the spirit of the time, support may be gained easier, and less resistance may be raised. If applied cleverly, the already occurring change processes may be influenced

and adjusted, in order to enlarge the chances for the integration of sustainable development. And it may be less expensive in terms of time, effort and money.
There may also be some disadvantages to the second strategy. The major risk is that the occurring changes are too small or too insignificant, or are leading in the 'wrong' direction, being not in accordance with the needs and demands of sustainable development. And so, whether the second strategy can be effective, depends on the circumstances.
Roughly speaking, the two strategies may be described as 'revolution' and 'evolution', respectively. The second strategy may be compared with a Chinese principle, derived from Taoism. It is called "wei wu wei". The principle was described as follows:

> "Enough support. When the time is ripe. Those are essential demands to realize major societal changes in a peaceful way. A Chinese expression exists that expresses these demands in a peculiar way: *Wei wu wei*. This expression may be translated as: 'Doing without doing'. This sounds contradictory, but it is not, because the two words 'doing' have a different meaning. The first 'doing' stands for: act effectively, really get something done. The second 'doing' means: take action, force, push through. (…)
> Doing without doing is like swimming in a river with the flow, and not against or perpendicular to it. It may also be compared to pushing someone sitting on a swing. If you do this just at the right moment, it is possible with repeated small pushes to make the swing reach great heights. This is doing without doing. But if you push at the wrong instant, e.g. when the swing approaches you full speed, then you will only break the speed while simultaneously risk breaking your arms." (Roorda, 2007)

The second strategy may, under the right circumstances, be much more effective than the first. It may be described as 'sailing on the winds of change'. As it is the leading strategy that has been used for all research described in this dissertation, it has been selected as the title of the dissertation.
Consequently, the central hypothesis for the dissertation is:

> ***A strategy of 'sailing on the winds of change', i.e. adapting to and using already occurring processes of change in the field of higher education, will under suitable circumstances be highly effective for the process of integration of sustainable development in higher education.***

This strategy can only be successful if those suitable circumstances can be found, i.e. if a section of higher education can be found which has the necessary characteristics of a long-lasting, profound process of change. And so, the selection of a suitable section, as a field for ESD research, is essential.
A sector clearly meeting this requirement is the higher education of the Dutch Universities of Applied Sciences (in Dutch: 'Hoger Beroepsonderwijs', HBO). In a period of more than twenty years, a series of adaptations and innovations took place in this entire sector, which makes up about two thirds of all higher education in the Netherlands. Chapter 3 will describe the sector and its change processes, and offer more reasons why this sector was selected as the field of study for the research.
In the course of the research program, which took place between 1991 and 2009, a series of experiments has been done, each lasting on average about four years. Each of these experiments was inspired by, and made use of one or more innovations that at that time took place in HBO. So, the story of HBO in the last decades forms the backbone for the story of the ESD research program described in this dissertation.
In table 1, a range of possible experiments was mentioned. Some of these are in accordance with the first strategy that was just described: trying to change education without making use of the already occurring change processes. However, all experiments that were selected match with the second strategy. This is the meaning of the title of the dissertation: all experiments 'sailed on the winds of change' in HBO.

1.3. Theories of change

Many theories have been developed in order to describe and understand change processes in organizations or systems of organizations. Some of these theories appeared to be of great value for the evaluation of the successes and failures of the various experiments that were performed. These theories will be described briefly in this section.

1.3.1. Levels of change: the Sterling approach

The difficulties in trying to change existing education depend (partially) on the desired level of change. Such levels are described by Sterling (2004), see table 2. The levels remind of the three levels of environmental innovation that were described by Cramer & Jansen (1995): optimize, improve, renew.

Table 2. Levels of change towards education for sustainable development				
	Level 0	**Level 1: Accommodation**	**Level 2: Reformation**	**Level 3: Transformation**
Type of change	No or weak change	Green gloss	Serious reform	Whole system redesign
Type of learning	Ignorance or denial (no learning)	Adaptive	Critically reflective	Transformative
Response	Rejection or minimum	'Bolt-on'	'Build-in'	Rebuild or redesign
Effect on ESD	No change	Cosmetic reform	Serious greening	Wholly integrative
State of education	As usual	Education *about* sustainability	Education *for* sustainability	Sustainable education
Based on: Sterling (2004)				

At level 1, 'accomodation', according to Sterling, there is a minimal effect on the institution and on the values and behavior of the students. The response is often content-oriented, characterized by incoherence and conflict between reflected educational values, e.g. where sustainability concepts are introduced in some parts of the curriculum but ignored or even contradicted in other parts.
A typical example of a level 1 approach was the contribution to education of the Center of Technology for Sustainable Development (TDO) of Eindhoven Polytechnic University, which enabled the students to acquire a special certificate for sustainable development (TDO, 2000), added to their Master's degree.
In fact it can be argued that the development of the M2 program, discussed in chapter 4, was another example of a level 1 process. It 'bolted on' a new study program to the existing spectrum of programs in the Hogeschool Midden-Brabant, without changing anything to those existing programs.

At level 2, 'reformation', the education content is directed towards sustainability in a more coherent way. Attempts are made to base values and skills on sustainable development, and the education is aiming explicitly at learning for change. According to Sammalisto & Lindhqvist (2008), a typical example of a contribution on this level of ESD development is a series of 'disciplinary reviews' which were developed by the Dutch Foundation for Sustainable Higher Education (DHO; see Appel et al, 2004). These books, published between 2001 and 2008, describe all kinds of options to integrate sustainable development into the study programs of various disciplines, ranging from civil engineering to e.g. religion studies, health, philosophy, chemistry, ICT, management, and fashion.

At level 3, 'transformation', education is completely redesigned, based on sustainability principles. This requires a paradigm shift towards learning as change, engaging the whole learning institution. This includes the ability to work with ambiguity and uncertainty, allowing creativity, imagination, and cooperative learning. Inter- and transdisciplinarity is common, there is an emphasis on real-life issues, and the boundaries between institution and community is fluid. As it is most in conflict with existing structures, values and methodologies, Sterling argues, it cannot be imposed and it is the most difficult to achieve, particularly on an institutional level.

The various experiments of the research program differ in the level of change, and so it will be interesting to compare them, using the Sterling approach.

1.3.2. Types of change: the five colors model of De Caluwé and Vermaak

In 1999, Léon de Caluwé and Hans Vermaak published the first version of a model for the typology of organizational change processes. For the overview of the model in this section, use was made of the second, reviewed edition (De Caluwé & Vermaak, 2006).
The model makes a distinction between five types of organizational change. As one of them is typified by a blueprint, it is called 'blueprint thinking'. Accordingly, the other four received names based on other colors. This results in the following (table 3):

Table 3. The colors model of De Caluwé & Vermaak		
Name	**Characterization**	**Examples**
Yellowprint	Focus on power play and negotiations Create coalitions, win-win situations Only 'those who matter' are involved	Politics Machiavelli
Blueprint	Focus on clear, measurable targets (the 'blueprint') Stepwise implementation plan Adjust, stabilize, reduce complexity	Project planning Production company Taylor (1947)
Redprint	Focus on human resource management (HRM) Stimulate and motivate people Offer social setting, rewards, status, attention, trust, health program	Mayo (1933) Maslow (1954)
Greenprint	Focus on learning organization Stimulate awareness of new viewpoints, involvement Motivate learning, personal responsibility	Action learning Organization of professionals
Whiteprint	Focus on creativity Offer space for individual energy, inspiration, drives Create dynamics, complexity, chaos	Artists group Brainstorming

There is no general preference for one of these five approaches to change processes. Which one of them is the most suitable, depends on the kind of organization and on the concrete situation, according to De Caluwé and Vermaak. If however an inappropriate process is attempted, this may fail partially or completely, or even create disaster.
The successes and failures of the various experiments of the present research will be compared with the above colors, in an attempt to understand them and to draw conclusions that the ESD process will benefit from.
(By the way: the colors model of De Caluwé and Vermaak is not related to other models of organizational change that use colors as symbols, e.g. the Spiral Dynamics model of Graves, see Beck & Cowan (1996).)

1.3.3. The natural development of organisations: the Bridges model

Where the colors model focuses on processes of change, other authors focus on long chains of change processes, together forming the life cycle of an organization. One of them is William Bridges, who states that the life of an organization usually follows a typical series of phases.
In order to characterize these phases, Bridges makes use of four dichotomies with which organizations can be categorized. Only one will be described here: it is the distinction between 'extraverted' organizations (focusing on the outside world, with open boundaries, quickly reacting to external changes) and 'introverted' organizations (focusing on the internal processes and procedures, with closed boundaries, reacting to external change only after careful reflection).
(The other dichotomies are: sensing vs. intuitive; thinking vs. feeling; judging vs. perceiving. The four dichotomies are derived from the 'Myers-Briggs Type Indicator', MBTI, which is a psychological model that was developed for the characterization of individual people; see: Briggs-Myers, 1980.)
Making use of this dichotomy, the following natural organizational development phases can be described. Every phase will only follow if the preceding phase was passed successfully, according to Bridges (2000):

1. The dream. An idea or ideal is in someone's mind, nothing more than that yet. The phase is introverted.
2. The venture. Action is taken to realize the dream. This demands a lot of creativity and involvement of the (small) staff. In this phase there is an intensive interaction with the outside world, and the phase is extraverted.
3. Getting organized. The success of the organization increases, and so does the size of the organization, which becomes more complex. This demands a set of fixed procedures and some standardization. In this phase the organization is introverted, trying to develop its structure.
4. Making it. Now that the internal processes are all right, the organization is able to grow further. This demands the discovery of new market opportunities, and so the organization is extraverted again, as account managers swarm the earth.
5. Becoming an institution. Some organizations may exist for a long time and become a part of the 'establishment'. Its name is known to many. It may even be the dominant market leader, able to set the standards that others have to follow. In this phase, the urge to renew the organization or its products and services may shrink, since the organization 'knows' what the customers want. Therefore, the tendency is to become introverted again.
6. Closing in. This is actually a deepening of phase 5. The bureaucracy weighs heavy on the organization. The introversion gets so strong that customers are made to feel that the organization is doing them a favor by serving them. The organization is a 'rusty mammoth'.
7. Death. Because the organization has virtually lost its ability to change, the very first significant external change will kill it. Its place is taken by a dozen new extraverted ventures, based on new dreams, and so one generation disappears and make place for the next one.

Many variations exist to this natural development process. Organizations in phase 6, or any earlier phase, may be revitalized and start a 'second life', perhaps even entering an iterative process of repeated rejuvenation. Organizations in phase 4 may meet a sudden change (a trend break) in the external circumstances, and die. But generally, the described development pattern is recognizable in many existing and past organizations.
In the educational sector, the natural organizational development can be applied on several levels, e.g. to universities, university departments, and individual study programs. In this dissertation, it will also be applied to describe the organizational development of an NGO: the Dutch Foundation for Sustainable Higher Education (DHO), in chapter 7.
The concept of a natural organizational development is also present in other, well-known management theories and models. It can be found in the Deming cycle, describing the process of continuous quality improvement (Deming, 1986), and in the EFQM model for quality management of the European Foundation for Quality Management (EFQM, 1991). The so-called 'five stages model', developed by INK on the basis of the EFQM model (INK, 2000), shows a resemblance with some of the phases of the Bridges model: for instance, stage 1 of INK clearly shows a resemblance with phases 1 and 2 of the Bridges model. This will all be explained in chapter 7, where it will become apparent that the main subject of experiment #5, the AISHE assessment tool, can partly be explained using the Bridges model.

Some other models for change or for management will occasionally be used. Examples are: the sequence of 'forming – storming – norming – performing', first described by Tuckman (1965); a theory about the diffusion of innovations by Rogers (2003); and an application of the already mentioned Maslow motivation theory at the level of entire organizations.

1.4. Research characteristics

The experiments of the research program all have some characteristics in common, as this section describes.

1.4.1. Case study

As already mentioned, all experiments were performed in HBO, the Dutch higher education sector of Universities of Applied Sciences. This implies that the research has the character of a case study, HBO being the 'case'. Some of the experiments had an even more evident case study nature, as they were entirely dedicated to one specific study program (experiments #1 and #2) or to a faculty of one university (experiment #3).

Typically, questions that are suitable for case studies begin with 'how' or 'why' (Yin, 2009, p. 10). This is the case with the present study, as the central question to the study of ESD was described above as: "How can education contribute effectively to sustainable development?" (which was subsequently specified as "Which strategies can be used in order to make education contribute effectively to sustainable development?")
For case studies, Yin (p. 18) gives the following definition and explanation:

> "A case study is an empirical enquiry that
> - investigates a contemporary phenomenon in depth and within its real-life context, especially, when
> - the boundaries between phenomenon and context are not clearly evident.
>
> (...)
>
> The case study inquiry
> - copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result
> - relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result
> - benefits from the prior development of theoretical propositions to guide data collection and analysis."

The concept of triangulation offers a powerful method to gather and combine empirical information about the results of the experiments. Yin writes about this (p. 115):

> "The most important advantage presented by using multiple sources of evidence is the development of converging lines of inquiry, a process of triangulation and corroboration (...). Thus, any case study finding or conclusion is likely to be more convincing and accurate if it is based on several different sources of information, following a corroborative mode."

Four types of triangulation exist, according to Patton (2002):
1. Investigator triangulation: use evaluations by various investigators or observers.

2. Data triangulation: examine the consistency of different data sources, using the same method. Example: Comparable data at different moments in time.
3. Methodological triangulation, also referred to as 'mixed methods' (Denzin, 1989): examine the consistency of data sources, collected using different methods. When either qualitative or quantitative data are combined, the triangulation is described as 'within method'; when both are combined, as 'across methods'.
4. Theory triangulation: use various theories or perspectives to examine and interpret the data.

Triangulation was used to evaluate the results of the various experiments of this dissertation. An example will illustrate this.

Example
The case of experiment #1 is illustrative. The question at the start of this experiment was:

Question #1: Can education contribute effectively to sustainable development through the development of a separate study program dedicated to (main aspects of) sustainable development?

The experiment that was used to investigate the question was:

Experiment #1: Development of a new study program on sustainable technology (1991-1994).

The best way to assess this question empirically is a matter of perspective. When is a study program successful? If it attracts a lot of students? If it has a clear contribution to the professional field? For this reason, several criteria were selected to define the rate of success of the study program, and thus to assess the question. They will be discussed in chapter 4, but they are already mentioned here:

Criteria:
1. The study program meets the demands of ESD
2. The study program attracts a sufficient number of students.
3. Students appreciate (the ESD character of) the study program.
4. External stakeholders appreciate (the ESD character of) the study program.
5. The graduates contribute to SD in the professional field.
6. The program contributes to ESD implementation elsewhere.

Some of the indicators that were used to assess these criteria were:
- Report of the Inspection of Higher Education
- Self-evaluations
- Visitation reports
- Alumni assessment (questionnaire)
- Overview of internships
- Student numbers

Several triangulation types were thus applied. For instance:
- *Investigator triangulation*: The situation of the study program was assessed, within a year, by the program team itself (self-evaluation), the Inspection of Higher Education, and a national Visitation Commission.
- *Methodological triangulation*: in order to examine the contribution to sustainable development in the professional field (criterion 5), an overview of internships was used, as well as the answers to a questionnaire among alumni concerning their professional career.

In other experiments, other triangulation types were used too, e.g. data triangulation in experiment # 4 (during the validation of the AISHE assessment tool). Theory triangulation was used by applying the three theories / models of change that were described in §1.3, in order to interpret and understand the results of the various experiments.

1.4.2. Action research, Mode-2 science, postnormal science
The research has a number of characteristics of action research, mode-2 science and postnormal science, as this section will show.

Action research
Several definitions of action research exist. For instance:

> "Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework. (...) [Action research is] the study of a social setting involving the participants themselves as researchers with a view to improve the quality of action within it." (Rapoport, 1970)

> "Action Research is small-scale intervention in the functioning of the real world (...) and the close examination of the effects of such interventions." (Halsey, 1972)

This implies that action research is a combination of two main characteristics:
1. Trying to accomplish something that is important within the real world, while at the same time learning from the process and the results in order to contribute to science;
2. A mutual interaction between the observer and the observed. In other words: an active participation of the researcher in the system that the research is about.

Reason & Bradbury (2001) go even further, describing action research as

> "a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes, grounded in a participatory worldview which we believe is emerging at this historical moment. It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities."

This view makes action research extremely suitable for the study of sustainable development, and more specifically for the study of ESD.
Saunders, Lewis & Thornhill (2006) also refer to a democratic nature, as they describe four characteristics of action research:
1. Research in action, instead of research on action
2. A democratic and close cooperation between the investigated people and the investigators
3. A repetitive cycle of diagnosing, planning, acting and evaluation
4. Implications outside of the direct assessment area

So, a major aspect of action research is its repeated evaluation and improvement of the research goals and procedures in an iterative process. Another aspect is that the lessons learnt from it should be transferable to other contexts.
Not only is action research, according to several authors, a democratic process, it is also not value-free, and it is engaged, as it aims at achieving some real goals in the world. "Action research rejects the notion of an objective, value-free approach to knowledge generation in favor of an explicitly political, socially engaged, and democratic practice." (Brydon-Miller, Greenwood, Maguire, 2003)
This implies that action research shares a number of characteristics with Mode-2 science.

Mode-2 science
As sustainable development deals with a complexity of concepts, subjects, problems, sciences, and syndromes, this makes the concept of sustainable development difficult to define or to understand. This has some severe consequences for the scientific study of sustainable development. Martens (2006):

> "A new research paradigm is needed that is better able to reflect the complexity and the multidimensional character of sustainable development. The new paradigm must be able to encompass different magnitudes of scale (of time, space, and function), multiple balances (dynamics), multiple actors (interests) and multiple failures (systemic faults). This paradigm emerges from a scientific sub-current that characterizes the evolution of science in general – a shift from mode-1 to mode-2 science (see table [4]) (Gibbons, 1994). Mode-1 science is completely academic in nature, monodisciplinary and the scientists themselves are mainly responsible for their own professional performance. In mode-2 science, which is at core both inter- and intra-disciplinary, the scientists are part of a heterogeneous network. Their scientific tasks are components of an extensive process of knowledge production and they are also responsible for more than merely scientific production."

Table 4. Properties of mode-1 and mode-2 science	
Mode-1 science	**Mode-2 science**
Academic	Academic and social
Mono-disciplinary	Trans- and interdisciplinary
Technocratic	Participative
Certain	Uncertain
Predictive	Exploratory
Source: Martens, 2006	

Gibbons (1994) writes about this new kind of science:

> "One of the characteristic features of Mode 2 is its transdisciplinarity. Another is what we call its social distribution, that is, its diffusion over a wide range of potential sites of knowledge production and different contexts of application or use. But the socially distributed nature of Mode 2 knowledge production is above all embodied in people and the ways they are interacting in socially organised forms. (...)
> Mode 2 knowledge (...) is characterised by a constant flow back and forth by the fundamental and the applied, between the theoretical and the practical."

Whereas action research may be categorized as a scientific methodology, Mode-2 science is a more profound scientific paradigm shift. The same is true for postnormal science.

Postnormal science

The term 'postnormal science' was introduced by Funtowicz & Ravetz. They describe it as a way to include complexity and uncertainty within the scientific research. "To characterize an issue involving risk and the environment, in what we call 'postnormal science', we can think of it as one where facts are uncertain, values in dispute, stakes high and decisions urgent." (Funtowicz & Ravetz, 1993). In the same publication, they write:

> "The traditional fact/value distinction has not merely been inverted; in postnormal science the two categories cannot be realistically separated. The uncertainties go beyond those of the systems, to include ethics as well. All policy issues of risk and the environment involve new forms of equity, which had previously been considered 'externalities' to the real business of the scientific-technical enterprise, that is the production and consumption of commodities. These new policy issues involve the welfare of new stakeholders, such as future generations, other species, and the planetary environment as a whole. The intimate connection between uncertainties in knowledge and in ethics is well illustrated by the problems of extinction of species, either singly or on a global scale. It is impossible to produce a simple rationale for adjudicating between the rights of people who would benefit from some development, and those of a species of animal or plant which would be harmed. However, the ethical uncertainties should not deter us from searching for solutions; nor can decision makers overlook the political force of those humans who have a passionate concern for those who cannot plead or vote. Only a dialogue between all sides, in which scientific expertise takes its place at the table with local and environmental concerns, can achieve creative solutions to such problems, which can then be implemented and enforced."

With these explicit referrals to subjects like equity, ethics and species extinction, it is no wonder that in many publications about postnormal science, a direct relation with sustainable development is emphasized, e.g. Ravetz (2006).
In postnormal science, the important concept of an "extended peer community" is introduced. (Funtowicz & Ravetz, 1993):

> "The dynamic of resolution of policy issues in post-normal science involves the inclusion of an ever-growing set of legitimate participants in the process of quality assurance of the scientific inputs. (…) In post-normal science, the manifold uncertainties in both products and processes require that the relative importance of persons becomes enhanced. Hence the establishment of the legitimacy and competence of participants will inevitably involve broader societal and cultural institutions and movements. For example, persons directly affected by an environmental problem will have a keener awareness of its symptoms, and a more pressing concern with the quality of official reassurances, than those in any other role. Thus they perform a function analogous to that of professional colleagues in the peer-review or refereeing process in traditional science, which otherwise might not occur in these new contexts."

All three scientific methodologies or paradigms – action research, mode-2 science, and postnormal science – clearly share a number of characteristics, that all are present in the research program, as will be illustrated.

1.4.3. Transdisciplinary research

The experiments of the research all have the character of multi-, inter- and transdisciplinary research. Unfortunately, these terms are not always used in a consistent way, and so it is important to have an exact definition of them, as

they form a central theme, not only for the research described in the present dissertation, but also for education for sustainable development, as will become clear below.
RMNO (2000) describes the three terms as follows, relating them to scientific research:

> "***Multidisciplinary*** research is research in which strong cooperation exists between various disciplines, with conservation of the own identities regarding the methodological approach and the theoretical perspectives."
> "***Interdisciplinary*** research is research in which strong cooperation exists between various disciplines with relations and feedback between the generated contributions in order to solve a problem together."
> "***Transdisciplinary*** research is problem oriented interdisciplinary research. In transdisciplinary research interactions take place between scientists and the problem owners."

The same viewpoint was taken by Pohl & Hirsch Hadorn (2007). Roorda (2001) defined them in a comparable way, applied to education:

> "In a ***multidisciplinary*** approach there is cooperation between various disciplines, keeping intact every separate set of theoretical concepts and methodological approaches.
> In an ***interdisciplinary*** approach there is cooperation between various disciplines, where a common methodological approach and theoretical fundament is looked for, as a synthesis of the participating disciplines. Participants try to speak 'one language'.
> In a ***transdisciplinary*** approach, not only co-operation takes place between specialists of various disciplines, but also others are directly involved: users, problem owners, clients, stakeholders, etc. (transdisciplinary = (literally:) beyond the disciplines)"

The definitions given in Roorda (2001) were cited and adopted by others, e.g. Lozano (2006). In this dissertation, the three concepts will be used as defined above.
Pohl & Hirsch Hadorn (2007) mention several characteristics of transdisciplinary research. Such research is needed when:

- "knowledge about a societally relevant problem field is uncertain (…),
- the concrete nature of problems is disputed, and
- there is a great deal at stake for those concerned by problems and involved in dealing with them."

A vital aspect of transdisciplinary research is the question of its validity, as a quantitative and statistical analysis based on repeated experiments is usually not possible. Scholz et al (2006) state that five kinds of validity are specifically important for transdisciplinary research:

- ***Functional validity***, testing whether the study is "effectually devoted to the goal or to the guiding question". Krippendorff (2004) describes this as "the degree to which analytical constructs are vindicated in use rather than in structure", adding that this means that the research is useful and successful: this kind of validity is about "whether or not or how well it works".
- ***Ecological validity***, testing whether the appropriate information from the case has been acquired. According to Brewer (2000), this requires that the methods, materials and setting of the study must approximate the real-life situation that is under investigation.
- ***Consequential validity***. An experiment is said to have consequential validity if society benefits from applying the experiment.
- ***External validity***, referring to the demand that the results are generic, and can be transferred to other regions, situations or cases than the ones that were investigated.
- ***Convergent validity***, implying that results from different sources or methods, combined through triangulation, converge, i.e. confirm each other.

These five kinds of validity will give shape to the ways in which the experiment results will be assessed (chapter 3).

A cluster of scientific approaches
The various characteristics of the research program, mentioned in §1.4.1, §1.4.2 and the present section, are all strongly related. For instance, Elzinga (2008) mentions participation and reflexivity as core elements of transdisciplinary research. Krohn (2008) does the same for case studies. According to Funtowicz and Ravetz (2008), "transdisciplinary research and post-normal science are a complementary pair of approaches to the new understanding of science. (…) In the former, experience of the new sorts of tasks for science led to this new synthesis. In the latter, the approach was more philosophical, considering how radical the changes in our conceptions of science would need to be. In practice, the two approaches have much in common."
This all implies that the concepts of case study, action research, mode-2 science, postnormal science, and transdisciplinary research, together form a cluster of approaches to science that, when combined, define a paradigm shift in the philosophy and the societal meaning of science. This 'cluster concept' forms the basis of the present study and its

experiments. The paradigm shift is described strikingly by Hirsch Hadorn et al (2008), who refer to transdisciplinary research, but might just as well have referred to the broader cluster of new scientific approaches:

> "The birth of science is based on a strict dissociation of scientific knowledge from the various aspects of practical knowledge. The ideal of scientific knowledge as it was shaped in antiquity is still influential today, although the conception of science and the relationship between science and the life-world has undergone major changes. (…) Transdisciplinary research is challenged by the following requirements:
> - To grasp the complexity of the problems,
> - to take into account the diversity of scientific and societal views of the problems,
> - to link abstract and case specific knowledge, and
> - to constitute knowledge with a focus on problem-solving for what is perceived to be the common good."

The research program

Aspects of active involvement in the research were clearly visible in all experiments. In some cases, the *researcher* acted as a project manager or as the manager of a study program. In others, as a developer: of a study program, of an assessment tool that was to be used in higher education, or as the author of educational books. In some experiments, the role was that of a consultant, trainer, teacher, coach or auditor.

Every experiment was designed to achieve some targets in the real world of higher education, and thus to actively contribute to sustainable development. Besides, all experiments explicitly aimed at a 'learning by doing' process, in which reflection on, and scientific examination of the process and the results were used to repeatedly improve the goals and activities in an iterative process, and also to transfer the results to other areas within higher education and (sometimes) to other levels of education. Examples of this transfer are:

- The lessons learnt from the M2 study program (experiments #1 and #2) were used as input for the larger Cirrus Project (experiment #3);
- The basic module on sustainable technology, a product of this Cirrus Project, was actively distributed to all Universities of Applied Sciences in the Netherlands, and used by many of them;
- The AISHE assessment tool (experiment #4), designed for higher education, has also been used in secondary vocational education, and an assessment tool for primary education has been derived from it;
- The Basic Book on sustainable development (experiment #5) has been used for post-graduate courses of regional civil servants.

The 'extended peer community' is recognizable in several experiments. As an example, while the Basic Book on sustainable development was developed, a regular feedback was asked. One feedback group consisted of seven highly qualified scientific researchers on sustainable development: the classical peer community. But a second group was the 'resonance group', consisting of about 30 teachers in higher education institutions that were likely to start using the book with their students after its publication. Other members of this resonance group were representatives of societal organizations, e.g. environmental interest groups, third world development groups, and government departments. Besides – last but not least – groups of students gave systematic feedback, and so the primary stakeholders were also present.

2. The interaction between education and sustainable development

This chapter will lead to a systematic list of demands for ESD that in the next chapters can be used as a reference to investigate if the various ESD development experiments were successful. In order to develop such a systematic list, a number of subjects will be discussed. First, some general characteristics of the concept of sustainable development will be described, as this concept is crucial to ESD. Next, the possible or expected contributions of education to sustainable development, according to the available literature, will be investigated. From this, a number of characteristics of education can be derived, as has been done by many authors. Based on their contributions, and strengthened by own experiences, the systematic list of demands will be developed.

2.1. Sustainable development

2.1.1. Definition

The term "sustainable development" was first introduced in a publication by IUCN, UNEP and WWF in 1980. It received worldwide attention when it was studied thoroughly, on the request of the United Nations, by the World Commission on Environment and Development (WCED), also known after its chair person as the Brundtland Commission. In its final report 'Our common future' (WCED, 1987), sustainable development was defined as a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This definition of sustainable development by the WCED was quite generally accepted as a basic definition. But, as it leaves a lot of room for interpretation, and as it does not render precise indications for how to "do" sustainable development, many attempts have been made to enhance or specify the definition. Some of these put the emphasis on ecological boundaries, e.g.:

> "Sustainable development means that economic activities should only be extended as far as the level of maintenance of man-made and natural capital will permit. A narrower definition of sustainability excludes the substitution between natural and man-made assets and requires maintenance of the level of natural assets as well as man-made assets. A sustainable development seems to necessitate especially a sufficient water supply, a sufficient level of land quality (prevention of soil erosion), protection of existing ecosystems (e.g. the virgin tropical forests) and maintaining air and water quality (prevention of degradation by residuals). In these cases, the sustainability concept should not only imply constancy of the natural assets as a whole (with some possibility of substitution) but constancy of each type of natural assets (e.g. of the specific ecosystems)." (United Nations Statistical Office, 1992).

Others emphasize humans and the quality of life, like:

> "Sustainable development involves devising a social and economic system, which ensures that these goals are sustained, i.e. that real incomes rise, that educational standards increase, that the health of the nation improves, that the general quality of life is advanced." (Pearce et al, 1989).

Attempts to combine these two aspects have been made, e.g. Hill et al, 2003:

> "Sustainability relates to ways of thinking about the world, and forms of social and personal practice that lead to:
> - ethical, empowered and personally fulfilled individuals;
> - communities built on collaborative engagement, tolerance and equity;
> - social systems and institutions that are participatory, transparent and just;
> - environmental practices that value and sustain biodiversity and life-supporting ecological processes."

Other definitions also point at structural and political aspects, e.g.:

> "Sustainable development involves a process of deep and profound change in the political, social, economic, institutional, and technological order, including redefinition of relations between developing and more developed countries." (Strong, 1992).

Attempts have been made to integrate all these aspects, for instance by Gilbert et al (1996), who refer to what is often described as the Triple P ('people', 'planet', 'profit'), as they write:

> "The concept of sustainability relates to the maintenance and enhancement of environmental, social and economic resources, in order to meet the needs of current and future generations. The three components of sustainability are:

- Environmental sustainability – which requires that natural capital remains intact. This means that the source and sink functions of the environment should not be degraded. Therefore, the extraction of renewable resources should not exceed the rate at which they are renewed, and the absorptive capacity to the environment to assimilate wastes should not be exceeded. Furthermore, the extraction of non-renewable resources should be minimised and should not exceed agreed minimum strategic levels.
- Social sustainability – which requires that the cohesion of society and its ability to work towards common goals be maintained. Individual needs, such as those for health and well-being, nutrition, shelter, education and cultural expression should be met.
- Economic sustainability – which occurs when development, which moves towards social and environmental sustainability, is financially feasible."

One of the first authors using this Triple P was Serageldin (1996). The approach soon became well-known, e.g. thanks to publications of Elkington, for instance Elkington (1998). The general idea is that the three 'P's' should be in balance. This balance concept has been worked out e.g. by the Dutch organization Telos, which described 'three capitals', and developed a monitoring tool that enables national or local governments to design a sustainability strategy or policy (Telos, 2004).
The second large UN sustainability conference, the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002, recommended the use of the term 'prosperity' instead of 'profit', adding subjects like the prosperity of a country, a community, the income of civilians, in short: everything related to money and financial welfare.
For ESD, the Triple P approach has been taken as an important fundament, as UNESCO writes in its Draft Implementation Scheme for the UN Decade of Education for Sustainable Development (see box 2). Throughout the present dissertation, this view was applied as the definition of sustainable development.

Box 2. Sustainable development according to the DESD Draft Implementation Scheme

"Three interlinked areas are most commonly identified with sustainable development. These are: society, environment, and economy, where political aspects are subsumed under the heading of society. These three elements, reaffirmed at the Johannesburg Summit [in 2002] as the three pillars of sustainable development, give shape and content to sustainable learning:

- Society: an understanding of social institutions and their role in change and development, as well as the democratic and participatory systems which give opportunity for the expression of opinion, the selection of governments, the forging of consensus and the resolution of differences.
- Environment: an awareness of the resources and fragility of the physical environment and the effects on it of human activity and decisions, with a commitment to factoring environmental concerns into social and economic policy development.
- Economy: a sensitivity to the limits and potential of economic growth and their impact on society and on the environment, with a commitment to assess personal and societal levels of consumption out of concern for the environment and for social justice.

These three elements assume an ongoing and long-term process of change - sustainable development is a dynamic concept, with the recognition that human society is in constant movement. Sustainable development is not about maintenance of the status quo, but rather about the direction and implications of change. The emphasis on linking poverty with issues of sustainable development points to the concern of the international community the ending deprivation and powerlessness is as much at the heart of our concern for the future of the world as is environmental protection. Balancing this equation is the central challenge of sustainable development."

Source: UNESCO (2004b)

An overview of many SD definitions is offered by Murcott, S. (1997), who builds upon Pearce et al (1989) and Morita et al (1993). What they don't mention is a description *avant la lettre*, reflecting the notion of "don't steal from your grandchildren", which was written by Thomas Jefferson in 1789:

> "Then I say the earth belongs to each (...) generation during its course, fully and in its own right. The second generation receives it clear of the debts and encumbrances, the third of the second, and so on. For if the first could charge it with a debt, then the earth would belong to the dead and not to the living generation. Then, no generation can contract debts greater than may be paid during the course of it's own existence."

All in all, the concept of sustainable development has been described as "ill-defined" (van Weelie & Wals, 2002), although perhaps the term 'over-defined' might be more accurate, as more than three hundred definitions are avail-

able (Dobson, 1996). This does not prevent the concept from being scientifically assessable or practically applicable: it is argued that the ill-definedness is a distinguishing property of the concept (Corcoran & Wals, 2004, p. 87).

2.1.2. Complexity

In 1992, the first massive conference about sustainable development was held in Rio de Janeiro: the United Nations Conference on Environment and Development (UNCED), also known as the 'Earth Summit' or just shortly 'Rio'. One of the main results was the sizeable 'Agenda 21' (UNCED, 1992), the agenda for action in the 21st century. Agenda 21 deals with a lot of subjects, problems, disciplines and sectors of society, economy, and nature. It is no wonder that sustainable development is seen by many as a 'container concept': as it intends to deal with just about 'everything', it seems to explain or solve nothing. This is however far from accurate, because fundamentally sustainable development as a scientific program seeks to describe and explain the links between all of the subjects and problems it deals with, interpreting them together as a (highly) complex system. Over the years, several attempts have been made to systematize this complexity in order to make it more understandable. One such attempt is the above mentioned Triple P concept. As an illustration, another attempt, known as the 'Syndrome Approach', will be described here.

The Syndrome Approach

Generally, the term "syndrome" is used as a description for a combination of phenomena seen in association, usually relating to a situation of illness or malfunctioning. Related to sustainable development, the term is used to describe complex patterns of non-sustainability. Barth & Burandt (2008) describe the Syndrome Approach as follows:

> "Within the sustainability science and global change research a number of different approaches has been developed that enable to systematically deal with complex problems. Such a systemic analysis is offered by the syndrome approach, developed by the German Advisory Council on Global Change. It does not only describe the actual global situation but offers possibilities of a systemic understanding of complexity. The syndrome approach represents the thesis that the global change in its dynamics may be ascribed to a manageable number of functional patterns in the human-nature relationship. The non-sustainable courses of these dynamic patterns are identified as syndromes of global change.
> Syndromes can be understood as typical, functional patterns of problematic human-nature relationships. So far 16 different syndromes have been identified and can be grouped according to basic human usage of nature: as a source for production, as a medium for socio-economic development and as a sink for civilizational outputs.
> Names of the syndromes come from typical regions, incidents or mechanisms connected with the syndrome. This leads to syndromes like the Sahel Syndrome (overuse of marginal land), the Dust Bowl Syndrome (non-sustainable agro-industrial use of soils and bodies of water) or the Asian Tiger Syndrome (damage of landscapes as a result of large-scale projects)."

The above mentioned German Advisory Council on Global Change (WBGU) illustrates this notion by describing several of these syndromes, e.g. the Sahel Syndrome (WBGU, 1996, p. 117):

> "The *Sahel Syndrome* typically appears in subsistence economies where groups of rural poor and sections of the population threatened with marginalization are confronted with increasing degradation of their natural environment due to overexploitation of agricultural land (e.g. overgrazing, spread of farming to ecologically sensitive regions). The syndrome-specific problems of the population include mounting poverty, rural exodus, greater vulnerability to food crises as well as rising frequency of political and social conflicts over scarce resources. The replacement of sustainable farming with intensified land management methods, such as abandonment of crop rotation systems or shortened fallow periods, is an important element of the syndrome. Unwise development strategies (sedentarization of nomads, construction of deep wells) may also operate as contributory factors. Development of the syndrome is reinforced by rapid population growth, and occurs within the wider context of social transformation, as evidenced by the collapse of traditional solidarity systems, disruption of local price mechanisms by subsidized exports from industrialized countries, and cultural transformation. In the course of the *Sahel Syndrome*, the scope for action on the part of the affected social groups gradually narrows (to severe famine in extreme cases) due to the mutual reinforcement of poverty, overexploitation and environmental degradation. In the Sahel zone itself, more than half the population is threatened by starvation following destabilization of rural production and social systems. As a result of population growth, traditional crop rotation methods have approached their critical limits, forcing an expansion of agricultural production to marginal lands. The consequence of such inappropriate land use is desertification and rural-urban migration. Another typical trend within the *Sahel Syndrome* is forest conversion at marginal locations and subsequent exploitation by subsistence farming – otherwise known as *shifting cultivation* or *slash-and-burn agriculture*. In southern Thailand, for example, severe floods caused by soil erosion are a direct consequence of this form of land use in the northern part of the country.
> *Symptoms:* Destabilization of ecosystems, loss of biodiversity, soil degradation, desertification, threats to food security, marginalization, rural exodus."

2.1.3. Transitions and transition management

The various definitions and systemizations of sustainable development together show that the concept is a complex combination of subjects and of processes of change. Agenda 21 illustrates this by mentioning a list of nearly 40 different main topics. Whichever way is used to schematize this total complexity – the Triple P, the Syndrome Approach or whatever – it is evident that sustainable development is a complicated, long-lasting process, consisting of much more than minor adaptations. Instead, sustainable development is all about fundamental systemic change, and thus about transitions.
As the Dutch Ministry of Environment put it:

> "Solving the major environmental problems requires system innovation; in many cases this can take on the form of a long-drawn-out transformation (often lasting longer than one generation) comprising technological, economic, socio-cultural and institutional changes, which influence and reinforce each other. The period until such a transformation is complete can be seen as a transition. During the transition, objectives are formulated and modified and interrelated policy instruments are applied. Transition requires kinds of planning and transition management, which is not a new phenomenon. In the past, this occurred when a drinking water and sewerage network was laid to improve public health, when agriculture was increased in scale (after WWII) and natural gas was introduced as domestic fuel in the late 1960's." (Ministry of VROM, 2001)

Martens and Rotmans (2002) characterize a transition as "a set of connected changes which reinforce each other but take place in several different areas, such as technology, the economy, institutions, behavior, culture, ecology and belief systems". Rotmans (2005) adds to this:

> "There are no easy, off-the-shelf solutions for persistent societal problems, because these are caused by fundamental flaws in our societal systems. Such systemic errors demand radical changes in our thinking and actions, i.e. transitions and system innovations. Transitions require a long period (one to two generations), and take time, patience, money, confidence, but also courage, daring and perseverance to gain the upper hand over various types of resistance. Research into transitions is by definition multidisciplinary and interdisciplinary. For this we need knowledge and experience from systems analysis, social administration, history, innovation science, economics, business administration and technology. The nature of research into transitions is fundamental, explorative, creative and practical."

Where new paradigms and approaches are necessary, new basic philosophies are as well. Many texts have been written about the philosophy underlying sustainable development. One of the most influential of these sources is the Earth Charter (2000), which has been formally endorsed by many national and local governments, by international organizations like UNESCO and IUCN, by many individuals, and by hundreds of universities and university organizations. The Earth Charter mentions the relevance of education: "The arts, sciences, religions, educational institutions, media, businesses, nongovernmental organizations, and governments are all called to offer creative leadership."
The necessary multi- and interdisciplinarity of transitions and of sustainable development will have far-reaching consequences for education for sustainable development (ESD), as will be discussed later in this chapter. One of the relevant questions to be answered is, whether the developments within HBO in the last decades can be seen as transitional processes. Another question is, how the concepts of transition and of transformation (as defined by Sterling, see above) are to be compared with each other. A third relevant question is whether transition processes, either in general or specifically in a sector of education, can be influenced or even managed. If so, what does this tell us about the ESD development process?

Transition management

Transitions can be seen as a process of co-evolution (Rotmans et al, 2001), in which "different subsystems are shaping but not determining each other (relative autonomy)" (Kemp et al, 2006). The concept of 'punctuated equilibrium' has been adopted from evolution biology (Eldredge & Gould, 1972), to describe the process as a "punctuated equilibrium in which periods of slow change are punctuated by periods of radical change" (Kemp et al, 2006). Several stages in such a process can be discerned (Rotmans et al, 2001):

> "At the conceptual level, we can distinguish four different transition phases:
> - A predevelopment phase of dynamic equilibrium where the status quo does not visibly change.
> - A take-off phase where the process of change gets under way because the state of the system begins to shift.
> - An acceleration phase where visible structural changes take place through an accumulation of socio-cultural, economic, ecological and institutional changes that react to each other. During the acceleration phase, there are collective learning processes, diffusion and embedding processes.
> - A stabilization phase where the speed of social change decreases and a new dynamic equilibrium is reached."

Opinions are divided about the question whether the process of a transition can be influenced (Hajer & Poorter, 2005). Geels & Kemp (2000) indicate that transitions can be influenced up to a certain level, but not fully controlled. In their eyes, transition management is primarily anticipative, reflexive and adaptive. Rotmans & Loorbach (2001) add that the classical process of 'command and control' does not work with transition management. They recommend the creation of preconditions that are favorable for the desired developments, thanks to suitable initiatives at the right moment. Characteristics of transition management are (Rotmans, 2000; Rotmans et al, 2001):

- "Long-term thinking (at least 25 years) as a framework for shaping short-term policy
- Thinking in terms of more than one domain (multi-domain) and different actors (multi-actor) at different scale levels (multi-level)
- A focus on learning and a special learning philosophy (learning-by-doing and doing-by-learning)
- Trying to bring about system innovation alongside system improvement
- Keeping a large number of options open (wide playing field)."

For changing the order and direction of society and managing transitions of societal systems, a form of multi-level governance is needed in which the above elements are integrated in some way. The way in which this is done in transition management is through interaction between three levels (Loorbach, 2004):

- Strategic level: processes of vision development, strategic discussions, long term goal formulation, etc.
- Tactical level: processes of agenda-building, negotiating, networking, coalition building, etc.
- Operational level: processes of experimenting, project building, implementation, etc.

In other words, transition management is a process of interaction (Loeber, 2003) in which many actors, at different levels, operate as a complex network.
The processes of change in the last decades within Dutch HBO share a lot of these characteristics of transitions, e.g. the multi-actor and multi-level approach, as will be described below. As a part of these processes, the experiments described in the dissertation took place primarily at the operational level, and in some respects at the tactical level. The dissertation itself is an attempt to contribute also at the strategic level, aiming at vision development and at provoking strategic discussions, as chapter 10 will show.

2.2. The impact of higher education on sustainable development

2.2.1. The essential role of knowledge exchange

Agenda 21 is very clear about the essential role of education towards sustainable development. Chapter 36 gives the details.

> "Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues. (...) Both formal and non-formal education are indispensable to changing people's attitudes so that they have the capacity to assess and address their sustainable development concerns. It is also critical for achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision-making. To be effective, environment and development education should deal with the dynamics of both the physical/biological and socio-economic environment and human (which may include spiritual) development, should be integrated in all disciplines, and should employ formal and non-formal methods and effective means of communication." (§36.3)

This text speaks of both formal and non-formal education. Other texts use the general term 'learning', restricting the word 'education' to formal ways of learning through educational institutions. "In this vision learning is taken to have a broad meaning that includes the generation of understanding and knowledge (especially on the important questions of life and development, wellbeing, our relationships to others within the same and following generations, our relationship to nature, etc.), including the integration of understanding and knowledge from disparate fields and sources, as well as its transfer both in formal, organized, institutional contexts (education) and in less formal contexts, such as is implied in social learning." (Jansen, Weaver & Van Dam-Mieras, 2008).
Social learning is described as a process in which participants learn from each other in many ways and many directions. Differences between people, e.g. in their backgrounds, expertise and values, are seen as an opportunity. It is used in informal groups as well as in formal organizations like companies, as a means to involve many different kinds of stakeholders in processes of change (Wals (ed.), 2007). Social learning has been described as reminding of "an improvising jazz ensemble" (Wals et al, 2009). It is considered as vital for transition processes, as those cannot be managed in a classical top-down structure.
As far as (formal) higher education is concerned, social learning is relevant for two different kinds of learning processes: not just for the educational task of the university (i.e. the learning process of the students), but also for

the universities themselves as learning organizations (Wals & Corcoran, 2004). Regarding the students' learning process, the desire to make use of social learning will have consequences for the educational methodologies (e.g. problem oriented education) as well as the organization and structure of the education (e.g. transdisciplinary education). These subjects will be discussed more thoroughly in later chapters.

The above text of Agenda 21 uses the word 'critical' several times. It states that sustainable development should be integrated in *all disciplines*, and so it sets a strong target for education, e.g. for higher education.
One of the objectives described in chapter 36 is:

> "To promote integration of environment and development concepts, including demography, in all educational programmes, in particular the analysis of the causes of major environment and development issues in a local context, drawing on the best available scientific evidence and other appropriate sources of knowledge, and giving special emphasis to the further training of decision makers at all levels." (§36.4d)

The essential role of knowledge and knowledge exchange for sustainable development was described in more detail by the Dutch Advisory Council for Research on Spatial planning, Nature and the Environment (Raad voor Ruimtelijk, Milieu- en Natuuronderzoek, RMNO):

> "The RMNO has the opinion that the development and sharing of knowledge and the exchange of experiences (which can be seen as practical knowledge) is one of the key factors for success of sustainable development. If sustainable development is seen as a transition, this implies something different from when sustainable development is seen as an incremental development process. To a transition belongs a clear image of where the jump will lead to. For this, vision development is essential. In order to produce the jump towards a sustainable society, stimulating initiatives and sharing acquired knowledge in society is vital." (RMNO, 2002)

What such relations and interactions between transitions (or system renewals) and education might look like, is shown graphically by Jansen (2002), see figure 2.

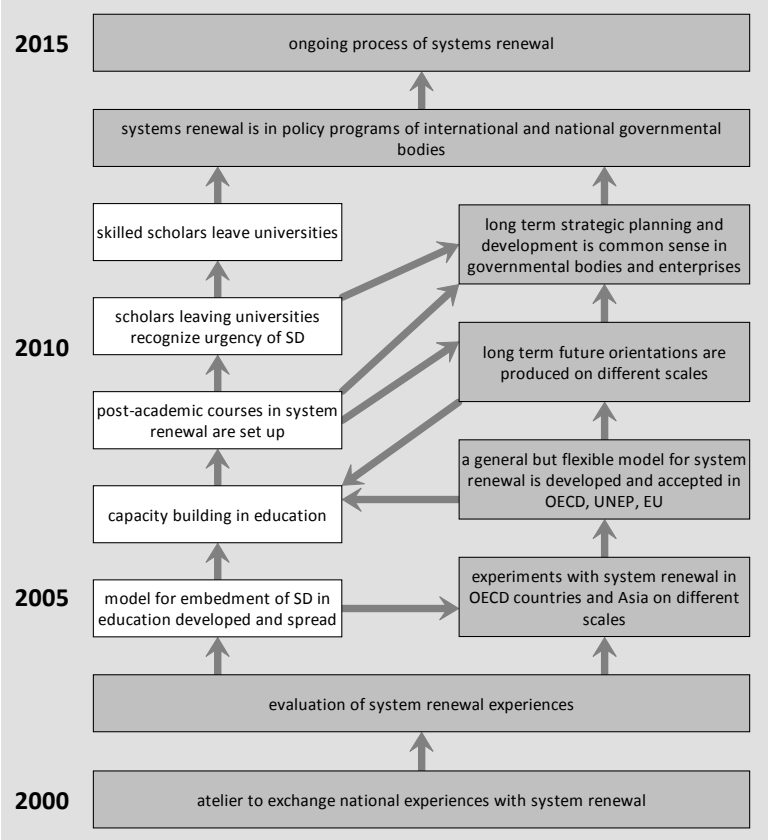


Figure 2. Interactions between system renewal and education. (Source: Jansen, 2002)

Martens (2006) insists on the presence of sustainable development in all levels of education:

> "Today's students will be the business leaders, scientific researchers, politicians, artists, and citizens of tomorrow. The extent to which they will be prepared to make decisions in favour of a sustainable future depends on the awareness, knowledge, expertise, and values they have acquired during their studies and in the subsequent

> years. For this reason, the concepts and themes of sustainability should be integrated into all levels of education. Curricula must be revised so that sustainable development forms a guiding principle throughout the entire period of their studies - and afterwards too."

Focusing specifically on higher education, De Groene (2003a) specifies four reasons why it has a vital role towards sustainable development. She mentions:

1. "The flow of tens of thousands of graduates to key positions in companies and governments (*impact*);
2. The relatively large receptiveness of students to the challenge of sustainability (*effectiveness*) (...);
3. The long lasting influence of students in society (*continuity*);
4. The rate of organisation of the educational field (*attainableness* and *dissemination*)."

Thus, over the years the expectations from 'Education for Sustainable Development' (ESD) have taken shape, and the research on how to meet those expectations has become a subject of study itself. This study was pushed forward strongly by a decision by the UN General Assembly in 2002.

2.2.2. DESD, the United Nations Decade of Education for Sustainable Development

During the World Summit on Sustainable Development (WSSD) in Johannesburg, 2002, specifications were designed for the development of ESD. One of the proposals was the launch of a decade dedicated to ESD (UN, 2002a). In the same year, the General Assembly of the United Nations made the decision to adopt this proposal. The Decade of Education for Sustainable Development (DESD) was to begin in 2005 (Resolution 57/254, UN, 2002b). Later resolutions of the General Assembly (58/219, 2003 and 59/237, 2004) confirmed this decision and elaborated on it. The decision was made that UNESCO was to coordinate the DESD. In UNESCO's International Implementation Scheme, published in 2005, the fundaments of the DESD are formulated: (UNESCO, 2005b):

> "The United Nations Decade of Education for Sustainable Development is a complex and far-reaching undertaking. The environmental, social, and economic implications are enormous and touch many aspects of life of the world's population. The overall goal of the DESD is to integrate the principles, values, and practices of sustainable development into all aspects of education and learning. This educational effort will encourage changes in behaviour that will create a more sustainable future in terms of environmental integrity, economic viability, and a just society for present and future generations.
> The basic vision of the DESD is a world where everyone has the opportunity to benefit from education and learn the values, behaviour and lifestyles required for a sustainable future and for positive societal transformation."

In this International Implementation Scheme, four goals of the DESD are derived from Agenda 21. A description and explanation of them was published by UNESCO Bangkok (2007):

1. "Promoting and improving quality education to share knowledge, skills and values throughout a lifetime of learning in such a way that it supports citizens to lead sustainable livelihoods;
2. Re-orienting education programmes from pre-school to universities. Emphasis lies on re-orienting curricula, as opposed to developing new curricula, to encourage content and pedagogy that support sustainable development with clear focus on developing the knowledge, skills, values and perspectives associated with change for a sustainable future;
3. Building public understanding and awareness through community education, including informal education through media; and
4. Providing practical training to businesses, institutions and civil society to build the capacity to carry out sustainable practices at the local, provincial and national levels."

Following the recommendations of UNESCO, many countries developed a national strategy for learning for sustainable development. One of those countries was the Netherlands.

2.2.3. The Dutch National Strategy for ESD

As all experiments of this dissertation took place in the Netherlands, it is important to describe the context in which they were performed.
In the Netherlands, the national policy on sustainable development in the last decade of the 20th century was focusing strongly on environmental sustainability. Several National Environmental Policy Plans made this clear (e.g. NMP: Ministry of VROM, 1989, and NMP+: Ministry of VROM, 1990).
The fourth edition of this plan (NMP4), published in 2001, widened the focus to sustainable development in a more full scope. However, it still paid little attention to education. The most relevant occurrence of education was (Ministry of VROM, 2001):

> "In co-operation with Dutch organisations, a national campaign will be initiated to raise awareness about biodiversity. If possible, this will be linked to developing action perspectives for citizens and consumers. This will be a follow-up to existing education schemes of the National Committee for International Co-operation and Sustain-

> able Development. Co-operation in this area will also be improved at an interministerial level, for instance, by assisting educational and public institutions – such as museums, zoos, botanical gardens – and environmental education institutions to integrate the issue of biodiversity into their work."

One year later, in the beginning of 2002, the Dutch Ministry of Environment published a national strategy on sustainable development (Ministry of VROM, 2002). This mentioned education more strongly. But it gave no clear indication as to what the consequences of the sustainability strategy should be for the educational institutions.
In 2003, the Dutch government published 'Duurzame daadkracht' ('sustainable initiative': Ministry of VROM and Ministry of Foreign Affairs, 2003), in which the consequences of the Johannesburg conference were worked out. Education was not mentioned. In the same period however, the general acceptation of sustainable development by the main public was growing, as sociological research showed (Beckers et al, 2004).
Nevertheless, the Dutch government did have a national program called 'Learning for Sustainability' ('Leren voor Duurzaamheid'), which started in 2000. Why it was not integrated or at least mentioned in the wider national sustainability policy (e.g. in 'Duurzame daadkracht') is not clear. This first program focused on the stimulation of small projects, mostly initiatives by ngo's, schools and local governments, with much attention to non-formal learning.
The follow-up program, called 'Learning for Sustainable Development' ('Leren voor Duurzame Ontwikkeling', LvDO), started in 2004. The program consists of three 'pillars', one of which is focusing on formal education (LvDO, 2004). The program was planned to last until 2008, but in that year it was extended for another period of four years (LvDO, 2008). All levels of formal education were included. The development of a policy towards primary and secondary education was supported by Dutch educational research institutes (Remmers, 2007). The development of tools and guiding lines for higher education, and the support of higher education institutions, by the Dutch Foundation for Sustainable Higher Education (DHO, 'Duurzaam Hoger Onderwijs') was supported by LvDO. (DHO, founded in 1998, will be described in detail in chapter 7.)
And so, partly thanks to the support of UNESCO and of the Dutch and many other national governments, education was expected to have a strong influence on the global and local sustainable development. But, as Isaac Newton put it (in 1687): action equals reaction. What kind of influence does sustainable development have on education, and more specifically, on higher education?

2.3. The impact of sustainable development on higher education

2.3.1. Reorienting education

One of the goals of Chapter 36 of Agenda 21 is 'reorienting education'. An explanation of this goal was given by IUCN (Tilbury et al, 2002):

> "The term 'reorienting education' has become a powerful descriptor that helps administrators and educators at every level to understand the changes required for ESD. An appropriately reoriented basic education includes more principles, skills, perspectives, and values related to sustainability than are currently included in most education systems. Hence, it is not only a question of quantity of education, but also one of appropriateness and relevance. ESD encompasses a vision that integrates environment, economy and society. Reorienting education is also seen as developing an education that involves learning the knowledge, skills, perspectives, and values that will guide and motivate people to lead sustainable livelihoods, to participate in a democratic society, and to live in a sustainable manner."

According to Agenda 21, this objective should be achieved through a series of activities. Focusing on the activities that are related to formal education, and more specifically to higher education, table 5 offers an overview of the main topics mentioned in Agenda 21.
This is an ambitious program, which probably cannot be fulfilled by just adding a few alterations to the existing education. Indeed, several authors emphasize the need for profound changes to the education.
One of the ESD developers who say so is Sterling, who claims that the nature of sustainable development requires a fundamental change of epistemology, and therefore, of education. Sterling (2004):

> "Sustainability does not simply require an 'add-on' to existing structures and curricula, but implies a change of fundamental epistemology in our culture and hence also in our educational thinking and practice. Seen in this light, sustainability is not just another issue to be added to an overcrowded curriculum, but a gateway to a different view of curriculum, of pedagogy, of organizational change, of policy and particularly of ethos. At the same time, the effect of patterns of un-sustainability on our current and future prospects is so pressing that the response of higher education should not be predicated only on the 'integration of sustainability' into higher education, because this invites a limited, adaptive, response…. We need to see the relationship the other way around - that is, the necessary transformation of higher education towards the integrative and more whole state implied by a systemic view of sustainability in education and society."

Table 5. Activities of higher education for sustainable development according to Agenda 21	
Activities	**Agenda 21, chapter 36**
Policy plan for sustainable development	"designing environmental activity work plans" (§5e)
Redesign curricula	"thorough review of curricula" (§5b)
Innovative educational methodologies	"promote proven educational methods and the development of innovative teaching methods for educational settings" (§5f)
Involvement of students and staff	"with the participation of students and staff" (§5e)
Multi- or interdisciplinary approach	"integrating environment and development as a cross-cutting issue into education" (§5b) "a multidisciplinary approach" (§5b) "Cross-disciplinary courses (...) available to all students" (§5i)
Transdisciplinary approach	"in cooperation with all sectors of society" (§5b)
Staff education & training	"training programmes for all teachers, administrators, and educational planners" (5d)
Cooperation with ngo's and businesses	"Non-governmental organizations can make an important contribution in designing and implementing educational programmes" (§5a) "new partnerships and bridges created with the business and other independent sectors" (§5i)
International cooperation	"new partnerships and bridges created with (...) all countries for technology, know-how, and knowledge exchange (§5i)
Information sharing	"promoting cooperative research and information sharing and dissemination" (§5j)
Contributions to society	"stimulate educational establishments in all sectors, especially the tertiary sector, to contribute more to awareness building" (§10d)

Several authors tried to define this new kind of education, e.g. through key competences:

> "Within the international discussion about ESD different sets of competencies as educational objectives of ESD exist but still a broad consensus can be found of the basic aspects that need to be involved. The German debate about ESD led to a definition of key competencies ("*Gestaltungskompetenz*") to provide for an active, reflective and cooperative participation in the obligation to shape a sustainable development. This definition is based upon an understanding of education which is marked by the education-theoretical premises of openness, reflexivity and future viability:
> - *Openness*, because the existing stock of knowledge has proved to be subjective and relative.
> - *Reflexivity*, because subject and object underlie dynamic changes which may only be grasped by a higher level reflexivity.
> - *Future viability*, because in the increasing dynamic of global change, only he who has learned to responsibly cope with insecurities and risks will remain functionable.
>
> The acquisition of Gestaltungskompetenz is seen as central educational objective of ESD. The term is used to describe the forward-looking ability, 'to modify and to shape the futures of those societies we live in via active participation in terms of a sustainable development'."
> (Barth & Burandt, 2008, citing De Haan, 2002, and De Haan & Harenberg, 1999)

Some even go further. Orr (1992, pp. 137-138), for instance, writes about 'connective education':

> "Education for sustainability will (...) connect disciplines as well as disparate parts of the personality: intellect, hands, and heart. Connective education must go beyond 'interdisciplinarity' or team-taught courses by changing the structure and purposes of education. Its goals are twofold. First it aims toward the establishment of a community of life that includes future generations, male and female, all races and nations, rich and poor, and the natural world. The essence of community is the recognition, indeed the celebration, of interdependence between all parts. Its indicators are the requisites of sustainability: peace, harmony, justice, and participation. (…)
> A second aim of connective education is personal wholeness and transcendence. (…) Connective education means restructuring the learning environment in order to overcome the centripetal effects of academic specialization and the split between intellect and experience. Rearranging pigeonholes won't do. Disciplines, courses, and division do have a certain logic which makes knowledge more accessible by organizing it. But they are also barriers to wholeness. Fragmentation and specialization are diseases of the curriculum as much as of cultures. But connective education is impossible unless the learning environment itself forces the mixing of disciplines and perspectives."

Connective education can be realized in various ways. One way of distinguishing between several levels of connectedness is through the terms 'multi-', 'inter-' and 'transdisciplinary' education.

Van Dam-Mieras agrees with the need of a competence oriented approach, but also warns not to go too far. She pleas for a balance between this and a disciplinary approach. Van Dam-Mieras (2007, p. 31):

> "It seems likely that a certain amount of discipline-based teaching will remain useful in the future, but in a more competence-oriented approach. Learners should also be trained in matters like applying knowledge to solve societal problems or using it creatively in a business context. Of course, the pendulum should not swing to the other extreme by emphasizing only competences and neglecting disciplinary knowledge. Context-embedded action learning and problem-based learning may be good approaches to find a balance between the two."

2.3.2. Transition of education

Earlier in this chapter (§2.1.3), the relevance of transitions for sustainable development was mentioned. Next, in §2.2 it became evident that education is seen as having an important role in the process of sustainable development. The citations of §2.3.1 indicate that ESD authors expect that education itself will have to change drastically too, i.e. it has to go through a process of transformation. This raises the question whether, in the context of ESD, the terms 'transition' and 'transformation' can be considered as equal.

In §1.3.1, Sterling (2004) was cited, defining several levels of change, the highest being called 'transformation'. The description shows a strong resemblance with the concept of transition. Sterling himself descibes a process of transformation as "a deep, conscious reordering of assumptions which leads to paradigm change" (Sterling, 2004). Others (Morrell & O'Connor, 2002) describe 'transformative learning' similarly as "a shift of consciousness that dramatically and permanently alters our way of being in the world". Both citations may seem to indicate an emphasis on the learning process, and less so on the actual system innovation which is, just as a fundamental learning process, characteristic of a transition. In that case the terms 'transformation' and 'treansition' might have a different meaning or at least a different focus. But Sterling stresses the importance of 'learning as change' of transformation processes, implying that within a transformation the learning process and the systemic change take place simultaneously and as one undividable development: the learning *is* the change and v.v.

Some sources about sustainable development make use of both the terms 'transition' and 'transformation', e.g. Speth (1992) and Mazmanian & Kraft (1999). They do this in such a way that they seem to treat them as more or less the same concept.

All in all, the use of the term 'transformation' or of 'transition' seems to be a 'cultural' difference between the science of SD and that of ESD. In the literature about SD related with systemic change, the term 'transition' is commonly used. In the literature about ESD this is still true if the role of education towards sustainable transitions is discussed. But when it comes to changes within the education itself, the term 'transformation' is mostly used. In this dissertation the two terms will be treated as being equal, both referring to a profound change in the design of a system (such as the educational system) based on a paradigm shift.

The expectations of the various ESD authors cited in §2.3.1 indicate that a genuine transformation, and not just an adaptation or a reformation, of education may be needed in order to let education contribute sufficiently to sustainable development. For this reason, the question is relevant, at which level the consecutive change processes in HBO in the last decades took place, i.e. whether they realized a transformation of the educational sector of HBO. This question will return several times in the next chapters, and will finally be answered in the closing chapter, in which also the relation with the management of transitions will be discussed.

2.3.3. Characteristics of ESD: a checklist

So, what is to be expected from education? In other words: what are the main characteristics of education that is equipped to effectively contribute to sustainable development?

The United Nations Economic Commission for Europe (UNECE) developed a strategy on ESD in 2005. During a high-level meeting of its Committee on Environmental Policy, ministers of environment and of education agreed "to develop and incorporate ESD into their formal education systems, in all relevant subjects, and in non-formal and informal education. This will equip people with knowledge of and skills in sustainable development, making them more competent and confident and increasing their opportunities for acting for a healthy and productive life in harmony with nature3 and with concern for social values, gender equity and cultural diversity." (UNECE, 2005). In this strategy, a series of characteristics of ESD are mentioned:

> "To be effective ESD should:
> a) Be addressed in two ways: (i) through the integration of ESD themes across all relevant subjects, programmes and courses; and (ii) through the provision of specific subject programmes and courses;
> b) Focus on enabling meaningful learning experiences that foster sustainable behaviour, including in educational institutions, the workplace, families and communities;
> c) Increase cooperation and partnerships among members of the educational community and other stakeholders. Further involvement of the private sector and industry in educational processes will help to address rapid technological development and changing working conditions. Learning activities in close relation with society will add to learners' practical experience;

d) Provide an insight into global, regional, national and local environmental problems explaining them by means of a life-cycle approach and focusing not only on the environmental impact, but also on the economic and social implications, addressing both the natural environment and that modified by humans;
e) Use a wide range of participatory, process- and solution-oriented educational methods tailored to the learner. Apart from the traditional ones, these should include among other things discussions, conceptual and perceptual mapping, philosophical inquiry, value clarification, simulations, scenarios, modelling, role playing, games, information and communication technology (ICT), surveys, case studies, excursions and outdoor learning, learner-driven projects, good practice analyses, workplace experience and problem solving;
f) Be supported by relevant instruction materials, such as, methodological, pedagogic and didactic publications, textbooks, visual aids, brochures, cases studies and good practices, electronic, audio and video resources."

In 2008, Dieleman and Juárez-Nájera summarized a number of characteristics of ESD. When these, the above authors, and other sources are integrated, table 6 results.

Table 6. The checklist: characteristics of Education for Sustainable Development

Principles	Characteristics	Details
Connectivity, complexity	Systems thinking	Connecting parts, subsystems or aspect systems. Connecting an analytic with a holistic approach; the small with the large; and the local with the global.
	Multi-, inter- or transdisciplinary	Connecting disciplines and stakeholders. Balanced regarding Triple P; balanced with disciplinary aspects.
	Life-cycle approach	Connecting phases in the lifecycle. Regarding lifecycles of people, products, companies, habitats, cultures, designs, paradigms, etc.
	Intercultural, international	Connecting people, (sub)cultures, regions, nations. Openness for values and perspectives of others.
	Future orientation	Connecting the past, the present and the future. Concerns both long-term and short-term targets, based on visions of sustainable future developments.
Innovativity	Openness to changing conditions	Flexibility of mind; capability of dealing with uncertainties
	Openness to new solutions	Creativity, non-linearity, out of the box thinking, acceptance of the unexpected.
	Function orientation	Stimulating creative thought and design processes by zooming out from actual products or services to underlying functions or needs, aiming at finding alternative ways of fulfilling them.
Action learning, social learning	Application of knowledge	Acquisition and application of knowledge, either sequentially or simultaneously (learning by doing). Aiming at finding useful solutions to real problems.
	Multi-methods	E.g. just-in-time lectures, art, discussions, drama, games, etc.
	Real-life situations	Context-embedded learning, either in simulated or actually existing situations.
	Commitment	Personally engaged towards objectives of sustainable development.
	Cooperation	Teamwork within student groups; cooperation with experts, professionals.
Reflexivity	Learning to learn	Reflection on own learning process, aiming at continuous improvement. Lifelong learning.
	Responsibility	Responsibility for own learning process, and for the definition of learning goals (up to a certain level). Also: responsibility for results of professional activities (stakeholder approach).
	Value-driven	Aware of the relevance and the relativity of embedded values and opinions
	Critical thinking	Critical attitude towards questions, tasks, methods, answers, own functioning
	Robustness of information	Awareness of level of certainty of knowledge, data, conclusions: subjective, intersubjective, objective (opinions, theories, facts)

Main sources: Agenda 21 (UNCED, 1992), Orr (1992), De Haan & Harenberg (1999), De Haan (2002),Sterling (2004), UNESCO (2004a, 2005), UNECE (2005), Martens (2006), Van Dam-Mieras (2007), Dyball, Brown & Keen (2007), Barth & Burandt (2008), Dieleman and Juárez-Nájera (2008).

The list of characteristics in table 6 will be used throughout this dissertation as a checklist to investigate the level to which study programs meet the demands of ESD. The list only contains general characteristics, and no discipline-related subjects, as these vary with each discipline in higher education.

3. Selection of the research field

The dissertation has the character of a case study, the case being the integration of sustainable development in the Dutch HBO (the Universities of Applied Sciences, 'hogescholen'), as was announced in chapter 1. The present chapter will describe the reasons for this choice.

3.1. The boundaries of the research field

First of all, the field of research for the ESD study is chosen to be within formal education. As shown before, ESD in general is also concerned with all kinds of non-formal or informal learning, but this global field is much too wide for one research that studies a coherent series of processes of ESD development. So, the field of investigation has to be narrowed, and this is done in four steps, each of them limiting the research area:

Learning → Formal education → Higher education → Dutch higher education → HBO

There are three good reasons why the selection of the Dutch HBO is a suitable one for the research:
1. Dutch HBO consists of a clearly defined and cohesive set of higher education institutions, with comparable regulations, diplomas, financing and inflowing students.
2. Dutch HBO has been very innovative for the last decades. Many of the changes in education that ESD asks for (see table 6) have been implemented or are being implemented in Dutch HBO.
3. Many Dutch hogescholen, as well as the Dutch association of hogescholen (HBO Council, in Dutch: HBO-raad) expressly have stated the wish to contribute to sustainable development.

The HBO Council (2007a) explains:

> "Dutch society is changing and the Universities of Applied Sciences are changing too. Besides providing high-quality higher professional education programmes, Universities of Applied Sciences are expected to become knowledge partners for regional, national and international professional practice. Universities of Applied Sciences are also responding proactively to important social themes like sustainability, social integration, ageing and safety. Added to this, Universities of Applied Sciences want to play an important role in strengthening the Netherlands innovative force. (...)
> The most important added value provided by Universities of Applied Sciences is their close alignment to professional practice. They have traditionally always had close ties with the business sector (in this context, this also includes employers in the public sector). Actually, many Universities of Applied Sciences were founded by the business sector."

This is illustrated by the foreword to one of the books of the *researcher* (Roorda, 2007), which is written by the chairman of the HBO Council. A part of this foreword (Terpstra, 2007):

> "Schools and universities have the obligation to answer the call from young people and from society as a whole to work on sustainable development. This means that knowledge transfer must take place in the context of sustainable development. Students have to learn to look beyond the boundaries of the own discipline and to investigate critically the consequences of the own actions. Not only must they ask themselves 'Am I doing it right?' but also be able to ask themselves 'Am I doing the right things?' Only if they are able to do this, they will be able to do what so many young people of today want eagerly: to work on sustainable development."

First now, a description of HBO within the Dutch education system will be given.

3.2. Higher Education of Applied Sciences (HBO) in the Netherlands

The Dutch higher education system is a binary system, based upon the distinction between the research university sector and the higher education of Applied Sciences (HBO). HBO institutions prepare students for a professional career. In Dutch, the HBO institutions are called 'hogescholen'. Comparable binary systems, with some variations, exist e.g. in Germany and Austria, where they are called 'Fachhochschüle', Sweden ('högskole'), Finland ('ammattikorkeakoulu'), Denmark ('CVU's'), and Ireland ('institutes of technology').

HBO students make out nearly two thirds of all Dutch students. In 2008 there were 383,833 HBO students (HBO Council, 2009a) and 219,018 students in research universities (VSNU, 2009). So, the HBO is a major sector of higher education in the Netherlands.

One of the differences between the Dutch HBO and the research universities is that the entrance to HBO is granted on the basis of completion of the five year upper general secondary education (HAVO), upper secondary vocational education (MBO) and the six-year university preparatory education (VWO). University education is only open after finishing VWO or completion of the first year of HBO (see figure 3).

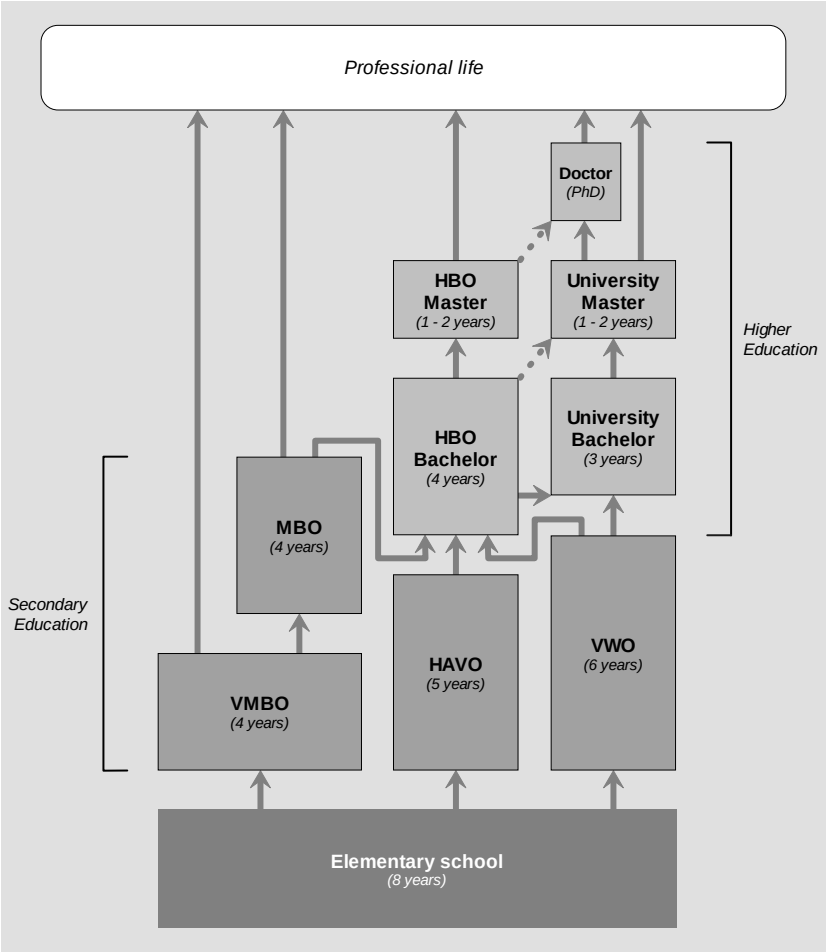


Figure 3. The structure of the Dutch education system

Full HBO-programs last four years and lead to a Bachelor title. The first three years of research university programs also lead to the Bachelor title. Afterwards, research university students have the possibility to follow a master of one or two years, which leads to a Master's title. Since a few years HBO also offers masters degree education for a limited number of educational programs. After their HBO program, HBO students can choose to follow a HBO-master or a master at research university level (for which often other requirements are set, e.g. HBO-students often have to attend a pre-master of one year to gain the knowledge and skills they need) (Van der Wende, 1996).

A distinctive element of HBO curricula is the mandatory period of practical work experience. No education in the formal sense takes place during this period. Most HBO-students gain work experience from the first year onwards, building up from a few days a week for some weeks to a fulltime job for several months. This is in contrast to research universities, where internships usually are not mandatory and where students only are offered the option, or themselves create such an option, to gain work experience (next to their study program) in the last year of the Bachelor-program and/or Master-program, for 3 or 4 months. This work experience is also different from the work experience the HBO students gain, as research university students often do research in a company in order to write their dissertation, whereas HBO students usually are co-workers in an organization.

3.3. Change processes in HBO: an overview

A large number of changes took place in HBO, mainly in the last two decades. This section offers an overview of the innovations that are most relevant for this dissertation. The section numbers refer to the sections in the dissertation. As has been explained above, the innovations in HBO formed the backbone of the research program, as each of the experiments was inspired by, and made use of one or more innovations that at that time took place in HBO.

A part of the below change processes have been described in van Hout et al (2006). However, no literature seems to exist that offers a full overview, and this was confirmed during a private conversation with the chairman of the HBO Council in June 2009.

The innovation processes are shown in a more or less chronological order.

Context of experiment #1 (1991 – 1994):

1. **Mergers** (§4.1.1)
A wave of mergers between HBO institutions created larger and more powerful Universities of Applied Sciences. Between 1983 and 2008, the number of HBO institutions decreased from 375 to 40.

2. **Improved accessibility** (§4.1.1)
The accessibility of HBO for all societal groups improved greatly, e.g. for women, minorities, and the lower classes. Between 1983 and 2008, the number of HBO students increased from 144,000 to 384,000.

3. **A wave of new education programs** (§4.1.2)
In the years around 1990, a large number of new study programs were developed by the enlarged HBO institutions.

4. **Toppling the organization** (§4.1.3)
In the nineties, the strong influence of the disciplinary teams on the education decreased significantly, making room for the influence of education program teams chaired by a program manager, thus enabling the institutions to develop more coherent and profession oriented curricula.

5. **Environmental education** (§4.1.4)
As a part of the wave of new education programs, programs on environmental education were developed in quite a lot of higher education institutions. As a consequence, the number of students studying environmental programs increased rapidly.

Context of experiment #2 (1994 – 1998):

6. **New educational methodologies** (§5.1)
Methodologies like Problem Based Learning, project education and thematic education were introduced. As a consequence, a responsibility shift took place: the students gained a stronger personal responsibility for their educational goals and progress.

Context of experiment #3 (1998 – 2002):

7. **Restructuring HBO** (§6.1.1)
In order to increase the recognizability and transparency of the study programs, the number of different programs was reduced significantly.

8. **Professorships and applied research** (§6.1.3)
In contrast with the research universities, the HBO institutions did not have professors doing fundamental research. In 2001, the HBO introduced professorships (in Dutch: 'lectoraten') chaired by 'lectors'. Because of the focus of the HBO institutions on profession oriented education, the task of the new professorships is to perform applied research and thus to contribute to knowledge development and education. The professorship teams ('kenniskringen') consist partly of teachers of the own university, and usually also partly of staff members from outside organizations, like companies, governments, ngo's, and centres of expertise, thanks to which a strong impulse is given to the professionalization of the teaching staff.

Context of experiment #4 (2000 – 2009):

9. **External quality assurance** (§7.1.1)
In 1990 an external quality assurance system was introduced in the Dutch higher education, in the form of a visitation system regulated by the educational sectors themselves. Following the Bologna agreement of 1999, the system was replaced in 2002 by an accreditation system.

10. **Internal quality management** (§7.1.2)
In the nineties, the visitation system stimulated the HBO institutions to set up a structured system for quality management. The accreditation system demanded an even stronger quality management system, which for the majority of the HBO institutions has become a part of the nature of the organization.

11. **Involvement with sustainable development** (§7.1.6)
The HBO Handvest, the sustainability charter of the HBO, was signed in 1999 by 29 HBO institutions. Not all, but certainly a part of them really worked hard on the implementation of the promises they made. In the course of the years, especially since around 2006, a strong increase took place in the sustainability efforts of many HBO institutions.

Context of experiment #5 (2004 – 2009):

12. **Flexibility of education** (§8.1.1)
The personal responsibility of the students, resulting from the introduction of new educational methodologies, was increased by attempts of many HBO institutions to offer flexible learning routes.

13. **ICT, distance learning** (§8.1.2)
More new methods for the education became available thanks to the use of computers and the Internet. Virtual classrooms, online learning materials and serious games offer new opportunities for learning.

14. **Internationalization** (§8.1.3)
Ties between Dutch HBO institutions and foreign universities and organizations became stronger. This resulted in exchange of expertise between teachers, an inflow of foreign students to HBO institutions, and an outflow of Dutch students doing their internships with foreign companies or ngo's.

15. **New structures** (§8.1.4)
One of the consequences of the Bologna agreement was the Europe-wide introduction of a structure of three 'cycles', which in the Netherlands and other countries are called 'bachelor', 'master' and 'doctor'. For HBO, this resulted in four year education programs ending with a bachelor's title. Another consequence was the introduction of the major - minor system.

Context of experiment #6, 7 & 8 (2005 – 2009):

16. **Competence based learning** (§9.1)
The innovations of the educational methodology received a strong new impulse with the introduction of competence based learning, in which the earlier end qualifications of the study programs were replaced with a series of professional competences.

Taken all together, these change processes and innovations in HBO form a powerful environment to work on the development and implementation of ESD, and a very suitable opportunity to test the hypothesis of this dissertation: sailing on the winds of change.

3.4. The four roles of higher education in society

The already mentioned Dutch HBO Charter ('Handvest') for ESD speaks of "the integration of sustainable development in the education, research and operations as a starting point in the strategic policy of the university" (Steunpunt Duurzaamheid, 1999). So, the Charter describes three directions in which ESD may be developed in higher education. Each of these directions is linked to one of the ways a university may be seen, i.e. of the roles a university has in society.
First, the university acts as an educational institution. In this respect, the impact it has on society is, to guide and assist students with their learning processes and thus deliver sustainably educated professionals.
Secondly, the university is a research institute. Considering the university from this perspective, it delivers the results of fundamental or applied scientific research to society.

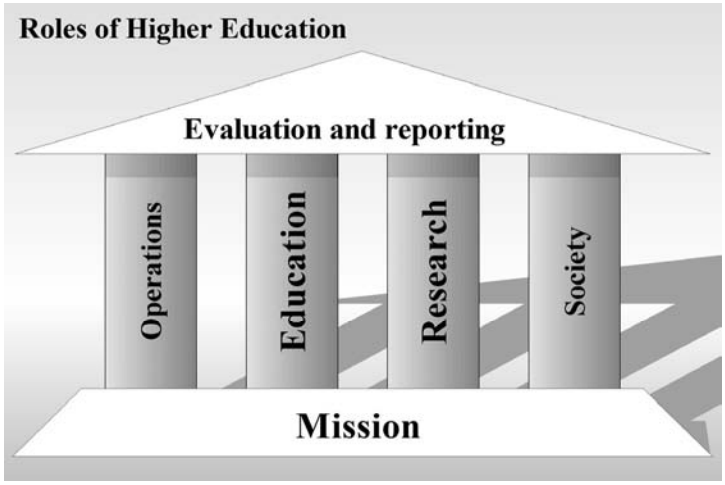


Figure 4. The four main roles of an educational institution in society

Thirdly, a university is an organization which, as all organizations, e.g. industrial companies, banks, government bodies, etc., has all kinds of operational interactions with the outside world, like the procurement, the employment of staff members, the use of energy and water, the transport of people and goods, and the production of waste, atmospheric gases, and other ways of environmental impacts (see: Clugston & Calder, 2000).
Besides these three roles, a university has a fourth role, which is not always emphasized. This is its direct interaction with society. This may take place together with the local community, for instance in the form of joint local Agenda 21 projects. It can also take the form of a participation

in cultural events. Other possibilities are: strengthening public discussions on subjects of present interest, e.g. through the media; participating in Third World development programs; assisting primary and secondary education; etc. More examples can be found in Megerle & Megerle (2000). In some countries, e.g. in Sweden, universities are obliged by law to actively work on this fourth role.
The division into the four roles of a university is used by others, e.g. Velazquez et al (2006). The four roles of the universities are shown in figure 4, in which the ideal situation is shown that all of those four roles are vested firmly on a fundament consisting of the organization vision and mission. Besides, in a university that is organizationally structured around quality management, the input from the organizational vision to the four roles has its counterpart in an output evaluation and reporting which, if used as an input to the organization mission, produces a closed loop of continuous improvement, in accordance with the so-called 'Deming cycle' of quality management (Deming, 1986).

As the above examples of the 'fourth role' show, it is not at all difficult for universities to find ways to strengthen sustainable development through this direct societal role. The same is true for the other three roles. Looking e.g. at the operations role, many aspects are relevant for sustainable development. An overview can e.g. be obtained by using the Triple P: see table 7.

Table 7. Some aspects of SD in the operations of a university

People	• Care for personnel, human resource management • Working conditions • Staff and student policy regarding women, immigrants, disabled • Protection against sexual intimidation, violence, discrimination • Policy regarding health of staff and students • Employment policy, relation with mission • Appreciation assessment among staff and students (in general, as well as regarding ESD policy)
Planet	• Sustainable building (new and existing buildings) • Energy consumption (savings, use of sustainable energy) • Water consumption (incl. 'grey' water system) • Traffic (of staff, students, goods) • Effects on the neighbourhood (smell, sound, safety, traffic and parking nuisance) • Procurement (paper, laboratory equipment, catering, etc.) • Waste (separation, prevention, reuse) • Garden management • Communication on environmental management (inventory of wishes and complaints; appreciation assessment) • Overall (environmental reporting, environmental management system, certification based on e.g. ISO 14000 or EMAS)
Profit	• Investments for SD; possibly longer cost recover periods • Savings (e.g. through reuse or economical use of energy and materials) • Long term strategy • Quality assurance: realisation of the university mission; special recognition or certification • Effects of SD on image, PR, marketing

A lot of universities have actively worked on sustainability in relation with their operations. The so-called 'Greening the Campus' projects (Shriberg, 2000), of which there were many, focuse mainly on 'Planet' aspects. An increasing number of universities have a fully functioning environmental management system (EMS) and are certified on the basis of e.g. ISO 14000, EMAS (European Community's Eco-Management & Audit Scheme; see Delakowitz & Hoffmann, 2000) or BS (British Standard) 7750. For an overview, see Sammalisto (2007).

Looking at the research performed by universities, there are two angles from which sustainable development can be considered. One is the research that has been specifically designed to contribute to sustainable development. The other considers all research, trying to study or to promote aspects of sustainable development in its goals and in the way it is performed. The same distinction can be made for the education, which may focus either on special study programs for (aspects of) sustainable development, or on all programs.

In this dissertation the main focus is on the educational role. Some experiments are dedicated to special study programs aiming at (aspects of) sustainable development. Other experiments consider more general study programs.
There are two main reasons for this selection. The first is that in the nineties, when the first experiments described in this dissertation took place, starting in 1991, a large majority of the projects on ESD in higher education all over the world was focusing on 'greening the campus' projects or other forms of operations-related subjects, and so there was a great need of ESD pilot projects aiming at the education itself.

The second reason is the potential impact of higher education on ESD through the various roles. When two of those roles, the education and the operations, are compared to each other, this comparison is relatively easy. If the university succeeds in integrating sustainable development in all or many of its operational activities, the consequence is that exactly one organization acts in a sustainable way: the university itself. But if sustainable development is integrated successfully in the study programs, it can be expected that a lot of students will, after graduation, eventually reach highly responsible positions in companies, governments, etc. where they will be able to do their work as professionals equipped with knowledge, skills, insights, and an attitude influenced by sustainable development. If so, then – on the long term – many organizations will work more and more sustainably, not just one. It is this snowball effect that makes the educational role so powerful (see figure 5).

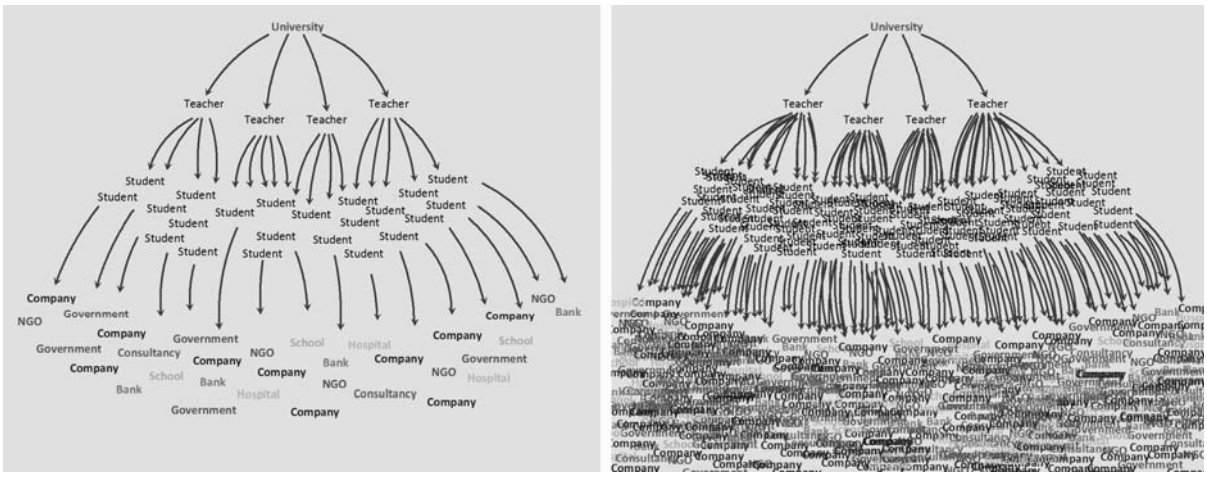


Figure 5. The snowball effect of the impact on society of sustainable development in the education of the universities. Left: the impact of one year. Right: the same, in a number of years.

On the other hand, the operations role is not only important because it can make just one organization, i.e. the university itself, more sustainable. It can also contribute to the educational role, because the universities then show that they 'practice what they preach'. Besides, the university and its campus can be applied as an object of study for the students, and thus contribute to the education too. Nevertheless, this only adds to the conclusion that universities can contribute strongly, perhaps even mainly, to sustainable development through its education.

3.5. Overview of the experiments

In the period of 1991 till 2009, eight experiments were performed or started in the course of the research program, in order to try and integrate sustainable development in HBO in the Netherlands. Each of them will be introduced briefly in this section. Next, they will be discussed in more detail, each in its own chapter or section.
As argued, the experiments took the shape of 'action research', as an example of 'learning by doing'. Each experiment reflects the time in which it was performed and the developments in higher education of that time, as the following brief overview will show. In these consecutive contexts, one or more appropriate questions were asked concerning the process of the design of education for sustainable development. Actions were performed, and the results were assessed in order to find answers to the questions posed.

3.5.1. Experiment #1: A new study program (1991 – 1994)

Question:

- Can higher education contribute effectively to sustainable development through a separate education program dedicated to (main aspects of) sustainable development?

Context:

- Fast increase of number of HBO bachelor programs
- Early interest in sustainable development

Actions:

- Formulation of the professional profile of a 'sustainable engineer';
- Development and deployment of an HBO bachelor program for sustainable technology ('M2')

In the years around and after 1990, the concept of sustainable development was fresh and new. The basic philosophy was laid down in 1987 by the Brundtland Commission. New insights and ideas spread and were recognized by higher education, like 'people – planet – profit', clean technology, life cycle assessment.
At the same time, many changes took place in the Dutch HBO. A lot of HBO institutions were in the midst of a wave of mergers, following the policy of the Dutch government to form larger and stronger educational institutions. These more powerful institutions buzzed with energy, and they started creating many new educational programs. So, it was natural to try and pick up the new ideas about sustainable development in the form of a brand new education program. This was done in the Hogeschool Midden-Brabant, a University of Applied Sciences in the city of Tilburg, in the southern part of the Netherlands. In 1990 the preparations were made to design the end terms for this program, based on an 'imaginary professional profile' that was developed in cooperation with a group of experts on sustainable development in the professional field. In 1991 the *researcher* joined the process as a member of a three person development team. At the same time the first students, a small group of five people, started studying the program, which had been given the name of 'Milieugerichte Materiaaltechnologie' ('M2' for short), in English: 'Environmentally Oriented Materials Technology'. Some years later, the program was unofficially renamed 'Sustainable Technology'. The first half year of the curriculum had been designed when the first students started; the rest of the four year program was made 'on the fly', as will be described in chapter 4.
In the final part of this chapter, a critical analysis will be made concerning the main question of this first experiment: is a separate study program dedicated to sustainable development a good idea? This analysis can only partially be answered in chapter 4, and will be continued at the end of chapter 5.

3.5.2. Experiment #2: Introduction of new education methodologies (1994 – 1998)

Question:

- Can an educational program optimize its contribution to sustainable development through a careful selection of educational methodologies?

Context:

- HBO-wide introduction of new educational concepts

Actions:

- Formulation of criteria for educational methodologies in order to contribute effectively to sustainable development;
- Selection of (existing or new) educational methodologies based on the criteria;
- Redevelopment and deployment of the existing HBO bachelor program for sustainable technology ('M2'), integrating the selected educational methodologies

Some years after the start of the M2 study program described in chapter 4, in 1994, the first group of M2 students were in their third year. By that time, the Dutch institutions for higher education were creating new ideas concerning the educational methodology. New ways of studying were introduced, like 'Problem Based Learning' (in Dutch: 'Probleem Gestuurd Onderwijs', PGO) and Project Education. These methods produced tremendous new opportunities for the integration of sustainable development, as will be described in chapter 5. It was no wonder that an external visitation committee, auditing M2 on behalf of the HBO Council, judged that the M2 program was well on its way to having a very good curriculum, considering the subjects it dealt with; but there were ample opportunities to adopt the new educational methods and thus improve the concept of the program. And so the team of teachers of M2, with the *researcher* now as the program manager, started a project to redevelop the M2 curriculum, embracing several new styles of education. It took them four years, from 1994 till 1998, to complete the task and find concrete answers to the question, how a variety of educational methodologies can be used to increase the effectiveness of education for sustainable development.

3.5.3. Experiment #3: Integration of sustainable development in existing programs (1998 – 2002)

Question:

- Can existing study programs, not yet giving much attention to (aspects of) sustainable development, be reformed in order to effectively increase their contribution to sustainable development?

Context:

- Decrease of number of HBO bachelor programs
- Increasing acceptation of sustainable development in many technological disciplines in the professional field
- Introduction of professorships in HBO

Actions:

- Adaptation of the professional profiles of the study programs of a Faculty of Technology, integrating aspects of sustainable development;
- Increasing the awareness, knowledge and skills of the teaching staff of these study programs;
- Integration of sustainable development in the study programs

In 1998, the climate towards the development of new HBO bachelor programs had changed. The Dutch Ministry of Education now tried to decrease the number of programs. At the same time, ideas in the professional field of many disciplines, especially in technological companies, concerning sustainable development had come forward, and they insisted more and more on the integration of sustainable development in many or all existing technological education programs.
So, in 1998 a project was prepared, aiming at the integration of sustainable development in all existing education programs of the Faculty of Technology of the Hogeschool Brabant in Tilburg and Breda. The 'Cirrus Project' was performed in four years, from 1999 till 2002, by a team of teachers chaired by the *researcher*. Chapter 6 shows the philosophy, the process and the results of the project, and especially the lessons learnt about the complicated process of reforming existing study program into education that contributes to sustainable development.

3.5.4. Experiment #4: Assessment of sustainable development in higher education (2000 – 2009)

Questions:

- Can sustainable development become a part of the mainstream of the educational processes in a university, implementing system integration of sustainable development?
- Can a quality management approach contribute effectively to this system integration?

Context:

- Growing importance of quality management in HBO
- Setup of ESD organizations, e.g. DHO in the Netherlands
- Development of Declarations and Charters about ESD, e.g. the HBO Charter on SD

Actions:

- Development of a system for standardized assessment and certification of study programs regarding the integration of sustainable development
- Application of the assessment system as a major element in the consultancy and coaching of managers and teachers in universities;
- Certification of successful study programs or university departments

In the nineties of the 20th century, both the Dutch Ministry of Education and the HBO institutions decided that the quality of higher education could and should be improved largely by introducing an external quality control mechanism as well as internal systems for quality management. In 1991 the external quality control was set up in the form of a visitation system of the HBO Council. Besides, a group of quality management experts in HBO institutions had adapted the existing 'EFQM model', an instrument for quality management of the European Foundation for Quality Management, to the Dutch HBO. This so-called 'Expert Model' was adopted by a part of the HBO institutions as the standard for their internal quality management.
Around 2000, the feeling had grown that the visitation system was not strong enough. As a part of the Bologna agreement (1999), the European Ministers of Education had agreed to fortify the quality control system of higher education, and in the Netherlands a new system was introduced in 2001, based on the concept of accreditation.
While these developments took place, DHO was set up (in 1998), the later Foundation for Sustainable Higher Education. In an attempt to bring sustainable development into the mainstream of the higher education activities, DHO decided in 2000 to develop a system for the assessment of educational programs called AISHE. For the development of AISHE, the HBO version of the EFQM model for quality management was used as a starting point. In two years, AISHE was developed, tested and validated by a DHO working group chaired by the *researcher*. From 2002, AISHE was used in many HBO institutions (and in research universities in and outside of the Netherlands), contributing to the awareness and involvement of managers, teachers and students of more than 100 educational programs, as well as to the policy development, action plans and results concerning sustainable development in these programs. Some of these programs were awarded the Certificate of Sustainability in Higher Education by DHO, based on the results of AISHE assessments. The Dutch and Flemish Higher Education Accreditation Organisation (NVAO) formally recognised AISHE and related it to the accreditation system, as chapter 7 describes.
The final part of this chapter discusses the question whether such an approach, following the strategy of quality management, can be used as a way to insert sustainable development right into the cores of the educational institutions, i.e. in the mainstream of their philosophy and their activities.

3.5.5. Experiment #5: An instrument for the introduction of sustainable development (2004 – 2009)

Question:

- Can an instrument be developed for the introduction to sustainable development that is applicable in study programs of many different educational sectors?

Context:

- Increasing flexibilization of higher education
- Increasing availability of innovative applications of ICT
- Internationalization of higher education
- New educational structures, resulting from the Bologna Agreement

Actions:

- Development and application of an instrument for the introduction of sustainable development for HBO teachers and HBO students, consisting of a text book, a website with accessories and a teacher manual

Projects for the integration of sustainable development in higher education, like the Cirrus Project, were performed in the years around 2000. The evaluation of such projects delivered important lessons about the do's and don'ts of such projects. From this, the 'tree model' for sustainable development education was developed, which is introduced in chapter 6. One of the elements of this model, the 'trunk' of the tree, is an introductory module for sustainable development. Many managers of HBO study programs accepted this tree model, as was experienced by ESD consultants now working for DHO. However, many managers indicated having a problem in realising the 'tree' in their program, because a suitable instrument for the introduction module was lacking. So, in cooperation with a large Dutch educational publishing company, the question was investigated, what the characteristics of such an introductory module should be, and a book, the 'Basisboek Duurzame Ontwikkeling' ('Basic book on sustainable development'), was written by the *researcher*. As accessories to this book, which was published in 2005, a series of online tools were designed, varying from spreadsheets, computer applications and supporting texts, to a teacher manual. As chapter 8 shows, the instrument was developed and evaluated in cooperation with top experts on sustainable development, HBO teachers and students.
Experiences of teachers and students will form part of the answer to the key question of chapter 8, whether the approach that was used was an effective one.

3.5.6. Experiment #6: Competences for sustainable development (2007 – present)

Questions:

- Which competences does a graduate need in order to contribute effectively to sustainable development?
- Can such competences be realized in the curricula of the study programs?

Context:

- Professional competences accepted as leading in HBO bachelor programs

Actions:

- Development of a set of competences for sustainable development (the 'RESFIA+D' model)
- Development of a method for the description and acquisition of sustainability competences for HBO teachers and graduating HBO students, consisting of a text book, a website with accessories, a teacher manual and a tool for sustainability-related competences assessment

Actually, the 'Basisboek Duurzame Ontwikkeling' was only the first half of a plan to develop educational materials about sustainable development for HBO. The second half consisted of a book with accessories for advanced HBO students called 'Werken aan duurzame ontwikkeling' ('Working on sustainable development'). This second book echoed a recent development in HBO in the 21st century, in which the intensifying relations between HBO and the professional field had lead to a reshaping of most HBO programs. The new curricula were based on a set of professional competences which replaced the earlier end terms.
A natural question was asked by a lot of HBO teachers about the consequences of competence based learning for sustainable development education. Should there be separate sustainability competences? Or should sustainable development rather be 'embedded' in other competences; and if so, how? The *researcher* tried to answer this question with a second book, as is described in §9.2. This experiment thus tried to find answers to the essential question of education for sustainable development: what can we expect from the graduates?
This experiment #6 is not yet finished, as only a small number of tests have been done with the competences assessment tool. The same is true for the experiments #7 and 8: they too will be finished in the coming few years.

3.5.7. Experiment #7: Scanning the Curriculum (2007 – present)

Question:

- Can a set of sustainability-related subjects be designed that is applicable to study programs of many disciplines as a checklist for the curriculum, in such a way that each discipline can put its own weights and preferences, making it fit to their needs?

Context:

- Increasing interest in sustainable development with teachers in HBO

Actions:

- Development and deployment of an SD Curriculum Scan

Many HBO teachers experience problems in trying to discover which concrete sustainability-related subjects they should integrate in their study programs. The introduction of competence based education made this question even more urgent to many. In an attempt to assist them, an instrument was developed by a team of DHO with which the curriculum of an existing or new study program can be assessed, discovering the strengths, weaknesses and 'white spots' concerning sustainable development. The instrument is described in §9.3.

3.5.8. Experiment #8: Assessing all roles of a university (2007 – present)

Question:

- Can an integrated quality management approach be applied to the education, the research, the operations and the societal activities of a university in a coherent way?

Context:

- On-going internationalization of higher education, including ESD

Actions:

- Development and deployment of a second version of AISHE, encompassing not only the education but also the other roles of a university

As AISHE, the assessment instrument that was developed in experiment #4, was used more and more in universities, requests came from different directions to enhance the instrument. As AISHE was directed mainly at the educational role of a university, some people asked for the opportunity to start using it for the operations of a university or a campus. Others requested an adaptation to enable them to apply it to the research of a university. Therefore, it was decided to redevelop AISHE, paying attention to all of those, and also to the fourth role, i.e. the direct societal activities of a university. The new instrument, 'AISHE 2.0', was developed by an international team, trying to make it a modular tool. A main problem that was tackled was the question, how to avoid that such a modular approach would deliver a fragmented view of the sustainability efforts of a university. In other words, how a holistic view can be achieved. The answer was given in the form of a basic 'Identity' module, as §9.4 describes.

3.6. Result assessment

All eight experiments intended to contribute to Education for Sustainable Development in Higher Education, or – through this – to sustainable development outside of higher education, e.g. its professional fields or even society in general.
In order to assess the results towards these goals, several criteria can be considered. In table 8, seven such criteria are mentioned. The experiments #6 till 8 are not yet finished, and their results will not be assessed in this dissertation. But the assessment of the first five experiments will each make use of all or most of these criteria.

Table 8. Criteria for result assessment					
Experiment Criterion	X1 M2 program	X2 M2 method.	X3 Cirrus	X4 AISHE	X5 SD intro
Contribution to ESD towards direct stakeholders					
1. Implementation of ESD in vision, policy	§4.3.1	§5.3.1	§6.3.1	§7.3.1	§8.3.1
2. Implementation of ESD in education	§4.3.1	§5.3.1	§6.3.2	§7.3.1	§8.3.1
3. Customer demand	(see §5.3.2)	§5.3.2		§7.3.2	§8.3.2
4. Customer appreciation	§4.3.2	§5.3.3		§7.3.3	§8.3.3
Contribution to SD towards indirect stakeholders					
5. Indirect stakeholder appreciation	§4.3.3	§5.3.4	§6.3.3	§7.3.4	§8.3.4
6. Contribution to SD through HE	§4.3.4	§5.3.5			
7. Transfer of expertise	(see §5.3.6)	§5.3.6	§6.3.4	§7.3.5	§8.3.5

Depending on the context or the kind of experiment, the criteria will be interpreted accordingly. As an example, for the 1st and 2nd experiment, the M2 study program, criterion #4, 'customer demand', will be interpreted as the number of students through the years. For experiment #4, AISHE, one of the indicators for this criterion will be the number of AISHE assessments that were performed, whereas in experiments #5, the Basic book, the number of books sold through the years will be one of the indicators.
The list of criteria distinguishes between direct and indirect stakeholders. The exact interpretation of these terms also depends on the type of experiment, but generally the direct stakeholders are persons or organizations that are explicitly mentioned as the ones at which the experiment focuses, while the indirect stakeholders are any others that may benefit from the results of the experiment.
In some experiments, one or more criteria are not applicable. The reasons will be explained in the appropriate chapters.
The above set of criteria meets the validity demands formulated by Scholz et al (2006) that were mentioned in §1.4.3:

- *Consequential validity*: The question whether higher education benefits from applying the experiment is tested in the criteria 1, 2 and 3.
- The criteria 4 and 5 test the *functional validity*, investigating whether, in the eyes of the internal and external stakeholders, the experimental actions function as they should.
- The *external validity* is tested in criteria 6 and especially 7.
- The *convergent validity* is tested by using triangulation of the results, first within each of the separate criteria for each individual experiment; next when combining the results of the various criteria for each experiment; and finally (in the closing chapter) when the conclusions of the separate experiments are joined in a 'grand triangulation'.
- The *ecological validity* is right at the fundament of the research. All experiments are performed directly in real life. The demand that the methods, materials and setting of the study must approximate the real-life situation (Brewer, 2000) is the basic principle of all experiments, worded as 'sailing on the winds of change'. The question whether the experiments are ecologically valid is the final test with which the dissertation ends.

3.7. Development of the dissertation

The description of the research program, consisting of eight experiments, and the dissertation as they were presented so far may seem to indicate that the whole process, covering about 19 years, was planned on beforehand. This is however not true. In order to render full account of the dissertation, the genesis of it will be described here briefly.
Actually, several development lines have occurred. One of them was the author's vision on sustainable development. In the first years of the research, this vision focused on the technological aspects of the concept, with an emphasis on lifecycle assessment, design for disassembly, etc. This was probably caused, at least partially, by a bias based on the original setting in which the first experiments took place - a Faculty of Technology - and perhaps also by the background of the researcher as a master in theoretical physics and the philosophy of science. This one-sided approach is reflected in the nature of the first experiment, aiming at realizing a study program on sustainable technology. Through the years, the view on sustainable development was widened, first to other aspects, as described by the Triple P, next to the concept of systemic change, paradigm shifts and transitions, and lastly to an increased emphasis

on subjects like human values, emancipation, participation and human dignity. This process was finalized (if it ever is) with the authoring of three books about sustainable development (Roorda 2005a, 2007, 2008).
Another development line was visible in the vision on ESD. Around 1991, the focus was on the development of separate education programs, of which the M2 program is witness, largely ignoring the rest of higher education. This shifted to the idea of the integration of SD into all study programs, however in such a way that it focused on separate, isolated modules within the curricula, this time largely ignoring the rest of the curriculum. The original targets of the Cirrus project (experiment #3) are a witness of this view (see chapter 6). In the course of this Cirrus project the notion grew - parallel to the growing awareness of the importance of systemic change - of the necessity of integrating SD thoroughly into the education process, resulting in the 'tree model' which is described in this dissertation. The final step in this development was the definition of the concept of 'SISD', system integration of sustainable development.
The third development line was the evolving view on the roles of the management. The original emphasis on line management, around 1994, shifted to project management which was functional to the Cirrus project in 1998, followed by quality management, resulting in the AISHE assessment tool in 2001, then to aspects of leadership (related to the consultancy that started in 2002), and next to change management and transition management. Each of these steps was accompanied by the study of scientific models and insights, and in most stages also by following a formal education program.
Do these three development lines reflect the development of science itself, either on SD or on ESD? Probably this is so, at least partially, but following the scientific development with a delay of some years, certainly in the first half of the research, only later to catch up and contribute to ESD theory development. This reflects the fourth development line, which was formed by a growing notion of the relevance of the results of the ESD experiments to the outside world. In the first years, immediately after 1991, there was no idea that the results of the M2 study program, viewed as an experiment or as a pilot project, might be interesting for others than the direct stakeholders, i.e. the students and their professional field. It took until 1996 and 1997 before the first articles were published, however not yet in international peer-reviewed ESD journal but in Dutch magazines for the professional field. In 1999 the first international presentation took place in an ESD conference, which indicates that only then it was realized that the lessons learned might contribute to the experiences and theory formation of ESD. The final step in this process was the idea of writing a dissertation based on the consecutive projects. Looking backwards, these projects were since then viewed as a series of experiments, together forming a research program. The actual authoring of the dissertation started at the beginning of 2009.
One basic view has always been present however, right from the beginning. It must be admitted that the notion of 'sailing on the winds of change' was not explicitly formulated any earlier than just a few years ago, after which it was investigated making use of scientific theories of management and change. But the corresponding mindset has always functioned as an implicit fundament. So, it is fair to state, as this dissertation does, that the principle of 'sailing' was the constant factor throughout all experiments. This constancy makes it possible at present to test the central hypothesis of the dissertation, making use of the entire series of experiments between 1991 and the present.
This all implies that the evaluation of the experiments in the next chapters is in some way an anachronism. The projects that are with hindsight considered as a series of experiments were performed with the mindset of the years in which they took place. In the evaluations however they will be judged with the views of today, starting with the first experiment right on the next page.

4. Experiment #1: 'M2', a new study program

In this chapter, the first of the experiments will be described. In this experiment, which started in 1991, after a preparatory year, an attempt was made to design an entirely new study program. This program was dedicated completely to an important aspect of sustainable development, i.e. sustainable technology. Thus, the experiment was an attempt to find answers to the following question:

Question:

- Can higher education contribute effectively to sustainable development through a separate education program dedicated to (main aspects of) sustainable development?

In the years around and after 1990, the concept of sustainable development was fresh and new. The basic philosophy was laid down in 1987 by the Brundtland Commission. New insights and ideas spread and were recognized by higher education, like 'people – planet – profit', clean technology, life cycle assessment.
At the same time, many changes took place in the Dutch HBO. A lot of HBO institutions were in the midst of a wave of mergers, following the policy of the Dutch government to form larger and stronger educational institutions. These more powerful institutions buzzed with energy, and they started creating many new educational programs. In short:

Context (§4.1):

- Fast increase of number of HBO bachelor programs
- Early interest in sustainable development

In those circumstances it was natural to try and pick up the new ideas about sustainable development in the form of a brand new education program. This was done in the Hogeschool Midden-Brabant, a University of Applied Sciences in the city of Tilburg, in the southern part of the Netherlands. In 1990 the preparations were made to design the end terms for this program, based on an 'imaginary professional profile' that was developed in cooperation with a group of experts on sustainable development in the professional field. In 1991 the *researcher* joined the process as a member of a three person development team. At the same time the first students, a small group of five people, started studying the program, which had been given the name of 'Milieugerichte Materiaaltechnologie' ('M2' for short), in English: 'Environmentally Oriented Materials Technology'. Some years later, the program was unofficially renamed 'Sustainable Technology'. The first half year of the curriculum had been designed when the first students started; the rest of the four year program was made 'on the fly'.

Action (§4.2):

- Formulation of the professional profile of a 'sustainable engineer';
- Development and deployment of an HBO bachelor program for sustainable technology ('M2')

Result assessment (§4.3):

In the final part of this chapter, a critical analysis will be made concerning the main question of this first experiment: is a separate study program dedicated to sustainable development a good idea?
Logically, a number of hypotheses can be formulated that can be tested in order to answer this question and thus define a successful special SD study program. Six such hypotheses for success will be used. They are the specifications of the general assessment criteria that were formulated in §3.6, of which the first two are combined:

1. The study program meets the demands of ESD.
2. The study program attracts a sufficient number of students.
3. Students appreciate (the ESD character of) the study program.
4. External stakeholders appreciate (the ESD character of) the study program.
5. The graduates contribute to SD in the professional field.
6. The program contributes to ESD implementation elsewhere.

The analysis of these hypotheses can only partially be answered in the present chapter, and will be continued at the end of chapter 5. The reason is that the M2 study program, as it was designed between 1991 and 1994, was changed drastically between 1994 and 1998. The reasons for this change will become clear in the course of this chapter. The change process which started in 1994 will be treated as a separate experiment of the ESD research program, and the result, the "second M2 program", will be described in chapter 5.
This means that the "first M2 program", which is the subject of the present chapter, does not deliver significant data concerning some of the six hypotheses (e.g. hypothesis #2, the student numbers), and so the discussion of them will

be postponed till the next chapter. Other hypotheses, e.g. meeting the demands of ESD (hypothesis #1) will be discussed extensively in the final part of the present chapter.

4.1. Context

4.1.1. Mergers and growth of HBO institutions

The origin of HBO

The roots of some parts of HBO lie in the 18th century, e.g. the arts education (Van Bemmel, 2006). Mostly these institutions were founded in the private sector. In 1785, the first nautical school on an HBO level started.

Early in the 19th century the guilds disappeared in the Netherlands, and so did the guild related vocational education. As a consequence, in the second half of the 19th century, independent schools for technical and economic education arose, mostly through private initiatives, strengthening the ongoing process of industrialization. In the 20th century, these forms of education nearly all became part of the public sector, financed by the government, a shift that was completed in 1963. Social studies, health and teacher education were founded.

In 1968, a new law on secondary education (the 'Mammoetwet') was installed. In this law, for the first time the HBO was recognized as a separate educational sector, although still being a part of secondary education. Only in 1986 the sector was officially described as belonging to higher education, as was put down in a new law on higher education (the Law on Higher and Professional Education, WHBO). From this year, the institutions have the name of 'hogescholen'.

Graduation in an HBO study program did not lead to an official title, apart from the technical education, which lead to the title of 'ingenieur' (engineer), as did the Universities of Technology; the distinction was visible in the abbreviation, which was 'ing.' for an HBO graduate (and 'ir.' for a university graduate). In 2002, following the Bologna Agreement, the official title of 'bachelor' became available in the Netherlands and was officially recognized for the HBO graduates in the whole of the European Higher Education Area (EHEA). Specific titles are e.g. Bachelor of Engineering (B. Eng) and Bachelor of Nursing (B. Nursing).

In 2009, the official title of 'Bachelor of Applied Sciences' (BASc) was introduced for technical, economic, and agricultural studies, and 'Bachelor of Applied Arts' (BAA) for other studies.

Since 2002, the HBO institutions also have the opportunity to develop Master's programs, but not all institutions make use of this, since - in contrast with the research universities – the Master's programs in the Universities of Applied Sciences are not funded with government money (HBO Council, 2006a).

The HBO education is divided in 7 sectors: agriculture, engineering and technology, economics and business administration, health care, fine and performing arts, education (teacher training), and social welfare.

Up-scaling

Since the beginning of the eighties much pressure was exercised by the Dutch national government to improve cooperation between HBO institutions. According to the Ministry of Education there were too many HBO institutions in the Netherlands, and the efficiency was too low, because of which the government expenses per student were too high. The HBO Council, the association of Dutch HBO institutions (founded in 1975), agreed that the number of HBO institutions should decrease, because many of them were too small to organize their education properly and cost-effectively.

In 1983 a policy document called 'Up-scaling, Task-Allocation and Concentration (STC)' was published (O&W, 1983), in which a proposal was formulated in order to strengthen the HBO structurally, educationally as well as organizationally, and to cut back government finances. The STC-operation formed the beginning of a long period of mergers of HBO institutions. It was also the first step in a process of deregulation and autonomy enlargement of the institutes (HAN, 2007). Goedgebuure (1992, p.6):

> "The STC-policy set conditions, which the HBO-institutions had to meet by the start of the educational year 1986-1987 in order to receive continued governmental funding. These conditions were:
> - an institution should have a minimum enrolment level of 600 students
> - an institution should function as an administrative and educational unit, implying one board of governors, one board of directors and one participatory body (formed by staff and students)
> - there should be a 'reasonable distance' between the several sites of an institution, so that potential (envisioned) benefits could be fully realized."

These essential conditions were the only ones set. The choice to merge, with which institutions and in what way was the responsibility of the institutions themselves. However, the government had the authority to approve or turn down plans for merging, and it created measures to prevent that institutions wouldn't be able to join in any of the

plans of merging (HBO Council, 1984, p.28). The HBO Council was asked by the government to act as the coordinating body for the process (Goedgebuure, 1992). The STC-process had three main goals:

1. Enlargement of the size of the institutions of HBO by means of mergers between HBO institutions. This created the possibility of interaction between different disciplines, a larger distribution of knowledge and experience over teaching staff, a broad spectrum of choices for students, a more solid basis for post-HBO education, facilitation and research and a strengthening of the innovative capacity.
2. Enlargement of the autonomy of the institutions with regard to personnel policy, the use of resources and the structuring of educational processes. This required a strengthening of the management in the institutions.
3. A greater efficiency in the use of resources by using larger groups, where possible, concentration of expensive equipment and other facilities, coordination and where possible a combination of course-elements.

In the STC-policy a preference was stated for multi-purpose institutions, but it remained possible for institutions to be mono-purpose. Especially the PABO's (institutions for teacher training in primary education), the agriculture and the arts sectors largely remained single-purpose, whereas other HBO sectors became part of multi-purpose institutions.
In 1987 the biggest wave of mergers had taken place, although it continued in a slower pace in the next twenty years. The number of institutions had decreased with a factor 4. In table 9, characteristics of the HBO-sector before (1983) and after (1987) the merge are indicated. Table 9 shows the decrease of HBO institutions from 1983 till 2007 and the increase of HBO students in the same period; see also figure 6.

Table 9. Effects of the STC operation (1983 – 1987)

Year	**1983**		**1987**		**2008 ***	
HBO institutions by size:						
0 – 600	270	(75%)	21	(25%)	2	(5%)
600 – 2000	81	(23%)	34	(40%)	16	(40%)
2000 – 5000	8	(2%)	18	(21%)	6	(15%)
5000 – 8000	-		6	(7%)	2	(5%)
8000 –	-		6	(7%)	14	(35%)
Total	**359**	**(100%)**	**85**	**(100%)**	**40**	**(100%)**
HBO institutions by educational field:						
1 discipline:	355		56			
Agriculture	*11*		*6*			
Technique	*63*		*2*			
Health	*35*		*2*			
Economics	*18*		*10*			
Behavior	*48*		*2*			
Arts	*54*		*12*			
Education	*126*		*22*			
2 disciplines	19		9			
3 disciplines	2		9			
4 disciplines	-		8			
5 disciplines	-		6			
6 disciplines	-		4			

Source: Goedgebuure (1992, p.158); * HBO Council (2009d)
Note: total number of institutions differs because of basis used

After the merge, most HBO institutions were large-scale, multi-purpose institutions (see figure 6). These institutions strived for a complete offer of educational HBO-programs in their region. However, many of the large-scale institutions still are segmented in relatively autonomous departments called 'schools' or 'academies' which offer their own educational programs (Schellekens, 2004). In other words, many HBO institutions are multidisciplinary but not strongly interdisciplinary.
In the 21st century, the cooperation between HBO and research universities intensified. Because of the bilateral system in the Netherlands, mergers between research universities and HBO institutions were not possible for some time. However, cooperation was possible in several ways:

- Moving up of students from HBO to universities after graduating
- Fine tuning of educational programs and end terms
- Development of educational material
- Making scientific research more accessible for all HBO programs

Table 10. HBO mergers and the increase in HBO student numbers (1983 – 2007)

Year	Number of HBO institutions	Number of HBO students
1983	375	143,934
1985	348	199,300
1987	88	215,767
1991	80	255,669
1997	58	263,590
2000	56	298,700
2004	49	350,056
2007	41	357,300

Source: Inspectie van het Onderwijs (1984, 1986, 1988, 1992, 1998, 2001, 2005 and 2008)

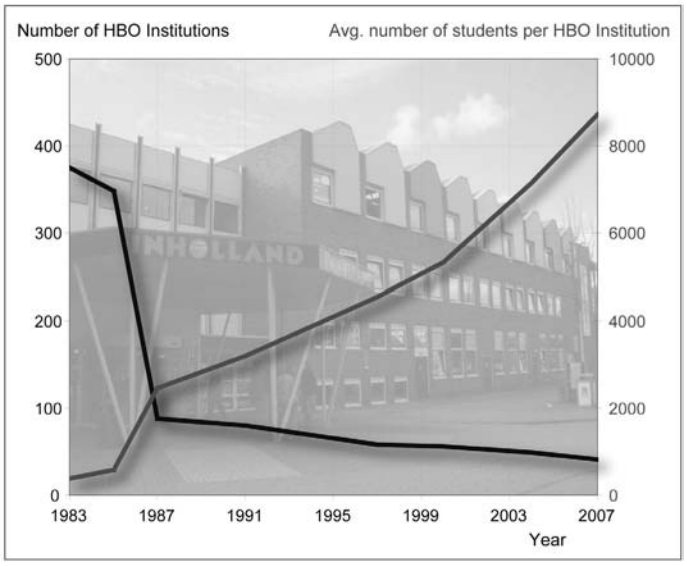


Figure 6. The decrease of the number of HBO Institutions and the increase of their sizes

Examples of such cooperation are (Inspectie van het Onderwijs, 2005):

- The University of Amsterdam and the Hogeschool of Amsterdam made agreements about moving on and referencing of students. They even offer a combined orientation year. The two institutions have a common Board.
- The Medical Centre of the Free University of Amsterdam and the Hogeschool INHOLLAND cooperate on the education for nurses.
- The Hogeschool INHOLLAND and the University of Nyenrode developed a joint-venture, offering a three-year Bachelor program in Business Administration.
- Wageningen University and the Hogeschool Van Hall Larenstein merged on the Board level in 2004.

Other examples of cooperation are described in Schrijvers & 't Hooft (2006).

Accessibility

The rapidly increasing numbers in table 10 are an indicator that higher education has become available for more and more people. The accessibility did increase, as other data show.

The emancipation of women has lead to an increasing number of women graduating in higher education. Looking at the age group of 15 till 64 years, the number of women who graduated as bachelors, masters or doctors was 16% in 1996. Ten years later, in 2006, this percentage was 24%. For males, these numbers are 22% and 25%, respectively (CBS, 2008b). Figure 7 focuses on HBO, and shows the annual increase in the number of people graduating. This graph shows that the number of females graduating in HBO has become significantly higher than the number of males.

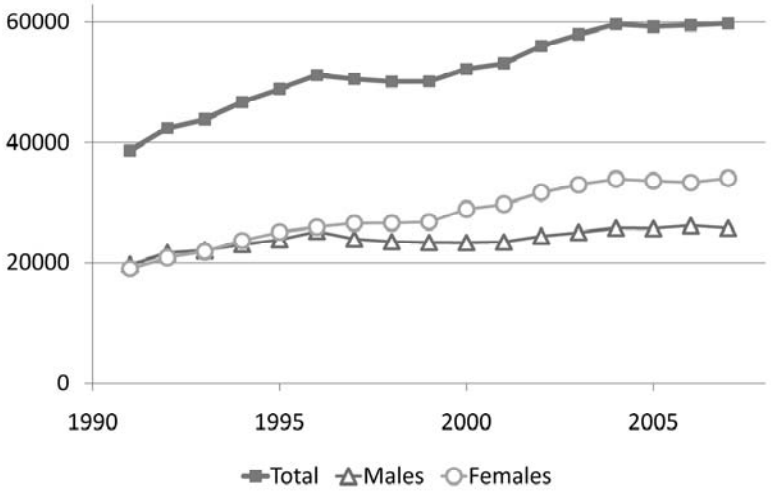


Figure 7. Number of male and female students graduating in HBO, 1991 – 2007.
Source: CBS, 2008a

The accessibility of minority groups in Dutch society also increased significantly. In 2004, the percentage of HBO students was: western immigrants 6%, non-western immigrants 5% (HBO Council, 2004). In 2007, these numbers were: western immigrants 8%, non-western immigrants 7% (HBO Council, 2007b). This means that in a short period of three years, the percentage of immigrant HBO students increased from 11% to 15%.

The strong increase of higher education graduates is hardly enough to meet the policy of the Dutch government and the demands of the labor market. This is one of the reasons why the Ministry of Education decided to support life-long learning (Schellekens, 2004). The HBO has a strong task in this, for instance attempting to involve the employees of companies and government institutions (HBO Council, 2006b).

4.1.2. A wave of new programs

In 1985 a report was published, the so-called "HOAK nota", by the Ministry of Education, which strived for an enlargement of autonomy of institutes of higher education (HE). Based on the HOAK note, the WHW (Higher Education and Research Act) was introduced in 1990, which increased the autonomy of the institutions. According to this new law, it was no longer demanded to receive approval by the government to start new educational programs. As a reaction to the increased autonomy of institutions and the decrease of regulations from the government a lot of new educational programs were created. Entirely new programs were introduced, not yet offered by any institutions yet, as well as programs already offered by other institutions.
In 1993, an Advisory Commission on Education (ACO, Adviescommissie Onderwijsaanbod) was set up by the Minister of Education, in order to assess the effectiveness of the new educational programs. The ACO had the authority to approve or reject curricula. Curricula also had to be registered in the CROHO (Central Register of Higher Education Study Programs). However, this still left institutions with the possibility to either register comparable programs under a different name in CROHO, or register extensively different programs with the same name in CROHO, since the WHW did not acknowledge standard educational programs (Inspectie van het Onderwijs, 1997).
One other restriction existed: institutions were not allowed to expand their 'educational profile' beyond the sectors of HBO they already covered. Also, within these sectors certain restrictions existed. As a reaction, institutions sought merging partners which broadened their domain. As a consequence, the character of the mergers after 1987 changed, compared to the period before. Where the institutions in the first period were relatively small when merging, from 1987 onwards large institutions merged with each other in order to extend their educational profile, enlarge enrolment and create a strong position at the supra-regional level (Goedgebuure, 1992).
The core tasks of the government in those years were:

- to stimulate that the education system was organized in such a way that the linkage to the labor market was optimal;
- to stimulate the effectiveness of education and research, both within the institutions and related to the welfare of society;
- to stimulate specific goals in education and research based on societal and political priorities.

4.1.3. Coherent curricula

In 1990, the *researcher* started working as a teacher in the Hogeschool Midden-Brabant, a University of Applied Sciences in Tilburg. At that time, all of the teachers were organized in discipline-oriented 'subject groups', and through this structure the contents of the curricula of all study programs of the university were determined, based on decisions of the subject groups. This was the way it had been done for many years in most or all other Dutch universities.
Nevertheless, dissatisfaction with some of the consequences of this system dated from at least the seventies of the 20th century. One of the reasons was (Willems, 2006) "that the programs showed a lack of coherence. Each teacher taught his subject, and it was left to the student to relate the various subjects to each other."
The main problem was illustrated by Graumans (1997), who presented the following case of an actual study program, in which the management team complained:

> "The involvement of the teachers limits itself primarily to the parts they themselves take care of. The coordination is a tough job. After a lot of pushing they gave us their education plans, but they keep changing them all the time without consulting us. They appeal to developments in the professional field. And who are we to say they should or should not do this. (...)
> [The teachers] expect that the students will be able to find coherence in the different, often dissonant pieces of information. In their viewpoint it is not their task to make this integration possible for the students by means of an inherent and programmatic coherence."

When, early in the nineties, the coherence in the curriculum became an explicit item in the external quality assurance through visitations of the HBO study programs by the HBO Council (which will be discussed in more detail in chapter 7), many of the HBO institutions changed the organizational structure. This change process, which may be described as 'toppling the organization', is shown graphically in figure 8.
Instead of an expert-driven organization, the structure became process-driven, the processes being the studies of the students. Teams were formed that together became responsible for the entire curriculum of a study program. Such a team derived the curriculum from the professional profile of the study program, which was designed and continuously improved in cooperation with the professional field. (This development may be considered as a precursor to the introduction of 'competence based learning' which was introduced widely in HBO in the first decade of the 21st cen-

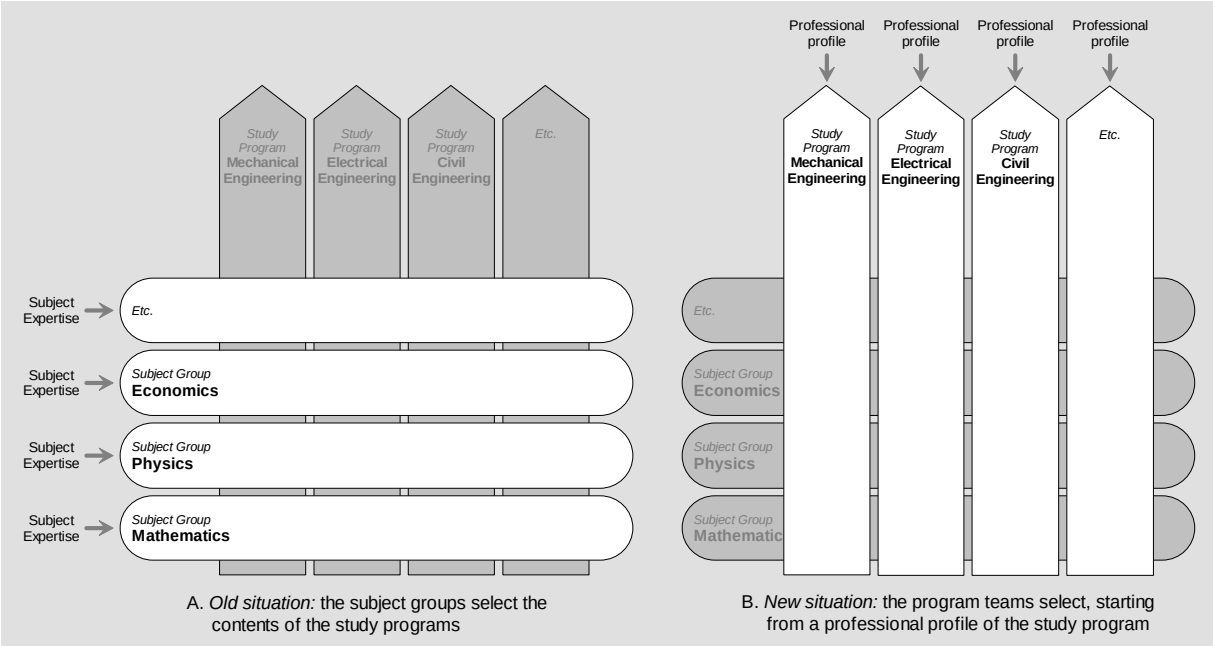


Figure 8. Toppling the organization: from expert-driven to process-driven curricula

tury, as chapter 9 will describe.) This strategy for curriculum development consists of four steps, according to I. ten Dam (1997):
Step 1: Determine the demands from the professional field.
Step 2: Derive from them the educational goals, also called the end terms.
Step 3: Fill in the outlines of the educational program.
Step 4: Detailed specification of contents and methodologies of each module.

In principle, such a development is a never ending, iterative process.
In later developments, where the educational developments put more emphasis on the educational methodologies and didactics, the selection of the methodologies shifted from step 4 to an earlier phase, since this too was considered to be a structural aspect of the curriculum as a whole. This will be described in chapter 5, where the methodological consequences of 'process-oriented education' will be discussed in more detail.
Croonen (1994) sees such a toppling of the organization structure as a logical step towards internal entrepreneurship in the process of effective decentralization. As such, the process was a part of the growing strength and self-confidence following the wave of mergers in HBO.
Thomassen (2002) describes the consequences of such an operation:

> "In the process of toppling the organization structure the primary process plays an ever increasing role. (…)
> New departments and teams are composed with employees who together are responsible for all functions of the primary process. (…)
> The importance of this organizational change related to customer directedness is that in this way the process for the customers can be controlled much better. (…)
> In many cases, while mapping the primary process, it appears that activities are being made which are unnecessary."

In the case of the HBO institutions, the primary process is the education. The customers Thomassen mentions are, on the one hand, the students, and on the other hand the future employers of these students, i.e. companies, government departments, etc. Indeed, in many cases it appeared that the curricula contained certain elements, not because the professional field asked for it, but only because the subject groups, many of which were dissolved in the change process, thought they were important. Many of those elements were cut away.
For the work of the teachers, the change had important consequences. In many HBO institutions an internal system of quality management was set up (see chapter 7) as a reaction to the external visitation system. In this internal quality management system, the roles of the individual teachers could no longer be one of an 'independent entrepreneur' or a 'member of a guild' (the subject group) within the study program. Bevers (1997) explains:

> "The fact that a study program is expressly working on the education (programming, selection of principles, etc.) is an element of the quality of the education.
> For the teachers this implies that the boundaries for action are fixed. Within those, there is still room for own

initiatives, but a completely autonomous design and implementation of the subjects / modules is impossible. The teacher will have to discover how large the maneuvering room is, by checking regularly the effects of their contribution to the education, and see if it still fits with the appointed principles of the program. A teacher will have to study the contents and didactic framework, decide what the consequences are for the own educational contribution, check how the course is prioritized in the program, and ask the colleagues about possible course transcending aspects that need to be considered."

Actually, this change process replaces an education which is oriented around the teacher, by one in which it is oriented around the student. Delhoofen describes it as follows:

"Teacher oriented education does not consider the notion that learning is an active, constructive and self-controlled process, in which the student, based on existing knowledge and experiences, builds internal knowledge models and images that change continuously." (Delhoofen, 1996)
"The organization has to topple: not the teacher, the subjects and the timetable are central but the student, the themes and the study table. 'Toppling of the organization' is not only a metaphor for 'drastic cultural changes' but also a concept to describe a well-formulated process of redesign. While toppling the organization we organize work processes around the primary process, where we strive to replace a complex organization with simple tasks with a simple organization with complex tasks." (Delhoofen, 1998)

More details about surrendering the autonomy by the teacher are given in chapter 6 of Delhoofen (1998).
For the integration process of sustainable development into higher education, this change process was highly relevant, because in the new organizational structure it became easier to investigate the best way to distribute sustainability related subjects over the curricula, thanks to a clearer and more complete overview of the entire curriculum. Besides, as the influence of the professional fields increased, the desires concerning sustainable development – if present – from these customers would stimulate the sustainability integration process.

4.1.4. Environmental education

In the seventies of the 20th century, environmental subjects received a lot of attention in the Netherlands, from the main public as well as in politics, partly due to publications like "Limits to Growth", the well-known report to the Club of Rome (Meadows et al, 1972). In those years, gradually a number of environmental subjects were adopted by some study programs in higher education. Some research universities developed new study programs dedicated to environmental management (Leuven et al, 1995). In primary and secondary education, as well as in informal learning, the emphasis was on nature and environmental education (Tauritz & Wals, 2009).
In 1984, two HBO institutions started their first environmental study programs. Other Universities of Applied Sciences followed, as table 11 shows. In the same year, an impressive educational tool became available, the sizeable book "Basisboek Milieukunde" (Boersema et al (eds.), 1984), which covered all major fields of interest.

Table 11. Start of fulltime HBO environmental education programs

Year	Program	Institution
1984	Environmental management	Rijkshogeschool IJselland
1984	Environmental management	Van Hall Instituut
1987	Environmental education	Hogeschool Holland
1990	Environmental education	Hogeschool Utrecht
1991	Environmental management	Hogeschool West-Brabant
1991	Environmental management	Hogeschool Utrecht
1991	Environmental management	Agrarische Hogeschool Delft

Source: HBO Council, 1995

Ups and downs

The popularity of environmental subjects with the main public varied considerably over the years. So did the enthusiasm of students to choose an environmental study. VSNU (2002) describes a first "environmental wave" around 1970, and a second around 1990. ((It is remarkable that this report writes: "This is no reason to expect a next environmental rise around 2010 with, as a consequence, a rising demand for environmental experts". In reality, such a rise seems to take place, including the start of new study programs, e.g. on sustainable energy.)

The 'second wave', around 1990, was strengthened by an increasing attention to the environment by the Dutch government. In 1988 an influential report was published by the National Institute for Health and Environment, "Zorgen voor Morgen" ("Concerns for Tomorrow", RIVM 1988). This was soon followed by the first National Environmental Policy Plan (NMP, VROM 1989) by the Ministry of Environment, the first in a series of such plans. It is no wonder that the expectations about the environmental education were high. The situation in this educational sector at that time was described by de Voogd et al (1989), p. 181:

> "In HBO fulltime education, momentarily 85 different educational forms or subjects exist through which environmental expertise can be acquired. In most cases this is education in which the environment is inserted as an extra."

De Voogd et al expected a growth of the number of jobs for environmentalists of 4.5% annually. An increasing number of them would be from HBO (compared to university graduates), considering the needs of the professional field. Indeed, the number of environmental graduates from HBO increased rapidly, as figure 9 illustrates.

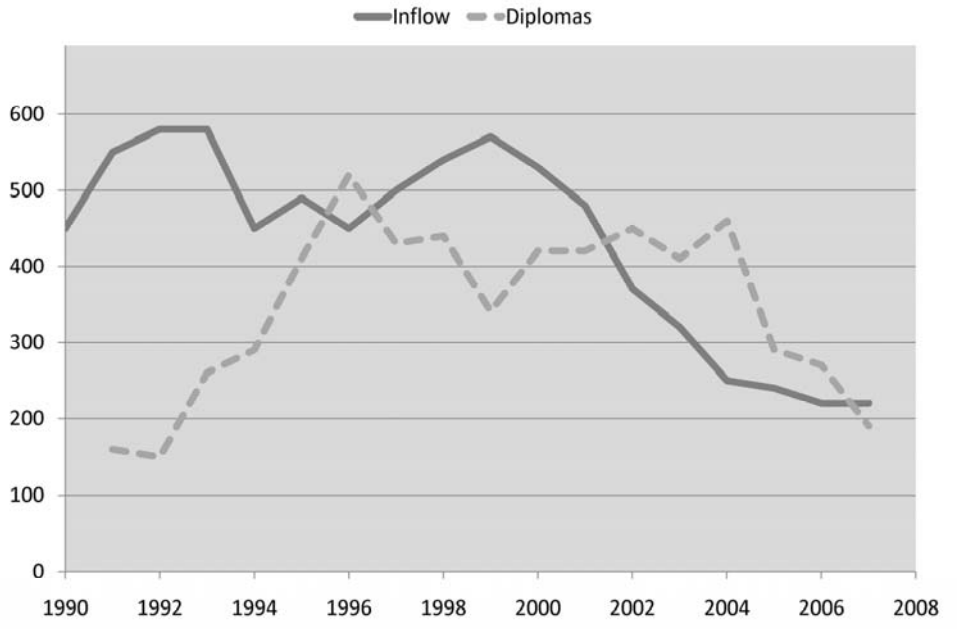


Figure 9. Number of students flowing in and graduating in HBO environmental education, 1990 – 2007.
Source: CBS, 2008a

For a number of years, the environmental studies were very popular. But just as the first wave, also the second wave of environmental enthusiasm diminished. In 1996, the Dutch Association of Universities (VSNU) expected a decrease in the demand for environmental experts from higher education, in the period between 1996 and 2005 or 2010, of around 10% (VSNU, 1996). For some years, the number of environmental HBO students remained quite high, but after 2004 the number decreased rapidly, and several study programs were shut down.

At present, the attention to environmental subjects has increased sharply, perhaps partly thanks to the famous book and movie by Al Gore, "An inconvenient truth" (Gore, 2006). This time, the main focus is on climate change. Several Dutch HBO institutions are preparing special study programs dedicated to environment and energy. As a consequence, the number of environmental students may rise again in the coming years, creating perhaps a 'third wave'.

The complicated relation between environmental education and sustainable development

As the concept of 'sustainable development' became more and more important in the nineties, the environmental education was in doubt about its relation to the concept. As the expectations for the need for environmental experts decreased, it was natural to ask, what the role of the environmental experts could be or should be in the coming years, and consequently, what the nature of the environmental study programs should be. As a part of this discussion, the final report of the 2001 Visitation Commission of the HBO environmental study programs formulated serious doubts about the nature of the programs at that moment (HBO Council, 2001).

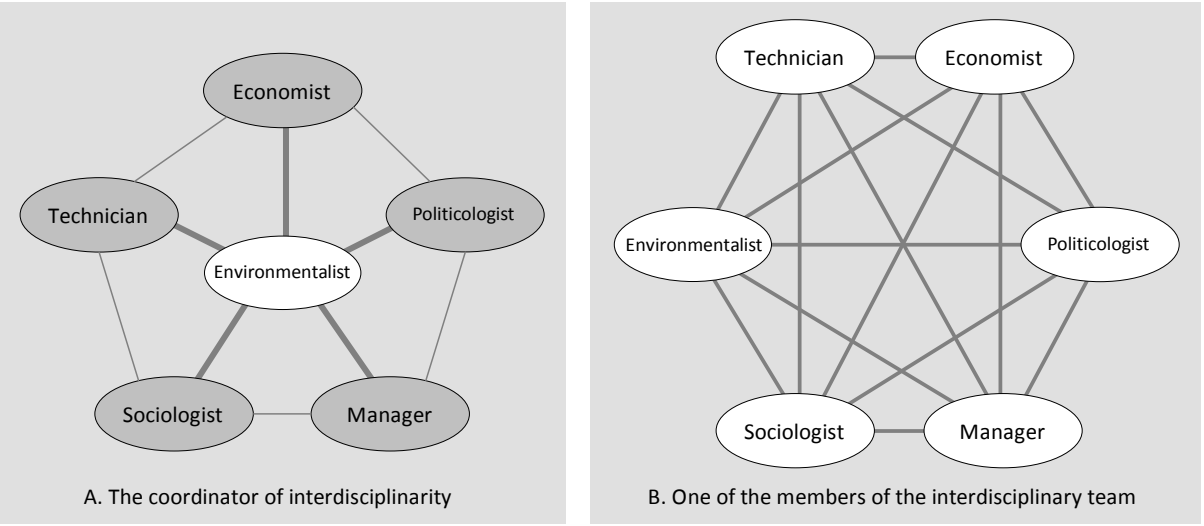
Several field studies were performed. In one of them, Dröge and Schoot Uiterkamp (2001) looked at the future needs of the professional field for environmentalists, and attempted to redefine the professional competences they would need. In another investigation, a commission of the HBO Council looked at the question, what the relation should be between the environmental study programs and sustainable development, regarding the fact that more and more non-environmental university programs were already integrating aspects of sustainable development in the curriculum: the environmental programs were 'loosing territory' (Verkenningscommissie Milieuopleidingen, 2000).

In the final report of this latter investigation, it was recommended that three major profiles were to be discerned for the future environmental experts: the *consultant*; the *researcher*; and the *process manager*. For all of those profiles, an interdisciplinary role as part of a team of various disciplines would be vital.

After the report was published, many of the universities with environmental programs were searching for a new definition of their program, a new '*raison-d'etre*'.
In this context, a series of AISHE audits were done in the environmental programs of a number of HBO institutions: HAS Den Bosch (2002), Van Hall Instituut (2002), Hogeschool Brabant (2002), Hogeschool IJselland (2003), and Hogeschool Inholland (2005). (AISHE will be described in more detail in chapter 7, as its development by the *researcher*, and the application in many universities, is one of the experiments of this dissertation.)
Not surprisingly, the results showed an emphasis on the need for the development of a new vision. The high priorities for improvement were chosen for criteria 1.1 till 1.3 (vision, policy, communication), 2.3 (staff development), 3.1 (profile of the graduate), and 4.1 (curriculum). Some citations from the audit reports illustrate the dilemma (DHO 2002a, b, c, 2003, 2005):

> "A 'kind of' vision exists, but the contents are not formulated very explicitly. There is much emphasis on environmental subjects, and not enough attention to sustainable development in general. That is to say, sustainability is interpreted too narrowly as 'mainly environmental matters'."
> "It is virtually impossible to check whether the students acquire the correct and sufficient professional competences, because the staff team hardly has an idea about what kind of professional competences related to sustainable development they should be teaching."
> "We should make a clearer distinction between environmental subjects and sustainable development".
> "Sustainable development is not a main subject in the examination regulations."
> "The vision about our study program has to be re-evaluated considering the three P's".
> "The university has a professor and an expert group on sustainable development, but the environmental study program is not represented in it."
> "Sustainable development is not a structural item on the agenda of the staff meetings. Communication about it mainly takes place during the coffee breaks."
> "There is a vision on sustainable development, but it has not been translated into a concrete policy."
> "If sustainable development is to be a part of the study program, it should be an element in the development plans."
> "The Mission Statement of our university mentions sustainable development. We did not yet make this concrete for our department. We should work on this, e.g. during a conference or a study day."

The ambiguity regarding the role of the environmental professional, discussed during the audits, appeared to focus on two different views on the professional role of the future graduates. The above mentioned HBO Council report had emphasized an interdisciplinary role, and this was interpreted by some as a recommendation to see the environmental expert as specializing in interdisciplinarity, as a 'spider in a web', as the one who was going to connect all kinds of other specialists with each other. In contrast, others thought of quite another interdisciplinary role, where the environmentalist would still be a specialist in his own field, and would function as just one of the members of an interdisciplinary team. Figure 10 shows the distinction between the two visions.



A. The coordinator of interdisciplinarity

B. One of the members of the interdisciplinary team

Figure 10. Two visions on the interdisciplinary role of the environmental professional.

In one of the universities mentioned, the team of the environmental study program concluded that it was possible to structure a decision process as a step-by-step approach (Roorda, 2004). First, decisions about the profile of the graduate should be made: especially, a fundamental choice between the two possible roles of the environmentalist should be made. From there, a vision about the relevance of sustainable development for the study program could be developed, followed by a policy plan leading to a curriculum and to a staff development plan for sustainability subjects.
Even before that, it was vital to develop a good plan for the communication with all kinds of stakeholders. Only if there was a solid communication structure, guaranteeing that all interests of the professional field, of NGO's, of governments and of other stakeholders would get the right attention, it was to be expected that a valid and durable profile of the graduate could be developed.
As a consequence, a development scheme was designed (see figure 11).

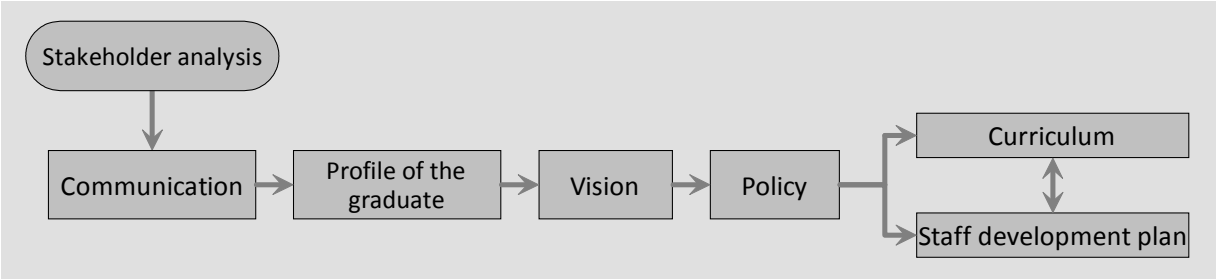


Figure 11. The development scheme for the environmental programme

This example illustrates the dilemma of the environmental study programs around the subject of sustainable development. Recent private discussions with managers of such study programs show that this dilemma is not yet a theme of the past.
More details of the above case can be found in Roorda & Martens (2008), which is reprinted in this dissertation as Appendix 5.
Around 1990, the Hogeschool Midden Brabant decided to follow another kind of approach. This was to be the first experiment of the present dissertation.

4.2. Action: Development of M2, a study program for sustainable technology (1991 – 1994)

To summarize the situation around 1990: The HBO in the Netherlands had become a strong and dynamic educational sector of higher education, possessing innovative power. One of the ways in which this power was expressed was the development of a large number of new education programs. A new category of study programs had been developed recently and was still growing, i.e. the environmental studies.
In this context, if a university developed the idea of integrating sustainable development into its education, the natural way was, to design an entirely new study program. That is what the 'Hogeschool Midden-Brabant' ('HMB'), located in the city of Tilburg in the south of the Netherlands, did.

4.2.1. The Single Program approach to Sustainable Development Education

It was a daring approach, when the HMB decided in 1990 to investigate the possibility of a new study program, dedicated to sustainable technology. The already mentioned 1989 reconnaissance of the environmental education (de Voogd et al, 1989) did not make any relation between environmental education and sustainable development; the Brundtland Report (WCED, 1986) was not even mentioned in the 1989 report. Besides, there was hardly any trace of a desire expressed by the professional field for sustainability experts.
On the other hand, the approach, although daring, was also a logical one. In the years around 1990, many HBO institutions launched new study programs. Up to a certain level, this was the way the HBO fulfilled its new role of entrepreneurship: the development of new 'products', i.e. study programs. So, developing a special study program around the concept of sustainable development was an example of 'sailing on the winds of change'.
As the main architect of the new study program, Leo Siemons, wrote (Siemons, 1993):

> "Starting point in the thinking about a new study program is a study day on October 10, 1986 about environment and materials. The national Council for Environmental and Nature Research (RMNO) and the Royal Institute for Engineers (KIvI) set as goals for this day:
> '.....to define the future environmental aspects, which are linked to the expected application, use, reuse and waste treatment of materials....' "

The new study program was to be called 'Environmentally Oriented Materials Technology' ('Milieugerichte Materiaaltechnologie', or 'M2' for short). The Brundtland Report was explicitly mentioned as an important source of inspiration for the developing team in Tilburg. So was the most recent version of the Dutch National Environmental Policy Plan, the NMP+ (Ministry of VROM, 1990). Agenda 21 did *not* influence the original ideas and plans, as it was only published in 1992. Siemons (1993):

> "In the creation of opinions leading to the study program, the final conclusion of the Brundtland Commission played a major role:
> '… a targeted policy is possible through which an adequate environmental quality is reached, partly due to innovative technological-economic and social-cultural developments. For this a sustainable development is necessary in a long term strategy …'
> Criterion for sustainability is:
> '… not transferring environmental problems to other countries or future generations. The transfer mechanism can be combated through an effect-oriented track and through a source-oriented track …' "
>
> "In contrast with many other study programs, the graduated M2 technologist does not fulfill a clearly defined function in society. Not yet! No professional field, no organization has formulated in clearly realizable terms what their future needs will be.
> During the preparations, the HMB analyzed vacancies published in [newspapers and professional magazines]. The conclusion was drawn that a significant part of the functions could well be fulfilled by the M2 technologist, perhaps even better than those who have been educated 'post-actively' through refresher courses or supplementary training.
> The M2 study program aims at pro-active, anticipative and preventive policies, entirely in accordance with the NMP+ plan:
> 'Fundamentally different production and consumption within one generation. (...) Principally, each generation leaves behind a good environmental quality and not a negative environmental inheritance.' "

Other sources that explicitly were used for the design of the program were 'Limits to growth' (Meadows et al, 1972); Commoner (1990); and a report of the Dutch National Council for Environmental and Nature Research (RMNO), which emphasized the importance of a cooperation between disciplines (de Wit, 1990):

> "... acceptance of sustainable development as a guiding principle will have certain consequences as regards the work of the various disciplines. It will entail a more pronounced emphasis on certain tendencies or combinations of tendencies within and among these disciplines."

Based on these ideas, a development group of experts within and outside of the HMB was formed to develop the new study program.

4.2.2. The 'imaginary' professional profile

The development group made explicit that the new study program was fundamentally different from the existing environmental education. At the same time, although focusing on materials, products, and production processes, the study program also was principally different from an existing program of materials technology. Siemons (1993):

> "A thorough investigation of the present developments show a dualism in the problem description:
> - On the one hand, the demand exists to control an ever increasing complexity of products and industrial processes, for which an increasing split-up of study programs and professional disciplines is necessary (…).
> - On the other hand the need has become manifest for an integrated approach to the design and the realization of innovative projects, but also to the continuation of existing processes, within ecological and economical constraints. Such an approach demands a wide variety of inventive combinations based on elements of various specialties and a strong insight in the interface problematic (…).
> A study program that wants to bring graduates to the labor market who are capable to think pro-actively in the wide area of materials, environment, energy, and sustainability, is fundamentally different from the materials technology program in [the] Utrecht [University of Applied sciences]; and is at the same time different from the environmental study programs in the Netherlands."

An overview of the main principles of the M2 program made the distinction between M2 and the environmental education more clear (Siemons, 1993):

> "In our university, the thinking is focusing increasingly towards a source related policy, in contrast with the environmental study programs which have been realized in several other Universities of Applied Sciences, which aim primarily at effect oriented policies (e.g. investigation of water, soil, air, cleaning technologies).
> The source related approach results in:
> 1. *Integral chain management*
>   Considered is the chain: raw materials - transformation - product - waste - and emission in an integral way

2. *Energy extensivation*
   Aim the process at reduction of the total energy use from present energy sources by raising the energy efficiency, use of sustainable energy sources and reduction of energy needs.
3. *Quality improvement*
   Aim the process at improvement of the quality of the resources, products, transformations, waste, and emissions to the environment.

Essentially these three subjects form the main pillars of the study program."

Since there was no pull or demand from the labor market for experts in sustainable technology, the HMB defined, as it was called, an "imaginary professional field", based on expectations of future developments. This was described (Siemons, 1993) as:

1. "Industry:
   - designing new products, new product technologies and new production technologies.
   - optimizing products, technologies etc., regarding materials, environment, sustainable energy, etc. (process integrated).
2. Architecture: as above.
3. Chemical industry: as above.
4. Insurance companies: estimating environmental effects
5. Banks: preparation of investments.
6. Consultancy:
   - national, regional and local governments
   - consultancy agencies
7. Education on a secondary or tertiary professional level
8. Research institutes: TNO, multinationals, universities."

The proposal for the new study program was submitted to the Ministry of Education, which approved the plans in November 1990. Consequently, the program was opened for subscription of new students, who could start in the summer of 1991.
Also in 1991, the *researcher* became a member of a 3-person developing and management team for M2, further consisting of the director of education innovation of the HMB (Leo Siemons), temporarily acting as the manager of the study program (until 1994), and an external expert on sustainable technology (Hans Vermeulen).
The external members of the original development group became members of a newly formed Advisory Board for the study program. Among them were representatives of large and medium sized enterprises and of centers of expertise, e.g. Fuji Photo Film, PRC Bouwcentrum, Van Sprang Management & Consultancy, Nederlands Verpakkingscentrum (Dutch Packaging Center), Delft University of Technology, ProTerra, Heijmans Milieutechniek, and TNO Delft.

4.2.3. The curriculum

During the development process of the study program, the end qualifications of the future graduates were formulated and, in an iterative process, reformulated several times, as is characteristic for action research (see §1.4.2, and see Saunders, Lewis & Thornhill, 2006). This went on until the end qualifications were explicated in a self-evaluation report (Siemons, 1993) as follows:

"In companies, the graduate should be capable of:

- gathering relevant information from all parts of the organization or outside of it
- making an analysis of the primary processes, considering selection of materials, production technologies, energy, emissions, waste flows, etc.
- translate the results of the analysis relating to qualitative, ecological and economic effects
- describing relations between the analysis results and the environmental laws and regulations
- formulate proposals for each phase in the primary process in order to improve realized selections
- elaborate proposals regarding waste flows, recycling and reuse
- perform LCA's (Lifecycle Analyses) of products
- chairing a team of various disciplines
- discussing the problems with specialists, and specifying and quantifying the solutions in an integral perspective
- weighing against each other the ecological and economic aspects of new products and processes
- transferring external and internal information about the approach (internal consultancy tasks)
- approaching colleagues in a convincing way
- cooperating intensively with the management
- implementing, coaching, evaluating, and optimizing proposed changes in production processes

- discussing with representatives of various governments
- designing and defending environmental policy plans of the organization
- communicating on an expert level with suppliers of materials, and equipment
- communicating with and advising designers
- interpreting the environmental laws in relation with the strategic goals of the company
- estimating the economic and social consequences of plans"

When the first students started on the M2 study program, in 1991, only the first year of the program had been designed completely. During the next years, gradually the rest of the program was developed in detail by the management trio, assisted by the various teachers of the study program, all the time working backwards from the desired professional profile. In 1993, the self-evaluation report described a number of subjects that were planned to be a part of the curriculum:

"The new study program M2 focuses on the following subjects:

- depletion of resources (non-renewable, slowly renewable)
- depletion of non-renewable energy sources
- reuse of products, components, parts; recycling of materials
- longer lifespan of products and processes (focus on service and efficiency with the customer)
- control of pollutions (greenhouse effect, ozone layer, toxicity for humans, flora and fauna, acidification, eutrophication, odors and stench, noise, waste heat, radiation, calamities, waste)
- degradation of ecosystems (spatial quality)
- integration of environmental aspects in the initial phase of innovation projects (industry, architecture, government, society)
- market opportunities for environmentally sensitive products ('green products', 'clean technologies')
- focus on a pro-active approach to environmental problems
- relations between improved product quality and improved environmental quality."

In 1994 it was possible to draw a map of the entire study program. This map is shown in figure 12.

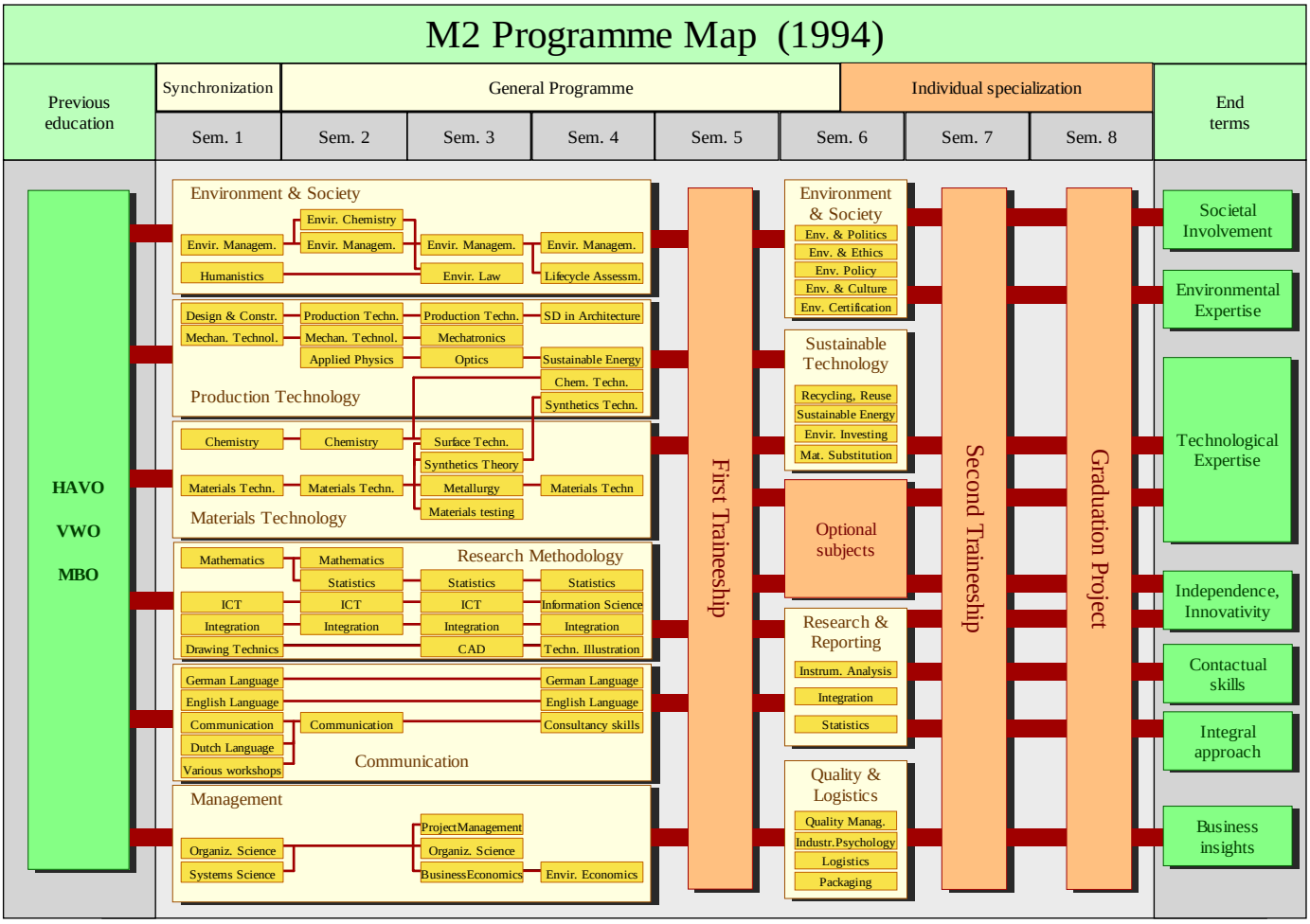


Figure 12. Outline of the curriculum of the M2 program as it was used in 1994. Source: Roorda, 1994

Some of the curriculum elements, expertise of which not being present in the teaching staff, were developed by external experts, who acted as guest teachers in the first years, thus transferring their expertise to the teaching staff of the HMB. Examples were: environmental law, packaging materials & technology, and industrial psychology. Some other modules were developed by the students themselves, coached by the teaching staff and by external experts. An example of this was Life Cycle Assessment (LCA), see Dorgelo (1994).

4.2.4. Integration as a subject

As a multidisciplinary approach was emphasized, special attention was given to the interrelatedness of the subjects in the curriculum. The way to realize this multidisciplinarity was through a series of special modules called "Integration". These were placed in the semesters 1 till 4 and in semester 6. They were developed by Hans Vermeulen, the external member of the managing trio. In the first years, he acted as the teacher of these integration modules, while transferring them gradually to the own internal teachers of the study program.
In the years between 1991 and 1994, the integration modules and the background materials were developed and written, resulting in a book called "Introduction: M2 Integration Concept" (Vermeulen, 1994).
It is not easy to briefly describe the contents of the five integration modules. For that reason, this dissertation limits itself to a short overview in the shape of four figures derived from the "M2 Integration Concept", illustrating some of the ways in which all kinds of subjects and disciplines were brought in relation with each other (figures 13 – 16).

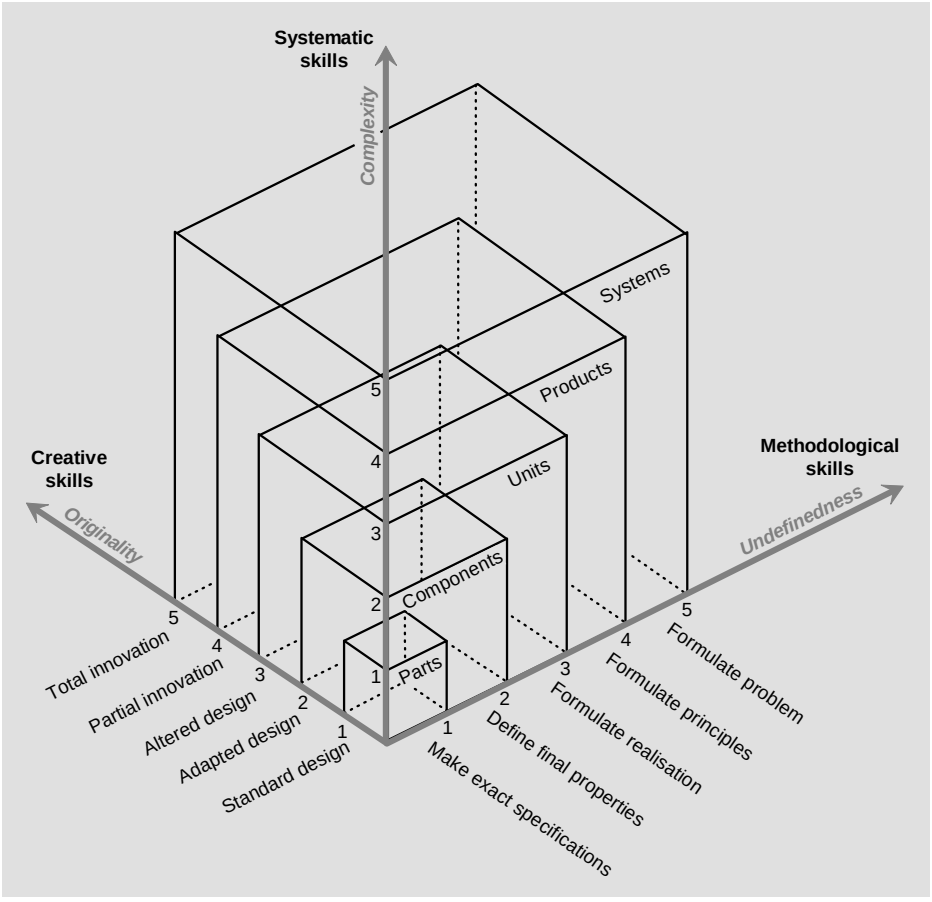


Figure 13. The product innovation cube. *Source:* Vermeulen (1994), p. 56.

Figure 13 shows three dimensions which together define the characteristics of an innovation process. The figure illustrates that the M2 students were not only trained in innovative ways of thinking, but also to observe themselves at a meta level. Figure 14 is related to the design process of an industrial product. The principle of 'design for recycling' (also called, with slight variations, 'design for disassembly' or 'design for environment') is shown, as an example of chain integration. Product development is viewed from a different angle in figure 15, while figure 16 illustrates various levels of creating closed materials loops, either on a high level (reuse) or a low level (recycling or burning. i.e. energy recycling).
The four examples illustrate the integrative way of thinking, in which the relations between many different subjects and disciplines are highlighted and practiced. Up to a certain level, the integration modules made the M2 program a multidisciplinary study program – but in a limited way, as will be discussed in the next part of this chapter.

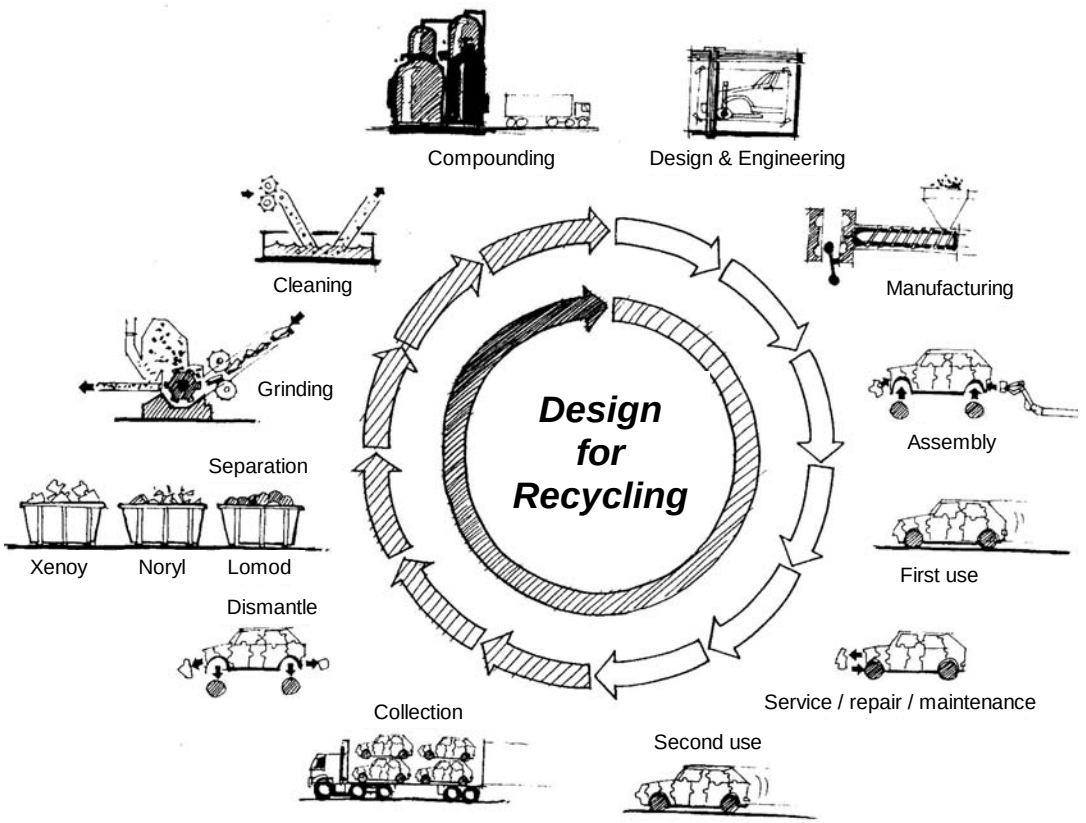


Figure 14. The thermoplasts cycle in the automotive industry. *Source:* Vermeulen (1994), p. 119.

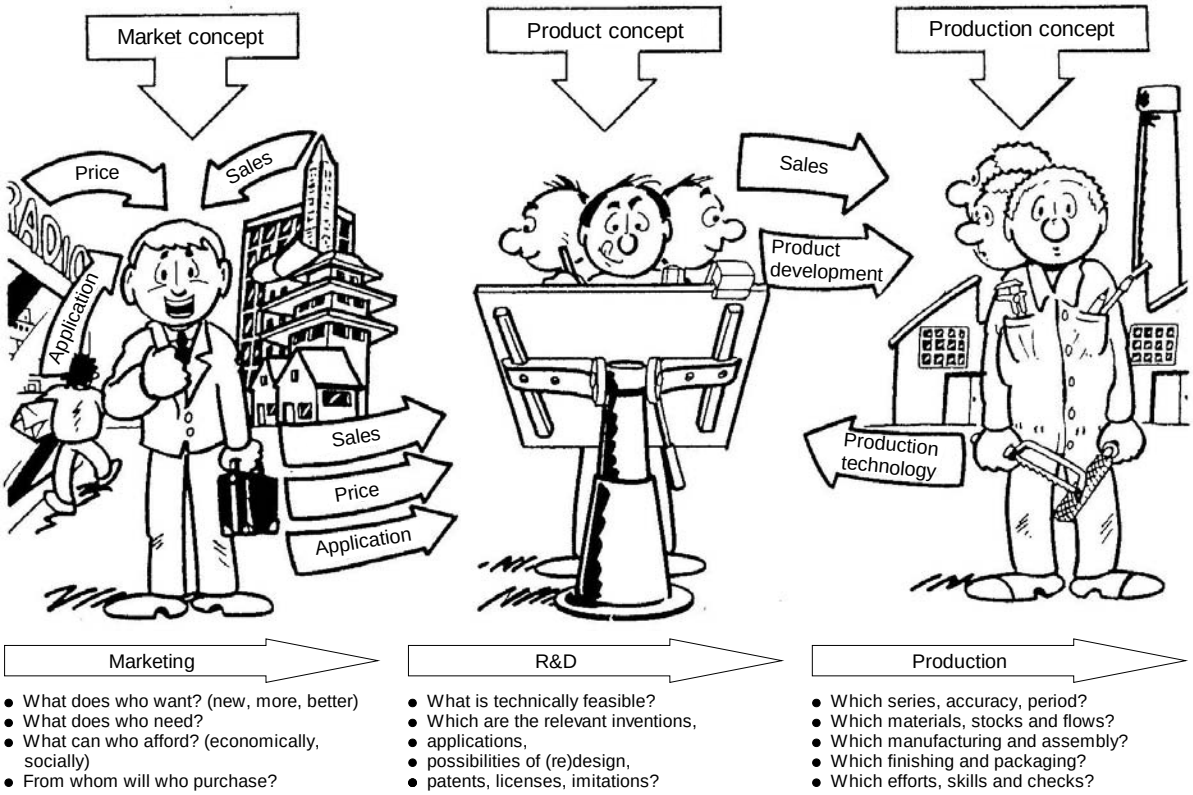


Figure 15. Integration of three information flows. *Source:* Vermeulen (1994), p. 70.

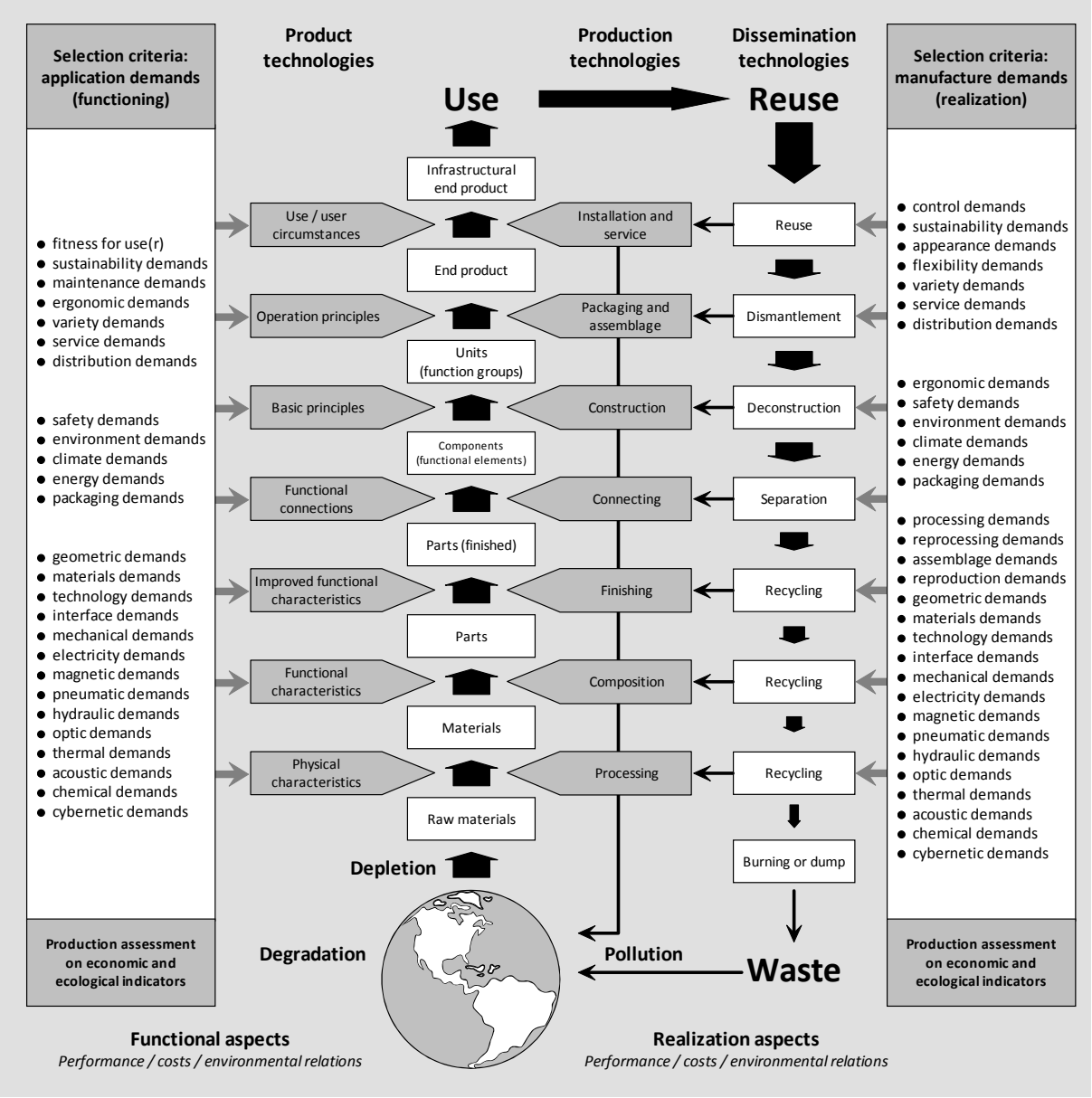


Figure 16. Composition and decomposition of products in process industry and architecture. *Source:* Vermeulen (1994), p. 162.

The integration process of the study program was strengthened by the two traineeships, both lasting an entire semester, and the graduation project, filling the final semester. All three projects had to be fulfilled in a practical and realistic professional situation, i.e. in a company, a government department, etc.

4.3. Result assessment

The central question to this chapter is, as was announced at the beginning: Can higher education contribute effectively to sustainable development through a separate education program dedicated to (main aspects of) sustainable development?
The M2 study program was designed in an attempt to prove that the answer to the question is 'yes'. In the beginning of this chapter, six hypotheses were formulated that will be assessed in order to test this assertion, i.e. to investigate whether the M2 program, as it was developed between 1991 and 1994, was successful from a viewpoint of Education for Sustainable Development.
At the end of chapter 3, an overview was given of the seven criteria that will be used to assess the rate of success of all six experiments. Table 12 relates these criteria to the six hypotheses of the present chapter, and shows the section numbers where they will be assessed.

Table 12. Experiment # 1: Criteria for result assessment		
Experiment Criterion	X1 M2 program	Assessed hypothesis
Contribution to ESD towards direct stakeholders		
Implementation of ESD in vision, policy	§4.3.1	1. The study program meets the demands of ESD.
Implementation of ESD in education	§4.3.1	
Customer demand	*(see §5.3.2)*	2. The study program attracts a sufficient number of students.
Customer appreciation	§4.3.2	3. Students appreciate (the ESD character of) the study program.
Contribution to SD towards indirect stakeholders		
Indirect stakeholder appreciation	§4.3.3	4. External stakeholders appreciate (the ESD character of) the study program.
Contribution to SD through HE	§4.3.4	5. The graduates contribute to SD in the professional field.
Transfer of expertise	*(see §5.3.6)*	6. The program contributes to ESD implementation elsewhere.

As the first M2 program, which started in 1991, was redesigned, starting in 1994, creating the second M2 program which will be discussed in the next chapter, not all of the six hypotheses can be investigated thoroughly in the present chapter, as data over a too short period are available. One example is the number of students. In the years 1991 till 1994, the numbers of newly arriving students were: 5; 14; 23; and 18 respectively, i.e. 60 students in total. These numbers were lower than was expected at the start of M2. Nevertheless, around 1994 the expectations for the coming years were still high. Anyway, these four numbers are not enough to give a definitive answer to the question whether the second hypothesis, a sufficient number of students, was met. And so, the answer to this question will be postponed until the next chapter, where the numbers of later years will be added.
Also, the period of 1991 till 1994 is too short to make it possible to study in a significant way hypothesis #6, the transfer of knowledge and expertise to elsewhere. Not only are the students numbers low: even the very first M2 students, who started in 1991, graduated only in 1995. So, this subject too will be discussed in chapter 5.

Sources of information
Several sources of information were used in order to discuss the other criteria. Among them are: study guides and study materials of M2; and informal external evaluations of M2 between 1991 and 1994. Also, an overview of internships between 1994 and 1997 will be used. This may seem to fall outside of the period of the first M2 program. But this program was not replaced overnight by the second M2 program in 1994. Instead, the consecutive years of the old program were replaced by those of the new program gradually. The internships between 1994 and 1997 were still based on the old program, and therefore can be used as indicators for the old program.
A special attention will be paid to a systematic external investigation in 1994. In that year, the M2 program was assessed for the first time by an official visitation commission of the HBO Council. The visitation system of the HBO Council will be described in more detail in §7.1.1. For now, it suffices to say that the visitation of every study program that was to be investigated, was prepared by the team of the study program by writing an extensive "self-evaluation report". Several quotes from the M2 self-evaluation report, written one year earlier (Siemons, 1993), have been given earlier in this chapter.
After a thorough study of the self-evaluation report, the visitation commission visited the HMB in 1994. It interviewed the University Board, the program management, a number of teachers and students, some members of the non-teaching staff, and some members of the external Advisory Board. It studied many educational materials used by the study program, e.g. books, study guides, locations, computer equipment and applications, etc. As a result, the commission wrote and published its visitation report (HBO Council, 1994). This report will be used extensively for the result assessment of experiment #1.
Another source of information was an investigation in the form of a questionnaire among former M2 students, which was performed in 2009. Most of the conclusions of this investigation will be discussed in the next chapter, but some of the results are significant to the present chapter.

The evaluation of the various success criteria of the first M2 program will be based on a combined use of information sources. Consequently, the conclusions will be based on a methodological triangulation 'within methods', as all sources are qualitative in nature.

4.3.1. M2 as Education for Sustainable Development
First now, criterion #1 will be discussed: the question whether M2 meets the demands of ESD. As a reference, table 6 will be used, in which a checklist of such demands is given. In order to apply this checklist, a combination of sources will be used: the study guides and study materials of M2, and the visitation report of 1994.
As a start, a fundamental question will be discussed: was M2 really an SD program?

Sustainable technology, not sustainable development

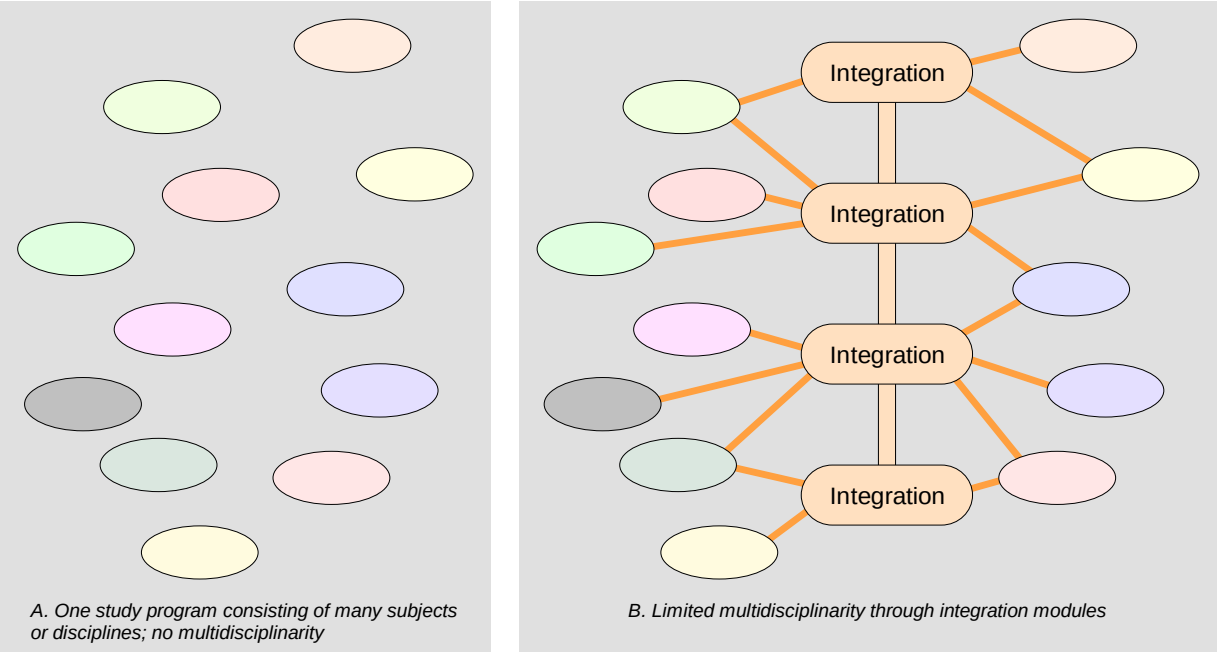
The central question of this chapter is about sustainable development. However, at first glance it is clear: the M2 study program is not a 'sustainable development' program. It does not treat sustainable development in a balanced way throughout the curriculum, and it was never intended to do that. The program developers specifically aimed at a study program in the technical sector, with an emphasis, not only on technology but also on environment and on business. This means that, considering the Triple P, the 'planet' and the 'profit' aspects are represented much stronger than the 'people' aspect. Not to mention 'prosperity', since this term was not yet introduced in the Triple P around 1990, and especially because M2 clearly focused on the economics of businesses, not of individual people. The orientation of M2 is clearly visible in the four figures from the integration modules, figures 13 – 16. Some 'people' aspects were present in the curriculum, e.g. in the subjects of HRM and industrial psychology, but both subjects are concerned with people from a business perspective.

This raises the question: should the M2 curriculum have been more balanced considering the Triple P? How far should the curriculum go in treating the full content of the complicated sustainable development concept?
This question is relevant, not only for the M2 program, but for most or perhaps even all disciplines and study programs in every university. For instance: should study programs in the 'planet' sector of education (e.g. environmental management, environmental technology, biology, geology) pay as much attention to 'people' as they do to 'planet'? Should typical 'people' programs (e.g. psychology, nursing, social work) pay ample attention to 'planet' and 'profit' / 'prosperity'? If the answer to questions like these would be 'yes', this would have strong consequences. One would be that students would be 'bothered' with subjects many of them are probably not interested in. Another would be that the study programs would be overloaded with a lot of subjects, for which they probably have no space or time. Finally, if followed through to its uttermost consequences, the complete differentiation in specialists and disciplines would fade away, which would hardly be effective. So, sustainable development could and should not be realized by an attempt to educate every specialist up to a level at which everybody is a full expert on all aspects of sustainable development. That is the very reason why an interdisciplinary cooperation is so important. Thus, the key question is: how much does an expert in whatever kind of discipline need to know and understand of the concept of sustainable development, within as well as outside of his/her own discipline, to be able to participate effectively in such an interdisciplinary cooperation?
This key question for the science of ESD will be discussed later in this dissertation again (in chapter 8). For now, it is enough to relate the question to the M2 study program. For M2, the question is quite comparable with the question the environmental education posed, as was illustrated in figure 10. What was to be the role of an M2 engineer in the interdisciplinary cooperation: should he/she be the coordinator of the process, or rather just one of the participants?

In the Mission Statement of the study program (Roorda, 1996b), the future M2 graduate is described as a 'generalist' and as a 'specialist in integration'. This seems to indicate that the M2 engineer was seen as the coordinator of the interdisciplinary cooperation, rather than as 'just' a member among other specialists, although this question was never explicitly formulated in this way at the time. In the early nineties, this was probably a logical expectation, because there were hardly or no other study programs, at least in Dutch HBO, which paid any attention to sustainable development in a source-oriented way. Later, when it appeared that many other study programs started integrating sustainable development aspects in the curriculum, the role of the M2 engineer would naturally shift to that of 'one among many'.
One claim of the M2 developing team was certainly correct. The study program did differ considerably from the existing kinds of environmental education, as well as from the study program of materials technology. Important differences were e.g. the orientation on the future; the focus on life cycles and closed material loops; the integration; and the roots in sustainable development theory, such as the Brundtland Report.
Looking back with the knowledge of nearly twenty years after the start of M2, probably some decisions would have been made differently. The curriculum did not offer a broad overview of sustainable development, nor a regular reflection of it, nor a Triple P balanced approach. If the curriculum was to be designed now, with all the experiences and insights of nearly two decades of ESD development, this would probably have been done differently. No doubt, more attention would be given to 'people' aspects, e.g. discussing subjects like culture, poverty eradication, health & education, human rights, participation, etc. Nevertheless, the emphasis in the curriculum would certainly still be on technology, environment and business, since this is the professional profile that was explicitly selected.

The level of multidisciplinarity

There is another important aspect of the M2 curriculum that no doubt would have been designed in a different way, if M2 was to be developed at present. Actually, it *was* redesigned in this direction much earlier: in the second half of the nineties, as will be described in the next chapter. This concerns the way in which the various subjects were related to each other, through the 'integration' modules. This integration was very important, and the visitation commission was enthusiastic about it (see below). Indeed, around 1990 this was an innovative approach. But it was certainly not an interdisciplinary strategy, which in many sources is seen as essential for sustainable development, as



A. One study program consisting of many subjects or disciplines; no multidisciplinarity

B. Limited multidisciplinarity through integration modules

C. Multidisciplinarity through a variety of education methodologies

D. Interdisciplinarity through cooperation with study programs in other disciplines, or even transdisciplinarity through cooperation with non-disciplinary partners

Figure 17. Various ways to combine disciplines in an education program

was described in §2.3 (see table 6). At best it could be described as a 'limited multidisciplinarity', as figure 17 illustrates.

Without the integration modules, the curriculum would have been like figure 17A: many subjects and disciplines would be present in the curriculum, but nevertheless it could not be called 'multidisciplinary', because all those disciplines would not have a clear relation with each other.

The way in which M2 realized the integration of subjects was, to a certain level, one-way: from the various monodisciplinary modules to the integration modules (figure 17B). The monodisciplinary modules were not strongly influenced by the integration process. It would be too pessimistic to say that the presence of the integration modules just raised the number of separate modules. But on the other hand, the integration modules did hardly contribute to a connection between the other modules themselves, and so the multidisciplinary approach was limited. If the integration modules would, by coincidence, all be scheduled on Tuesdays, it might look to the students as if integration would just be relevant one day a week…

Theoretically, the level of multidisciplinarity would be much higher if all or most of the modules in the curriculum would be strongly and mutually interrelated (as in figure 17C). Or alternatively, if the curriculum was not structured

through a set of separate modules but in some fundamentally different way. Either way, the integration modules might even turn out to be unnecessary, since the integration would take place within all parts of the education (and on all days of the week). The developments in the nineties within HBO (and in other sectors of education in and outside of the Netherlands) showed that this was more than theory, and this was exactly what was applied during the redevelopment of the "second M2" program, starting in 1994, as the next chapter will demonstrate.
Regarding the difference between multi- and interdisciplinarity, this is a different subject. This is not just a matter of organizing the education within one study program or discipline, because interdisciplinary education by definition demands cooperation between different disciplines and, consequently, between different study programs (figure 17D). This subject will get attention in chapter 6.

Other ESD aspects
In the above, some characteristics of the checklist of table 6 have been discussed amply. Other elements of table 6 will be treated here, after which the checklist will be filled in, resulting in table 13.

Systems thinking
The ability of thinking at certain moments on a synthetic, system-oriented level and at other moments on an analytic, detailed level was theoretically treated and intensively practiced during the integration modules. Also, the clustering of subjects into larger parts contributed to the ability of thinking at a systems level. This is visible in the study materials, and evaluated in the visitation report of 1994:

> "The professional profile of the graduate is that of an 'integration engineer', acting in the field of an integral approach to product innovations; and analyzing products and production technologies (where the selection of materials, production, and energy sources are checked on economic and ecological constraints). (…)
> The curriculum contents, the number of subjects and the learning goals of the study program are so extensive, that for many subjects only broad knowledge will be acquired.
> The multitude of subjects (often specialist, e.g. mechatronics, optics, CAD, instrumental analysis, chemical technology, systems theory, and information theory) has a dissipative effect on the students. An integration module has been created in order to combat this problem. Besides these integration subjects, also the grouping of the various subjects reflect cohesion. The division of the curriculum into five large parts is done consistently."

Life-cycle approach
The study materials show that there was ample attention to a lifecycle approach. This was vested in the fundaments of the program, i.e. in its source-oriented approach. Technical aspects were studied intensively, e.g. aiming at lifecycle analysis (LCA) and design for recycling. Economic and management aspects were studied, e.g. in subjects like environmental economy and integral chain management.
The life-cycle approach was developed in close cooperation with experts on the subjects. A main role was played by Pré, an engineering company which had a leading role in the Netherlands on LCA's: among other things, they were the developer of the Simapro computer application, which for many companies was the standard for their LCA's. The lifecycle education was designed by a combined effort of the founding manager of Pré, who acted as a guest teacher, other staff members of Pré, the members of the managing trio of M2, other M2 teachers, and one of the M2 students, Rob Dorgelo, who completed the LCA study guide as a part of an internship (Dorgelo, 1994).

Future orientation
Orientation on the future was one of the pillars of the program, which was naturally based on the source oriented approach and the Brundtland principles. This was recognized by the visitation commission:

> "While designing the curriculum, the program team laid itself out to develop an innovative and future oriented field of study, regarding the contents. Just as creditable, it has attempted (considering the practical limitations) to implement new and attractive educational methodologies."

Openness to new solutions
Creativity, non-linearity, and out of the box thinking were all strongly stimulated and exercised, especially in the integration modules.

Multi-methods
The integration modules certainly used a number of different educational methodologies, as the visitation report confirms:

> "With the insertion of integration subjects, the study program shows innovation and ambition. The subject 'integration' may be considered as very special, as it consists for 50% of tasks and exercises and for the rest of a number of unorthodox mixed methodologies."

On the other hand, the majority of the subjects was treated using traditional education methodologies. This left ample space for improvement, as the visitation commission recommended. This task was taken up after 1994, in the development of the "second M2" program.

Real-life situations
During three semesters, students were confronted with real-life situations: i.e. during their two internships and their graduation project. In other parts of the program, especially the integration modules, real-life situations were theoretically studied or simulated. This implies however that during the entire first half of the program, no confrontations with actual real-life situations took place, leaving a lot of opportunities for improvement.

Commitment
During intake meetings with students, it appeared that the 'typical' M2 student was highly engaged in environmental and societal subjects. During their studies, the students showed the same high personal involvement and engagement. This attitude was reflected and fortified by the same kind of attitude of the managing trio and the teachers. Apparently, the character of M2 attracted a certain kind of people to its program: students, as well as staff.

Value-driven
The appeal of M2 to a certain, personally engaged kind of people was no doubt based at least partly on the value-driven character of M2, built on the principles of the Brundtland Report and the Dutch policy on sustainable development, described in the NMP+. M2 was certainly not value-free, and this was a conscious decision.

Table 13. Education for Sustainable Development compared with the first M2 program

Principles	Characteristics	First M2 program	Judgment
Connectivity, complexity	Systems thinking	Realized intensively through the integration modules	++
	Multi-, inter- or transdisciplinary	Limited multidisciplinarity	(+)
	Life-cycle approach	Strong emphasis on product lifecycles: e.g. source orientation, integral chain management, design for recycling, lifecycle assessment (LCA)	++
	Intercultural, international	Hardly any attention	–
	Future orientation	Explicitly present, e.g. through attention to innovativity at several levels and time spans; no specific methodologies	+
Innovativity	Openness to changing conditions	Theoretical approach in integration modules; exercised during internships	+
	Openness to new solutions	Creativity, non-linearity, out of the box thinking: all strongly stimulated and exercised, esp. in the integration modules	++
	Function orientation	Thorough treatment in integration modules; exercised in these modules and during internships	++
Action learning, social learning	Application of knowledge	Primarily present in internships and graduation projects, and to some extent in integration modules; largely absent elsewhere	+
	Multi-methods	Mainly traditional forms of education, apart from the integration modules	–
	Real-life situations	Simulated in some modules; present in internships and graduation projects	+
	Commitment	High sustainability engagement with both the teachers and the students	++
	Cooperation	Teamwork within student groups in several modules, sometimes guided by professionals as guest teachers	+
Reflexivity	Learning to learn	Not much attention	–
	Responsibility	Discussed, but not intensively practiced	+
	Value-driven	Explicit fundament in the Brundtland principles	++
	Critical thinking	Theoretical approach in integration modules; exercised during internships	+
	Robustness of information	Theoretical approach in integration modules; exercised during internships	+
Overall			+

The ESD Checklist
The results of the above discussion is summarized in table 13, making use of the checklist offered in table 6. In the context of 1991, when M2 started, this was certainly a very good score. Developments went fast, however, because already in 1994, the visitation commission concluded that much could be gained by the introduction of new educational methodologies. This offered an indication for the direction in which most of the 'weak spots' of the M2 pro-

gram, as shown in table 13, could be strengthened. Whether this was successful in the years after 1994, will be investigated in the next chapter.

4.3.2. Student appreciation of ESD in M2

In 1994, the visitation commission had a series of interviews with M2 students of several study years. In its report, the commission draws the following conclusion:

> "An important experience, just as with other new study programs in this country, is that unfamiliarity with the program of the incoming students is a very important factor. The students (…) find it hard to describe for which profession they are educated, although they informed the commission that the study program meets the expectations they had from information brochures and intake discussions. When asked, they state that they don't regret selecting this study program; if they would have the opportunity, they would make the same decision again. (…)
> The students indicated that the integration modules appeal to them strongly."

In 2009, an investigation among the former students of M2 was made. The details of this investigation will be given in the next chapter. Some of the conclusions can however be used in this chapter for the evaluation of the first M2 program. The investigation was made in the form of a questionnaire. As a preparation, the contact data of as many alumni as possible were searched. As a result, the e-mail addresses of 77% of all former M2 students were found. They all received the questionnaire, and 53% of them (or 41% of the total group) responded.
For the group of 60 students who started their study between 1991 and 1994, 26 of them responded.
The main part of the questionnaire consisted of 26 statements, to which the respondents could react on a five-point scale, varying from "certainly true", "mostly true", "partly true, partly not true", "mostly not true" till "certainly not true".
Counting the reactions "certainly true" and "mostly true" as agreeing with the assertions, the following percentages of the respondents agreed:
"In my opinion sustainable development is important": 81%
"I understand very well what sustainable development is": 92%
"Aspects of sustainable development were for me a reason to study M2": 58%
"M2 contributed to my sustainable attitude and behavior": 65%

This indicates that a majority of the alumni appreciated the sustainable character of M2. This is in agreement with the findings of the visitation commission.

4.3.3. External stakeholder appreciation of ESD in M2

Several sources are available to estimate the external appreciation for M2 and for its sustainability philosophy and content.
First of all, there was a clear preparedness of a range of companies and other organizations to support the program in several ways. One of these ways was a financial support: among the sponsors of M2 were large companies like PNEM and DHV, and the city of Tilburg. Another was the preparedness to delegate a staff member, usually at a Board or a management level, to the Advisory Board, as was discussed in §4.2.1.
Besides, quite a lot of companies were prepared to contribute to M2 with their expertise through visiting teachers. One example has been described in the context of the development of the lifecycle approach.
On several occasions, the appreciation of M2 was formulated in explicit comments. One of them was from the Mayor of the city of Tilburg, G. Ph. Brokx, who wrote in 1991:

> "Important is the awakening of consciousness of the professional field regarding the environmental problems. In order to be able to take the necessary actions, the professional field must have the availability of adequately educated employees. Until now, these specialists are not available. The education program 'Environmentally oriented Materials technology' fills up this gap. It is my opinion that this unique program has an exemplary position within higher professional education, and will be a source of inspiration to other HBO institutions in the country."

In the same year, Dr. Gérard R. M. Mustert was the CEO of the Noord-Brabant Development Agency (Brabantse Ontwikkelings Maatschappij), a semi-governmental expertise organization supporting trade and industry in the province of Noord-Brabant, where the city of Tilburg is located. Mustert wrote (BOM, 1991):

> "Although at the moment the reality of the environmental policy and actions of the companies are strongly aiming at so-called 'end-of-pipe' solutions, in the future the emphasis will no doubt be on measures directing at sustainable development. Since there is little knowledge exchange in this field at present, the birth of the education program "Environmentally oriented Materials technology" in the Hogeschool Midden-Brabant, dedicated to this, is highly important."

In 1994, the visitation commission formulated its final opinion about M2 as follows:

> "The university showed an entrepreneurship attitude by starting the M2 program at its own initiative. This entrepreneurship is appreciated by the professional field, but there is a feasibility risk. The future will show whether the timing was right. Regarding the signals that have reached the commission, employability opportunities exist in large companies and intermediate organizations. As yet, the employability aspects regarding SME seem doubtful."

In the same year, the study program was nominated for the "Tilburg Moderne Industriestad Prijs voor moderne ontwikkeling" ("Tilburg Modern Industrial City Award for modern development"). It won the second prize.

In 1994 the program was still young, and its effects on the outside world were hard to measure. The opinions in 1991 about M2 were positive, but they were not based on any effects at all. The opinion of the visitation commission in 1994 was on the one hand positive, but on the other hand showed a real concern about the chances of survival of the program, regarding the opportunities for the employability of the graduates. This raises the subject of the relation between M2 and the professional field.

4.3.4. Contribution to SD in the professional field.

A meaningful research into the employability of the M2 graduates can only be made if not only the graduates of the first M2 program are investigated, as they are only a relative small number, but also the graduates of later years. So, this investigation will be discussed in the next chapter.
There is however an interesting source of information available, even for the first M2 program.
Although the professional profile of the M2 program was 'imaginary', it did not take much time or effort to convince a considerable number of organizations in this (imaginary) professional field to cooperate and to contribute to M2 with their expertise. Some years later, when the first shifts of students did their first and second traineeship and next their graduation project, quite a lot of companies and other organizations were willing to offer them interesting and relevant projects. Table 14 offers an overview of a number of the sectors and topics the students worked with. The table deals with internships in the period of 1994 till 1997, as this was the period in which internships were performed by the students who started their study in the period of 1991 – 1994.
The table shows that the projects reflect remarkably well the goals of the study program and the professional field that was imagined before the start of the program.

Table 14. Overview of traineeships and graduation projects of M2 students, 1994 - 1997

Division according to sector		**Division according to topic**	
Sector	#	*Topic category*	#
Consultancy	11	Energy	8
Services	3	Chain management, LCA	32
Food	4	Quality management, labor circumstances	23
Graphical industry	8	Environmental management	26
Architecture	11	Materials research	16
Chemistry	2	Technical research	21
Electronics	7		
Metal	11		
Installation	7		
Plastics	7		
Other industry	24		
Research	22		
Government	9		
Total	126		126

Even during their internships and graduation projects, the students of the first M2 program were able to offer a meaningful sustainability contribution to their professional field. As said, their contribution as graduated professionals will be studied in chapter 5.

4.4. Conclusions

Putting all conclusions together, the following result arises (table 15).

Table 15. Experiment # 1: Evaluation				
Experiment Criterion	X1 M2 program	Assessed hypothesis	Evaluation	Judgment
Contribution to ESD towards direct stakeholders				
Implementation of ESD in vision, policy	§4.3.1	1. The study program meets the demands of ESD (see table 6)	Certain demands are met, in a (for 1991) innovative way, but (from the perspective of later years) leaving ample room for improvement (see table 13).	+
Implementation of ESD in education	§4.3.1			
Customer demand	*(see §5.3.2)*	2. The study program attracts a sufficient number of students.	The numbers are lower than expected. Data of the first 4 years are insufficient for significant conclusions.	–?
Customer appreciation	§4.3.2	3. Students appreciate (the ESD character of) the study program.	Both the 1994 visitation and the 2009 investigation show that a majority of the students was enthusiastic.	+
Contribution to SD towards indirect stakeholders				
Indirect stakeholder appreciation	§4.3.3	4. External stakeholders appreciate (the ESD character of) the study program.	Formal and informal stakeholders were enthusiastic. The visitation commission was the same, but with concerns about the chances of survival.	+
Contribution to SD through HE	§4.3.4	5. The graduates contribute to SD in the professional field.	Internships and graduation projects contribute to SD. For other conclusions, the data are insufficient.	+?
Transfer of expertise	*(see §5.3.6)*	6. The program contributes to ESD implementation elsewhere.	Data of the first 4 years are insufficient for significant conclusions.	?
In all places where the data are insufficient, added data in the next chapter will enable significant conclusions.				

Strong points of the first M2 program are: the innovative character of the program, being one of the first to be based on the fundaments of sustainable development; and the enthusiasm of the managing trio, the teachers, the students and the professional field.
Weak points are: the limited multidisciplinarity; the use mainly of traditional educational methods; a low number of students; and uncertainty about the employability of the graduates.

These results can be understood by applying the various models of change that were described in chapter 1.
First of all, the Bridges model of organizational development offers a very good description of the M2 development. The design of the M2 fundaments, 1990 – 1991, formed phase 1: the *dream*. The next years, in which the first students arrived, together formed phase 2: the *venture*. Characteristic for this phase was the high creativity and engagement of the involved people, i.e. the managing trio, the teachers and the students. The visitation commission recognized this, and described an inherent risk:

> "At present there is a super-trio that leads the program. Considering the expected growth and the organizational change in 1995, it is recommended to create a team approach and a formalization of the structure. It is questionable how long the program will be able to go on based on 'idealism' when the scale increases."

In terms of the Bridges model, the commission recommended to enter into phase 3: *getting organized*. This was done soon after the visitation through the formation of a genuine management team, which made the start of the development of the second M2 program. In this management team of 1994, the *researcher* was the program manager. Besides, there was a first year manager, a second year manager, a semester 6 manager, and an internship & graduation manager. With this team, in 1994 the internal organization of M2 was ready to enter phase 4: *making it*. Whether M2 did make it in the years after 1994, is one of the subjects of the next chapter.
The already mentioned creativity, engagement and idealism were a direct consequence of a change style that was described by De Caluwé & Vermaak. It was a combination of *greenprint* (e.g. action learning, personal responsibility, awareness of new viewpoints) and *whiteprint* (e.g. creativity, brainstorming, dynamics, individual energy). Many afternoons were filled with inspired, complex, sometimes even chaotic brainstorms in which the development of new parts of the curriculum found its origin.
At the same time, a major weak point of M2 can be understood by this typology of De Caluwé & Vermaak. The unfamiliarity of newer educational methodologies by the M2 staff was not the only cause for the use of traditional education methods. In a typical *yellowprint* process, the basics of the M2 curriculum were the result of negotiations between the developers and the University Board, which led to a number of unfavorable compromises, e.g. combined

education with other, rather traditional study programs, especially Mechanical Engineering. The visitation commission wrote about this:

> "The majority of the subjects is at present treated using traditional education methodologies. (…) It is regrettable that outside constraints cause limitations. The commission recommends enhancing the contents and the principles of the integration subjects. (…)
> A number of limiting constraints caused concessions from the very beginning. Fitting the program in the traditional boundaries of the other programs for the sake of cooperation and the clustering of shared basic subjects, the use of laboratories and learning equipment and especially the limited means to develop the 'integration education' to its full capacity, cause damage to the freedom of curriculum development."

A reason behind this *yellowprint* process can be found by applying the Sterling model about the level of change. Considering the M2 development process itself, this level was the highest, *transformation*, although not in a literal sense, because there was no actual transformation from an earlier situation, as M2 was entirely new. But M2 certainly was an attempt to redesign education as it existed in e.g. the environmental education in the Dutch universities, shifting the attention from an end-of-pipe approach to a source oriented approach. The principles of sustainable development were attempted to be integrated fully throughout the curriculum, with the integration modules as the main result.
On the other hand, from the viewpoint of the university, the development was not a transformative process at all. To the contrary: the M2 program was just added to the existing spectrum of study programs. No attempt at all was made to learn from the M2 development, as a tool for improvement of the rest of the university. This was a waste of money, as a lot of money was invested in the M2 program, and the impact on the university could have been much stronger. As it was, M2 was 'bolted-on', and thus a typical example of a level 1 change process: *accommodation*. If the development of M2 would have been 'owned' intrinsically by the University Board, the *yellowprint* negotiations and compromises might have been less strict, or even a *greenprint* approach at the university level might have been possible. M2 might have been considered more as a pilot study and an educational laboratory, and the transfer of expertise within the university might have been stronger.

And so, what is the answer to the central question of this chapter:

- Is it possible for a new study program, dedicated to (main aspects of) sustainable development, to successfully contribute to the process of sustainable development?

Did M2 prove the answer to be positive?
A final answer to this question can only be given when all relevant data are available, and so it will have to wait until the end of the next chapter. But a partial answer can be given here.
In the first four years of its existence, M2 did not strongly contribute to sustainable development, as it was too young and too small. But, given its age and its size, it did contribute to the professional field. And given its educational innovativity, based on the principles of sustainable development, it could have contributed much more to the transfer of its expertise than it did, which makes it likely that an M2-like, sustainability-based study program offers potentially a valuable contribution to sustainable development.

5. Experiment #2: Introduction of new education methodologies

The M2 study program in its first shape, as described in chapter 4, was based mostly on traditional didactical principles, which had been used in many universities for decades. Only the integration modules made a modest use of new methodologies. So, experiment #1, the initial development of M2, did not fully investigate the opportunities for sustainable development that came forth from new kinds of educational methods. Experiment #2 did exactly this, trying to find answers to the following question:

Question:

- Can an educational program optimize its contribution to sustainable development through a careful selection of educational methodologies?

This second experiment started in 1994, some years after the start of the initial M2 study program, when the M2 students of the first group were in their third year. By that time, the Dutch institutions for higher education were creating a variety of new ideas concerning the educational methodology. New ways of studying were introduced, like 'Problem Based Learning' (in Dutch: 'Probleem Gestuurd Onderwijs', PGO) and Project Learning. These methods produced tremendous new opportunities for the integration of sustainable development. In short:

Context (§5.1):

- HBO-wide introduction of new educational concepts

One of the main reasons for this development was a dissatisfaction among teachers and students about the traditional ways of teaching, in which it seemed that in many cases the teachers were the active party and the students a group of passive 'education consumers'. An example of this were the large lecture halls in the institutions, in which one lecturer held a 'one (wo)man show' for hundreds of students, who were not always very interested or attentive. This passivity of many students raised an attitude in which many students tended to put the responsibility of their learning process with the teachers, a role which most of them accepted and even strengthened. The various new methodologies were attempts to activate the students, to put the responsibility with them and also to confront them with realistic practical situations in which they could exercise their future roles as professionals.
The fact that relevant terms in this development were e.g. 'responsibility', 'practical situations', 'action oriented', and 'learning to learn', suggests that this way of learning creates tremendous new opportunities for ESD. That is why experiment 2 took the following actions:

Action (§5.2):

- Formulation of criteria for educational methodologies in order to contribute effectively to sustainable development;
- Selection of (existing or new) educational methodologies based on the criteria;
- Redevelopment and deployment of the existing HBO bachelor program for sustainable technology ('M2'), integrating the selected educational methodologies

This resulted in the redesign of the M2 study program, a project which took about four years. Whether the results formed an answer to the question formulated above, will be assessed on the basis of a series of results:

Result assessment (§5.3):

In the third part of this chapter, a critical analysis will be made concerning the main question of this second experiment: can a carefully selected range of methodologies help to increase the success of a study program concerning ESD?
In chapter 4, where the first M2 program was investigated, six hypotheses were formulated that define a successful study program (related to ESD). These six hypotheses will be used again in this chapter, enabling a comparison between the two versions of M2. The hypotheses are:

1. The study program meets the demands of ESD.
2. The study program attracts a sufficient number of students.
3. Students appreciate (the ESD character of) the study program.
4. External stakeholders appreciate (the ESD character of) the study program.
5. The graduates contribute to SD in the professional field.
6. The program contributes to ESD implementation elsewhere.

As the analysis of these hypotheses could only partially be answered in the last chapter, the evaluation will be continued at the end of the present chapter.
The chapter starts with an overview of some new educational methodologies that became available in the years around 1994, thus outlining the context in which the new M2 program was developed.

5.1. Context

5.1.1. The need for new methodologies

The problem with the traditional education was illustrated by Van Woerden (1997), describing the following case of a study of Industrial Engineering:

> "The study program of Industrial Engineering attracts a lot of students. The program appeals to them, because it consists of a combination of technical and society-related subjects. (…)
> Because the students have to become all-rounders, the curriculum contains many subjects, like mathematics, technical and management subjects. The students start their study enthusiastically, but soon they are turned down by the large number of preliminary examinations: each trimester five or six subjects are assessed. (…)
> After a few months, the fun is over. Just 'stressing' for examinations, absorbing a lot of knowledge, and developing just a few skills, is insufficient to keep the motivation high.
> The dissatisfaction of the students is fortified by the methodologies used. The program mainly consists of classical lectures with hardly any opportunity for interaction, just a little bit of practical work, and self-study for which only a list of books to study is given. The relatively large number of students (N=200) gives the program a character of mass education. How will the students learn the skills they will need as a manager, if they mainly attend to mass lectures and study books? But the teachers as well lose their enthusiasm. They have to give lectures to students who don't keep up with the subjects or even don't appear anymore. They have to correct preliminary examinations for which the students hardly made any real efforts.
> All in all, almost everybody is disappointed with the study program. The success-rate of the propaedeutic after a year has gone down to ten percent."

Whether the traditional education methodology is considered as the right kind of education, depends on the expectations of the teachers. Lowyck & Vermunt (1997) describe some stereotypical teachers. Among them are:

Teacher 1:

> "The task of a good teacher is to present acquired knowledge in a clear and systematic way to students. It is no use to give the impression to the students that they have to invent the wheel all over again. Besides, they are not skilled enough to distinguish main subjects from side subjects. In a time of abundant information it is all the more important they are assisted to acquire 'true' knowledge, without detours and dead end streets."

Teacher 3:

> "After more than twenty years of experience as a teacher, it has become clear to me that it doesn't help to offer students ready responses to questions they did not ask themselves. After graduation it will be expected from them to find solutions to new problems. So, I stimulate my students to find by themselves problems and solve them. For this, they have to use knowledge they already have, which nowadays is even available through electronic databanks."

'Teacher 1' sees the teacher as the expert whose main role it is to hand over his/her expertise to the students, probably using traditional methods. 'Teacher 3' emphasizes the importance that it's the students who do the learning process. And it is not only learning that is necessary, also 'learning to learn'. Lowyck & Vermunt again: "In this approach, education does not aim at knowledge transfer but at stimulation of independence in learning ('learning to learn') and thinking."
As higher education in the Netherlands around 1990 contained a lot of 'teacher 1' type teachers, the shift towards newer education methodologies did not go without struggle. Nevertheless, it was seen by university boards as a logical next step, being another aspect of the process orientation which had set in when the organization of the HBO institutions had toppled (see chapter 4). In higher education, this meant a shift from a teacher orientation to a student orientation. So naturally, the focus shifted from teaching styles to learning styles, and from teacher activities to student activities. That is why Van Woerden (1997) and other education developers wished to develop and implement "activating education". Vermunt (1997), using the term "process oriented education", describes:

> "Process oriented education is oriented on coherent teaching of disciplinary knowledge and of thinking strategies to construct that knowledge. It stimulates congruencies and constructive frictions and avoids destructives frictions. The aim is to see to it that students perform the right thinking activities to learn. Central to it is a grad-

ual transfer of the control of the educational learning process from the teacher to the students. The main task of the teacher is no longer the transfer of knowledge, but initiating, coaching and influencing the thought processes students use to learn."

In the same period, attention went to the 'studiability', i.e. the real chances for students to go through the study program as planned and get their degree. In the Netherlands, a famous investigation about the studiability of higher education was done by the Commission Wijnen; the report (Wijnen, 1992), offering 83 different proposals to improve the studiability, received a lot of attention.
Several methods were introduced in Dutch higher education to implement this process oriented, activating education. According to Delhoofen, the HBO went ahead of the research universities in the Netherlands: HBO "understood the innovation message better" (Delhoofen 1998, p. 25). Two methods appeared to be very important: Problem Based Learning (PBL) and project education. They will be described in the next two sections.

5.1.2. Problem based learning (PBL)

Problem-based learning (PBL) was introduced first in medical studies in Canada (Barrows & Tamblyn, 1980). The problem-based approach focuses on the integration of knowledge and skills from different domains. Already during their study, students have to put the knowledge they learned into practice. Medical students have to analyze the problems of a real patient systematically and have to gather information in order to make a better diagnosis and discuss this under the guidance of a teacher. Advantage of this learning method is that students gain knowledge in a meaningful context, and this context provides a connection between different kinds of knowledge that otherwise would have been provided separately.
In the Netherlands PBL was introduced at the Medical Faculty of Maastricht University. Characteristics of a PBL based curriculum are, according to De Graaff (1993):

- integration of discipline and skills
- curriculum structure with thematic blocks
- learning oriented work in small groups
- self-directed learning

Assessment of student achievements in the context of PBL has to be different from traditional educational programs. De Graaff (1993): "[As] PBL focuses on self-directed learning, assessment methods should be selected that do not direct students to a limited domain of study materials". Another important aspect of PBL is the integration of theory and practice. Therefore the content and format of the assessment methods have to be selected taking into account both ways of learning. Also the multidisciplinary approach of PBL has to be integrated in the assessment methods. Therefore most of the traditional assessment methods are not suitable for the PBL approach. In the new way of assessment it is desirable to distinguish three different competence domains: (1) factual knowledge, (2) practical skills and (3) design (De Graaff, 1993). The traditional exams are therefore replaced by assessments based on e.g. reports written by students and the level of active participation in group processes, not only assessed by the teaching staff but partly also by peer students.

The process of PBL is described in several sources, e.g. Schmidt & Moust (1998) and Delhoofen (1996). In a typical PBL situation, the number of lectures is reduced considerably or even completely absent. Instead, students come together in groups of e.g. 8 people, together with a member of the teaching staff who acts as a 'tutor'. The students, who at first have been trained in using the methodology and thus know what is expected from them, choose among themselves a chair person and a secretary who takes notes. They are presented with a 'problem' (hence the name of the methodology) describing a situation which may occur in their professional life after graduation. An example of such a situation is shown in box 3.

Box 3. Example of a PBL problem description

"Who am I?
On December 3, 1979 about 8000 people stood waiting for a concert of the pop group The Who in the Riverfront Coliseum in Cincinnati. The queues before the small doors were long, and when the doors opened and the crowd could hear the band rehearsing, the fences were down. People on the outside pushed forward, causing the rows of fans on the front side to be squashed. People fainted, or were pushed over and fell to the concrete floor. The crowd just saw the open doors and heard the music. Imperturbably, the mass made its way to the entrance, with no eye for others, who were crunched below their feet. Eleven people died, many were injured."

Source: Moust et al, 1997

As box 3 illustrates, many PBL exercises don't formulate exact questions or tasks for the students. Other PBL exercises do, but in such a way that the group of students has ample space for own initiatives.
In a typical PBL situation, the student group treats the exercise in a relatively short period of e.g. one or two weeks. A methodology that is used frequently is called the 'Seven-step' (in Dutch: 'zevensprong'), consisting of the following steps (Moust et al, 1997; Busfield & Peijs, 2003):

Phase 1: First group meeting:
Step 1: Explain unknown wording, statements and concepts
Step 2: Define the problem(s): what is to be understood / explained?
Step 3: Brainstorm: produce ideas to analyze or explain the problem(s)
Step 4: Make a systematic inventory of explanations
Step 5: Formulate self-study assignments, learning goals, division of tasks

Phase 2: Individually:
Step 6: Perform self-study assignments: search external information

Phase 3: Second group meeting:
Step 7: Synthesize: report and evaluate on self-study.

The main characteristics of the 'seven-step', often called the 'Maastricht model', are described by Moust, Bouhuijs & Schmidt (1989) as:

- A problem description that challenges thought processes;
- Preliminary knowledge that is activated by this thought process;
- Questions that arise due to the problem;
- A rising motivation to find out in detail in a book how things really are;
- Think together with others who are also interested in the problem;
- Work under the guidance of a teacher.

Well beyond 1989, to the 'book' in this citation all kinds of multimedia may be added. Other characteristics, not mentioned in the above source, are:

- Many problems are based on realistic situations;
- Usually the problem has a multidisciplinary nature;
- The process stimulates creativity and (depending on the kind of problem) out of the box thinking;
- The students carry their own responsibility, e.g. when formulating as a group their own learning goals, dividing the tasks, chairing the meetings, choosing the relevant sources of information, making a planning (however just for a short period).

In this process, the teacher acts as a 'tutor', i.e. as a facilitator and stimulator rather than a content expert. In the years when PBL was first introduced, many teachers were not used to such a role. Therefore, training programs for teachers were organized and books were published. In the Netherlands, practical information about the construction of PBL tasks was offered e.g. by Dolmans & Snellen-Balendong (1995); Snellen-Balendong & Dolmans (1996), Dolmans et al (1999). Study materials for students were written, so they could study the PBL method themselves, e.g. Moust et al (1997).
According to Delhoofen (1996), PBL mainly focuses on the acquisition of knowledge, and much less on the application of it. More appropriate for this goal are other forms of education, like project education.

The effects of PBL on the learning outcomes have been investigated by several researches, e.g. in Maastricht University. Students appear to score significantly higher in several respects, compared to more traditional education methodologies. For instance, Dochy et al (2003) report "a robust positive effect from PBL on the skills of students". Concerning the acquired knowledge, Gijbels (2005) describes how several studies rendered different results, as in some studies the knowledge level seems to be lower with PBL, while other studies found no difference. Considering the application of the acquired knowledge however, Gijbels found that "there is a robust positive effect from PBL on the knowledge application of students." This makes clear that "the students' path towards successful problem-solvers has been accelerated." Besides, Gijbels reports that, due to PBL, students are better able to deal with "conceptual conflicts and dilemmas" and "sharing ideas with others".
As a possibly negative effect, Gijbels describes that the assessment takes more time for the teaching staff.

5.1.3. Project education and other educational methods

Project (based) education in many ways resembles PBL. Most characteristics of PBL that are mentioned above also apply to project education. There are however some significant differences. One major difference is that many of the projects that are performed by the students as a learning process last considerably longer than a PBL task, e.g. several months to a half or a whole year.

According to Van Woerden, Bertels & Blom (1988), project education can be characterized by:

- The starting point of a learning process is a problem situation;
- The students work on their own on the problem;
- Knowledge, insights and skills within the field of expertise have to be applied;
- The education concerns real life problems that are embedded in a societal context;
- The teacher acts as a coach to the learning process;
- The project goes through stages that all are closed with assessments in which both the process and the product are judged and evaluated.

Box 4 shows an example of project education in the University of Adelaide.

Box 4. Example of project education

"A fuel cell powered Unmanned Aerial Vehicle

A team of five undergraduate Aerospace Engineering students at the University of Adelaide worked on the project titled "The design, development and manufacture of a fuel cell powered Unmanned Aerial Vehicle (UAV)". The project required the formulation of project goals, research, and conceptual design, manufacturing and testing of a vehicle. To simulate an industry setting, each team member took on a role; for example as technical manager, manufacturing manager, or testing manager. The students were also responsible for correspondence between manufacturers, suppliers and other technicians throughout the fabrication and testing stages of the project. The manufacture of the aircraft components allows for the students to be further involved in the complete overview of the project. The initial manufacturing process requires the selection of manufacturing techniques to be used for the various components, and sourcing a technician or workshop capable of such techniques. (…)

The first stage of the manufacturing process was the quality control scheme that was implemented in the Fuel Cell UAV project by the group. This involved basic inspection of the externally fabricated components, which included non-destructive testing to quantify the quality of the products. (…) In the case of the fuel cell UAV project, the quality control process revealed that the fuselage and wings produced by an external manufacturer did not meet acceptable standards, which resulted in the necessary remake of those components. It was determined by the project team that the most efficient means of achieving a remake was not to commission another external company to manufacture the components, but rather to fabricate the parts themselves with the assistance of the technicians from the University workshop. The students examined each of the rejected components with the aid of technicians. By observing these parts, the project group engaged in active understanding of the various manufacturing methods available. This knowledge gained was applied to the reconstruction effort, during which the components were rebuilt, undergoing a slight redesign based on the results of the quality control regime. Through implementing this technique of reverse engineering, the project group successfully manufactured a tailless prototype UAV. (…)

Within the Fuel Cell UAV project, the interactions between the student members and technicians proved to be invaluable, particularly in the exchange of ideas and experiences. The proximity of the engineering workshop on campus allowed the students to regularly consult the technicians about proposed designs and fabrication techniques."

Source: Valiyff et al, 2008

The example of box 4 illustrates some of the major difference between PBL and project education. Below is a list of these differences, based partly on Delhoofen (1996, p. 59) and Van Woerden (1997, p. 196):

- With project education, the goal is problem solving, not just problem analysis as in PBL;
- As a consequence, the emphasis is on the application of acquired knowledge, while in PBL the emphasis is on knowledge acquisition;
- As already said, the time span of a project is usually much longer than that of a PBL task;
- This requires a careful planning process and project management, all done by the students themselves;
- The role of teamwork in project education is essential, as the students work together for a high percentage of the time, while in PBL much time is spent individually, searching for information;

- This teamwork in project education is all the more important, because the project output is necessarily a team result;
- Consequently, the role of the teacher is more like a team coach, while the PBL tutor is rather a facilitator;
- The number of degrees of freedom is significantly higher in project education, since the project is more complex and lasts longer;
- The reporting of the results is more important in project education, as it is used to assess the results;
- The project is not just based on a description of a real life situation, as in PBL, but actually takes place in a real life situation.

With project education, the structure of knowledge transfer, based partly on lectures, is often maintained, at least in part. However, if the curriculum is designed smartly, the knowledge is offered 'just in time' (JIT). That is, lectures are offered at the very moment the students have come to realize that they cannot proceed within the project if they don't increase the knowledge they have on certain subjects. As a consequence, when this knowledge is offered by the members of the teaching staff, the students are eager to absorb it. In many cases this direct knowledge transfer through lectures is kept 'ALARA' ('as low as reasonably acceptable'), since wherever it is possible, it is considered as better when the students find their own ways to get the knowledge they need. But several reasons may exist why this is not always possible, e.g. because the subject requires a highly new way of thinking that is hard to acquire or to structure by the students all by themselves, or simply due to reasons of time efficiency.
The principle of JIT information is described in detail by Janssen-Noordman & van Merriënboer (2002), who show that such information can be given in many forms (i.e. not only through lectures), and give as an example:

> "An example from health education concerns the skill 'judging the quality of the heartbeat of a patient by feeling his pulse'. The student will probably want to consult supporting information (e.g. by finding the positions of the arteries around the wrist in a medical atlas) before starting the tasks. For this learning task the pulse must be felt of a number of (simulating) patients. (…) While working on the learning task, at a certain moment the student will want to know exactly how he should hold the wrist of the patient in order to be able to feel the pulse optimally. It is this information that ideally can be offered 'just in time', e.g. by a present teacher or tutor who brings the hand of the student in the right position."

Many traineeships and graduation projects can also be seen as examples of project education, in most cases with one major difference: the students usually don't work together as groups but are temporary members of an already existing team of professionals.
Besides traditional lectures, traineeships, PBL, and project education, modern higher education makes use of a whole range of other educational methods. Examples are: discussions, interviews, games (e.g. role playing games, simulations), research programs, art, drama, seminars (organized by students), presentations and publications by students. Combinations of these methods create an even higher diversity of education, and the availability of the internet offers even more opportunities for learning, e.g. the creation of Wikipedia-like sites, virtual classrooms, international cooperation, etc. In 'thematic education', such combinations of educational methods are used in a creative way to study a range of subjects around a major theme of the study program. Examples are described in Sass (1997), and Wang Hongqi (2004)
Many of these methods offer possibilities for integrating sustainable development in the learning process. That is where the second experiment started, in 1994.

5.2. Action: Redesign of M2, using new educational methods (1994 – 1998)

In 1994, The Hogeschool Midden-Brabant (HMB) received the report of the visitation commission that had investigated the M2 program. In this report, the most important recommendation was, to introduce new education methodologies in the curriculum, as was described in chapter 4. This task was taken up by the management team of M2, which was newly formed, also following a recommendation of the visitation commission.
Many educational methods were studied. Most attention went to Problem Based Learning and Project Education, since both methodologies could be used as constructive principles for large parts of the curriculum. This did not exclude other methods, like discussions, games, etc., but these were seen more as possible occasional contributions.
At that moment, new sources of inspiration had become available concerning sustainable development. The most important were: the outcomes of the Rio Conference (UNCED) of 1992, especially Agenda 21; and in the Netherlands the second National Environmental Policy Plan ("NMP2", Ministry of VROM 1993). These sources were used to improve the educational goals and to derive demanded characteristics concerning ESD.

5.2.1. ESD demands to educational methodologies

Many characteristics of ESD have been described in chapter 2 of this dissertation, especially in §2.3. Table 6 in §2.3 shows a list of demands for ESD, that already has been used in chapter 4 as a checklist.
An attempt can be made to describe the extent to which several educational methods are suitable to contribute to the realization of the characteristics of ESD. This is done in table 16 for two methods – Problem Based Learning (PBL) and Project Education (PE). As a comparison, the same is done for one kind of traditional education: lectures (Lect.). The results are shown as '+' (suitable to some extent) and '++' (highly suitable).

Table 16. Overview of characteristics of ESD and their presence in some educational methodologies

Principles	Characteristics	Details	Lect.	PBL	PE
Connectivity, complexity	Systems thinking	Connecting parts, subsystems or aspect systems. Connecting an analytic with a holistic approach; the small with the large; and the local with the global.	+	+	++
	Multi-, inter- or trans-disciplinary	Connecting disciplines and stakeholders. Balanced regarding Triple P; balanced with disciplinary aspects.	+	++	++
	Life-cycle approach	Connecting phases in the lifecycle. Regarding lifecycles of people, products, companies, habitats, cultures, designs, paradigms, etc.	+	+	++
	Intercultural, international	Connecting people, (sub)cultures, regions, nations. Openness for values and perspectives of others.	+	+	++
	Future orientation	Connecting the past, the present and the future. Concerns both long-term and short-term targets, based on visions of sustainable future developments.	+	+	++
Innovativity	Openness to changing conditions	Flexibility of mind; capability of dealing with uncertainties		++	++
	Openness to new solutions	Creativity, non-linearity, out of the box thinking, acceptance of the unexpected.		++	++
	Function orientation	Stimulating creative thought and design processes by zooming out from actual products or services to underlying functions or needs, aiming at finding alternatives ways of fulfilling them.	+	++	++
Action learning	Application of knowledge	Acquisition and application of knowledge, either sequentially or simultaneously (learning by doing). Aiming at finding useful solutions to real problems.			++
	Multi-methods	E.g. just-in-time (JIT) lectures, art, discussions, drama, games, etc.		+	++
	Real-life situations	Context-embedded learning, either in simulated or actually existing situations.		++	++
	Commitment	Personally engaged towards objectives of sustainable development.		++	++
	Cooperation	Teamwork within student groups; cooperation with experts, professionals.		+	++
Reflexivity	Learning to learn	Reflection on own learning process, aiming at continuous improvement. Lifelong learning.		+	++
	Responsibility	Responsibility for own learning process, and for the definition of learning goals (up to a certain level). Also: responsibility for results of professional activities (stakeholder approach).		+	++
	Value-driven	Aware of the relevance and the relativity of embedded values and opinions	+	+	++
	Critical thinking	Critical attitude towards questions, tasks, methods, answers, own functioning	+	+	++
	Robustness of information	Awareness of level of certainty of knowledge, data, conclusions: subjective, intersubjective, objective (opinions, theories, facts)	+	++	++

Lect. = Traditional lectures; PBL = Problem Based Learning; PE = Project Education.
+ = Characteristic can be realized to some extent; ++ = Characteristic can be realized to a high extent

As table 16 shows, traditional lectures can be used in order to realize some of the goals of ESD, but only to a certain extent, since in lectures the subjects can only be treated verbally by a teacher, and not practiced or experienced personally by the students.

PBL offers much more opportunities for these personal experiences, but the same is true on a much higher level for project education. At first glance, this seems to indicate that the ideal curriculum would consist entirely of project education. However, this is not true, as the M2 team concluded, because project education has a number of limitations that are not visible in table 16.
First of all, project education usually is very time consuming. This is not necessarily a waste of time, as all kinds of activities, like group discussions, organizing meetings, visiting participating companies, can be valuable learning processes. But reasons of efficiency can lead to a decision to not use project education all over the curriculum. Another reason for this may be that, when just one methodology is used in the entire curriculum, the students' enthusiasm may drop: variation creates motivation. But besides, there are more fundamental objections to project education, especially related to early parts of the curriculum.
One essential characteristic of ESD is connectivity & complexity. This goal can be realized in the course of the curriculum, but it does not have to be realized on the highest level immediately, i.e. in the first year. To the contrary, a high level of complexity in early stages of the learning process may well be too much for the beginning students: their capability to integrate a lot of subjects is less than their more experienced colleagues'. So, the complexity should increase gradually over the curriculum, in a carefully planned way. This makes project education a highly appropriate educational methodology for higher levels of education, but less so for the first year.
This complexity has not only to do with the contents of the student activities, but also with the organization around it. Project education requires a careful planning process by the students themselves, and for beginning students this may prove to be too complicated, as it takes a lot of attention to focus just on the contents of their tasks. It is just like someone who has his first swimming lessons: focusing the attention to the arms, the legs, the respiratory rhythm, the speed and the direction all at the same time may not yet be possible.
Another reason is the fact that project education is very usable to apply acquired knowledge, insights and skills. This is possible only if the students possess such knowledge, insights and skills, at least at some level. Besides, companies in which projects are performed by inexperienced students may not react overly enthusiastic.
The above disadvantages don't apply to problem based learning. This why the M2 team decided in 1994 to use PBL as the basis for the first year of the new curriculum, and project learning for the second year and the 6th semester (Roorda, 1995). Both the PBL and the project education were accompanied by other educational methods, e.g. lectures, role playing games, discussions, and excursions, which were offered JIT wherever possible.
The first semester of year 3 was used – as before – for the first traineeship of five months, as this was just another way of realizing project education. The second traineeship and the graduation project together formed the 4th and final year.

5.2.2. Reshaping the curriculum

The development of the new M2 program fitted very well in the educational development within the entire university, the HMB (Hogeschool Midden-Brabant, 1995), which was part of a larger innovation process taking place in HBO in the Netherlands, in reaction to the needs that were described in the first section of this chapter. During the innovation process of M2, the HMB operated together with the Hogeschool IJselland, a University of Applied Sciences in the north of the Netherlands. This university renamed its study program 'Materials Technology' to 'Milieugerichte Materiaaltechnologie', the name that the HMB used (for which the letters 'M2' stand). Both universities together developed a new document describing the 'core qualifications' of the M2 study program (Siemons and Blom, 1994). Following this, a new mission of the study program was developed and approved by the management and the teachers of M2, the Advisory Board of M2 (in which representatives of industry, the local and national government, and centers of expertise on sustainable development were represented), and the Board of the university. The new mission was published in 1996 (Roorda, 1996).
After the change process of M2, which took place in the years 1994 – 1998, the curriculum looked like figure 18. The separate integration modules, which formed the key to multidisciplinarity in the first design, had been replaced by PBL and project learning in the second design.

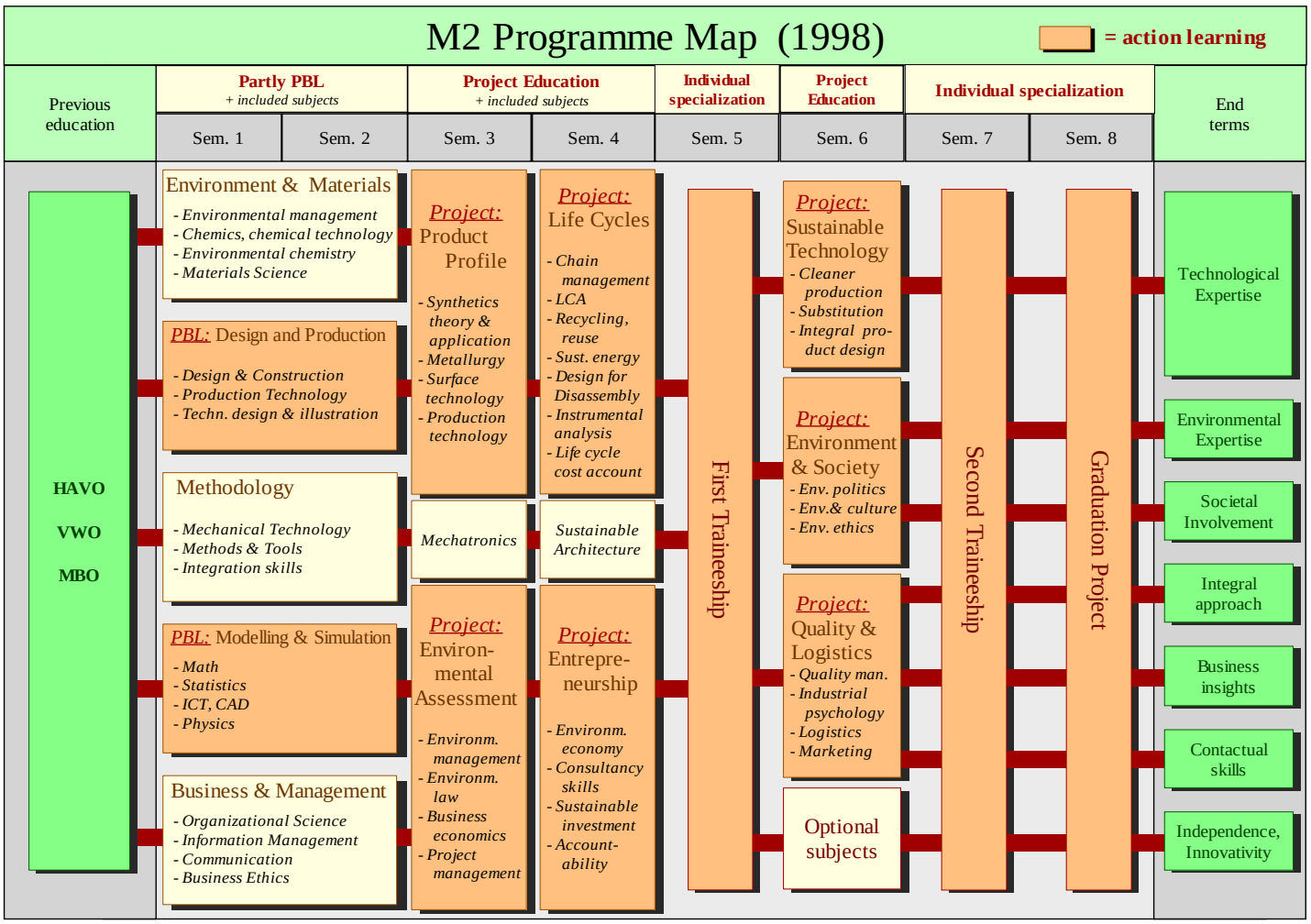


Figure 18. Outline of the M2 program in 1998, after it was rebuilt from a subject oriented curriculum (shown in figure 12, §4.2.3) to one based on Problem Based Learning and Project Education

5.2.3. Problem Based Learning in the first year of the study

In the first year of the study program, two streams of PBL were designed. One was called 'Modeling & Simulation', offering basic subjects like mathematics, statistics and physics in a PBL context. Box 5 shows one of the tasks of this stream.

Box 5. M2: A PBL task of the stream 'Modelling and Simulation'

"The Factory Enlargement

Somewhere in the countryside there is a production plant. In the halls there is some heavy machinery, with a total power of 200 kW. They produce rather a heavy noise, which can be heard quite well in the surroundings: at a distance of 1000 meter, where the outskirts of the nearest town are situated, the volume of the sound is 30 dB when the factory is operating on full power.

This is no problem, since local environmental regulations indicate that the maximum sound volume is allowed to be as high as 36 dB.

Now, the factory wants to enlarge its capacity: it wants to add new machinery, in order to enlarge the production of the same kind of products it was manufacturing up till now. The company is planning to raise the total machine power to 500 kW.

At the very moment the plans are completed, an announcement is received from the local government that the development plan of the nearby town is going to be changed: a new suburb will be built, because of which the distance between it and the factory will become only 600 meters.

What do you think: does the factory have a chance to receive a licence to enlarge its machinery according to the plans? (You only have to look at the sound aspects of the environmental regulations.)"

Source: Roorda, 1997a

The teacher's instruction to the PBL task of Box 5 explains that the question with which the task ends is actually a wrong question. An exact answer can be calculated, making use of elementary formulas of acoustics. This straightforward calculation shows that the company will certainly not get its license. But whether this exact answer is really relevant depends strongly on the specific circumstances in the surroundings of the factory. Besides, the company has the option of constructing extra soundproofing measures. As a consequence, the real question should not be if the company will receive a license but what they will have to do in order to receive it.
It is expected that the students together will perform the exact calculation, discover the weakness of its result and thus of the original question (if necessary with some help from the tutor), replace it with a better one, and find a suitable answer.
Another example of a PBL task, belonging to the stream called 'Design & Production', is given in Box 6.

Box 6. M2: A PBL task of the stream 'Design & Production'

"Crash barrier
Thanks to the surface treatment of the crash barriers along the Dutch highways, the environment is polluted seriously. Some renowned engineering agencies have started a research to investigate the seriousness of this pollution. The Ministry of Traffic has put up an award for the best alternative."

Source: Van Nuijs & Bijsterveld, 1998

An important aspect of the PBL task in Box 6 is the discussion of the term "best alternative". In order to complete the task in a meaningful way, it is necessary for the students to consider aspects like the technical demands, the selection of materials, the surface treatment, the financial costs, the durability of the chosen solution, the environmental aspects, among which the recyclability, etc., and weigh all of these against each other. Together, the two cases offer an overview of the way in which the PBL in the first year of the study program was designed. Both streams together filled around 2 to 3 days a week. In the other days, combinations of lectures (partly by external experts), practical exercises, discussions and excursions took place.

5.2.4. Project Education in the second and third year of the study

As figure 18 shows, two large projects were designed for semester 3, another two for semester 4, and three somewhat smaller projects for semester 6. Box 7 cites a part of a document from 1995, in which the philosophy behind the projects was explained. The cited text, describing the semester 3 projects, is illustrative of the way the education was designed.

Box 7. M2: The projects of semester 3

"In semester 3 two projects have been inserted that each, during half a year, fill two days a week.

The project '*Product Profile'* has as its goal to design an 'M2 profile' of one product. This means that a complete insight is gained in the most important properties of the product. This concerns properties regarding: materials use; production processes; environmental impact; production costs; user demands; waste treatment. All these aspects are investigated by the students themselves, and described in the final report. Wherever possible, the conclusions are quantified, i.e. represented in the form of representative numbers. For this project, a lot of knowledge and experience is needed, which the students partly don't possess at the moment they start with the project. For this reason, a number of theoretical subjects are embedded in the project, and it is seen to it that these lectures are offered at the moment this information is necessary for the project.

The project '*Environmental Assessment'* works with the same scheme. Its theme is the assessment of a company. For half a year the students work on the investigation and description of the situation in a real, existing company (in 1995: Novum, a furniture factory in the village of Boxtel). This happens according to a systematic method, 'Enviroscan'. During the research, indicators are measured that are representative for the production in the company involved, e.g. concerning: materials use; types and quantities of waste; discharge of polluting materials; energy use; hazardous storage and use of materials. In several cases the research delivered a lot of information that was unknown to the company itself, and which had far-reaching consequences for the operational management. As an example, the research of Novum will be used to apply for a new environmental licence in relation to the Environmental Management Act ('Wet Milieubeheer')."

Source: Roorda, 1995

Besides the Novum Furniture Factory, projects have been done over the years in e.g. Van Besouw Textile Industries, Assenburg Furniture, Gianotten Graphics and Printing, the Municipality of Tilburg, and the Fire Brigade Training Center in Tilburg.
In the 4th semester, an interesting project was the Mini Enterprise. In this project, each year the students founded a real company, including registration at the Chamber of Commerce. They defined a product (or in some cases a service), designed and produced it, sold it to a suitable group of customers, and thus tried to make a profit out of it. The costs for these firms not only consisted of the procurement of materials and production equipment, but also of a (low) salary for the crew, i.e. the students themselves. Projects like this have been done in quite a lot of other universities, but with M2 a natural condition was that the students were able to explain that their company acted within strict sustainability rules (considerably stronger than legal requirements), and if possible even contributed to sustainable development.

With all these projects, the students could make use of the so-called 'M2 Toolbox'. In this toolbox, a large number of methods and tools were described. The formation of this toolbox was a process in which nearly all M2 teachers cooperated for several years. Box 8 offers an overview of some of the methods and tools.

Box 8. M2 Toolbox

Methods:
MICON Enviroscan; Berenschot Systems Management Model; Quality, Health, Safety & Environment System; Business Environmental Policy Plan (BMP); Product Oriented Environmental Management System; Risk Assessment for Equipment Safety; Integral Chain Management; Design for Disassembly (DfD), for Recyling, or for Environment (DfE); Sustainable Product Design; Life Cycle Assessment (LCA); Systematic Materials Selection; Life Cycle Cost Account (LCCA).

Tools:
Decision Matrix; Morphologic Diagram; Brainstorm; Black box; Moon Journey Approach; Functional Block Diagram; Relation Diagram; Fishbone Diagram (Ishikawa Diagram); Flow Chart; Tree Diagram; Organogram; Cause Relation Diagram; Checklist; Exploded View; Pareto Diagram; Histogram.

Source: Van den Beemt, 1998

The curriculum had a carefully planned gradual increase of complexity and multidisciplinarity. Where the projects of the second year each focused on a main aspect of the professions that M2 aimed at, the semester 6 projects tried to integrate them all.

5.2.5. Traineeships and graduation

For all traineeships and graduation projects, a number of demands were formulated (Van den Beemt, 1996). Besides the usual conditions, some of them were: the project must be a contribution to sustainable development; and it has to have a multidisciplinary subject and approach.
Box 9 shows a summary of one of the graduation projects, which illustrates the kind of work the graduating students performed.

Box 9. M2: An example of a graduation project

Copper or polybutene?
In the nineties, a research program was performed investigating the use of heavy metals in building industry and civil engineering. One of the projects in this program was the M2 graduation project of Patrick Roegies. He investigated the use of materials in pipelines for drinking water. A main reason was that environmental research in 1992 had shown that the concentration of copper in at least 90% of Dutch surface water was higher than the MAC value (Maximum Acceptable Concentration). Patrick compared the use of copper with a synthetic material, polybutene.
For his investigation, he studied the available literature and performed calculations. He interviewed experts, managers and engineers of construction companies, and members of the working crew of those companies. Finally, he joined the work forces in order to get a real understanding of the use of both materials in the construction work.
In his comparison, he focused on ecological, technical and economic aspects. He looked e.g. at the materials costs, the realization characteristics, the technical demands, the environmental influences. All these were studied from a viewpoint of Integral Chain Management, aiming at the complete life cycle of a pipeline system.
Some of his conclusions were:

Ecology:
- When copper becomes available as waste after demolition, a very high percentage is recycled. Up to date, polybutene is burnt and thus only the energy in it is reused.
- The energy needed for copper pipelines is significantly higher than for polybutene. This is still true if 100% recycled copper is used.

Economy:
- If the installation costs form the major part of the total costs, polybutene is cheaper. If the costs of materials are the major part, copper is cheaper.
- Financial loss due to theft of copper on the building site can amount to 10% of the project price. This is not the case for polybutene.

Technology:
- Due to a lower surface roughness of polybutene, in the user phase it has a better flow profile.
- No estrogen migrates from polybutene to the drinking water during the use phase, at least within the boundaries of Dutch law.

Patrick's conclusions and recommendations were accepted by the Ministry of Environment, and cited in its final program report.

Source: Roegies, 1997

5.3. Result assessment

In this chapter, the central question is: Can an educational program optimize its contribution to sustainable development through a careful selection of educational methodologies?
The second M2 program was designed to investigate this question, or more precisely, to prove that M2 gave a clear answer to it by being a good example of an ESD dedicated study program.
In the former chapter, six hypotheses were formulated that can be used to test the success rate of such an ESD dedicated program. These six hypotheses will be used again for the evaluation of M2 in the present chapter, enabling a comparison between the two versions of M2. The hypotheses are again combined with table 8 to form the following table 17:

Table 17. Experiment # 2: Criteria for result assessment		
Experiment Criterion	X2 M2 method.	Assessed hypothesis
Contribution to ESD towards direct stakeholders		
Implementation of ESD in vision, policy	§5.3.1	1. The study program meets the demands of ESD.
Implementation of ESD in education	§5.3.1	
Customer demand	§5.3.2	2. The study program attracts a sufficient number of students.
Customer appreciation	§5.3.3	3. Students appreciate (the ESD character of) the study program.
Contribution to SD towards indirect stakeholders		
Indirect stakeholder appreciation	§5.3.4	4. External stakeholders appreciate (the ESD character of) the study program.
Contribution to SD through HE	§5.3.5	5. The graduates contribute to SD in the professional field.
Transfer of expertise	§5.3.6	6. The program contributes to ESD implementation elsewhere.

Sources of information

Several sources of information were used to discuss the six hypotheses. Among them are the examination regulations, the study guides and the study materials of M2.

The rate of success of M2 concerning the number of students will be discussed based on the annual enrolment numbers.

An indication for the external appreciation of M2 will be based on the support, partly financial, by external partners and organizations.

A first formal evaluation of the M2 study program appeared in 1997. As was usual, some years after a visitation by an HBO Council commission (which visited M2 in 1994), the Inspection of the Ministry of Education visited the University, trying to discover what had been done with the recommendations of the visitation commission. The Inspection interviewed a number of students. Their reactions are laid down in a report (HMB 1997).

In the year 1999, the M2 study program was again assessed by a visitation commission of the HBO Council, just as in 1994. (The visitation system will be described in more detail in §7.1.1.) Again, the visitation was prepared by a self-evaluation by the M2 team.

As a preparation to the self-evaluation, this time a preparatory analysis of the study program and its organization was made. For this analysis, an instrument for quality management was used called 'Expert Model' (Van Kemenade & Vermeulen, 2004). The basis of this system was the EFQM model, named after its designing organization, the European Foundation for Quality Management. Based on this system, the Dutch organization INK developed the so-called 'five-stage model', which was used by a group of quality management experts in HBO institutions to develop the 'Expert Model', which was entirely dedicated to higher education.

(The subject of these various models will be described in much more detail in chapter 7, as it formed the starting point for the development of AISHE, an instrument for the assessment of ESD.)

The EFQM analysis was carried out by the central quality department of the university. Based on the report of the analysis (Molthof, 1998), a self-evaluation report (Roorda, 1998a) was written, to which many team members of M2 contributed.

The visitation took place in June 1999. The report (HBO Council, 2000) was published in January 2000. The conclusions in the report are highly indicative for the rate of success of the M2 redevelopment, and therefore also for the main research question of this chapter. The EFQM report, the self-evaluation report and the visitation report will all be used.

Another source of information was an investigation in the form of a questionnaire among former M2 students, which was performed in 2009.

The evaluation of the various success criteria of the second M2 program will be based on a combined use of information sources. Consequently, the conclusions for each separate criterion will be based on a methodological triangulation 'within methods', as all sources are either qualitative or quantitative in nature. Besides, an investigator triangulation will be applied, as the conclusions of the university quality department, the self-evaluation by the M2 team, the Inspection of Higher Education, and the HBO Council visitation commission will be combined. The final answer to the question of this experiment will be based on triangulation 'across methods', as all (both qualitative and quantitative) data will be combined.

5.3.1. M2 as Education for Sustainable Development

The first of the six criteria is about the level to which the renewed M2 program meets the demands of ESD, as listed in table 6.

The evaluation of the first M2 program, in chapter 4, showed that M2 actually was not a sustainable development program in its full meaning, as it focused on sustainable technology. The emphasis was, besides technology, on environmental and economic subjects. During the redevelopment of M2, no attempt was made to change this. And so, around 1998, when the change process was completed, there was still no balance between the three 'pillars' of sustainability: the social, economic and environmental dimensions. (Inter)cultural subjects were superficially touched, as was the relation between cultural, structural and technological aspects, but not given much attention. On the one hand, this was intentionally and logical, as M2 was explicitly defined as an engineering program. On the other hand, the conclusion of chapter 4 can also be applied in this chapter: it would have been good if, at least at an elementary level, the full range of sustainable development, including a balanced approach to the Triple P, would have received more attention.
The focus of the redevelopment however was on the educational goals and methodologies, not on the curriculum contents. About these goals, the 1999 visitation commission was satisfied, just as its predecessor in 1994. The visitation report shows that the commission did not experience a shortage of attention to cultural aspects:

> "The study program has as its goal, to educate students who are capable of working on the stimulation of sustainable development through technological means. So, the M2 engineer will have to solve many problems that are very new and that are related to combined aspects of technology, environment, culture and structure. All four of those subjects receive attention, with the emphasis on technological subjects. Therefore, the study program is described as 'exceptionally broad'. The commission thinks the image, described in various documents, is convincing."

Just as in 1994, this broadness of the educational goals is found by the commission in the curriculum contents. The commission is partly positive, and partly less so:

> "The curriculum surely is very broad. The advantage is that students have the ability to come to integrative approaches. The disadvantage is that there is a risk of superficiality. (...)
> Many technical and theoretical subjects that are considered as important by the commission, receive (some) attention. New developments receive sufficient attention, both environmental and technological (e.g. new materials). Students as well as graduates indicate to have acquired enough skills to master new knowledge quickly. (…) The commission thinks that, especially in the field of designing, improvements are needed and possible. In too many cases, designing is confused with LCA. More attention should be given to methods and skills concerning the product life cycle."

Following the earlier visitation report of 1994, the 1999 visitation report pays ample attention to the integration of subjects.

> "Vertical consistency (through the years of the study) is realized because the elements of the first year return in a more extended and profession aimed way in the second and third year. The attention to sustainable development / sustainable technology forms a clear thread throughout the curriculum. Learning to think in an integrative way is mentioned in the same way by the students. Thanks to the introduction of PBL, much progress has been made concerning the integration of subjects. This concerns not only the integration of knowledge and skills, but also of theory and practice.
> In the third year, the project 'sustainable technology' has a strong integrative nature, because it tries to be a combination of all aspects of the study program. Integration of knowledge, skills and attitudes also takes place in the traineeships and the graduation project."

PBL and project education receive a lot of attention from the visitation commission. This is no wonder, since the former commission, five years before, made some strong recommendations about the educational methods that were used at that time. The commission of 1999 is happy with the improvements:

> "The commission has much appreciation for the way in, and the extent to which the study program has given its shape concerning education methods and student activities. A combination has been selected of Problem Oriented Learning (PBL) in the first year and project education (PE) in higher years. The PBL is more directive, aiming at the acquisition of knowledge, while the PE is dedicated to the application of knowledge from various subjects. The autonomy of the students increases through the years of the program. To a high level the student is personally responsible for progress and specifications. The option to select optional subjects in semester 6, and the traineeships and the graduation project contribute strongly to this. These educational methods have been selected to be able to implement goals like a stronger integration of subjects and of knowledge and skills: i.e. active knowledge acquisition, 'learning to learn'. At the moment, 50% of the curriculum consists of PBL and PE. From the meetings the commission had with teachers and students it has become clear that the vision is supported widely. Students and teachers are enthusiastic. There is a clear introduction for students to the specific way of working, and the Yearbook 'works'. The exercises are clear and the students enjoy working on them."

The commission has the opinion that action learning has been successfully created thanks to the new curriculum:

> "Thanks to the introduction of PBL and PE, to the orientation on themes, and to the introduction of concrete tasks in companies, activating education methods have been implemented and the professional orientation is improved strongly. Combined with existing traditional education methods a good mix has been created, through which it is possible to realize all kinds of learning goals (knowledge, insight, etc.)."

This is in accordance with the findings of the self-evaluation in 1998. Its report presents the results of an assessment among teachers and students:

> "Since the start of the new educational model, the variety of didactical methods has increased. The experiences with the new methods are positive. Especially the projects are seen by teachers and students as very meaningful."

Earlier, the importance of the use of real-life situations was emphasized by the Inspection of Higher Education (HMB, 1997), focusing on the early parts of the curriculum:

> "Early in the study program, the students are confronted with real-life situations through excursions and company visits in the course of their PBL tasks. In many occasions, first-year students are accompanied in the companies by graduated former M2 students."

The ESD checklist

The situation around 1998 can be summarized as in table 18, which - just as table 13 – is based on table 6, the ESD checklist. For comparison reasons, the scores of the first M2 program are copied from table 13.

Table 18. Education for Sustainable Development compared with the second M2 program			**2nd**	**1st**
Principles	**Characteristics**	**Second M2 program**	**M2**	**M2**
Connectivity, complexity	Systems thinking	Realized intensively through PBL and PE	++	++
	Multi-, inter- or transdisciplinary	Extensive multidisciplinarity, no (intentional) interdisciplinarity	+	(+)
	Life-cycle approach	Strong emphasis on product lifecycles: e.g. source orientation, integral chain management, design for recycling, lifecycle assessment (LCA)	++	++
	Intercultural, international	Not much attention	+	–
	Future orientation	Explicitly present, e.g. through attention to innovativity at several levels and time spans	++	+
Innovativity	Openness to changing conditions	Theoretical and simulated approach in PBL; exercised during PE and internships	++	+
	Openness to new solutions	Creativity, non-linearity, out of the box thinking: all strongly stimulated and exercised, esp. in the integration modules	++	++
	Function orientation	Thorough treatment in PBL; exercised in PE and internships	++	++
Action learning, social learning	Application of knowledge	Primarily present in PE, internships and graduation projects, and to some extent in PBL	++	+
	Multi-methods	A systematic and highly appreciated curriculum structure with a variety of methods	++	–
	Real-life situations	Simulated in PBL; fundamental in PE, internships and graduation projects	++	+
	Commitment	High sustainability engagement with both the teachers and the students	++	++
	Cooperation	Teamwork within student groups in all study years; during PE also intensive cooperation with professionals and experts	++	+
Reflexivity	Learning to learn	Practiced throughout the curriculum, being one of the cornerstones of PBL and PE	++	–
	Responsibility	Practiced throughout the curriculum	++	+
	Value-driven	Explicit fundament in the Brundtland principles	++	++
	Critical thinking	Practiced throughout the curriculum	++	+
	Robustness of information	Practiced throughout the curriculum	++	+
Overall			++	+

The table shows two scores below the optimum. First, the level of multidisciplinarity was strongly improved compared to the first M2 program. Graphically, this is shown in figure 17 as the shift from figure 17B to 17C. But no expli-

cit attempts were made to create an interdisciplinary cooperation (as shown in figure 17D), e.g. through the formation of interdisciplinary student teams working on PBL or PE tasks, which would have given a higher score in table 18. Besides, as was discussed already, the intercultural and international aspects of sustainable development might have received a stronger attention in the curriculum.
Nevertheless, it is clear that the second M2 program was a major improvement compared to the first program. The renewed program was a solid example of a study program for (main aspects of) sustainable development, meeting nearly all ESD demands.

5.3.2. Student numbers

Considering the number of students, the M2 study program has never been very successful. In the first year, 1991, only four students started with the program. In the following years the inflow increased, but not as fast as the M2 management team or the University Board had wished.
In an attempt to increase the number of students more quickly, the managing trio of the first M2 program paid extraordinary attention to PR activities. A special PR plan for this purpose was developed (Roorda, 1993) and carried out in 1994 till 1996, partially financed by the Ministry of Environment in 1994 and 1995. In the next years the inflow rose to a maximum of 32 in the year 1996. After this year the capacity for this extraordinary effort towards PR was no longer available, and immediately the inflow dropped sharply to 10 new students in 1997.
Several attempts were made to improve the situation. As the percentage of female students was low – 20% on average – the focus in the PR activities was put on aspects of the program that might interest especially girls and women; this did not lead to an increase of the percentage of female students.
As the city of Tilburg is near the Belgian border, the option was studied to interest Belgian students, especially from Flanders, the Dutch-speaking part of Belgium, in the program. However, since the educational structure, laws and regulations were quite different in both countries, this turned out to be very complicated, and the attempt was abandon.
The option was studied to change the name of the study program. The name 'Milieugerichte Materiaaltechnologie' ('Environmentally Oriented Materials Technology'), selected in 1991, was a long and complicated name, that perhaps did not appeal to potential students. A proposal was made (Roorda, 1997b) to change the name officially to 'Duurzame Technologie' ('Sustainable Technology'). In 1999, the visitation commission seconded this proposal (HBO Council, 2000), but it was not accepted by the University Board.
As a consequence of the low student numbers throughout the years, concessions had to be made in order to operate cost-efficient. In the years between 1991 and 1994, a part of the curriculum was implemented together with other study programs. I.e., some lectures and practical work were offered together with the programs of either Mechanical Engineering or Technology Management. After the introduction of PBL and project education, when at the same time the inflow improved (between 1994 and 1996), it was possible to end this, which made it possible to optimize the curriculum.
After the student numbers dropped, starting in 1997, this situation could not continue for long. In 1998, the same year in which the self-evaluation was made as a preparation for the visitation in 1999, the University Board decided to combine M2 and the study program of Environmental Management under one program manager – the manager

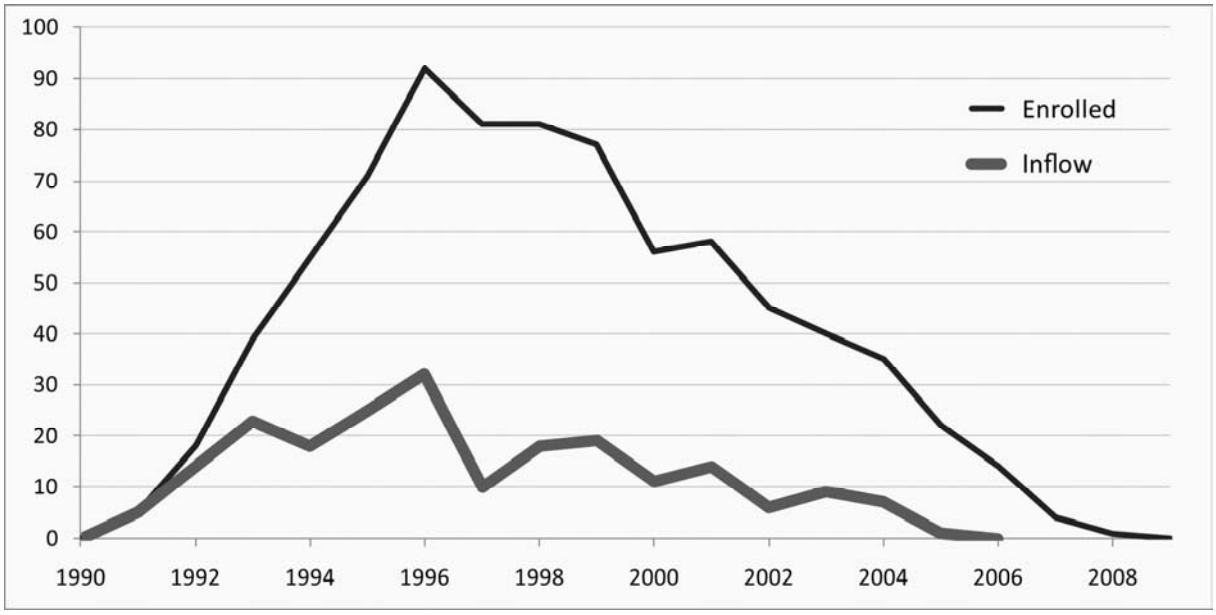


Figure 19. The number of students of M2 through the years

of Environmental Management. At the same time, a number of curriculum elements had to be combined between the two programs; M2, being the smaller program, made the strongest programmatic concessions. Some years later, when both study programs continued to decrease in their student inflow, a further combined management was made, together with a partially combined curriculum, with the study program of Chemical Technology.
It is impossible to prove that the two consecutive program mergers (on a managerial level, and partly on a curriculum level) caused the inflow to drop further, since a comparison cannot be made with a situation in which M2 would have remained completely independent; but it seems likely, since the particular character of M2, which had appealed strongly to the M2 students, vanished more and more, and so did the number of students (see figure 19).
In 2005, only 2 new students chose to start with M2. Shortly after, the University Board decided to end the study program. The last M2 student graduated in 2008, thus putting a definite end to the study program.

5.3.3. Student appreciation of ESD in M2

In the years around 1996, there were not yet strong indications that M2 would once have to close down. At that time, the students were enthusiastic about the program. The first external organization that concluded this was the Inspection of Higher Education, when they interviewed a number of students in 1997. The students indicated that they experienced the PBL as highly motivating. They had also much appreciation for the ability to work autonomously. This was stimulating their development as an independent professional (HMB, 1997):

> "As very positive aspects of the study program, the students mention:
> - The pleasant atmosphere and relation between teachers and students;
> - The ability to study autonomously;
> - The stimulation by the program of personal growth; (…)
> - The positive contacts with companies;
> - The positive evaluations of the companies after the graduation projects.
>
> Negative aspects mentioned by the students are:
> - The name of the program does not cover the contents anymore ('sustainable technology' would be better); (…)
> - The [low external] name recognition;
> - The character of the program still has to be explained too often to companies."

The negative aspects mentioned by the students signalize the problem that was already known in the earlier years: the program was not well-known, both with the potential students in secondary education, and in the professional field.
The 1999 visitation commission also interviewed the students, and besides met with a number of graduates. Some of the comments:

> "Graduates with whom the commission spoke were very satisfied with their study, and indicated that it attunes well with the work they found. (…)
> The graduates are proud of the broad basis they have acquired, and of the level of multidisciplinary thinking that enables them to quickly adjust to new situations or specialties. They are happy with the skills about project engineering and -consultancy they have acquired. To their opinion, environmental aspects are treated sufficiently. More attention should be given to business and economic aspects and to knowledge of sustainable energy. (…) Some students indicated they would have wished to go deeper into certain subjects."

Some more insight on the opinions of the former M2 students can be acquired through an investigation among them in 2009.

The alumni investigation of 2009

In May and June of the year 2009, an investigation was made into the long term effects of the M2 study program. First, the total number of M2 students was found – which appeared to be difficult, because database applications that were used in the nineties were not in use anymore, and the data had not been transformed to the new software. Nevertheless, the numbers of students over the years were discovered, and they are shown in figure 19. It appeared that in total, 212 students have enrolled for the M2 study program. One student tragically died in his first year of study due to a traffic accident. Out of the 211 other students, the e-mail addresses of 163 people could be discovered (77%). They all received a questionnaire by e-mail. From them, 87 students responded and sent back a completed questionnaire. This is 53% of the former students that could be reached, and 41% of all former students. Based on their reactions, a long term study of the effects of the M2 program could be made.
When asked if the students finished with a bachelor's degree, 96% of the respondents answered positive. This is an extremely high number, compared to the average success rate of HBO or of the HMB. Partly this high number can be explained by the fact that M2 through the years indeed had a very high success rate. Probably another partial explanation is a possible bias in the results of the questionnaire, as it is to be expected that successful former students (both regarding their study and their professional career) tend to be more responsive than others.

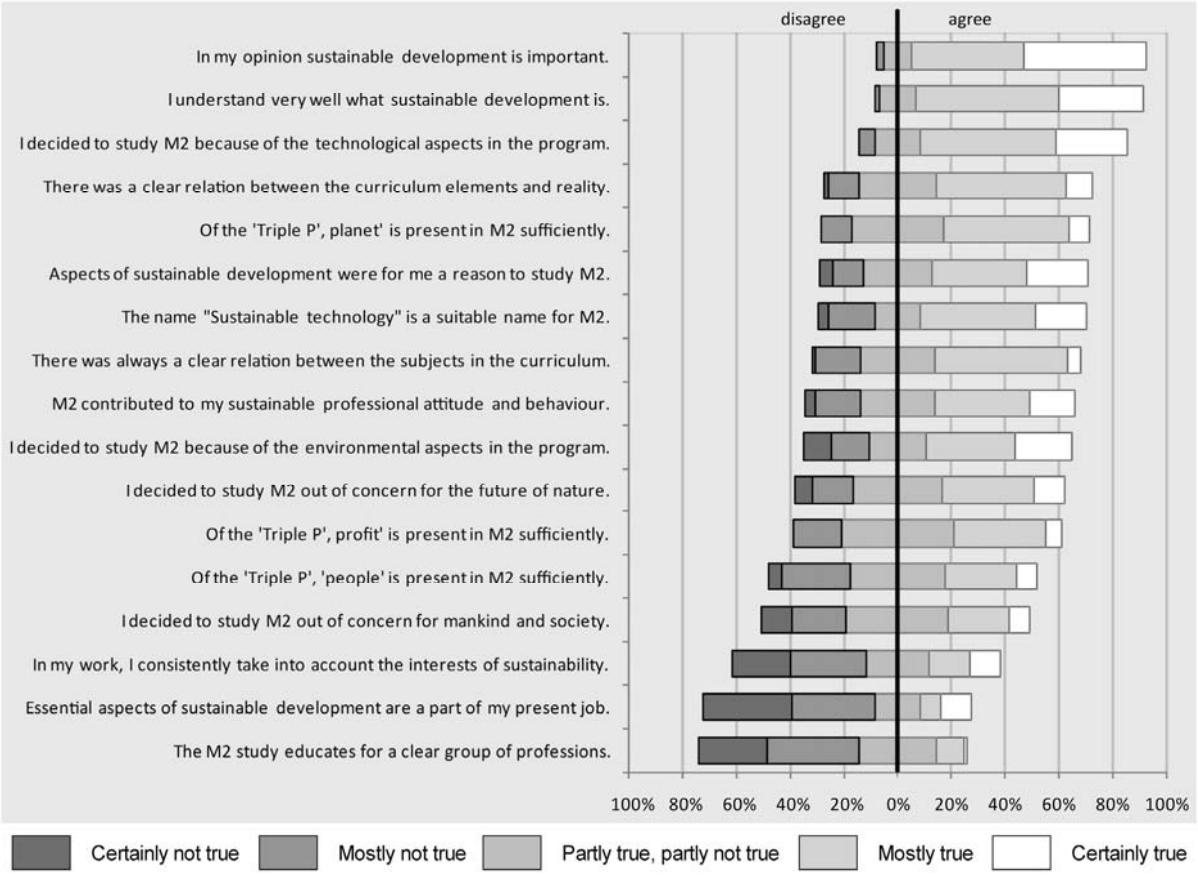


Figure 20. Opinions of M2 graduates in 2009: various subjects

The main part of the questionnaire consisted of 26 statements, to which the respondents could react on a five-point scale, varying from “certainly true”, mostly true”, “partly true, partly not true”, “mostly not true” till “certainly not true”. The statements are shown in figures 20 and 21. Figure 21 (shown below, in §5.3.5) is related to main aspects of the former students’ present professional situation, whereas figure 20 deals with a variety of other subjects. The boxes in both figures show the level of (dis)agreement with the remarks, i.e. the percentage of respondents in each of the five answer categories, with “certainly not true” on the left and “certainly true” on the right.

As figure 20 shows, nearly all responding former M2 students agree that sustainable development is an important subject. This may have been influenced by the media attention the subject has received in recent years. This is however not a likely explanation for the fact that the respondents in a large majority estimate that they understand the concept of sustainable development very well. Both answers, taken together, imply that the study program was successful regarding the acquisition of knowledge, insights and attitude concerning sustainable development. When asked whether M2 contributed to this attitude and behavior, 51% agreed at least partially, while 20% disagreed at least partially.
Reasons to select the study program varied. Of the reasons the respondents could choose from, technology was the most important one, followed by sustainable development, environmental aspects, concern for the future of nature, and finally concern for mankind and society. This implies that M2 attracted students in the first place because it was a technological study program, rather than one about sustainable development, although probably the combination was the most important reason the program appealed to them.
Several respondents added the remark, that the broadness of the study program was for them a main reason to select it. A large majority of the respondents agreed that the title ‘sustainable technology’ would have been a suitable name, although one respondent added: “Sustainable technology is not a fair name for M2, as it does not do right to other subjects that are present, e.g. economics, management and law.” Another person suggested “sustainable management” as a suitable name.
The presence of ‘planet’, as an element of the Triple P, is recognized as sufficient, followed by ‘profit’ and finally ‘people’. This is in agreement with conclusions that were made at the end of chapter 4 of this dissertation, and it shows that at least part of the respondents would have liked to see more ‘people’ elements in the curriculum, although it must be said that the differences between the three ‘P’s’ are not large.

As to the integration principle in the curriculum: a clear relation between the curriculum elements, as well as between the curriculum and real life, is recognized, as 56% agreed (at least partially) while only 11 - 12% disagreed on both items.
In order to investigate more fully what the effects were of the history of the M2 program through the years, the total group of students was split into three subgroups, based on their starting year. The first group consists of the students that started in 1991 till 1994, i.e. in the first curriculum (that was described in chapter 4). The students of the second group started in 1995 till 1998, i.e. in the newly developed study program, described in the current chapter. The third group of students started after 1998, in a period in which an increasing amount of concessions had to be made due to the cooperation with other study programs. The number of respondents in the three groups are 26, 30 and 31 respectively.
As it turned out, there was no significant difference between the three groups in their judgment towards both statements about integration. This implies that the reformative efforts between 1994 and 1998 did not result in a visible effect in the students' opinion about the level of connectedness. This may be caused by the fact that this connectedness was already high in the first period, according to the students of group 1, as 56% of them was in favor of the statement of connectedness within the curriculum (18% was against), and 64% was in favor of the statement about the connections between the curriculum and real life (14% was against).

5.3.4. External stakeholder appreciation of ESD in M2

The professional field was enthusiastic about the M2 students and -graduates. Especially in SME's, the students were already during their internships able to work in an innovative way, thanks to the fact that they usually knew much more about sustainable development than anyone in the companies they worked in, and were better able than anyone to think and act in an integrative way. In 1997, the Inspection of Higher Education concluded, based on its interviews with students (HMB, 1997):

> "In many cases, the companies regard the interns as experts. A consequence of this is that the internship tasks are strongly based on actual 'hot' issues within the companies. As a result, during the internship the student is working in a highly innovative way. Thanks to this, the companies profit strongly from the students' achievements. Frequently, newly developed subjects are taken back to the study program by the students, through which they contribute to adaptations of the curriculum."

The M2 team itself concluded in its self-evaluation (1998):

> "The letters of recommendation and the graduation assessments by the companies show that the companies are highly satisfied with the quality of the M2 graduates. Especially the aspects "System oriented and independent working in an interdisciplinary context" and "the high level of expertise" are mentioned regularly in such evaluations."

This conclusion was seconded by the visitation commission in 1999, which – after interviews with representatives of the professional field – wrote in its report:

> "The representatives of the professional field the commission met were very satisfied about the quality of the trainees and the graduates. They were described as enthusiastic and passionate. They are perfectly able to work in a project setting, in which the ability to integrate knowledge and strong communicative skills play an important role. The technical and theoretical training suffices, but now and then the desired depth is missing. The opinion was shared that there should be more attention to methodic designing."

Again it appears that the broad curriculum caused a problem towards its depth in some respects. This problem has never really been solved.
The final results of the study program can be assessed through the study of the graduation projects, and this is what the visitation commission did. Their report writes:

> "The M2 study program is completed with a graduation project in a company. An important goal is that the graduate is able to work in an interdisciplinary cooperation and to create real changes in an organization. For this goal it is expected that he functions on the level of a project manager or -consultant, and that he pays attention to possibilities for sustainable solutions. (...)
> The problem descriptions and the contents of the graduation reports [the commission has studied] are sufficiently relevant in relation to the end terms, and are relevant for the professional practice of the sustainability engineer. The graduation reports show that the qualifications that are considered by the commission as necessary are realized."

Another stakeholder of M2 was the Dutch Ministry of Environment (VROM). The development of the second M2 curriculum, between 1994 and 1998, received a lot of support from this Ministry. This was shown financially by the subsidies the Ministry donated to the study program. The money was used for the educational developments; for importing a lot of external expertise through guest teachers (who not only trained the students but the internal

teachers as well); for the acquisition of ICT equipment and software; for the setting up of a library on sustainable development and an environmental laboratory; and for a number of marketing activities.
The total amount of subsidies was 437,000 Dutch guilders, which is approximately € 200,000. (Due to inflation, a comparable subsidy in 2010 would amount to approximately € 270,000.)

5.3.5. Contribution to SD in the professional field

Although the 1999 visitation commission was positive about the curriculum contents and methodologies, it was less content about the employability of the graduates.

> "The philosophy of sustainable technology is communicated loud and clear. The described professional image however is so general, that it has not become clear, what a student actually is going to do after graduation. From the meetings with different parts of the organization it became clear that the graduate will not be a researcher or a designer, but nevertheless he is neither a real materials engineer nor an environmental expert. (...) The commission realizes that the professional field is developing quickly, and there is no clear view to what it will be in the end."

This employability problem was reflected by the careers of the M2 graduates. The visitation commission interviewed a number of them, and concluded:

> "All [graduates] had a profession related to the environment, but just a few have a 'real' M2-like job. This is illustrated by the fact that out of 33 graduates only 14 persons are convinced to have found an M2-like profession. The cause is sought in the fact that the study is not well known in business. M2 engineers are hardly ever asked for vacancies."

Clearly the weakest point of M2, apart from the low number of students, is the relation with the professional life after the study. Even the 2009 investigation reflects this, showing that the problem is not even solved on the long term: it is probably no coincidence that the three statements that deal with this subject all are at the bottom of figure 20. Many respondents strongly disagree with the statement that M2 educates for a clear group of professions. For most of the respondents, essential elements of sustainable development are not a part of their current job, and a majority said 'no' to the statement that sustainable development is constantly taken into account within their present work.
These outcomes in figure 20 match with the results to some other questions in the 2009 questionnaire. Only 28% of the respondents answer that they found a job, shortly after their graduation, that they considered as suitable after the M2 study, considering the contents and the level of their first jobs. The first jobs of 40% were less appropriate. Ten percent started another HBO study, immediately after graduating with M2, while 9% did the same in a research university. Although both routes are not unfamiliar, the amount of nearly 20% that directly followed another study program after M2 may indicate that at least some of them were dissatisfied with the labor market opportunities after their first bachelor's grade.
Only 6% of the respondents answered that, after graduation, they were unemployed for at least six months. This number is lower than the average of HBO, which may be partly caused by the same bias that was already mentioned. For another part, it may explain why a relatively high number of graduates immediately started a second higher education study: maybe they did so because they could not easily find a proper job.
All in all, it is clear that the connection between the study program and the following professional life was less than optimal. The 1999 visitation commission wrote:

> "It appears that only a limited percentage of graduates (about 50%) find a job which is in line with their education. As representatives of the professional field indicate, this may in part be explained by a low awareness of the sustainability issue within the companies. However, this is changing, and a suitable labor market for the M2 graduates will come into being."

In other words, the main cause for the weak relation between M2 and the labor market may perhaps not have to be found within the M2 program but rather within the professional field. Whether this is true or not, the visitation commission expected that this problem might decrease in the course of time. Indeed, the attention to sustainable development within society, companies and governments has risen sharply in the last years, but M2 did not live to see this happen. This may imply that, on the one hand, M2 perhaps started too early (in 1991), but on the other hand also ended too early (in 2005).
Looking at the present jobs of the M2 graduates, some of this topic becomes clear by studying figure 21, in which some more statements are shown that were a part of the 2009 questionnaire. As this figure shows, policy development and consultancy are mentioned by about 50% of the graduates as main aspects of their jobs. This is followed by typical 'planet' subjects like environment, energy and nature. Management, especially quality management, scores relatively high. Less mentioned are job aspects like finances, teaching & training, and research. A few of the graduates mention some kind of social work as an aspect of their work, which is in accordance with the character of the study program.

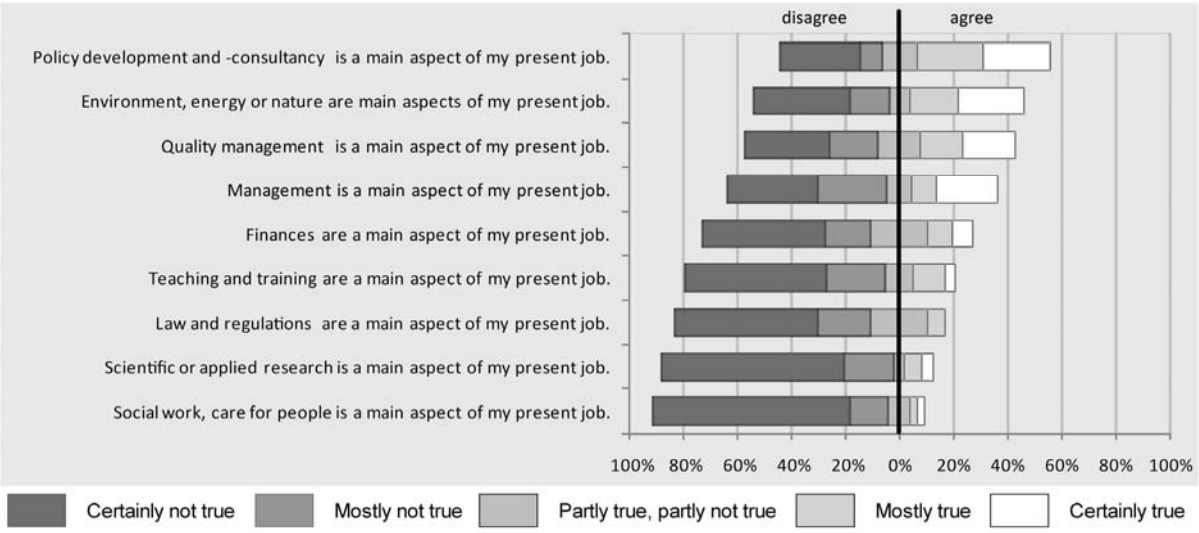


Figure 21. Opinions of M2 graduates in 2009: Main aspects of present jobs

There is one significant difference between the three subgroups that were described above, concerning the character of their present work. The respondents of subgroup 1 (who started their study between 1991 and 1994) report a higher presence than average of management activities: 63%, against 32% for the entire group. This is easily explained by the fact that they dispose of a longer career: they graduated on average 12 years before answering the questionnaire (in 2009), while group 2 (starting M2 between 1995 and 1998) graduated on average 8 years before, and group 3 even less. Nevertheless, the percentage of 63% is interesting, as it indicates that many of the respondents of subgroup 1 succeeded in finding positions with at least a certain level of managerial responsibility.
At present, 82% of the respondents work as an employee in a company or other organization. Six percent works as an owner or co-owner of a company or in an independent position.
51% works in industry, 6% in architecture, 4% in a financial company, 16% in a governmental organization, and 5% in a consultancy organization.
The respondents were asked whether they wanted to add a closing remark to their answers to the questionnaire. One of them answered that he would like to see a restart of M2, considering recent societal and professional developments. Quite a lot of respondents emphasized that the broadness of the study program was an important factor for them to find a suitable job, or helped them to realize a high quality in their work.

5.3.6. Transfer of expertise

The last criterion for a successful ESD contribution of a study program is the transfer of knowledge and experiences to elsewhere. Considering M2, four possible levels of such transfer may be discerned: within the own university; within the educational sector; within the professional field; and within society as a whole.
Possible tools and methods for transfer could be e.g.: publications, presentations, workshops, network building, graduates, projects, etc.
For some reasons, the M2 team never attempted to transfer its experiences to other universities. One reason was that the team did not clearly realize that their achievements might be interesting for the rest of higher education in the Netherlands, let alone in other countries. Another was that the University Board was rather protective about the internal expertise, perhaps based on the fact that much had been invested in the M2 program, and was not enthusiastic about sharing this expertise with other universities. As a result, no attempts were made to submit proposals for publications to scientific or educational journals, and no presentations were given at conferences or symposia. There were a few exceptions. In 1996, a paper about M2 was presented during a conference of the Dutch Association of Environmental Professionals (VVM), and a short article (VVM, 1996) was published in Arena, the magazine of this association. Besides, in 1997 a paper (Roorda, 1997b) was published in a magazine on sustainable architecture ('Praktijkjournaal Duurzaam Bouwen'). Both magazines however were no peer reviewed scientific journals.

Concerning the professional field, M2 has certainly contributed to the awareness and enthusiasm of sustainable development within a number of companies and government institutions, thanks to a growing network around M2. This network consisted of the members of the Advisory Board, the guest teachers and their organizations, and the organizations where the students did their internships and graduation projects. These projects themselves contributed to this process too, as they made evident that a sustainable approach could be realistic and even profitable.

In one way, the M2 program did have an important follow-up. In 1998 the Hogeschool Midden-Brabant (HMB), in which M2 was developed, merged with a University of Applied Sciences in the city of Breda. The merged university went on under the name of Hogeschool Brabant. In the same year, the M2 management was merged with the management of the study program of Environmental Management, as was described above. As it gradually became clear that, regarding the inflow of students, M2 was in trouble, the situation was discussed with the Advisory Board. This suggested that, if under the present circumstances the M2 program might not be sufficiently successful, perhaps a totally different approach could be adopted: instead of concentrating the SD efforts on just one study program, the M2 experiences could be used to integrate sustainable development in all the engineering programs within the newly formed Hogeschool Brabant. Following this recommendation, the *researcher* proposed to the University Board to start a new project. After a careful preparation, the project started in 1999 under the name of Cirrus Project. When the visitation commission investigated M2 in 1999, it was enthusiastic about the project. The report says:

> "[For the future of M2] the impact will be important of a university-wide project "Sustainable Technology" that aims at integrating sustainable technology thoroughly in all 14 study programs of the Faculty of Technology and Nature. The commission thinks this is an excellent initiative. It is to be investigated which role M2 - after having changed its name – can fulfill in the project, either as an independent study program or as a specialty of other programs." (HBO Council, 2000)

The Cirrus Project is discussed thoroughly as "experiment #3" of this dissertation, in the next chapter.

5.4. Conclusions

Putting all conclusions together, the following result arises (table 19).

Table 19. Experiment # 2: Evaluation

Experiment / Criterion	X2 M2 methods	Assessed hypothesis	Evaluation	Judgment
Contribution to ESD towards direct stakeholders				
Implementation of ESD in vision, policy	§5.3.1	1. The study program meets the demands of ESD (see table 6).	In nearly all respects, the program meets the demands of ESD (see table 18).	++
Implementation of ESD in education	§5.3.1			
Customer demand	§5.3.2	2. The study program attracts a sufficient number of students.	The program never reached a high number of students, and had to close down.	– –
Customer appreciation	§5.3.3	3. Students appreciate (the ESD character of) the study program.	A majority of the students was enthusiastic about most aspects, as the Inspection investigation of 1997, the 1999 visitation and the 2009 investigation show.	+
Contribution to SD towards indirect stakeholders				
Indirect stakeholder appreciation	§5.3.4	4. External stakeholders appreciate (the ESD character of) the study program.	Formal and informal stakeholders were enthusiastic about the curriculum and the competences of the graduates, with some worry over a limited expertise on some aspects, due to the broadness of the program.	+
Contribution to SD through HE	§5.3.5	5. The graduates contribute to SD in the professional field.	Internships and graduation projects contributed to SD. Many graduates did not find jobs that corresponded to their specific education.	–
Transfer of expertise	§5.3.6	6. The program contributes to ESD implementation elsewhere.	Opportunities for transfer within higher education were hardly used, apart from the preparation of a large project within the own university.	–

Strong points of the second M2 program are: the innovative character of the program, not only focusing on sustainable development, but also realizing sustainability goals through a range of educational methods; and the enthusiasm of the management team, the teachers, the students and the professional field.
Weak points are: just a multidisciplinary approach, no interdisciplinarity; a too low number of students; a serious lack of employability of the graduates within the M2 field; and a low transfer rate of the experiences to other universities.

The weak points proved to be more important than the strong points, and M2 did not survive. As survival is a quintessential aspect of a successful ESD related study program, it is important to study this failure more deeply.
In chapter 4, where the first M2 program was discussed, the development of M2 was compared to the Bridges model of organizational development. There, it was concluded that the phases 1, 2 and 3 were passed in the years 1990 till 1994, preparing the organization for phase 4: *making it*. In this phase, the organization is supposed to grow further. Indeed, M2 did grow for some years, but this came to a sudden halt in 1997, after which the inflow never reached a sound level. In other words, M2 did *not* make it and failed to survive phase 4.
The program failed, not only due to low student numbers, but also to the lack of suitable employability. The insufficient success of graduates in finding suitable jobs seems paradoxical, regarding the fact that the companies where the students did their internships were enthusiastic about the students' achievements. In an attempt to interpret this paradox as well as the low number of students, three possible hypotheses may be proposed. (A combination of these hypotheses is possible.)

Hypothesis 1: Insufficient PR
The first hypothesis is that the PR of the study program was insufficient. If the name and fame of M2 would have become much stronger, a situation might have been created in which companies and other organizations in the professional field would have explicitly asked for M2 graduates in their vacancies. This was the original intention of the M2 designers. However, such a situation was very difficult to create as long as only one (at first) or two (later) universities offered the M2 program, both with just a small number of students. Perhaps the only way to achieve this would have been if many more Universities of Applied Sciences would have started an M2 program – but this never happened.
According to the "insufficient PR" hypothesis, more should have been invested in the PR, in order to attract more students. There is some support for this hypothesis, due to the fact that the student numbers did rise as long as an extraordinary PR effort was made, i.e. until 1997. When these efforts were reduced, the student inflow immediately dropped dramatically.

Hypothesis 2: Bad timing
The simple fact that an extraordinary PR effort was necessary to raise the student inflow up to 32 in 1996, may be interpreted as an indication that an alternative hypothesis may be true: "bad timing". Did M2 start at the wrong moment? Perhaps M2 suffered from a lack of interest in environment and sustainability in the professional field and in society as a whole, including the pupils in secondary education. Around 1991, when M2 started, there was much attention to environmental subjects. Besides, the concept of sustainable development was relatively young, and it received a lot of attention in 1992, thanks to the Rio conference. But afterwards, both subjects lost a lot of interest to the companies and the news media, which was reflected in a sharp decrease in the number of students in environmental programs. M2 may well have suffered from the same development. If this is indeed the main reason why M2 failed, both in attracting enough students and in creating a suitable labor market, all thinkable PR activities might have been in vain.
If M2 perhaps just started too early, it is unlikely that it would have been more successful if it had started e.g. a decade later, somewhere in the beginning of the 21st century, because at that time sustainable development was perhaps at its lowest popularity. Besides, in those years the popularity of study programs in the field of science and technology was generally low. So, if M2 perhaps started too early, the only alternative might have been that it started not one but two decades later, for instance around 2007 or even later, when the attention to sustainable development was – and still is – much higher.
This hypothesis is supported by another observation. M2 was not the only attempt in the Netherlands to start a new study program dedicated to sustainable development, although it probably was the most serious attempt, i.e. it was started first and sustained the longest. The second M2 program, in the Hogeschool IJselland in the city of Deventer, was already mentioned. It was no more successful in attracting students than the M2 program in Tilburg, and it ended in the first years of the 21st century, about four years earlier than the Tilburg program.
A comparable attempt was made by the Technische Hogeschool Rijswijk (a polytechnic University of Applied Sciences in the west of the Netherlands). This university started the preparations for a bachelor's study program on sustainable technology in 2002 (Woudstra et al, 2002), and accepted the first students in 2003. This attempt too was unsuccessful due to a lack of students. A few years later the study program was changed into an optional specialty of the other study programs.
Yet another attempt was a bachelor's study program called Sustainable Molecular Science and Technology (SMST), which was a joint initiative of the University of Leiden and Delft Polytechnic University (both research universities). The program started in 2002, and focused on sustainable aspects of chemistry, nano physics and life sciences (Juurlink et al, 2002). This attempt ended when the program was merged in 2006 with the Leiden program of Chemistry and the Delft program "Chemical Technology and Bioprocess Technology", because all three programs suffered from a shortage of students.

At present, entirely new initiatives are under way. Maastricht University (a research university) is developing a Master's program called "Sustainable Development". The Haagse Hogeschool (an HBO institution) has designed a Bachelor's program entitled "Climate & Environment" (Kok, 2009) which started in the fall of 2009. Time will tell whether these initiatives will be successful. The chances seem to be higher than before, since sustainable development, including subjects like climate change, has become a major topic in governmental and business policies all over the world. Perhaps now it is the "right time".
The same may be true concerning the other major problem of M2. Both the visitation of 1999 and the 2009 investigation show that the fresh graduates had a lot of problems finding the right jobs, i.e. the jobs that were in line with the study program regarding contents and level. The visitation commission hypothesized that this might be caused by the unfamiliarity in the professional field with the M2 program, or even with the subject of sustainable development in general. If this is true, the situation around 2009 may be more favorable.

Hypothesis 3: Lack of depth
Even a third hypothesis is possible, which is related to the intrinsic character of M2: its broadness and multidisciplinarity. As was shown, in some respects this caused a lack of depth, i.e. of detailed knowledge and expertise, and a lack of clarity about the professional competences of an M2 graduate. Whereas the broadness attracted some students, it may not have appealed to others, causing the inflow to stay low. And it certainly was a factor in the problems of the graduates to find suitable jobs.
The broadness of the M2 curriculum was a fundamental characteristic. This logically caused a reduction of the average depth, as the multiplication of broadness and depth is a constant, determined by the total length of the study program, which for all HBO bachelor studies is fixed at four years by law.
Could the curriculum have been designed in a different way? Is it possible to design a study program dedicated to sustainable development, with less broadness and more depth, thus more recognizable for the professional field and for potential students?
This seems not easy. One of the main characteristics of sustainable development is its complexity and connectedness. This does not necessarily mean that M2-like, generalist professionals are absolutely necessary for sustainable development; instead, interdisciplinary teams of specialist professionals can very well realize the necessary connectedness without the presence of a generalist expert on sustainable development. But *if* the goal is to create a study program aiming specifically at sustainable development, such a broadness may be unavoidable, unless a more specific orientation is selected, as e.g. may be the case with the program of Climate & Environment that the Haagse Hogeschool has recently started. The Maastricht program uses a different solution, as it is a *master's* program, offered to those who have already acquired expertise in one or more disciplines in their bachelor's study.
In the end it can be concluded that specific study programs aiming at (aspects of) sustainable development may be successful. But various attempts to realize this were not successful, due to a lack of students and to unfamiliarity with the idea in the professional field. Only if both problems can be solved effectively, such a study program can prove that this is a successful route for ESD.

M2 as a pilot study
On the other hand, M2 was not a total failure, as many positive things were realized. The program had a strong ESD curriculum, and so it was a success, if seen as a pilot study. It is interesting to investigate how this success came to be, because: if higher education wants to make use of the lessons of this pilot study, not only the negative but also the positive sides should be understood.
In chapter 4, the program development process was compared with the model of De Caluwé and Vermaak, defining several types of change processes. There, it was concluded that the development was a combination of *greenprint* (e.g. action learning, personal responsibility, awareness of new viewpoints) and *whiteprint* (e.g. creativity, brainstorming, dynamics, individual energy). This kind of process was possible, thanks to the fact that the developing and managing trio acted in a highly informal way, which suited very well with Bridges' phase 2 in which the program was. In 1994, the organization structure was made more formal, when a genuine management team was formed. Nevertheless, the combined *greenprint* and *whiteprint* style continued within this management team. At the same time, the number of teachers increased, and another approach appeared to be valuable: a typical redprint style (e.g. stimulate and motivate, offer attention, trust, rewards). This was noticed by the university quality department in 1997, which wrote in its EFQM report:

> "The program manager is strongly personally involved with various matters; he stimulates ideas and initiatives of staff members; he dedicates time to the exchange of information and experiences through actions. The manager offers, both on his own initiative and on request, support for initiatives for quality improvement and appreciates successful initiatives. The support is made concrete, as time, money and expertise are made available if needed. (…) Extraordinary achievements [of staff members] are awarded with a [financial] incentive."

The only setback to this was that the management style was combined with a typical *yellowprint* approach (negotiations, power play) by the University Board. In chapter 4 it was already noticed that the M2 program was the result of

negotiations, which led to compromises in the form of combined education with other study programs. As an explanation, the Sterling model was used to describe how M2 was 'bolted-on' to the university, in which the Board had no real feeling of 'ownership'. The merger with another university in 1998, for which as a first step a new University Board was formed, may have caused an even stronger lack of ownership. This hypothesis gets some support from the fact that immediately after the merger M2 was partly merged with the program of Environmental Management. Perhaps it is important to add that the Hogeschool West-Brabant, with which the HMB merged, was by far the larger of the two; the newly formed Board was nearly equal to the former Board of West-Brabant; and also, the Environmental Management program, a West-Brabant program, was considerably larger than M2.
The successful integration of modern educational methodologies, on the other hand, received a lot of support from the Board, as this was a process that was stimulated, not only in M2, but in all programs of the university. From the viewpoint of the Board, this probably was a *blueprint* process, as the Board had clear targets and a fixed implementation plan for this change, which had the character of a level 2 process, *reformation*, in terms of the Sterling model. For some study program this may perhaps have been experienced as forcing, but for M2 it did not, because the process fitted perfectly, both with the ideas of M2 about sustainable development, and with the recommendations of the 1994 visitation commission.

The answers to two questions
The present chapter started with a question:

- Can the contribution to sustainable development of an existing study program be optimized through the introduction of a carefully selected range of educational methodologies?

The M2 study program as such has failed, i.e. it did not survive, as student numbers were too low. It also did not show to be successful with respect to other indicators, especially the contribution to sustainable development in the professional field and elsewhere. But those subjects are not the issue of the central question of experiment #2. The redesign of the M2 program, introducing a wide variety of new educational methodologies, was proved to be a success if viewed as a pilot experiment on ESD research, as the second M2 program met the demands of ESD to a high degree, as table 18 shows. Besides, both internal and external stakeholders were mostly happy with the resulting curriculum. This implies that experiment #2 proved that its central question can be answered positive.
The former chapter, chapter 4, also started with a question:

- Can education contribute effectively to sustainable development through the development of a separate study program dedicated to (main aspects of) sustainable development?

This question is to be answered here, as chapter 4 did not have sufficient data for a definitive answer. The added data of the present chapter make it possible to give this answer.
The history of M2 was not successful. After an existence of about fifteen years it stopped, as the number of students was too low. All kinds of various reasons or excuses for this may be found, but they cannot deny that M2 simply did not prove the answer to the above question to be positive. The same is true for other serious problems the program met, especially that of the low employability of the graduates. Given more time, it is possible that this problem might have been solved or reduced, but this too was not proved.
The main importance of M2 therefore is, retrospectively, that of a pilot for higher education in general, for which the lessons learnt can be seen as modestly positive. But as a whole, the answer to the question of chapter 4 has to be: 'There is no indication that it can'.

The two above questions are part of a longer series of questions that were presented in chapter 1 as specifications of the main question that is central to this dissertation. In the final chapter (chapter 10), the answers to all these specific questions will be summarized and compared, leading to a synthesis that will enable an answer to the main question.

6. Experiment #3: Introducing sustainable development in existing programs

> "To be effective, ESD should (...) be addressed in two ways: (i) through the integration of ESD themes across all relevant subjects, programs and courses; and (ii) through the provision of specific subject programs and courses." (UNECE, 2005)

The above quotation (part of a longer quote that was already cited in §2.3) is from the UNECE Strategy for Education for Sustainable Development, formulated by the United Nations Economic Commission for Europe (UNECE) in 2005. After two chapters about experiments dedicated to the second way UNECE mentions (i.e. specific programs), the present chapter will describe an experiment along the lines of the other way: the integration of sustainable development themes into existing study programs.

Question:

- Can existing study programs, not yet giving much attention to (aspects of) sustainable development, be reformed in order to effectively increase their contribution to sustainable development?

In 1998, the Hogeschool Midden-Brabant – where the M2 program, described in chapters 4 and 5, was developed – merged with another University of Applied Sciences, the Hogeschool West-Brabant in the city of Breda. Together they formed the Hogeschool Brabant (HB). One of the faculties of this university was the Faculty of Technology and Nature (FTN).
In the same year, 1998, the *researcher* proposed a new ESD project to the Management of the FTN, aiming at the integration of sustainable development in all existing education programs of the FTN. The central question of the proposed project was: how should this be done? At the time, there were hardly any attempts elsewhere from which lessons could be learned, and so the project had a strong pioneering character.
This third experiment was performed from 1999 till 2002, after a thorough preparation in 1998. In that year, the climate towards the development of new HBO bachelor programs had changed. The Dutch Ministry of Education now tried to decrease the number of programs. At the same time, ideas in the professional field of many disciplines, especially in technological companies, concerning sustainable development had come forward, and they insisted more and more on the integration of sustainable development in many or all existing technological education programs.
Another development within HBO that was significant for the Cirrus Project, especially in its final stages, was the introduction of professorships within HBO.

Context (§6.1):

- Decrease of number of HBO bachelor programs
- Increasing acceptation of sustainable development in many technological disciplines in the professional field
- Introduction of professorships in HBO

The proposal for the 'Cirrus Project' was accepted by the FTN management, and it was performed in the next four years, from 1999 till 2002, by a team of teachers chaired by the *researcher*. Chapter 6 shows the philosophy, the process and the results of the project, and especially the lessons learnt about the complicated process of reforming existing study programs into education that contributes to sustainable development.

Action (§6.2):

- Adaptation of the professional profiles of the study programs of a Faculty of Technology, integrating aspects of sustainable development;
- Increasing awareness, knowledge and skills of the teaching staff of these study programs;
- Integration of sustainable development in the study programs

Result assessment (§6.3):

In the third part of this chapter, a critical analysis will be made concerning the main question of this third experiment: can existing study programs be reformed in the direction of ESD?
In chapter 4 and 5, where the M2 program was investigated, six hypotheses were used for a successful ESD oriented study program, derived from the systematic result assessment described in §3.6 (table 8). Some of these hypotheses cannot be used in the present chapter:

- Student numbers: if the numbers would appear to increase or decrease, there is no way of telling to which percentage this would be caused by the sustainable development implementation process.

- Student appreciation for the ESD aspects in the curricula. This might have been an interesting criterion, but in the years during and shortly after the Cirrus Project, they were simply not assessed, as was explicitly concluded during an AISHE audit.
- The contribution to SD in the professional field. This too has not been investigated during or after the Cirrus Project. Besides, it would have been very hard to assess this in a significant way, as the total range of professional fields of all the study programs of the FTN is large and complex.

The other hypotheses are again suitable for the result assessment of the present experiment. Consequently, the following hypotheses will be tested in relation to the 3rd experiment:

1. The project contributed to the vision and policy on education and SD of the study programs
2. The project contributed to the ESD character of the study programs.
3. External stakeholders appreciate the ESD consequences of the project.
4. The project contributed to ESD development elsewhere.

6.1. Context

6.1.1. Restructuring HBO

Around the year 1998, an operation in HBO was at full speed to decrease the number of different study programs.
In some educational sectors, this process had started much earlier. As far back as 1988, an advisory commission (the so-called Commission Van der Top, after its chairman) was installed by the HBO Council with the task of restructuring the social and agogic education, trying to reduce the variety of programs (HBO Council, 1988). For the economic sector of education, the Commission Braakman did the same, starting in 1991, followed by the Commission Koumans in 1992 that investigated the technology sector. The report of the latter commission, 'Vlag en Lading', (Koumans et al, 1993) proposed a serious reduction of the variety of technical study programs, including the disappearance of the M2 program. As the continuation of this program shows, not all recommendations were accepted by the Minister of Education.
One reason for these operations was that the amount of different study programs was so large that the potential students were finding difficulties in selecting the right program. Besides, the professional field had comparable problems, since they found it hard to estimate the real value of an HBO grade.
Despite of all the efforts, the number of different study programs did not really decrease for some years, since the HBO institutions were very creative in designing more and more new study programs. And so, a new commission, the Commission Frame of Reference Program Availability (the 'Commission Brouwer') was installed in 1994. In 1995, this commission proposed a moratorium for all new study programs in HBO, and this moratorium was not only accepted in 1996 but even prolonged in 1998 for two more years (Van der Hek & de Graaf , 1998).

> "After, in the past, the HBO Council had made several steps towards improvement of the recognizability and transparency of the available study programs, in October 1998 the decision was made to make further adaptations to complete the reorienting operation. Through this, the ca. 170 study programs of HBO can be reduced to ca. 110 programs.
> Thus, future students will be more able to select a study program, and employers will be more able to judge the capacities of HBO candidates." (HBO Council, 1998)

Looking back, the ministerial Advisory Commission on Education Availability (Adviescommissie Onderwijsaanbod, ACO) discerned three periods between 1993 and 2003 (ACO, 2003). In the first period, 1993 – 1996, an avalanche of 235 requests for new study programs was handed to the Minister of Education by HBO institutions. In the second period, 1996 – 2000, only 83 requests were received by the minister. Despite the moratorium, 40 of these requests were approved, which shows that the moratorium was not absolute.
In the third period, 2000 – 2003, the government policy was changed again, this time in a liberal direction, which resulted in 371 requests for new programs.
In the year 2003 the ACO commission ended its tasks, handing them over to the newly shaped Dutch Accreditation Organization (NAO), which soon after was expanded to be the Dutch and Flemish Accreditation Organization (NVAO), which based its decisions about the approval of new study programs on the new quality control system, the accreditation. This subject will be described in more detail in chapter 7.

During the nineties, the emphasis of the governmental policy towards higher education was not just aiming at transparency through the reduction of the number of available study programs, but also at improving the quality and the inherent strength of the programs. One of the means for this was the formation in 1994 of the Innovation Fund for HBO ('Vernieuwingsfonds HBO'). This would appear to be of great importance for the Cirrus Project, which is the subject of this chapter.
In this context in 1998, the attention concerning ESD development shifted naturally – 'sailing on the winds of change' - from designing new study programs dedicated to ESD to attempts to improve the existing programs. This idea was

strengthened all the more because of signals from the professional field that they wished for such improvements, since they needed graduates from HBO with more knowledge and skills concerning sustainable development.

6.1.2. Expectations about sustainable development from the professional field

After the Dutch government had published its first National Environmental Policy Plan ('Nationaal Milieubeleidsplan', NMP) in 1989 and an improved version (NMP+) in 1990, the second such plan, NMP2, appeared in 1993, followed by the third version, NMP3, in 1998. Pivotal to these plans was an approach that is typical for the Dutch situation, sometimes called the 'polder model'. This approach is based on agreements between all major stakeholders. Much of the environmental and sustainability policy was not forced by laws and regulations but was realized through covenants and long-term agreements that the various parties voluntarily accepted. Some of those parties were, apart from governmental departments and environmental organizations, the employers' organizations (representing both the large companies and the SME's), and the trade unions. Together they formed the Social-Economic Council (Sociaal-Economische Raad, SER), an important advisory commission for the government.
It is illustrative to study some parts of the reaction of the SER to the draft of the NMP3 of 1998.

> "The SER concludes with approval that in the last years a broadening has taken place of the use of environmental instruments. The larger role for environmental covenants, long-term agreements about a higher energy efficiency (mja's) and financial instruments (the 'price track') form a logical and necessary step to deal with the environmental problems effectively."
> "In line with earlier recommendations the SER recognizes that it can be effective to make a broader use of financial measures (taxes, subsidies, fiscal greening) to correct for negative external environmental effects."
> "With the proposed NMP3 policy the desired decrease of emissions of greenhouses gases (including CO_2) will not take place sufficiently. (...) The Council recommends the so-called flexible Kyoto instruments (Joint Implementation, trade of emission rights with Eastern Europe, Clean Development Mechanism with developing countries) as an important incentive in order to find cost efficient measures to handle the global climate problem." (SER, 1998)

These citations show that the employers and the trade unions, together with independent expert members of the SER, urge the government to handle the problem of climate change more seriously, and indicate that they are prepared for financial sacrifices. This proves that, in the eleven years since the Brundtland Report was published, the Dutch business world had adopted the line of thinking up to an important level. This is further illustrated by a list of covenants and long-term agreements that were accepted. Some of them are (De Bruijn et al, 2003):

- Intention Declaration for the Chemical Industry (1993)
- Intention Declaration for the Implementation of the Environmental Policy in Dairy Industry (1994)
- Intention Declaration for the Metal and Electrical Industry (1995)
- Agreement on the Implementation of the Environmental Policy in Bulb Cultivation Sector (1995)
- Covenant on the Benchmarking of Energy Efficiency (1999)
- Covenant on Energy from Waste (1999)
- Covenants on Packaging: I (1991), II (1997), and III (2002)

Companies and higher education

The fact that businesses in the Netherlands stressed the need to take sustainability demands seriously was also felt directly by the management team of the M2 study program, described in chapters 4 and 5. Several ways existed through which the program communicated with companies in the professional field. A number of large and smaller companies were represented in the Advisory Board. Many other companies commented on the M2 program and on higher education in general, through feedback on the achievements of M2 trainees, graduates and alumni. Quite a lot of them indicated that, in their opinion, sustainable development was extremely important, and they expressed the wish that not only the M2 students, but students in other disciplines as well (primarily in technological and business disciplines) should study aspects of sustainable development much more than they did as yet. Companies from which this message to M2 came loud and clear were e.g. large enterprises like Xerox, Fuji, Heijmans , and NedCar. But SME's brought the same recommendation, e.g. Gianotten (printing), Van Besouw (textile fabrics), Van Swaaij (wood).
And so, in 1998, several reasons existed for the technological faculty (Faculteit Techniek en Natuur, FTN) of the Hogeschool Brabant to reconsider its policy towards sustainable development, which up till then had been based entirely on the M2 program. These reasons were:

- Looking at the inflow of students, M2 did not do very well;
- The Ministry of Education and the HBO Council tried to reduce the number of independent study programs, and at the same time tried to strengthen the remaining ones;
- Industry and other businesses wished more elements of sustainable development in the various study programs.

Consequently, the Advisory Board of M2 recommended starting a new initiative to implement aspects of sustainable development into the existing study programs of the FTN.
This proposal received a strong impulse, thanks to the outcomes of a nation-wide initiative: STD.

The STD Program
In 1993, a large program started in the Netherlands with the aim of developing innovative solutions through technological means to the existing sustainability challenges. It was the Dutch National Inter-Ministerial Program for Sustainable Technology Development (in Dutch: 'Duurzame Technologische Ontwikkeling'), in short: the STD program (DTO programma).
The principles of the STD program were based on the conclusions of an inquiry, published some years before, by the Dutch Commission on Long-Term Environmental Policy (CLTM, 1990). The main conclusion of the CLTM was that usual innovation practices offered no prospect of technology playing anything other than a peripheral role in achieving sustainable development (Jansen, 1993). Central to this conclusion was "the scale of the mismatch (…) between the societal and technological challenge represented by sustainability and the magnitude of the expected contribution to attaining sustainability that present-day innovation practices could bring" (Weaver et al, 2000).
The STD program was launched with the ambition of bringing about fundamental changes in the existing innovation practices. It was supported by five Dutch ministries: the Ministry of Housing, Spatial Planning and the Environment (VROM); the Ministry of Agriculture, Nature Protection and Fisheries (LNV); the Ministry of Transport, Public Works and Water Management (V&W); the Ministry of Education and Science (O&W); and the Ministry of Economic Affairs (EZ).
For five years (1993 – 1997) the program worked on the development of new innovative strategies, and on the application of those strategies in a series of projects that were performed together with industrial companies, local governments etc.
One of the strategies that played a central role in the STD program was called 'backcasting'. This approach…

> "… begins with an attempt to envision an acceptable future system state, which takes into account the status of as many important defining constraints and criteria as possible, including the requirement to 'meet needs'. This system state is then used as a reference: for tracing pathways back to the present, for placing milestones along those pathways and for identifying short-term challenges and obstacles that will have to be overcome en route." (Weaver et al, 2000)

For this process of backcasting, STD used a period of about 50 years as a reference. The program philosophy and the use of backcasting were summarized in DTO (1997), which outlined possible sustainable developments between 2040 and 1998 (i.e. *back*casting).
After the program was finished, a lot of new insights and experiences had been gained, and the need was felt to spread and keep the results. So, a follow-up program was developed, called "STD – Knowledge Transfer and Implementation" (in Dutch: "DTO – Kennis Overdracht en Verankering"), or STD-KTI (DTO-KOV) for short. The aim of this program, which started in 1998 and lasted for three years, was the transfer of knowledge in two directions (DTO-KOV, 2000 & 2001):

- The professional practice, including companies, governments, research institutions, and societal organizations;
- Formal education, including primary and secondary education, vocational education, higher education (academic and technological education for Applied Sciences), and post-academic education.

For the various projects in the STD-KTI program, cooperation with companies, government institutions and educational institutions was necessary, in order to perform pilot projects as a starting point for spreading the results throughout the professional practice and all of education.

6.1.3. Lectorates: the HBO Professorships

The increased strength of the enlarged HBO institutions appeared clearly in 2000, when the initiative was taken to expand the role of HBO from education to research. The lack of research until then had formed the main difference between the research universities and the Universities of Applied Sciences: the research universities had their professors, having a combined education and research task, the HBO institutions had no such functions.
In 2000 the HBO Council proposed to introduce 'lectors', comparable with professors, except for one thing: their research was to focus on the application of knowledge rather than the generation of it, consistent with the profession-related character of the HBO institutions. Officially, the title of 'lector' had always existed in the HBO function descriptions, but the institutions had not used this function for years. In order to coordinate the introduction of the 'lectors-new style', a foundation was set up, the Stichting Kennisontwikkeling HBO (SKO, the Foundation for Knowledge Development in HBO). The lectors were financed by the Ministry of Education. SKO, 2008b:

> "The lectors are the top stone of a long development in HBO as a formal part of higher education. Until the middle of the '80s the then existing more than 400 HBO institutions were treated as schools for secondary educa-

> tion. The development of HBO as a profession oriented branch of higher education has proceeded since then, and at the end of the '90s the development has been completed in an institutional sense: the number of institutions has decreased to about 50. What was missing, however, was the attention to the teachers, who in a large majority were focused strongly on the educational practice, and who could hardly be characterized as innovative professionals who delivered a contribution through their (own) research to the progressing development of the professional practice, the renewal of the curriculum and the enlargement of the research skills of students."

Around each lector, a group of teachers was formed. This 'Knowledge Circle' ('Kenniskring') participated in the applied research, and cooperated with the lector to apply the produced knowledge to the innovation of the curricula. Students also participated, e.g. in their internships or graduation projects. Together, the lector and his/her Knowledge Circle formed a lectorate, which may be compared to the disciplinary group of a professor.
The lectorates had four main goals (SKO, 2008a):

- development of knowledge and expertise;
- professionalization of teachers;
- effects on the curricula;
- knowledge circulation to and from economy and society.

In 2008, an evaluation by SKO concluded…

> "… that within the HBO institutions, an intense change of climate is taking place. Thanks to the pressure of the professional outside world a number of developments have started to come together in the lectorates. This concerns a strong urge to adapt the education better to the rising professional standards and to anchor these adaptations sustainably. There is also an increasing demand for current knowledge about the profession and for a more approachable attitude of the HBO institutions as institutes of knowledge and training for the professional field, considering an accelerated innovation of the professional practice. This pressure from outside has been received relatively well within the HBO institutions, and the development of the lectorates can be seen as an offensive adaptation." (SKO, 2008a)

The word 'adaptation' is well chosen, compared to the Sterling model of the level of change. In 2009, most HBO institutions are still mainly at the accommodative, adaptive level (level 1), and are in the middle of a more thorough integration (level 2) of the research as a core activity. For this goal, the Forum for Applied research (Forum voor Praktijkgericht Onderzoek) was founded. HBO Council (2009):

> "After the first phase, which may be characterized as a pioneering phase, it is now important to develop the applied research further within HBO and in society. (…) The Forum for Applied Research fulfils an important role aiming at the development of the contents of the lectorships, the connection between education and research, and the relation with the professional practice."

Apart from the qualitative development of the lectorates and their integration in HBO, also the quantitative development gets the attention of the HBO Council (2009): "Around 330 lectors for 380,000 students is far too low, also in an international comparison. Therefore, a considerable increase of the number of lectorates is necessary." This is illustrated by an actual case of a multi-sectoral HBO institution that cooperates with foreign Universities of Applied Sciences. The three partners have the following characteristics:

Partner	**HBO Institution** *(Netherlands)*	**Hochschule** *(Germany)*	**University of Appl. Sc.** *(UK)*
Number of students	24,000	8,000	24,000
Number of lectors / professors	25	175	ca. 350

Nevertheless, the introduction of lectorates has caused a considerable increase of the strength of the HBO institutions, and this will probably become even stronger in future years. It also had an important consequence for the continuation of the efforts towards ESD at the end of the Cirrus Project in the Hogeschool Brabant.

6.2. Action: The Cirrus Project, integration of SD into the existing education (1998 – 2002)

Following the recommendations of the M2 Advisory Board, the *researcher* prepared a policy plan for what later would be called the Cirrus Project, aiming at integrating sustainable development into the existing education of the entire FTN. External support was looked for, which turned out to be very successful. Based on this support, a draft project plan was proposed to the management of the FTN and to the STD-KTI program, proposing the FTN to act as a program partner of STD-KTI and to perform a KTI pilot project

representing the Universities of Applied Sciences. Because of the experiences of the Hogeschool Brabant with the M2 program, STD-KTI expressed an interest in this proposal. Consequently, the preparation of the Cirrus Project started.

6.2.1. Project philosophy, goals and strategy

The situation within the FTN

In the same year in which the preparation for the Cirrus Project started, the university in which the M2 program was situated, the Hogeschool Midden-Brabant (HMB) in the city of Tilburg merged with the Hogeschool West-Brabant (HWB) in Breda, which was considerably larger. Together they formed the Hogeschool Brabant (HB). The HMB consisted almost completely of engineering study programs. The only exception was the small Library and Documentation Program (BDI). The HWB consisted of much more than just engineering education; its engineering programs together counted about as many students as the HMB as a whole.
After the merger, a new organization structure was developed. The engineering programs of the HWB, together with the entire HMB, were merged and formed the so-called Faculty of Technology and Nature (FTN). As a consequence, the FTN counted 13 study programs: one non-technical study program (the BDI), and 12 different engineering programs. The 12 engineering programs were organized in three departments, which a few years later were renamed as 'Academia':

Department of Industry (Academy of Technology and Management, ATM):
Mechanical Engineering, Environmentally Oriented Materials Technology (M2), Technology Management, Electrical Engineering, ICT, Environmental Technology, Chemical Technology.

Department of Construction (Academy of Building and Management, ABM):
Architecture, Civil Engineering, Constructional Management.

Department of Laboratory Education (Academy of Life Sciences, ALS):
Chemistry, Biomedical Sciences.

The newly formed faculty, the FTN, had a very inhomogeneous educational constitution. Most of the programs in Tilburg, from the former HMB, had introduced educational methodologies like PBL and project education, in a varying degree of completion. The programs in Breda had much less so. After a few years during the project the heterogeneity even increased, as a modest first attempt was made to reorient the education towards a professional competence base, the success of which differed greatly between the study programs.
The financial situation of the FTN was problematic. Not only was the Dutch government implementing a policy in which higher education received a considerably lower amount of money per student than before, which created reorganizations and compulsory redundancies in many Dutch universities, including the HB. Also, the higher engineering education was, just as the environmental education, getting more and more unpopular with potential students, and the inflow numbers decreased.

The budget

In the middle of a hard financial situation in the FTN in 1998, the proposal of the Cirrus Project was put to the faculty management. The proposal showed that a considerable number of companies and other external organizations were willing to support the project, not only with their expertise, but also financially. Besides, it seemed that there was a good chance that the HBO Council would decide to offer a considerable financial support through its Innovation Fund. When the program started, in January 1999, the following financial support was promised (*Dfl* = Dutch Guilders):

• Companies	Dfl 870,000	= € 396,000	
• STD-KTI	300,000	136,000	
• Governmental organizations	260,000	118,000	
• NGO's	150,000	68,000	
• HBO Council	1,200,000	545,000	
• Total subsidies & sponsoring	2,780,000	1,264,000	
• Own investment of HB	1,200,000	545,000	
• **Total budget of the Cirrus Project**	**3,980,000**	**1,809,000**	
• *Total budget, expressed in € of 2009:*		*2,249,000*	*(value, corrected for inflation)*

As the project was planned to last for four years (1999 – 2002), this meant an external support of nearly 700,000 Dutch guilders (ca. € 316,000) annually. For the FTN management, with its financial problems, this was a major reason for the approval of the proposal to start the Cirrus Project, as the FTN management itself expressed. This fact later proved to have a strong influence on the rate of success of the project (see below, §6.4).

Before the external sponsors gave their approval to the project, the project philosophy was worked out in detail, and concrete goals and plans were formulated (Roorda, 1998b). One of the pillars of the project philosophy was the method of 'backcasting' (Jansen, 1997; Weaver et al, 2000), which had also played a major role in the STD program that was followed-up by STD-KTI, of which Cirrus was to be a part.
The details of the philosophy, goals and plans can be found in this dissertation in Appendix 1, which is a reprint of a presentation (Roorda, 1999) about Cirrus in 1999 at a conference on ESD in Tampere, Finland. A paper about the backcasting philosophy (Roorda, 2001a) is reprinted as Appendix 2.
In order to be able to report and to give account of the project proceedings to the external sponsors, a so-called Curatorium was formed, in which representatives of the larger sponsors were present. The Curatorium also acted as an Advisory Board, and some of its members also belonged to the Advisory Board of M2.

Negotiations within the FTN
One of the major applications of the Cirrus budget was the formation of a project team, in which a representing teacher from every study program was to take place – 13 persons in total – who would be delegated to Cirrus, each for two days a week during the four years of the project. Besides, an external expert was to be appointed as a 'project adviser' who would act as a guiding, training and coaching person to the project team and to the FTN. To complete the project team, a secretary was found, while the *researcher* acted as the project manager.
Before the FTN management gave its final approval to the proposal, first a meeting took place with the managers of the 13 study programs, in which the project proposal was explained and discussed. This appeared to be the start of a

Box 10. Initially planned results of the Cirrus Project

"The project will result in the following:

Internal

1. Qualified organization:
   - *Core team* (13 teachers, distributed over the entire faculty): experience and integral vision on the entire area of sustainable technology. Initiating role towards application of sustainable technology in education and professional field.
   - *Large group* of disciplinary teachers: able to apply sustainable technology within their own disciplines
   - *All other teachers* within the faculty (often teachers in supporting / general areas): reasonable understanding of the relevant subjects
2. Learning goals and curricula (for all 13 study programs) in which sustainable technology is integrated.
3. Ca. 40 modules for the various study programs in which sustainable technology is operationalized in concrete contents and methodologies:
   - partly common, partly program specific
   - divided over all phases of the programs: propaedeutic, 2nd, 3rd year, internship, graduation
   - all modules have been developed, applied, evaluated and improved.
4. Project education has been developed and applied, based on intensive cooperation between students and staff members of various study programs. Internship- and graduation regulations have been adapted. In internships, graduation and other projects, al students are assessed based on relevant aspects of sustainable technology.
5. 'Scenarios' have been put down for the implementation of the strategy and experiences for this type within the university organization. Structure: process description, detached from the specific steps regarding the contents of the project.

External
The Faculty, in its role of a centre of expertise on sustainable technology, has become an essential and indispensible actor in the societal process of sustainable development and sustainability in education.
This implies:

6. Networks and projects:
   - extensive network with sources of expertise and with expertise asking organizations
   - projects and other activities with these organizations aiming at implementation of, and policy development about sustainable technology
   - knowledge transfer to other universities. Availability of educational materials. Training courses for teachers have been developed.
7. Teachers and students are able to assist companies with the introduction of sustainable technology & management.
8. The produced educational modules have been adapted for application in post-university education."

Source: Roorda, 1998b

series of negotiations about the constitution of the project team, as many of the program managers were not prepared to delegate their best teachers, as they explicitly stated. At the end of 1998, this resulted in a project team which was less than optimal. One of the members was only half a year separated from his retirement. Another had been on sick leave for the last six months due to overstrain; participation in Cirrus was an attempt to help him recover. Several others participated only because their program managers had told them to do so. Other team members however were highly motivated and involved.
The group of program managers demanded a detailed overview of the expected results of the project, before giving their approval. Such an overview was made, and it is shown in Box 10.
After the program managers, the FTN management, the various sponsors, and finally the University Board approved with the project proposal, it was ready to start on January 1, 1999.

6.2.2. The project process

Adaptations of circumstances, goals and methods
During the project, considerable changes were made in the original plans and goals. The changes were partly due to increased insight, which was to be expected for a pioneering project like this. Partly the changes were necessary because of structural and educational changes in the FTN. One of these changes was the disappearance of the BDI program and the ICT program out of the FTN, as they became a part of a new faculty within the university. It was decided that they would no longer be a part of the Cirrus Project, and so the project went on with eleven study programs.
Another development in the FTN was the introduction of educational methodologies in the programs of the former HWB in Breda. This caused the use of PBL and project education to spread all around the faculty. For Cirrus this was of great importance. In the original plans, it had been necessary to assume that many of the programs were based on traditional educational methodologies. Due to this, the original project plan had promised a result of about 40 concrete educational modules: finished products which could be inserted easily within the various curricula. The widespread use of PBL and PE made this impossible as well as undesirable, while at the same time opening a range of new opportunities to integrate sustainable development.
This had a deep influence on another main aspect of the project. The development of the staff was considered as a key part of the strategy (see Appendix 1). Some years later, an authoritative source confirmed this importance:

> "Educators, leaders and decision makers at all levels of education need to increase their knowledge about education for sustainable development in order to provide appropriate guidance and support. Therefore, competence-building efforts are necessary at all levels of both formal and non-formal education.
> Key actions to achieve this could be to: stimulate competence development for staff in the education system, including actions for the leaders to increase their awareness of SD issues; develop criteria for validating professional competence in ESD; introduce and develop management systems for SD in formal educational institutions and non-formal education settings; include SD-related issues in training and re-training programs for educators for all levels of education; and encourage educators, including those involved in non-formal and informal education, to share experiences." (UNECE, 2005)

In the original planning, the project was to consist of three phases, partly overlapping each other, as in figure 22. As one of the main study books for the training of the project team, Weizsäcker (1998) was used.

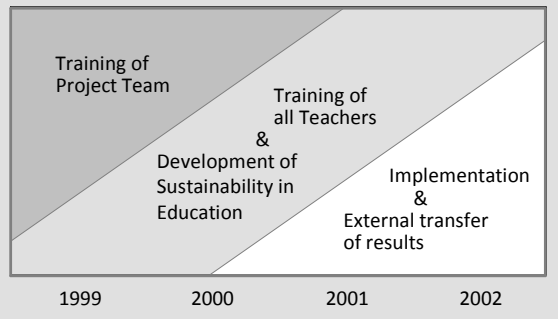


Figure 22. The three overlapping phases of Cirrus

In this original view, first the project adviser and the project manager would train the project team; next, the project team would train the rest of the FTN staff; and at the same time, the project team would write the 40 modules.
A part of this plan was realized in the first part of the project period. After themselves receiving some basic training, the project team designed a basic training program which was followed by groups of their colleagues, in total about half of the FTN staff.

Learning by doing

As the new educational approach in the FTN gained shape, the approach was changed dramatically, changing from a linear process of 'first learning, then doing' to a strategy of 'learning by doing', which itself was an important learning process for the project management and team. This team, together with the project adviser and the project manager, designed 'semi manufactured' educational materials, in a process that at the same time contributed to their own expertise on sustainable technology. These materials took e.g. the shape of 'toolboxes' that were offered to the colleagues in the faculty. Together with these colleagues, the materials were used to integrate sustainable development into the curricula: not as a range of separate modules, but as an aspect within many of the existing modules, PBL blocks, projects, etc.

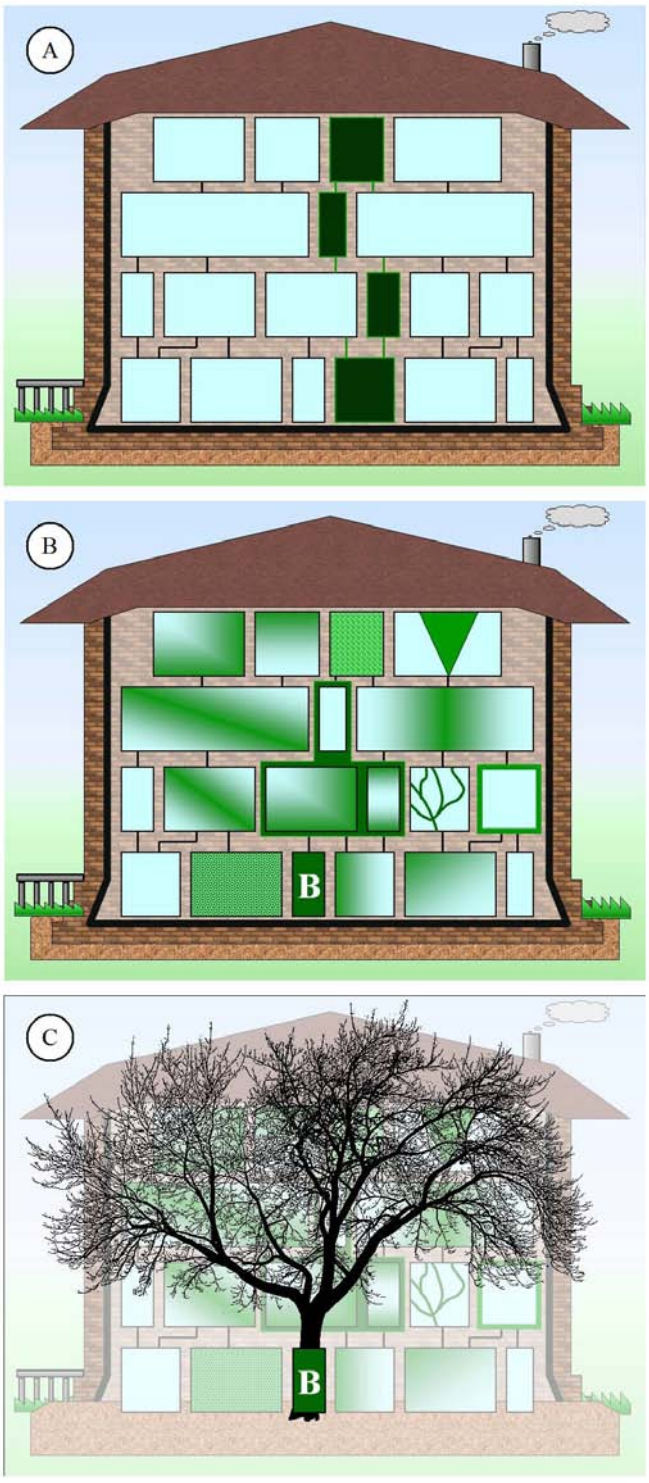


Figure 23. Two models of integration of SD into curricula: the building model (figures A and B); the tree model (figure C).

The situation may be shown in an illustrative way as in figure 23. The top 'building' (figure A) shows the original approach, in which a series of modules was to be 'dropped' onto the curricula. In this view, most of the existing modules are not changed in any way, and so the integration of sustainable development is only a limited adaptation operation at level 1 (Sterling).

In figure B, the revised Cirrus approach is shown. This time, hardly any new module is to be introduced. Most of the integration takes place by adapting the existing education. There is one exception. The Cirrus team concluded that it is of vital importance that all students, of whatever study program or discipline, receive a broad introduction to sustainable technology and even of sustainable development in general, early in the curriculum. This is represented in figure 23 as the white letter 'B': the 'Basic module'. Based on this introduction to sustainable development, in all the rest of the curriculum aspects of sustainable development can be inserted, each time with a reference to the introduction.

In this way, the curriculum can be described using the metaphor of a tree, with the introduction as the trunk of the tree, and the aspects of SD, spread across the curriculum, as its branches, as shown in figure 23C: the 'tree model'. The implementation process is, if successful, a level 2 operation of reformation.

The details of the redeveloped project philosophy were presented during the international EESD conference (Engineering Education in Sustainable Development) in Delft, 2002, and published in its proceedings (Venselaar, Roorda and Severijn, 2002). An example of the way in which the Cirrus approach was presented as another paper for the EESD Delft Conference, describing the adapted curricula of the study programs of Chemistry and of Chemical Technology (Hageman, van der Boom and Venselaar, 2002).

The Basic Module

In order to realize the 'trunk of the tree', the project team dedicated a lot of time to the development of the 'Basic Module on Sustainable Technology'. This was finished at the end of 2000 (Venselaar, Roorda and Quispel (eds.), 2000); see figure 24. In order to offer some impression of the contents of the Basic Module, which had the size of a book, Appendix 3 shows its Table of Contents.

Interdisciplinary internships

While the project team worked on the integration of a multidisciplinary approach to sustainable development in the curricula, it attempted to go even one step further: interdisciplinary education. Both concepts are defined in §2.3. An interdisciplinary approach resembles multidisciplinarity, but with an extra: an actual cooperation between experts – or, in the case of higher education, future experts, i.e. students – of various disciplines. This is not just a cooperation at a distance but in a team in which the members try to develop a common language in order to create synergy and profit optimally from each other's expertise.

Figure 24. The Basic Module on Sustainable Technology

Several experiments were performed during the Cirrus Project. They turned out to be a splendid learning experience: in the first attempts, many errors were made and unexpected problems arose. Later attempts were much more successful. The approach, including a description of the experiments, was published as Dejong, van Beek, Severijn and Venselaar (2002). The interdisciplinary experiments showed that such student projects have a number of specific problems that have to be tackled through a careful preparation. These problems range from communication between students and professional from different disciplines to pragmatic questions, e.g. different durations or numbers of ECTS between study programs. Such findings are confirmed by others (e.g. Muhar et al, 2006).

The need for an assessment tool

At the start of the Cirrus Project, the Curatorium was formed, which was intended to evaluate the project and check its proceedings and results. Right from the start, however, it was clear that this was a problem, as there did not exist a suitable method to evaluate the rate of integration of sustainable development in study programs.

At that time, the Dutch organization DHO, the later Foundation for Sustainable Higher Education, was planning to set up a working group to define a set of indicators for sustainable development in higher education. A cooperation between Cirrus and DHO was proposed, in order to develop not only a set of criteria, but also a tool for the assessment of those criteria. In 2000 and 2001, this project was carried out. The resulting method was called 'AISHE', short for 'Auditing Instrument of Sustainability in Higher Education'. It was published at the end of 2001 (Roorda, 2001), after it was tested and validated. AISHE will be described in more detail shortly, as its development and application is the theme of experiment #4 and of chapter 7 of the dissertation.

In 2002, the instrument was used for the final evaluation of the Cirrus Project.

6.3. Result assessment

At the start of this chapter, the central question for experiment #3 was formulated: Can existing study programs, not yet giving much attention to (aspects of) sustainable development, be reformed in order to effectively increase their contribution to sustainable development?

As announced at the start of this chapter, four hypotheses were formulated that will be used to evaluate whether the Cirrus Project may be called successful regarding the central question. They are shown in table 20.

Table 20. Experiment # 3: Criteria for result assessment

Experiment / Criterion	X3 Cirrus	Assessed hypothesis
Contribution to ESD within direct stakeholders		
Implementation of ESD in vision, policy	§6.3.1	1. The project contributed to the vision and policy on education and SD of the study programs
Implementation of ESD in education	§6.3.2	2. The project contributed to the ESD character of the study programs.
Customer demand		*(not applicable)*
Customer appreciation		*(not applicable)*
Contribution to SD within indirect stakeholders		
Indirect stakeholder appreciation	§6.3.3	3. External stakeholders appreciate the ESD consequences of the project.
Contribution to SD through HE		*(not applicable)*
Transfer of expertise	§6.3.4	4. The project contributed to ESD development elsewhere.

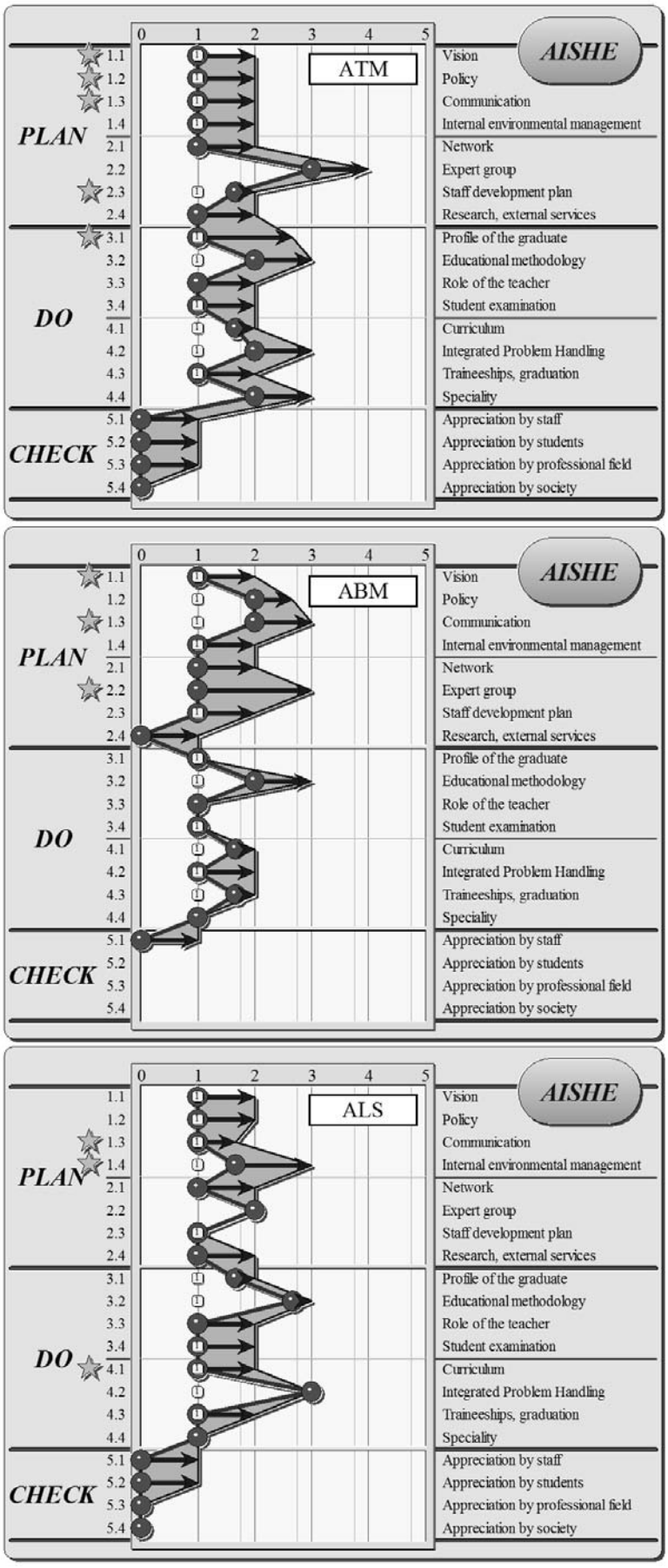


Figure 25. The results of the AISHE assessments in the FTN in 2002. From top to bottom: ATM, ABM, ALS.

Sources of information

The first three of the four criteria correspond with the three main groups of criteria of the AISHE assessment (see figure 25): 'Plan', 'Do' and 'Check', referring to the Deming cycle of quality management (Deming, 1986). This correspondence will be of help, as one of the main sources of information for the evaluation of the Cirrus Project is a series of AISHE assessments that were performed at the end of the project.

By the end of the project, the study programs that were involved in the project were grouped together in three academia: the Academy of Technology and Management (ATM) with six study programs, the Academy of Building and Management (ABM) with three programs, and the Academy of Life Sciences (ALS) with two programs. In each of the three academies, an AISHE audit was done in November or December 2002. Figure 25 shows the results of all three in a graphical way. (The balls represent the 'present situation' at the moment of the audit; the arrows represent the 'desired situation' at e.g. a year afterwards; and the stars on the left represent the highest priorities for improvement.) The audit reports will be used extensively for the evaluation of the Cirrus Project. A description of AISHE and its philosophy, criteria and stages can be found in Appendix 5.

Another important source for the evaluation is the Final Report (Dejong, Roorda, Severijn, Venselaar, 2003) of the Cirrus Project, which was published in the spring of 2003. This report, written by members of the project team, can be considered as a self-evaluation report, comparable to such reports that were used in the former chapters.

Four years after the end of Cirrus, in 2006, the long term consequences of the project were assessed through a series of interviews with academy managers and with the former project adviser, at that time lector. The report of this research (Roorda, 2006a) will also be used as a source. In addition, some former Cirrus team members were interviewed in 2009. Other sources are e.g. the preparedness of the professional field to invest and participate in the project, and an Award by the Dutch Ministries of Environment and of Education.

6.3.1. Vision and policy on Education and Sustainable Development

In this and the next section, a number of citations will be derived from the AISHE audits of the three academia: ATM, ABM and ALS. These reports will be extensively cited. The first group of citations consists of the most significant remarks from the 'Plan' group, i.e. the first 8 AISHE criteria:

ATM:

> "There has been a basic course for teachers. A sustainability module has been implemented in the education. We are stimulated to pay attention to SD in the coming years."
> "The managers don't have an explicit policy on the level of the ATM, although it does exist at the FTN level. The problem is that not everybody knows this. So there is a missing link between FTN and ATM. Does ATM want to adopt the vision of FTN? That is the question."
> "ATM is setting up an advisory board, in which several study programs are discussed. This helps to talk about the integration of sustainable development over the whole range."
> "There is a staff development plan concerning sustainable development. But sustainability is not a part of the individual development plans. Although there was a teacher training, in real life there is hardly any attention, and so it might all be gone in a couple of years."

ABM:

> "There is an ABM vision about sustainable development, and it is discussed, but it is still implicit, many teachers and students are not aware of it. Staff members are involved in the vision development: about 7 of them, out of a total of 75 staff members.
> "A sustainability policy document is in preparation. The concept is discussed in the academy commission. Students would like to attribute to the vision development. They are prepared to spend a number of days on this process."
> "During teacher meetings and in publications sustainability is an issue every now and then. E.g. the Cirrus Project and the STD program have been on the agenda. But there is a lack of clarity about the terminology: what exactly is sustainable development!"

ALS:

> "It is not known if there are documents and if sustainability is mentioned in them. At the level of the academy management, work has been done to develop a vision on sustainable development, but this was never put on paper. Besides, not everybody shares the same vision. It is a very new topic, and only recently the exact meaning for our academy has been studied. On the other hand: one of the eight recently developed professional competences is about sustainable development."
> "Students don't want an active role in the vision development. They just want to be kept informed, to be able to react afterwards to the vision developed by the management."
> "Hardly any staff member is involved in the policy development. It is all very top-down."
> "The internal communication is poor, not only regarding sustainable development but also in general. Some information about sustainability is given, but not much. The subject is pushed onto the students, and it does not match with the rest of the study, it is not integrated in the curriculum.
> The design of the new curriculum is discussed many more times, and sustainable development is a part of it."

These citations seem to indicate that only some superficial results were realized, and that intrinsically nothing much had changed. In part this is true: the final results of this and the next section were lower than originally planned. On the other hand, the reports are more negative than they would have been if the audits had not combined several (in the case of ATM even 6) study programs. The AISHE audits are intended to be applied to individual programs. The regulations of the application of AISHE allow combining more than one study program in one audit – if certain demands are met – but demand that, in that case, each of the 20 criteria scores at the level of the *lowest* performing program. Universities that want to combine programs in such a way always receive this message as a warning that the results may be disappointing. In spite of this warning, the three academies decided to ask for combined audits, for efficiency reasons.
The three sets of audit scores indeed were rather disappointing, according to some program managers. Each had a median score of 1 ('activity oriented'), and not 2 ('process oriented') or 3 ('system oriented'), which – if AISHE would have existed in 1998, when the project was prepared – no doubt would have been the ambition. But the scores of several individual study programs, if audited separately, would have been higher. E.g. in the case of the ATM, where six programs were combined, the Tilburg programs, i.e. the programs of M2, Mechanical Engineering and Technology Management, before the merger being a part of the HMB, probably would have scored significantly higher. The Breda programs, coming from the HWB merging partner, had much less experience with PBL, project education, and competence based learning, even at the end of the Cirrus Project. The Cirrus Final Report writes about this:

"The implementation of a detailed sustainability package takes place gradually at the moment and in the next years. In most study programs the first part of this happened in the year 2001/2002. Some programs were one year earlier, others a year behind. The main reason for this was that for a number of programs the education was redesigned, and it was wise to adapt the timing of the sustainability implementation to this.
The educational methodologies differ considerably between the study programs. There is a faculty-wide policy towards a homogeneity and flexibility, but at the moment the various programs and academies operate very differently concerning the actual implementation of sustainability in the curricula. In strongly PBL and PE oriented programs sustainable development has been integrated so thoroughly that only a limited number of separate introductory or integrative modules have been made. This is the case with e.g. ABM and the ATM program of Technology Management. The details can be found on the website www.projectcirrus.net. In ABM the students are, even in their introductory project and in their excursions, confronted with the concept of sustainable development. They appear to appreciate this highly.
In other study programs, structured around modules, a more extensive series of introductory and integrative modules has been made. Examples are ALS and the ATM program of Chemical Technology."

6.3.2. Education for Sustainable Development

Significant citations from the 'Do' part of the audit reports, i.e. of the AISHE criteria 9 till 16, are:

ATM:

"In the audit report, the lowest scores are chosen. Regarding sustainability in the graduate profile, this is stage 1, while for Chemical Technology, Environmental Management and M2 the real stage is higher. M2 is nearly on stage 4. With Environmental Management no students are actively involved in the profile development, but apart from that, they would be in stage 3; its program is rather multidisciplinary."
"Basic knowledge of sustainable development has a fixed place in the curriculum. This basic knowledge is applied throughout the rest of the curriculum of some of our study programs. The combination of basic knowledge and the other sustainability issues has not yet been related to the graduate profile."
"Regarding multidisciplinarity, sustainability aspects are not clearly assessed and related to each other. Technology Management has stage 3 here, as it is naturally multidisciplinary. Mechanical Engineering is between stage 2 and 3. If the multidisciplinary approach is carried through consistently, students from a variety of study programs will join and cooperate interdisciplinary. The question is whether such teams should start in the first year or later."

ABM:

"Our professional competences pay attention to sustainable development. It is an intrinsic element of the discipline. One teacher remarks that with him, no graduation candidate will pass if sustainable development is not an item in it. If not, it has to be motivated why sustainable development is not relevant. The same does not apply to all teachers."
"For a student of the specialty program of Architectural Design it is perfectly possible to hear nothing at all about sustainable development during the specialization study. In the specialty program of Urban Development however, sustainable development is a regular subject. In the study program of Constructional Management sustainable development is a thoroughly integrated subject."
Basic knowledge in the propaedeutic is, thanks to the Basic Module of Sustainable Technology, built-in for all study programs."
"In the study programs, integration of subjects clearly takes place, and an increasing level of complexity is well recognizable. Real-life learning is encouraged. We have had a number of interdisciplinary projects. They went well, but it is hard to find students for them."
"Not all students know that they are expected to pay attention to sustainability aspects in their practical projects. In some programs this has been made very clear."

ALS:

"Sustainable development is mentioned explicitly in the 'Conceptual Learning Lines' for the Competence Oriented Education: sustainability in a narrow sense is practiced. The latest version of the professional competences contains elements of sustainability, but this does not have any effect yet on the education."
"According to the students, the teachers' attitude shows that the organization aims at sustainable development. The teachers think that they don't get enough feedback from the students and from the organization. There has been a questionnaire for the students, about competences, but sustainable development was not an item in it."
"The Basic Module on Sustainable Technology is not in use yet, but it will be. The guiding lines and plans are ready, and will be carried out next year."

Here, too, the results were less than originally planned. Again, this is partly due to the combined audits. It seems that in many respects an implementation process was about halfway in realizing the desired concrete results.
The interviews with academy managers in 2006, and with former Cirrus team members in 2009, confirm that this is still the case several years later. The manager of ATM (2006): "SD still has to be integrated into the education in a lot of places. However, it should not be overdone: SD should not become the leading theme of the ATM programs."
According to a former team member delegated from ATM, in most study programs sustainable development is still not an important aspect of the curricula in 2009. In other words, it seems that the process, which was halfway at the end of 2002, was not followed through consistently in later years.
It seems that ABM performed well, as the managers told (2006): "ABM has a lot of SD aspects in the education, partly due to the Cirrus Project. We think about a triptych: technology – entrepreneurship – society. As a fundament to that, ABM feels the need to develop a clear integral and future oriented vision on SD, with support from a trend watcher with a visionary view on SD, and with experience in the constructional sector." In 2009, a former Cirrus team member confirmed this image, and underlined that sustainable development has become an intrinsic part of the character of the ABM programs.
A few years after Cirrus, ALS became integrated in a larger department, the Academy of Technology for Health and Environment (ATGM). In 2006, the ATGM manager told during his interview: "For ATGM, SD is of major importance. ATGM has a Major, called 'Environmental consultancy and sustainable management'. ATGM has started the development of a minor 'sustainable management' which will be available for the students of all Avans academies."
So, judging the results at the end of the Cirrus Project as well as some years later, a mixed image rises. It is true that, at the end of 2002, some study programs in other universities were ahead of the FTN, if their AISHE audit results are compared to those of the FTN. Again, this would probably have looked differently if separate FTN programs would have been audited. But apart from that, the higher scoring study programs elsewhere usually were separate programs, which had an isolated position within their universities. In comparison, the Cirrus Project tried to influence an entire faculty: an immense task. So, where the heights of the scores were not extreme for at least some study programs, the 'breadth' of the scores certainly was.

6.3.3. External stakeholder appreciation of Cirrus

Even before the start of the Cirrus Project, many external organizations showed a lot of enthusiasm about it. This appeared through their willingness to contribute to the project, even when only the first outlines of it were defined. In §6.2.1 the financial contributions were shown.
In a later stage, other organizations joined the project with their contributions. During the project, support, either financially, through transfer of expertise, or both, was received from:

Companies:
Flextronics, NedCar (later: PD&E Automotive), PRC Bouwcentrum, Essent, Van Melle, Rockwool Benelux, PNEM/MEGA Group, Xerox;
and SME's like Packaging Matters, Van Swaaij Hout, Pré Consultants, SME Milieu Adviseurs, CREM, Jules Goossens, NKF Kabel, Proterra.

(Semi-)governmental organizations:
Ministry of Economical Affairs, Ministry of Environmental Affairs, the Province of North Brabant, the City Council of Tilburg.

Expert centers, NGO's:
STD-KTI , ECN, National Committee for International Cooperation and Sustainable Development (NCDO), Brabant – Zeeland Employers' Association (BZW), Milieudefensie (the Dutch member of Friends of the Earth), Brabantse Milieufederatie (BMF), Intron, Project Office Brabant 2050, Syntens.

Educational Institutions:
HBO Council, Eindhoven Polytechnic University, Van Hall Institute, ROC Midden-Brabant.

The letters of intent of the project sponsors made clear why they supported the project. A few citations:

> "Apportioned subsidy: *Dfl* 150,000,--. (...) With the intention of giving sustainable technology its rightful place within the education of various subjects in a range of disciplines, a renewal of the educational materials is necessary, as well as education of the learning staff. This project meets these demands, and it can give a strong impulse to the introduction and integration of sustainable technology in the schools and the companies, also because the Hogeschool Brabant obliges itself to share the acquired knowledge and experiences with other institutions in higher and secondary technology education. Through the introduction of sustainable technology and the stimulation of students and teachers to practice it in their internships and work, in the eyes of NCDO this project

will deliver an important contribution to the realization of dematerialization in the professional field." (NCDO: on behalf of the Board: A. Waarts, director, June 15, 1998)

"PNEM/MEGA Group (PMG) is prepared to support the project with a total amount of *Dfl* 100,000.--, spread across 4 years (1999 – 2002). The introduction of education about sustainable technology fits well within the goals of PMG. PMG will raise the percentage of sustainable energy in the supply of energy. One of the steps in this is the stimulation of education about sustainable technology. Besides, PMG wants to have contacts with students and graduates in relation to possible internships and vacancies. We look forward to a fruitful cooperation and a successful introduction of sustainable technology into the education." (PNEM/MEGA Group: ir. A.D. Goedhuis, Manager Corporate Strategy and Development, July 3, 1998)

During and after the project, other forms of appreciation were showed. Among them were invitations to join several forums, to present at conferences, etc.; these will be discussed below. A very special sign of appreciation was received in 2001.

The 'Egg of Columbus' (2001)

In 2001, the Cirrus Project was nominated for the Brabant Sustainability Award by the regional government of the Province of North Brabant. The project was not the winner. Some time later however, it did win an award.

The 'National Award for Innovation and Sustainable Development' is awarded every two years by a group of government departments: the Ministries of Economic Affairs, Environmental Affairs, Foreign Affairs / Development Cooperation, Agriculture, and Education. The award is also called the 'Egg of Columbus' (see figure 26; see also www.ei-van-columbus.nl).

In 2001, the Cirrus Project was nominated for the award in the category of higher education. Among a number of other contestants, it won the award. The Jury report wrote about the Cirrus Project:

> "This project is appreciated by the jury for its very thoroughly designed approach to the introduction of sustainable development in HBO curricula. It offers a broad package of products, each elaborated scrupulously. A clear link is present with societal partners.
> Potentially a strong spin-off is possible towards the future professional practice of the graduates."
> "This contestant has been proclaimed winner in this category, i.e. HBO. Many projects exist in the Netherlands aiming at integrating sustainable development in the curriculum and the operations. The Cirrus Project excels, the Jury concludes, with respect to the breadth (oriented on both curriculum and operations) and the impact it may have on the professional practice of the engineer.
> The jury expresses the wish that the project will find a broader field of application, within other faculties and other HBO institutions."

Together with the award, the Cirrus Project received an amount of *Dfl* 30,000,-- which was later used for the stimulation of ESD, as will be described in §6.3.4.

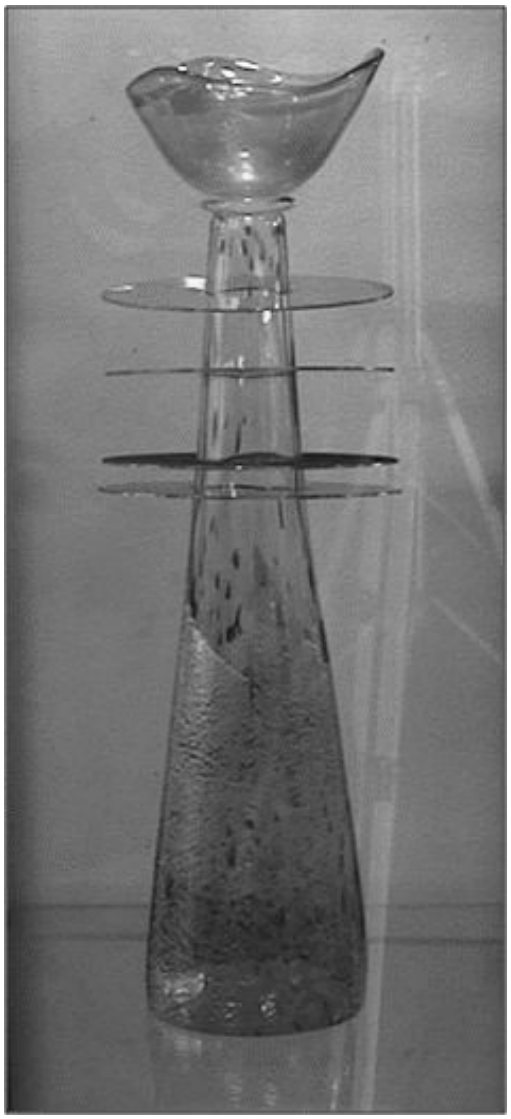


Figure 26. The cup: the physical appearance of the Egg of Columbus

The Certificate of Sustainability in Higher Education

In 1999, a group of HBO institutions designed a sustainability charter, especially for the Dutch HBO. The details of this will be described in the next chapter. One of the consequences of the charter was the introduction of a certificate that was awarded to university study programs that were able to prove that they satisfied the demands of a 'protocol' that belonged to the charter.

After AISHE was developed and introduced, this 'Certificate of Sustainability in Higher Education' (in Dutch: Keurmerk Duurzaam Hoger Onderwijs') was linked to the results of AISHE audits. Before AISHE existed, the assessments were done by an expert centre of sustainable development, SME. (The certificate was then only available to HBO institutions, and was named 'Keurmerk Duurzaam HBO' accordingly, see figure 27.)


KEURMERK DUURZAAM HBO

Keurmerk Duurzaam HBO

Stichting Duurzaam Hoger Onderwijs
verleent krachtens Protocol 2000
het Keurmerk Duurzaam HBO aan:

Opleidingen
Bouwkunde
Civiele Techniek
Technische Bedrijfskunde
Werktuigbouwkunde
Biologie en Medisch Laboratoriumonderzoek
Bouwtechnische Bedrijfskunde
Elektrotechniek
Chemische Technologie
Milieukunde
Milieugerichte Materiaaltechnologie
Chemie

Instelling
Stichting Brabantse Hogescholen,
Faculteit Techniek en Natuur

Duurzame ontwikkeling is hiermee een fundamentele oriëntatie in het onderwijs, onderzoek en de bedrijfsvoering van het instituut

Utrecht, 28 maart 2001

Voorzitter Stichting Duurzaam Hoger Onderwijs

Namens de opleidingen

Figure 27. The Certificate of Sustainable Higher Education was awarded to all study programs that participated in the Cirrus Project (March 2001)

In the beginning of 2001, the study programs of the FTN were assessed by SME. It concluded that all programs met the demands of the certificate. And so, in March of 2001, the FTN received the certificate for all of its 11 study programs.
The Certificate is valid for a period of three years. In order to prolong it, new AISHE audits are required. However, after the audits at the end of 2002, AISHE was never again applied in the HB. As a consequence, the FTN lost its Certificates in March 2004.

6.3.4. Transfer of expertise

In contrast with the M2 study program, the Cirrus developers were aware right from the beginning that the project and its results could be highly interesting for other universities. Even before the project started, external presentations were given in an attempt to start the external transfer and cooperation. Actually an active transfer of knowledge and experiences was one of the conditions for several of the sponsors of the project, e.g. NCDO and the HBO Council.

Basic Module, Website, Final Report, Symposium

In the course of the project, all kinds of transfer have taken place. After it was finished, the Basic Module on Sustainable Technology (Venselaar, Roorda and Quispel (eds., 2000) was sent to every manager of an engineering study program or faculty in the Netherlands. In the accompanying letter, the universities were told that they were free to use the module in any which way they wanted for their education, on condition that the source (the Cirrus Project) would be mentioned. About 10 universities have indeed used the module for a number of years for their first-year students.
Not only the Basic Module, also all other educational materials that were developed were made directly available through the website www.projectcirrus.net.
The final report (Dejong et al, 2003), which has been quoted above, was printed and mailed to many persons. It was also handed out to all visitors of the Symposium on Education for Sustainable Development that the FTN organized in the summer of 2003. This symposium was the formal end of the Cirrus Project. The project results were shown and discussed. The visitors came from nearly all Universities for Applied Science in the Netherlands, from several research universities, from companies and other project partners, and several universities in Belgium.

Publications

Through the years of the project, about 30 papers were published. One of them was published in a peer reviewed journal: the International Journal of Sustainability in Higher Education, IJSHE (Roorda, 2001a). Others were published as chapters in peer-reviewed printed books (Roorda, 2002a and 2004). In the also peer-reviewed web-based 'Encyclopedia of Life Support Systems' (EOLSS, www.eolss.net), a chapter was written about the principles of education development for sustainability (Roorda, 2005c), and another chapter offering examples of student tasks concerning sustainable development (Roorda, 2005b).
DHO, the Dutch organization for sustainable higher education, has published a series of 'disciplinary reviews' ('vakreviews'), each dedicated to a discipline in higher education. (This will be discussed in more detail in the next chapter.) Several members of the Cirrus team contributed to the reviews of Mechanical Engineering (Kirkels, 2002) and of Civil Engineering (Bras-Klapwijk, 2002). Another one, on Technology Management, was authored by a Cirrus team member (Severijn, 2003).
Short papers were published in e.g. 'Copernicus Nieuws' (1999 and other years), IACEE (International Association for Continuing Engineering Education) Newsletter (1999), 'Berichten van de Vereniging O2 Nederland' (2001), 'The Dec-

laration' (Journal of the Association of University Leaders for a Sustainable Future, Washington DC, 2002). Various papers were published in the proceedings of conferences and symposia, based on presentations.

Presentations
Some 40 papers about the Cirrus Project, its philosophy, process and results were presented at conferences, meetings, etc. outside of the HB. The earliest presentations already took place in 1998, when the project was being prepared. A number of them of them took place in international conferences, e.g.

- Entree 1999 Conference, Tampere (Finland), EEE (Environmental Engineering and Education) Network (Roorda, 1999).
- IFAC 2000 Conference (International Federation of Automatic Control), Aachen, Germany (Roorda, 2000a).
- CCC 2000 Conference, CRE Copernicus, Krakow, Poland (Roorda, 2000b)
- Entree 2000 Conference, Belfast (Northern Ireland), EEE Network (Keynote speech, Roorda, 2000)
- 6th International auDes Conference, Venice, Italy. Essence Network of Environmental Education (Roorda, 2001c)
- 3th European Congress on Chemical Engineering (ECCE3), 2001, Nuremberg, Germany (Venselaar, 2001)
- Entree 2001 Conference, Belfast, Northern Ireland. EEE Network, (Roorda, 2001d)
- ULSF Conference 2001, Association of University Leaders for a Sustainable Future, Washington DC (Roorda, 2001e)
- Four presentations at the EESD Conference (Engineering Education in Sustainable Development), Delft, Netherlands, 2002. Three of them were mentioned already; the fourth is Roorda (2002b).
- EMSU Conference 2002, Grahamstown, South Africa (Roorda, 2002c)

Training courses
Training programs, presentations and workshops aimed at higher education in a variety of Dutch Universities of Applied Sciences, e.g. Fontys Hogescholen, Hogeschool Utrecht, Hogeschool Larenstein, and contributed to the training of their staffs. Other workshops were given at seminars and meetings of e.g. DHO and IOM (Intersectoral Consultation of Environmental Education). Subjects were e.g. sustainable development, sustainable technology and sustainable energy.

Participations and memberships
Members of the project team participated in several commissions, groups and meetings, e.g.

- Commission on Sustainable Higher Education (CDHO);
- CDHO working groups: "Criteria for sustainable higher education", "Interdisciplinary graduation", "Disciplinary Exploration".
- Working Group on General Engineer Qualifications of the HBO Council.
- Consortium of the national project on sustainable architecture and professional education (Habiforum)
- "Brabant Elan", brainstorming sessions on the sustainability strategy of the Province of North Brabant
- NMP4 consultation, preparatory brainstorming for the development of the Fourth National Environmental Policy Plan
- Environmental working group of BORT (Bedrijven Overleg Regio Tilburg), an association of companies in the region of Tilburg
- Socrates Meeting, part of the Intensive Program "Sustainability and globalization for students of engineering and technology" (Porto)
- Task group Strategic Development of the Environmental Technology Valley Association (ETVA)

Continuity and dissemination within the university
After the Cirrus Project was finished, sustainability activities did not end in the HB. Not long before, a new development took place within HBO: the introduction of the lectorates. After the end of Cirrus, a lectorate was set up in 2003 as a follow-up to Cirrus. The project adviser of Cirrus, Jan Venselaar, was now appointed as the lector, and several members of the Cirrus team continued their sustainability work as members of the knowledge circle. The new lectorate focused on a combination of technology and management related to sustainable development, and was called 'Sustainable Management'. Thanks to the lectorate, the continuity of ESD in the HB was guaranteed. Besides, the new lectorate immediately started making connections with other academies in the HB, especially those with management disciplines, and thus worked on the transfer on the Cirrus knowledge and experiences to other parts of the university.
Another way in which the continuity was realized, was a series of sustainability activities in companies (e.g. workshops) that were performed together with NovaKnowledge, the commercial project- and training institute of the HB, aiming at the professional sector.

Cirrus Award

Last but not least, a special way has been set up in which Cirrus has outlived its own existence. When the project was awarded with the Egg of Columbus, it not only received a cup, but also a financial award of *Dfl* 30,000. This money was used to set up a special annual award inside the HB, available for graduation candidates. Students are invited to send in their graduation report, if they have the opinion that they have delivered an extraordinary contribution to sustainable development. Besides a certificate, the winner of the annual Cirrus Award receives a check of (originally) *Dfl* 5,000, or (presently) € 2,500. Two runners-up each receive € 500. The award still exists (in 2009).

Some of the titles of the winning graduation reports are:

- "Sustainable development of an industrial area in Bladel"
- "Energy savings in student housing … Wasted energy?"
- "End-of-life-management for sustainable entrepreneurship"
- "Kan Tan land project: Water resource management for the ecological development of Boruca in Costa Rica"
- "Eco-Energy-Index for energy generation".

At present, the concept of sustainable development is very much alive in the university, which is now called, after another merger – this time with the Hogeschool Den Bosch in the city of 's Hertogenbosch – Avans Hogeschool. Not only do the Lectorate and the Cirrus Award still exist. Besides, a new lectorate has started, 'Sustainable Energy', and a next one in inpreparation, called 'Finance & Sustainability". Other lectorates also pay explicit attention to aspects of sustainable development, while quite a lot of academies are working on a deeper integration of sustainability into their curricula.

To summarize: there is a direct causal relation, from the earliest ideas within the HMB about sustainable development in 1990, leading to the M2 study program, through the Cirrus Project, to the present activities around sustainable development in Avans Hogeschool. The Board of Avans has appointed sustainable development as one of the highest priorities in the university mission and strategy.

6.4. Conclusions

Putting all conclusions together, the following result arises (table 21).

Table 21. Experiment # 3: Evaluation

Experiment / Criterion	X3 Cirrus	Assessed hypothesis	Evaluation	Judgment
Contribution to ESD towards direct stakeholders				
Implementation of ESD in vision, policy	§6.3.1	1. The project contributed to the vision and policy on education and SD of the study programs	No strong organizational change was realized, as was originally intended. In a part of the study programs, a vision and a policy on SD were developed, although they were not strongly internalized.	–
Implementation of ESD in education	§6.3.2	2. The project contributed to the ESD character of the study programs.	The level of integration of SD into the curricula varied strongly between the programs. They all made progress, and so the volume of the improvement was not small.	+
Customer demand		*(not applicable)*		
Customer appreciation		*(not applicable)*		
Contribution to SD towards indirect stakeholders				
Indirect stakeholder appreciation	§6.3.3	3. External stakeholders appreciate (the ESD character of) the project.	Most external signs of appreciation mainly focus on the project design, rather than the results. The Certificate of Sustainability in Higher Education was awarded to all participating programs.	+
Contribution to SD through HE		*(not applicable)*		
Transfer of expertise	§6.3.4	4. The project contributed to ESD implementation elsewhere.	Cirrus had a significant contribution to ESD in other Dutch universities, through its Basic Module, website, symposium, workshops & courses, presentations & publications.	++

Strong points of the Cirrus Project are: its pioneering character, and the daring approach which aimed at an entire faculty with 13 study programs; the external support and appreciation; the learning process, based on both the successes and the failures; the lessons learnt and the transfer of results to other universities.
Weak points are: the lack of acceptance of the importance of sustainable development for higher education by a part of the management and the university board; the lack of real and deep internalization of ESD within the vision and policy of a part of the study programs and into their curricula; and the low level of organizational change that resulted.

At the end of the Cirrus Project, not all goals were realized, even if the original goals and promised results (see Box 10 and Appendix 1) are not taken literally but interpreted in accordance with later developments. By the end of 2002, the FTN as a whole should have been a centre of expertise of sustainable technology, and sustainable development should have been integrated into all of its education. This was certainly not the case. The thorough integration of sustainable technology in all curricula was, at best, on its way, and far from completion.
Much of this is due to a problematic process in the first part of the project. At the end of the first year, it seemed as if hardly anything had been accomplished.
The Final Report of the project (Dejong et al, 2003), described the situation as follows:

> "In the first part of the project, roughly in the first two years, few concrete results became available. If one had the expectation that the results would be delivered more or less linear (as the dotted line in figure [28] shows), it may have seemed that the project was about to fail.
> In reality it appeared that the 'harvesting', the realization of the targets, rather had the shape of an S-curve, in which the results are implemented in a relatively late stage. This is a usual element of large and complex projects like Cirrus, and this has been a major lesson for the Cirrus team and for the FTN.
> What are the concrete results? The FTN has gone through a development in which for some of the study programs sustainability has become a leading theme. The other programs deal with sustainability subjects in a greater or less depth. Much of the education has been made 'sustainable', at least on paper. On the other hand, the faculty vision on sustainable development is not yet sufficiently alive in all teacher teams. Besides, the expertise of the 'average' teacher is not yet at the desired level. The actual implementation of the adapted education is, partly thanks to this, incomplete, and the support among the teaching staff is still insufficient. The least satisfactory is the anchoring of sustainable development within the faculty. This concerns both the anchoring in the curricula and the anchoring in the heads of the staff members."

The typical S-shaped curve may be characteristic for large projects. Nevertheless, the specific situation within the FTN may be understood better by applying the three models of change that were described in chapter 1, as a means for theory triangulation.

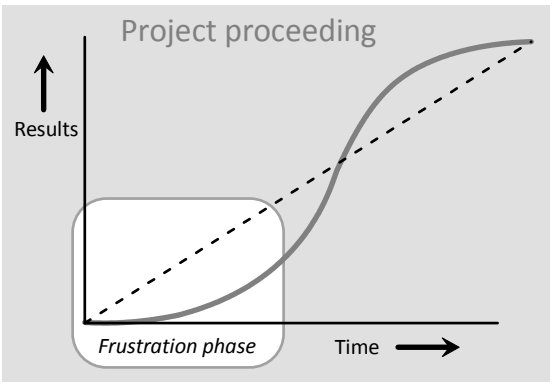


Figure 28. The S-shaped progress of the Cirrus Project

First, the Bridges model of organizational development offers a fruitful description of the HB, the FTN, and the Cirrus Project within them.
Exactly when the project was prepared, the HB was created through a merger of the HMB in Tilburg and the HWB in Breda. Up to a certain level, the HB can be considered at that moment as a new organization, and its development can be compared to the phases of the Bridges model. The merger was prepared in earlier years through a merger at the Board level; this can be described as phase 1, the *dream* (of the Board members). The actual merger in 1998 was phase 2: the *venture*. Immediately after, the HB went into phase 3: *Getting organized*. This was clearly visible, as the study programs of both locations were grouped into departments that a few years later were reformed into academies, chaired by academy managers after the removal of all managers at the study program level. At the same time, within the FTN, attempts were made to synchronize the educational methodologies between its study programs in Tilburg and Breda, which at first differed considerably. This process was not even halfway when another reformation was attempted: the introduction of competence based learning. This all happened at a time when financial circumstances caused compulsory redundancies, thanks to which the work had to be done by less staff members having less equipment, being in a state of anxiety considering the continuity of their own jobs. Phase 2, *getting organized*, is described by Bridges as typically introverted, and this was certainly true for the FTN in the years of Cirrus.
This was in a sharp contrast with the Cirrus Project itself. The goals of the project were clearly externally oriented, as sustainable development was at the core. It was built on a large network of external contacts, which financed, advised and trained the project team, and demanded results. The promise had been made to disseminate all results to

the entire HBO sector in the Netherlands. The project itself could be considered as being in phase 1, the *venture*, after starting as a *dream* (i.e. phase 1) of the initiator. Cirrus was highly extraverted.
The extraverted nature of Cirrus did not match at all with the introverted nature of the FTN. In fact, most study program managers were hardly interested in sustainable development, as their attention was directed at structuring their own internal organization, or even worse: directed at sheer survival. This explains why most of them were not prepared to delegate their best staff members to the Cirrus team. The same was true for the FTN management: the major reason to agree to the Cirrus Project was its financial problem, a typically internal consideration. This became apparent when one of the two members of the FTN management left the HB soon after the start of Cirrus in 1999. The manager who left had a real interest in sustainable development; e.g., he was also the chairman of the Brabant Environmental Federation (BMF). He was succeeded by a financial expert, who in 1999 explicitly stated that sustainable development was of no relevance for the FTN at that time. The Cirrus Final Report described the situation:

> "The start of the project can be characterized as follows:
> 1. A mainly externally oriented project plan, fitting to the expectations and ambitions of the financial donors and the project initiator;
> 2. A welcome project for the FTN offering a way to solve a difficult personnel situation (supernumerary staff due to financial problems) for four years;
> 3. The project management in the hands of an inspired and involved 'pioneer';
> 4. The resignation of the FTN management member who had the strongest involvement with the project;
> 5. A composition of the project team that was based, partly on individual wishes, partly on organizational interests."

Application of the colors model of De Caluwé and Vermaak gives another interesting clue to understand the problematic first years of the project.
The preparation and start of the project can be characterized by a *yellowprint* type of process. The negotiations with the FTN management, with the study program managers, and to a certain extent also with the external sponsors, made it unavoidable to make considerable concessions, which caused damage to the project. The insertion to the project team of a teacher who was on sick leave due to overstrain, and of a teacher who neared his retirement, were exemplary. In March 1999, three months after the start, another teacher – one of the excellent team members - was removed by the FTN management from the team for financial reasons, although she had been described by the project manager as vital to the project. Only after a heavy pressure (a resignation offer) by the project manager, she was reinstalled. As a consequence of the negotiations, the project start also had a strong *blueprint* character, typified by a concrete set of results that was promised, e.g. 40 education modules, by a clear time schedule and end date, and by a stepwise implementation plan.
However, after the project team was formed, the team members expected to be able to operate freely and independently, acting as creative and self-responsible professionals. This is typical for many organizations, and especially so in organizations of professionals, which a university certainly is. As De Caluwé and Vermaak (2006) state it:

> "In many (in all?) organizations, conflicting orientations exist: bureaucrats attempt to manage and control, and to let the employees do what the bureaucrats want. On the other hand the employees want to avoid management and control, especially if this is obstructing or contradictory to what they want. We call this the 'primordial conflict'."

Not only the team members wished to be able to operate independently. Their wish was supported by the project manager and the project adviser, as they hoped that the subject of sustainable development would be inspiring, motivating and creativity stimulating. In other words, what the project needed was a typical combination of a motivating *greenprint* and a creative *whiteprint* process.
The two approaches – the *yellowprint* and *blueprint* approach of the faculty and program managers, and the *greenprint* and *whiteprint* approach of the team and the project management – were highly conflicting. In fact, they were a sign of a fundamental difference of vision and even of paradigm. This showed to be a source of passive resistance by many of the team members, sometimes resulting in open conflicts between them, the project management and the FTN management. It is no wonder that the first concrete project results took long to be produced.
All this may also be interpreted as a natural process in the formation of a team, following the well-known sequence of 'forming – storming – norming – performing', first described by Tuckman (1965). But in that case, the storming phase was extremely long and heavy, and the performing phase delivered its first concrete result – the Basic Module – no sooner than after about one and a half year.

Even more insight in the process can be gained with the help of the Sterling model of the levels of change. The initial description of the project results in fact implied that sustainable development could be integrated by just adding some elements to the FTN organization. The target of the 40 modules speaks volumes. Interpreting the project concept afterwards, it has a high level 1 quality: *accommodation*. This implies that the problem was underestimated, as the implementation of sustainable development was seen as a simple, linear process: first the training of the project

team, next the training of the other teachers and the development of educational materials, and everything would be fine and ready.
It was only during the project that the team management came to realize that the real process was much more complicated. A real integration of sustainable development could only be realized if the character of the FTN would change fundamentally, or else the sustainability content of the faculty would remain superficial. This implies a change process of at least level 2, *reformation*, and possibly level 3, *transformation*. Both levels have not been reached during the four years of the project, as sustainable development did not get a high priority compared to all kinds of other change processes which indeed were at least on level 2. It is no wonder that the result curve of figure 28 is S-shaped. It is also no wonder that the citations from the three AISHE audit reports strongly indicate that the sustainability paradigm was not internalized by many study programs or their staff members; there did not grow a sense of ownership. No wonder either that the academy managers were very satisfied when the responsibility for the process and the results was put with the project team instead of with themselves. And finally: no wonder that the median results of the AISHE audits were in stage 1, *activity* oriented, instead of stage 2, *process* oriented, or even stage 3, *system* oriented.
At the very end of the Cirrus Project, during the Final Symposium, the *researcher* made a number of recommendations to the audience, based on the experiences and the lessons learnt.

> "From the experiences with the project and the evaluations, conclusions can be drawn that may be useful for possible future projects in other universities.

1. A full integration of sustainable development in a study program and a curriculum is certainly feasible. Important is:
   - to investigate the state of affairs concerning logical connections with the existing subjects and modules;
   - to decide about a clear package of aspects and issues that are to be treated at least, e.g. based on the set of core themes and learning goals developed in the Cirrus Project;
   - to set up introduction and integration modules c.q. projects to demonstrate the coherence and the connections.

2. A stepwise development and building of expertise through the composition of a core team with links to all study programs can be highly effective. For an optimal approach, the following is important:
   - a careful selection of the involved staff members, not based on improper grounds (supernumerary staff, lack of time for a good coordination, etc.);
   - really exempt the team members of their other duties for the agreed period and intensity, since in real life the 'usual business' of educational activities will often get priority;
   - a well structured feedback from the project team to the study programs.

3. For a thorough integration it is desirable to involve the study programs and their teachers, right from the beginning, by informing them about the ideas and approaches and by disseminating information about sustainable development. In the Cirrus Project this has been done only at a relatively late stage. Because of this, at the moment the integration started, the study programs lagged behind in their understanding, involvement and motivation. If done properly, it will be 'their own' project instead of just a project of the team or the university.

4. Attention to external publicity helps to get the project on the internal agenda. Especially the 'top-down' legitimization can be promoted, because it gets a clearer strategic importance. The Cirrus Project started with a highly 'bottom-up' approach. It appeared to be difficult to get it on the agendas high up in the organization, which was at least partly caused by all kinds of other developments taking place in education and to all the attention they asked.

5. A strong involvement of the teachers can be realized by letting them think for themselves during short workshops about the contribution of their discipline to sustainable development and the relevance of sustainable development for their discipline. In the Cirrus Project this has been done only once for all the teachers. Looking back it can be said this should be repeated regularly, at least once a year, especially during the implementation phase.

6. The involvement of teachers – and of their study programs as a whole – with sustainable development is stimulated maximally by offering them opportunities to discover all by themselves which sustainability items can contribute to their own subjects and activities. This may lead to new approaches to old problems. An extra impulse can thus be given to subjects that seem to have become too traditional. It may lead to an increase of interest by offering new challenges in the various aspects of the subject.

7. For the sake of time and speed, in the Cirrus Project much work has been done by the project team itself regarding the integration of sustainable development in the existing curricula. This concerned the translation of the criteria and learning goals to the various subjects and modules, the distribution over the various years,

the development of sustainability related PBL, etc. Through this, the project team appeared to accept responsibility for the implementation within the study programs. In the study programs, everybody found this nice and easy. The consequence was that, later in the implementation trajectory, it was nearly impossible to get the involvement of the study programs. Therefore, it is recommended to put the responsibility for the implementation right from the start explicitly with the study programs. Each of them may have to compose a small internal team which will function directly under the responsibility of the program manager. Thus, the role of the project team will be advisory.

8. Ready-made educational modules are, considering the findings no. 5, 6 and 7, not necessary and not even wanted. It is necessary though to make available basic information to the teachers (the toolboxes) to enable them to make a start. If ready-made modules about specific items are necessary, they will probably be abundantly available at other institutions, on the internet or in the literature.
9. A formal assessment of the progress of the implementation of sustainable development into the education is absolutely necessary. If this does not take place, a noncommittal attitude will gain the upper hand, even if everybody endorses the importance of sustainable development.
10. For the future progress and sustenance of the results that have been realized in a project for the implementation of sustainable development into the education, a formal arrangement is necessary. The tasks, responsibilities and authority of the study programs (and their managers) should be laid down explicitly. Besides, it seems advisable to appoint a central coordinator (as a consultant or as a guardian of the quality) as well."

Answer to a question

At the beginning of the project, in the process of negotiations with the faculty management and the study program managers, a lot of concessions have been made, which created a situation in which many problems were to be expected, and they came indeed. So, would it have been wise to negotiate stronger and make less concessions? The probability is high that, in that case, the entire project would have been turned down, and Cirrus would have delivered no results at all, since it would never have started.

The Cirrus Project has proved the high importance of the conditions under which the integration process takes place. Among the necessary conditions are: a strong sense of urgency by the management and the teachers; the willingness and ability to invest; and a feeling of ownership by all who are involved, at all organizational levels. If these demands are met, the rest, e.g. the acquisition of the necessary expertise, will come. If the demands are not met, the process will be like sailing *against* the winds of change, as was the case in the first years of the Cirrus Project. In that case, there is no 'wei wu wei' (doing without doing, see §1.2.2), but either 'not doing' or 'doing and having a hard time'.

The results of the Cirrus Project were lower than originally hoped for. Nevertheless they are not negligible. In March 2001, all study programs did receive the Certificate of Sustainability in Higher Education. At the end of 2002, when the three academies were audited with AISHE, the results confirmed these certificates. As the later AISHE-based certificate knew a 'star level' system, the audits of 2002 proved that the academies all would have had one star. This is not a bad result. At the end of the first decade of the 21st century, much more experience exists with education for sustainable development, and at present it may seem easy for a study program to receive a one-star certificate. But in 2002, this was another matter.

Besides, an important gain of the project is that many lessons have been learned. Some of them indicate how the implementation of sustainable development should *not* be done. Others teach us how it actually can be done. Both kinds of lessons are probably equally important.

Another important gain is that both the results and the lessons learned were actively shared with the rest of the world. The transfer was well organized, and it is likely that many other universities, within the Netherlands as well as elsewhere, profited from Cirrus.

The central question of experiment #3 was:

- Can existing study programs, not yet giving much attention to (aspects of) sustainable development, be reformed in order to effectively increase their contribution to sustainable development?

The Cirrus Project proved that the integration of sustainable development into an existing study program is possible. In the FTN programs this was realized at a low level, but – given the circumstances, and given the pioneering character of the Cirrus Project – this is a good achievement. It suggests that, under better circumstances, or with more experience, a deeper integration might have been realized, at the level of system integration, although Cirrus did not prove this. The answer to the question therefore is, apart from all kinds of remarks and conditions as described, a modest 'yes'.

The above question is part of a longer series of questions that were presented in chapter 1 as specifications of the main question that is central to this dissertation. In the final chapter (chapter 10), the answers to all these specific questions will be summarized and compared, leading to a synthesis that will enable an answer to the main question.

7. Experiment # 4: Assessment of sustainable development in higher education

After the Cirrus Project, described in the last chapter, was finished, an important question arose. Is it possible to integrate sustainable development into a study program in such a way that it becomes a fundamental aspect of the program, a part of its very nature? A program like that might be typified as a 'sustainable study program', and the resulting situation might be described as 'system integration of sustainable development' (SISD). If something like this would be possible, what would that mean exactly?
After this first question, a second one was natural. If a study program would become really sustainable, i.e. if SISD would be successful, *how would you know it*? Would it be possible to describe a series of criteria for it, and if so, could a method be developed to assess it? And next: if such a method could be developed, would it be possible to apply it as a tool to strengthen the process of implementation of sustainable development into the education?
As questions like these are all about trying to get sustainable development into the mainstream of the education, and about assessment, it seemed logical to try to make a connection with the quality management of the university. That is why the above questions were formulated as follows:

Questions:
- Can sustainable development become a part of the mainstream of the educational processes in a university, implementing system integration of sustainable development?
- Can a quality management approach contribute effectively to this system integration?

These questions were all the more relevant, as the external quality management within HBO was getting more and more strength. As a consequence, also the internal quality management of the HBO institutions gained strength.
Another important factor for the present experiment was the formation of network organisations for ESD, including DHO in the Netherlands, and of the development of a series of declarations and charters about ESD, among which a charter that was especially designed for the Dutch HBO.

Context (§7.1):
- Growing importance of quality management in HBO
- Setup of ESD organizations, e.g. DHO in the Netherlands
- Development of Declarations and Charters about ESD, e.g. the HBO Charter on SD

This enabled to perform the experiment which will be described in the present chapter, in such a way that it would be possible again to 'sail on the winds of change'. The following actions were performed:

Actions (§7.2):
- Development of a system for standardized assessment and certification of study programs regarding the integration of sustainable development
- Application of the assessment system as a major element in the consultancy and coaching of managers and teachers in universities;
- Certification of successful study programs or university departments

The results of these actions were the assessment instrument AISHE and the Certificate of Sustainability in Higher Education. Its development and application will be the subject of this chapter.

Result assessment (§7.3):
In the final part of the chapter, a critical analysis will be made concerning the main questions of this experiment.
The following hypotheses will be tested as indicators for the level of success of the experiment:
1. Application of AISHE contributes to system integration of sustainable development (SISD).
2. AISHE attracts a sufficient number of users.
3. Users appreciate the application of AISHE.
4. External stakeholders appreciate the application of AISHE.
5. AISHE contributes to ESD implementation elsewhere.

7.1. Context

7.1.1. Quality management

The first process that was important for the design of AISHE was the development of a system of quality management in the Dutch higher education.

External quality control

In the eighties of the 20th century, the Dutch government demanded clarity about the quality of higher education. In 1985 the HOAK note (see §4.1.2) gave an impulse to the quality management, as institutes of higher education were given more autonomy but had to account for their quality to the government. In 1987, discussions were held about the development of a quality system, with as starting points "ruling at a distance" and "output control". Institutes were held responsible for the quality and the monitoring. The government only had a stimulating and complementary role in it. This was the start of the visitation system, i.e. the external quality control system, which also gave an impulse to the internal quality management of the institutions themselves (Van Hout et al, 2006) which will be discussed below.

At the end of the eighties an ambitious international program was set up by the OECD (Organization for Economic Cooperation and Development) for the development of International Education Indicators. "These indicators enable countries to see themselves in the light of other countries' performance" (OECD 2004). In the Netherlands a discussion was started on how to improve the use of these indicators, also in accordance with quality management.

The visitation system

In 1990 the HBO Council advised the introduction of a sectorally oriented quality management system. Instruments in this system were: self-evaluation, exploration and validation. In the same year also the WHW (the Higher Education and Research Act, see §4.1.2) was set up, which led to more autonomy for higher education and the system of quality management. Goal of the government was to have all institutions of higher education assessed by external visitation committees by 1995.

In 1991 the first visitation report of HBO institutes was published. The visitations had focused on the educational program itself rather than on the educational institution. This was based on the relation between the visitation system and the CROHO (the Central Register of Higher Education Study Programs, see §4.1.2), which regulates the formal approval of curricula. (Non-registration in the CROHO means that the institution will not receive governmental funding for the curriculum, the curriculum degree will not be recognized, and students enrolled in the curriculum are not eligible for financial assistance, as described by Van der Wende, 1996). All educational programs of a certain discipline were simultaneously assessed every 5 to 7 years. The first cycle of visitation of all disciplines was completed in 1997.

Both visitations of the M2 program, the results of which were described in §4.3.2 and §5.3.2, were a part of this visitation system.

The HBO Council described the visitation approach as follows (Hogeschoolbericht 165, 1993):

> "The task of the HBO visitation commissions is:
> b) To give an argued judgment about the quality of the offered studies and of the education process, both on a national level and for each university.
> c) To formulate recommendations for quality improvement, both on a national level and for each university.
> d) In its judgment and recommendations, the commission involves the educational organization and the level of the graduates.
> e) The commission relates its judgment and recommendations to the goals of the universities, the societal context, the legal requirements and the legally prescribed characteristics of HBO.
> f) The commission forms its judgment and recommendations:
> - the general guiding line for the sectoral quality management of HBO regarding self evaluation and visitation;
> - the specific focuses selected by the Board of the HBO Council and sent to the involved HBO institutions;
> - the reports sent in by the HBO institutions about the performed self evaluations;
> - in situ meetings with management, teachers and students;
> - eventually the presence during lessons and other activities that the commission thinks are relevant."

Early in the new millennium, the visitation system was replaced by an accreditation system.

Accreditation

International cooperation and adjusting of external quality assurance was given attention in the Bologna agreement of 1999 (which will be described in more detail in §8.1). In 2003 the ministers of Education agreed that national quality systems would be set up, meeting four requirements:

1. The responsibilities between parties involved have to be clear.

2. Systems of quality management are to evaluate educational programs or institutes and make use of self-evaluation and external assessment. The involvement of students is required, as well as publication of the report.
3. An accreditation- or certification system is present.
4. International cooperation exists, in networks or through mutual participation in national activities.

The systems of quality management in the European Union are heterogeneous, but the organization is more or less the same: self-evaluation, peer-review, use of standards and public reports (Inspectie van het Onderwijs, 2005).
In 2002 the system of visitation in the Netherlands was replaced by an accreditation system. Just as in the visitation system, accreditation is set as a condition for the right to financing, the right to be able to hand diplomas to students and the possibility for students to be granted a loan for their study. Once every 6 years every educational program is assessed. Differences between the earlier visitation and the present accreditation are e.g.:

- The visitation system compared educational programs that were one of a kind, and worked with peer reviews. The accreditation system makes use of a panel of a Visiting and Assessing Institution (VBI: 'Visiterende en Beoordelende Instantie'). The results are assessed by the NVAO ('Nederlands-Vlaamse Accreditatieorganisatie', the Accreditation Organization of the Netherlands and Flanders).
- In the visitation system, the focus was mainly on the content of courses and less on aspects like personnel, students and internal quality management. In the accreditation system, educational programs have to score positive on six criteria: final qualifications, study program, results, personnel, internal quality management and facilities. External orientation via labor market, students and alumni are stressed.
- Besides these six obligatory criteria, in the accreditation system the institutions can try to establish a special excellence. Optionally, they may apply for granting a 'special quality' or a 'special characteristic' to an educational program, which will be granted if it is proved that the programs excels nationally or internationally.

Between 2002 and 2008 all study programs were accredited for the first time. Institutions that were used to peer reviews and an informal quality management, appeared to have considerable problems with the accreditation system (Douma, 2006). Besides, it became clear that the administrative and financial impact was heavy.
After an evaluation by the Ministry of Education in 2008 a number of changes were proposed. The most important adaptation was that a part of the assessment may be performed on the level of entire universities, where formerly every investigation was done completely on the level of separate study programs.
According to Van Kemenade (2009), the accreditation system causes resistance with the staff in a university, as the staff members, being highly educated professionals, experience the accreditation as a means to control their professional freedom and creativity. Here again, just as with the Cirrus project (chapter 6), the *yellowprint* and *blueprint* thinking – this time at a national level - collide with the *greenprint* and *whiteprint* approach that the professionals inside the universities desire: another example of the 'primordial conflict'. This conclusion offers an important indication for the way in which an assessment tool on ESD should or should *not* be used.

Internal quality management
Around 1990, the main reasons for the universities to introduce a system of internal quality management were the improvement of educational programs and the improvement of the linkage between education and the labor market. In 1992 the Inspection of Education however concluded that quality management wasn't systematically integrated in most universities. Instruments for quality management were not broadly used for analyzing the content of educational programs in order to improve them. Besides, a policy was largely lacking for staff management aiming at maintaining and improving didactic and content-related knowledge and skills of personnel (Inspectie van Onderwijs, 1993). In 1996 all institutes of higher education were obliged to have plans for quality management, which lead to flexibilization, control and improvement of the quality of the organization.
The internal quality management can be arranged in such a way that it makes an appeal to both the organization as a whole and to the individual professionals (Bevers, 1997), and so it potentially raises less resistance.
In a number of HBO institutions, an internal quality management system was set up, based on the EFQM model, developed by the European Foundation for Quality Management (EFQM, 1991; see also Nuland, 1999). Based on this model, a Dutch organization on quality management, INK, designed a so-called 'five-stage model', also known as the INK management model (INK, 2000; the ordinal five-stage scale will be described below). Both were developed primarily for industry and other commercial companies. Besides, the INK management model had been redesigned for several non-profit sectors, e.g. municipalities and hospitals.
In 1995 an expert group on quality management within HBO was formed, which developed an INK-based model that specifically aimed at higher education (Van Kemenade et al, 1995, 2004; see Van Schaik et al, 1998). In higher education, the model became well-known under the name of the 'EFQM model'; in order to distinguish it clearly from the general EFQM model (figure 29), below it will be referred to as the 'EFQM-HE model'. The model has been translated into English and four other languages. In cooperation between Dutch and Flemish Universities of Applied Sciences, a version was designed called the TRIS model (TRIS,1999), which is in use in Belgian universities. A recent overview of the situation around the EFQM-HE model is to be found in Van Kemenade & van Schaik (2006).

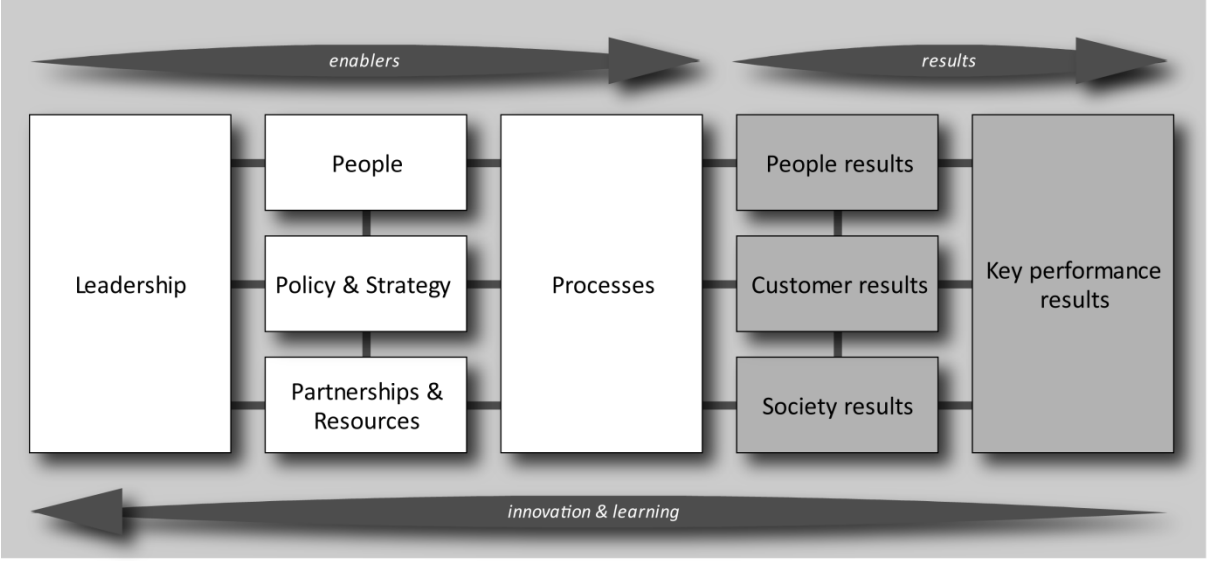


Figure 29. The EFQM model focuses on 9 fields

Not only the management and the staff, but also the students can have an important role in the internal quality management (Willems et al, 1992), as they are more or less a combination of the customers of a university and members of the university team, as they operate within the university for several years. The EFQM-HE model makes an intensive use of this principle, as during the assessment the management, the teaching and non-teaching staff, and the students participate on an equal level. For this and other reasons, the EFQM-HE model was very suitable to be used as the starting point for the development of an assessment instrument for ESD.
Before this is described, first some other important input for this instrument will be described.

7.1.2. ESD organizations, declarations and charters

The present European University Association (EUA) was formed in 2001 as a merger between two European organizations. One of them was CRE, the Association of European Universities. It was back in 1988 that CRE took two important initiatives strengthening the ESD process. One was the launch of an official declaration, the Magna Charta of European Universities. In this charter, it was stated (CRE, 1988):

1. "that at the approaching end of this millennium the future of mankind depends largely on cultural, scientific, and technical development; and that this is built up in centers of culture, knowledge, and research as represented by true universities;
2. that the universities' task of spreading knowledge among the younger generations implies that, in today's world, they must also serve society as a whole; and that the cultural, social, and economic future of society requires, in particular, a considerable investment in continuing education;
3. that universities must give future generations education and training that will teach them, and through them, others, to respect the great harmonies of their natural environment and of life itself."

Although this does not literally mention the term "sustainable", the charter breathes an attitude that is strongly associated with it.
The second initiative of CRE in 1988 was the formation of a new institute called 'CRE Copernicus'. The acronym 'Copernicus' stands for 'COoperation Programme in Europe for Research on Nature and Industry through Coordinated University Studies'. CRE Copernicus "represented an effort to mobilize the resources of universities and academia around the theme of sustainability and to support higher education institutions in the implementation of issues on sustainable development" (Winkelmann, 2002).
CRE Copernicus, later renamed as Copernicus Campus (after it became independent of CRE), was perhaps the first international network organization for sustainable development in higher education – if you don't count earlier organizations that were dedicated to only some aspects of sustainable development, e.g. environmental management or nature conservation.
The Copernicus network would not remain the only such organization, as table 22 illustrates. Over the years, many (sub)national and international networks on ESD were founded: no doubt table 22 is far from complete.

Table 22. Organizations and networks on ESD				
Full name	**Short name**	**Region, scope**	**Origin**	**Website**
Copernicus Campus [1)]		Europe	1988	www.copernicus-campus.org
Baltic University Programme	BUP	14 countries in the Baltic Sea region	1991	www.balticuniv.uu.se
Association of University Leaders for a Sustainable Future [2)]	ULSF	North America	1992	www.ulsf.org
Higher Education 21 [3)]	HE21	United Kingdom	1996	www.forumforthefuture.org
Environmental Association for Universities and Colleges	EAUC	United Kingdom	1996	www.eauc.org.uk
Duurzaam Hoger Onderwijs	DHO	Netherlands	1998	www.dho.nl
Sustainable Universities Initiative	SUI	South Carolina	1998	www.sc.edu/sustainableu
Global Higher Education for Sustainability Partnership	GHESP	Global	2000	www.unesco.org/iau/sd/sd_ghesp.html
Higher Education Partnership for Sustainability	HEPS	United Kingdom	2001	
Education for Sustainability Western Network [4)]	EFS West	Western USA and Canada	2001	
Ubuntu Alliance		Global	2002	
Högre Utbildning för Hållbar Utveckling	HU2	Sweden	2006	www.hu2.se
Association for the Advancement of Sustainability in Higher Education	AASHE	North America	2006	www.aashe.org
Xarxa de Recerca en Educació per la Sostenibilitat	Edusost	Catalonia	2006	www.edusost.cat
Duurzaam Hoger Onderwijs Vlaanderen	DHO Vlaanderen	Flanders	2008	www.dhovlaanderen.be

1) Originally called “CRE Copernicus”
2) Originally called “Secretariat of University Presidents for a Sustainable Future”
3) HE21 was a program by the Forum for the Future, out of which HEPS resulted in 2001
4) Expanded to become AASHE, 2006

The Dutch organization DHO will play an important role in this dissertation, and it will be described in the next section. Information about HEPS is to be found in Buckland et al (2002); ULSF: Calder & Clugston (2002).

A special case is GHESP, which is a network of networks: its members are Copernicus Campus, ULSF, UNESCO and the IAU (see: van Dam-Mieras et al (eds.), 2002, p. 249). It has the ambition to be a global network, and to strengthen this it has set up the GHESP Toolbox, containing a lot of examples, case studies and instruments for ESD. The assessment instrument AISHE, which is the main subject of this chapter, is adopted in this Toolbox.
Another, even larger, network of networks is the Ubuntu Alliance, which was formed in 2002, during the WSSD. Originally it consisted of GHESP and its members (Copernicus-Campus, UNESCO, ULSF, IAU), as well as the United Nations University (UNU), the African Academy of Science, the International Council for Science, the Science Council of Asia, the Third World Academy of Sciences, and the World Federation of Engineering Organizations. In 2006, IUCN and UNEP were invited to join the Ubuntu Alliance.

Declarations and charters
Quite a lot of ESD network organizations took the effort of designing a declaration or a charter on ESD. A number of these and other declarations and charters dedicated to or strongly influencing ESD, have been written and endorsed over the years, as table 23 shows.

Table 23. Declarations and charters, significant for ESD

Year	Declaration	Region, scope	Origin
1972	Stockholm Declaration	International	UNEP
1975	Belgrade Charter	Environmental Education	UNESCO
1977	Tbilisi Declaration	Environmental Education	UNESCO & UNEP
1988	Magna Charta of European Universities	European Higher Education	CRE
1990	Talloires Declaration	International	University Presidents Conference, Talloires, France
1991	Halifax Declaration	Canada	Halifax Conference on University Action for Sustainable Development
1992	Agenda 21	Formal and non-formal education	UNCED
1993	Kyoto Declaration	International	IAU
1993	Swansea Declaration	International	Association of Commonwealth Universities
1994	Copernicus Charter	Europe	CRE
1995	Student Declaration for a Sustainable Future	United Kingdom	Community Environmental Educational Development
1997	Declaration of Thessaloniki	International	UNESCO
1998	World Declaration on Higher Education for the Twenty-first Century	International	World Conference on Higher Education
1999	Handvest HBO	Netherlands: Universities for Applied Sciences (HBO)	DHO
2001	Lüneburg Declaration	International	GHESP
2002	Ubuntu Declaration	WSSD	Ubuntu Alliance
2004	Barcelona Declaration	Engineering Education	EESD
2005	Graz Declaration	Ministers of Education in the European Higher Education Area	Conference “Committing Universities to Sustainable Development”, Graz
2008	Gothenburg Recommendations	International	Swedish International Centre of Education for Sustainable Development (SWEDESD)
2009	Bonn Declaration	International	UNESCO World Conference on Education for Sustainable Development

The earlier declarations and charters focus on environmental management. The Stockholm Declaration is not specifically oriented towards education but treats it in one of its sections. The Belgrade Charter and the Tbilisi Declaration do focus on education, but are concerned only with environmental sustainability. The Magna Charta of European Universities did not mention sustainable development explicitly, as was described above, but it does breathe the spirit of SD. Agenda 21 may not be a declaration or a charter on ESD in a literal way, but it describes a range of possible contributions of universities to sustainable development (see chapter 1).

It was the Talloires Declaration that first focused on higher education and on ESD in its full meaning. In the declarations that followed, an evolution can be seen, going from basic principles to a call for, and a description of concrete activities (Wright, 2004). The Halifax Declaration was the first to offer an Action Plan. The Swansea Declaration added a new element, in emphasizing the importance of cooperation between universities in the rich countries with those in less developed countries. In order to illustrate what these declarations and charters may look like, box 11 shows a part of one of them, the Kyoto Declaration.

The Copernicus Charter was an effort by CRE to further the efforts of the Magna Charta. Both the Talloires Declaration and the Copernicus Charter were endorsed by over 300 universities, and so gained a considerable influence.

In the Dutch research universities, the Copernicus Charter received much attention: nearly all of them signed the Charter. Since the Dutch HBO institutions were not entitled to sign this charter, they developed their own charter, called “HBO Handvest”, the content of which was influenced by the Copernicus Charter. The HBO Handvest will be discussed in more detail in the next section, as it played an important role in the development of AISHE.

The Lüneburg Declaration was the result of an ESD conference in Lüneburg (Germany) in 2001 (Dam-Mieras et al (eds.), 2002). It was designed specifically to be presented at, and influence the WSSD in Johannesburg, 2002. Later, the Gothenburg Recommendations were designed with a comparable goal, aiming at the UNESCO World Conference on Education for Sustainable Development, Bonn 2009 (SWEDESD et al, 2008).

Box 11. A part of the Kyoto Declaration

"It is recommended that each university, in its own action plan, strives to:

1. Make an institutional commitment to the principle and practice of sustainable development within the academic milieu and to communicate that commitment to its students, its employees and to the public at large;
2. Promote sustainable consumption practices in its own operations;
3. Develop the capacities of its academic staff to teach environmental literacy;
4. Encourage among both staff and students an environmental perspective, whatever the field of study;
5. Utilise the intellectual resources of the university to build strong environmental education programs;
6. Encourage interdisciplinary and collaborative research programs related to sustainable development as part of the institution's central mission and to overcome traditional barriers between discipline's and departments;
7. Emphasize the ethical obligations of the immediate university community - current students, faculty and staff - to understand and defeat the forces that lead to environmental degradation, North-South disparities, and the inter-generational inequities; to work at ways that will help its academic community, and the graduates, friends and governments that support it, to accept these ethical obligations;
8. Promote interdisciplinary networks of environmental experts at the local, national and international level in order to disseminate knowledge and to collaborate on common environmental projects in both research and education;
9. Promote the mobility of staff and students as essential to the free trade of knowledge;
10. Forge partnerships with other sectors of society in transferring innovative and appropriate technologies that can benefit and enhance sustainable development practices."

Source: Kyoto Declaration (1993)

Several of the declarations and charters recommend that ESD should be a core element of the university activities, i.e. be a part of the identity of it. An example is the World Declaration on Higher Education for the Twenty-first Century: Vision and Action (UNESCO, 1998) which states:

> "Each higher education institution should define its mission according to the present and future needs of society and base it on an awareness of the fact that higher education is essential for any country or region to reach the necessary level of sustainable and environmentally sound economic and social development, cultural creativity nourished by better knowledge and understanding of the cultural heritage, higher living standards, and internal and international harmony and peace, based on human rights, democracy, tolerance and mutual respect."

Inspiring examples of how this can be formulated in official mission documents of universities are shown in box 12. Mission statements like these, as well as the cited text of the World Declaration on Higher Education for the Twenty-first Century, clearly express the idea of system integration of sustainable development, which is a major subject of the present chapter. In the Netherlands, the importance of SISD was emphasized by DHO. The HBO Handvest was an attempt to stimulate it, and this charter resulted in the development of AISHE.

7.1.3. DHO and the HBO Charter for sustainable development

The development of DHO

In 1993, nearly all Dutch research universities signed the Copernicus Charter. Two years later, an investigation into the results of this endorsement was made by a student organization called LHUMP ('Landelijk Hogeschool- en Universitair Milieu Platform', or 'National Higher Education Environmental Platform'). It appeared that several universities had already forgotten that they had ever signed, while others had done hardly anything (Van Mansvelt, 2002). In some universities, activities on the implementation had started, based mainly on individual initiatives. In part urged by the students, several universities set up a more serious attempt to deal with sustainable development, e.g. Utrecht University, Nijmegen University and Delft Polytechnic University.

In the same period, SD activities were initiated in some of the HBO institutions, e.g. Hogeschool IJselland and Hogeschool Midden-Brabant (as described in former chapters). The HBO institutions however were not admitted to sign the Copernicus Charter, as they were not members of CRE.

In 1998, a proposal was launched by the students of LHUMP and by staff members of universities to organize a national conference on ESD. This conference took place in December 1998. During this event, the decision was made to organize a more structured follow-up, consisting of a number of projects. In order to coordinate these projects, a Steering Committee was formed called the Commission on Sustainable Higher Education (CDHO). Members of the CDHO were staff members and board members of universities (both research universities and HBO institutions),

students, and staff members of several Ministries, e.g. the Ministry of Education, the Ministry of Agriculture and the Ministry of Environment.

Box 12. SD mission of some universities

Mission Statement of Aichi University of Education, Japan (abbreviated):
"Recalling the principles of the UNESCO World Declaration on Higher Education for the Twenty-First Century, the university declares that its universal mission is to contribute to world peace, human welfare, and the advancement of arts, culture and sciences. Aichi University of Education seeks to prepare its students to contribute to international peace and prosperity.
The university seeks to train qualified teachers who will educate children for the advancement of a peaceful future society. Through its arts and sciences programs, the university offers comprehensive as well as specialized learning and training opportunities, in preparation for diverse lives committed to the prosperity of society and the preservation and creation of cultural heritage.
Aichi University of Education ensures academic freedom with confidence that research in sciences, arts and humanities created out of free will contributes to world peace and the sustainable development and improvement of society.
Aichi University of Education strives to be fully responsible and accountable to society through public information and public relations, and by constantly responding to the voices of communities, nations and global society. In co-operation with educational and wider communities, by serving the needs of society by providing relevant expertise, it contributes to the progress of society.
Every member of Aichi University of Education respects the fundamental human rights and the equality of the sexes, and is committed to the proscription of any form of human rights abuse such as discrimination and oppression."

Source: www.aichi-edu.ac.jp/eng/mission_e.html, 2009

University of Gloucestershire, UK: vision on sustainable development:
"We have an institutional commitment to Sustainability and work to embed sustainability across our courses, plans and activities. It's not just about challenging unsustainable practice, but about changing ways of thinking and mindsets, creating promising futures for all through education.
We recognise that our sustainability efforts depend on staff and student engagement. We provide opportunities to become involved in hands-on projects, as well as, to engage in dialogue and learning with external stakeholders.
Our research agenda is increasingly focused on building interdisciplinary and socially relevant research in the area of sustainability. Through our partnership approach we seek to make real and relevant changes in our region and beyond.
We seek to practice what we preach and continue our quest to mirror our commitment across the campuses."

Source: www.glos.ac.uk/vision/sustainability/Pages/default.aspx, 2009

One of the projects was dedicated to the development of a series of so-called 'disciplinary reviews' ('vakreviews'). In these booklets, each related to its own discipline (e.g. mechanical engineering, management, law), the relations between this discipline and sustainable development are explored, and suggestions are offered to integrate sustainable development into the curricula. The first disciplinary reviews were published in 2001. By 2009, more than 20 of them have been made available.
A second project focused on interdisciplinary education. In this project, pilot projects were set up which, to a certain extent, were comparable with the interdisciplinary pilot projects that were organized at about the same time in the Cirrus Project (see chapter 6), offering students the opportunity to work in an interdisciplinary team on real-life problems and tasks.
A third project started to develop a set of criteria for sustainable development in study programs in higher education. This appeared to correlate strongly with one of the targets of the Cirrus Project: the development, not only of such a set of criteria, but also of a tool to assess them. So, Cirrus and the CDHO agreed to cooperate. Consequently, in the year 2000 the development of AISHE started, and the result was published at the end of 2001, as will be described in more detail below.
Besides these projects, a permanent network was set up, including people who, for whatever reason, had an interest or could contribute to the development of ESD in the Netherlands. Soon after the start, this network consisted of about 100 people. The first Dutch ESD conference (December 1998) was repeated one year later, and it became an event that took place annually. Thus, DHO was born.

In its first years, DHO was an informal network without any legal personality. In a few years' time however, the organization became more and more successful. The network attracted a lot of new members. More disciplinary reviews were published, interdisciplinary projects were realized, a group on North-South cooperation was set up which organized international student exchanges. AISHE was published and applied. And so, in 2002 it was concluded that it was necessary to reshape DHO as a legal foundation, the Foundation for Sustainable Higher Education (Stichting Duurzaam Hoger Onderwijs), still abbreviated with the letters DHO. The foundation board consisted of members of university boards: three from research universities, and three from HBO institutions.

The HBO Charter

As DHO took its first shape, another initiative was set up simultaneously, in a cooperation between LHUMP and the (Rijks)Hogeschool IJselland (after a merger, part of Saxion Hogeschool). As the HBO institutions were not admitted to sign the Copernicus Charter, the idea was born to design a new charter, this time especially aiming at the Dutch HBO. At the end of 1999, the 'HBO Handvest' (the 'Charter for Universities of Applied Sciences in the Netherlands') was signed by three ministers, the vice-chair of the HBO Council, and representatives of 29 Universities of Applied Sciences. Board members of those universities together formed a Steering Group.

The designers of the Handvest had learned from the experiences of the Copernicus Charter, especially its non-obligatory character. Therefore, to the Handvest was attached a 'Protocol', describing a number of concrete, assessable activities and results that were to be realized by the signing universities. The Protocol was to be renewed every two years, each time demanding higher achievements, in order to stimulate a process of continuous improvement. (The texts of the Handvest and of the first Protocol are reprinted in Appendix 4.)

An external expertise organization, SME Environmental Consultants, was given the task of periodically assessing whether the signing universities were able to meet the demands of the Protocol. Universities which were able to prove that they did received a special Certificate.

The Certificate of Sustainability in Higher Education

In this way, the Certificate of Sustainability in Higher Education was created. In the first years, the Certificate was based on the assessment by SME, and there was no formal relation yet with DHO. The SME method appeared to have some disadvantages. One was that the assessment was based on a set of questionnaires that were filled in by one representative of the assessed university, which made it easy to 'polish' the results. Besides, the assessment method had not known a validation process.

Another disadvantage appeared after some years. Universities that had signed the Handvest right at the start in 1999 and had kept up their continuous improvement in line with the increasing demands of the consecutive Protocols, were able to keep their Certificate. But other universities, that decided to join in a later stage or did not walk in pace with the protocols, had a difficulty in realizing the high demands of a later Protocol. Here, instead of a stimulant, the Protocols became the opposite.

When DHO was reformed into a foundation with a legal identity in 2002, the Steering Group of the HBO Handvest agreed to bring the Handvest under the flag of DHO, and so the two Dutch ESD tracks came together.

As AISHE was completed, validated and published in the meantime, soon after the merger between DHO and the Handvest the decision was made to replace the SME assessment with AISHE as the tool for the assessment of ESD and the awarding of the Certificate of Sustainability in Higher Education. The system of the Protocols with their periodically increasing demands was abandoned.

Figure 30. The Disciplinary review of Fashion (2006)

DHO after 2002

The history of DHO can be described using the Bridges model of organizational change, together with the colors model of De Caluwé and Vermaak. This is relevant, because it explains a lot about the application of AISHE after its development, which will be described in the next sections.

Evidently, for DHO phase 1, the *dream*, was the idea of a small number of students and university staff members to set up a nation-wide network stimulating ESD. Their dream became reality when the network was set up in 1998, and so DHO entered phase 2, the *venture*. DHO was highly extraverted in its first years, as is essential in this phase. DHO consisted of a small core team of about six people: the exact team size cannot be given, as some people were more strongly involved than others, and no-one had a labor contract: it was all volunteers' work. Around these team members, scores of people from many universities – staff as well as students – and from expertise centers cooperated in working groups that worked on the various projects. As the entire network was informal, all participants decided individually what their personal efforts would be.

Creativity, idealism and personal energy were the characteristics of the young DHO. It was a typical *whiteprint* organization, although the word 'organization' was perhaps not the proper word.
After a couple of years, the Criteria working group had published AISHE, and was in fact ready: the working group was dissolved. The Disciplinary working group had produced a series of disciplinary reviews. It was planning more of them, and it seemed that they could go on indefinitely. However, there was no clear image whether anyone in the outside world really used the booklets. The developments of both working groups were signs that the extrovertedness of DHO was shrinking. As more disciplinary reviews were planned and created (see figure 30), it seemed a little bit as if DHO had suddenly entered phase 5, *becoming an institution*: the DHO team 'knew' what the universities needed without really asking them.
When DHO turned into an official foundation, it entered, in terms of the Bridges model, phase 3, *getting organized*. DHO became even more introverted for a while, focusing on the internal organization. A management of two persons was formed. The members of the core team received a labor contract or a secondment contract. However, DHO implemented phase 3 only partially. It took several years before a secretary and a communications officer were appointed. Decisions kept being made by all team members in a diffuse process. The *whiteprint* culture remained at full strength, which blocked a genuine completion of phase 3. Due to this, typical phase 3 processes of getting organized would return over and over again in later years, disturbing a genuine development into phase 4, 'making it'.
In 2003, a fundamental discussion took place about the identity, strategy and mission of DHO. The discussion was about the question whether DHO should be primarily a network organization, linking universities with expert organizations, or rather also an expert organization by itself, coaching and training the universities as consultants. The discussion was vital, as the budget of DHO consisted almost entirely of subsidies from Dutch Ministries, and it was clear that these subsidies would not go on forever. A role as a consultancy would enable DHO to perform paid services to the universities. However, some DHO staff members objected against seeing the universities as 'customers', as they felt this term was not suitable to be combined with the concept of sustainable development and its idealistic connotations. Consequently, no real marketing policy was developed, and no customer contracts or standardized procedures were designed.
The 2003 discussion about the identity of DHO was repeated in 2005, and again in 2008-2009. In 2005, the decision was made to set up a strong consultancy policy, based on an account management. As a consequence, DHO became more extroverted again. Most of the staff members, who were to manage their own accounts consisting of a number of universities, received a training in account management and acquisition.
This policy was not unsuccessful, as in the following years the number of consultancy projects increased sharply. The name of DHO became well-known in universities, expert centers and ministries: DHO became a "brand". The DHO team increased to about sixteen people (ca. 9 FTE). So, DHO more or less entered phase 4, *making it.* The financial results however were disappointing, as the tariffs of workshops and audits were kept low, because it was estimated that higher prices would not be paid by the universities. At the same time, a part of the DHO staff still had trouble with the consultancy role of DHO. It is exemplary that several of them, including the marketing officer, still spoke of the "Network DHO" instead of the "Foundation DHO". After a lot of discussions, the marketing policy was finally completed in 2007 with the design and print of a catalogue of services and products (figure 31). But the consultancy role was never really internalized, and – in terms of the Sterling model of the level of organizational change – actually the consultancy role was 'bolted-on' to DHO (level 1) instead of becoming a part of its identity (level 3).

Figure 31. The DHO Catalogue of services and products (2007)

In 2008-2009, the identity discussion was on the agenda for the third time. This time, the decision was made to abandon the consultancy role and to go on as a network organization. This was to have consequences for the application and management of AISHE and the Certificate of Sustainability in Higher Education.
Nevertheless the consultancy, including the application of AISHE, contributed to the integration of ESD for a number of years, as the next section will describe.

7.2. Action: The quality approach: Development and application of AISHE (2000 – 2009)

7.2.1. Development, structure and validation

Fundamentals

The development of AISHE started with a definition phase. Many literature sources were studied by the members of the DHO working group. Existing models for quality management and for environmental management were compared, like the ISO 9000 and 14000 series, EFQM, BS 7750, EMAS. Literature about sustainable development and ESD was used, e.g. the various declarations and charters that have been described above.

Based on these sources and on a series of discussions within the working group and with experts on sustainable development, a number of decisions were made. The first decision was related to the four roles a university can fulfill towards sustainable development: see §3.4. It was decided to put the focus of the assessment instrument on the educational role, because it was estimated that the universities' contribution in this role has the greatest potential contribution to sustainable development in society, because of the 'snowball effect' that was described in §3.4.

Secondly, it was decided that the instrument that was to be developed should be highly comparable with existing instruments for quality management or environmental management that were already in use in higher education. This was an important condition, since it would make it easier to further the integration process of ESD: it would make the new tool more familiar looking and more acceptable to universities.

Three other fundamental decisions had to be made. The following is a (long) citation from the AISHE book that was published at the end of the development process (Roorda, 2001b). The cited sources are: British Standards Institute (1992), EMAS (1993), ISO (1994) and (1996), HE21 (1999) and Expertgroep HBO (1999):

Decision 1: Content oriented versus process oriented criteria

"Content oriented criteria are about the concrete selection of subjects that should or should not be part of certain curricula, from a sustainable perspective, and about guidelines for the organization management.

Process oriented criteria give information about the way in which the curricula are to be designed, and about the way in which decisions are made concerning the organization management. These are criteria on a meta level. Examples:

Decision 1	Content oriented	Process oriented
Curriculum	Photovoltaic cells are a part of the curriculum.	Decisions about sustainable subjects in the curriculum are made explicit.
Vision	The use of hen batteries is not compatible with sustainable development.	The organization has a vision on ethical questions that are relevant for the own professional fields. This vision is updated regularly.
Staff development	Engineering teachers receive supplementary schooling in environment oriented product development.	There is a policy and a budget for staff development in sustainable development.

Considerations

The advantage of content oriented criteria is, they offer clarity: clarity about the product that is to be delivered (the educational content) and about the process (e.g. curriculum development, staff development).

At the same time, this clarity is a disadvantage, for various reasons:

- They are absolute: they don't leave space for the own responsibility of an individual education institute (or a part of it);
- Fundamentally, they are not generally acceptable: they mirror the subjective opinion of the designer of the criterion, and so they carry the risk that others don't agree with them. If so, at best a never-ending yes-no-discussion could rise;
- They are time related and static: they have a risk of getting obsolete because of new developments. When for instance a new technical invention would be made which would make photovoltaic cells technically obsolete, at the same time the criterion would be obsolete.

  Although process oriented criteria carry the risk of vagueness, this doesn't really have to be a serious disadvantage. For instance, the above mentioned criterion about a vision on ethics entails that educational organizations in which animal welfare is a relevant subject, will not be allowed to deny taking position about hen batteries.

Decision

Actually, the point about adopting process-oriented criteria is that, if the processes are formulated carefully and are executed carefully as well, it may be expected that the resulting contents will be ok too.

On the basis of this point, in the AISHE method the process-oriented principle has been chosen."

Decision 2: Quantitative versus qualitative criteria

"Criteria can be formulated as quantitative measuring data, or in a less precise, more describing, qualitative way. In the British "Higher Education 21" programme ("HE21") a large amount of quantitative indicators has been designed. Some examples are shown in the table below, in the column "quantitative".

Decision 2	Quantitative	Qualitative
Curriculum	Percentage of students participating in modules that are related to sustainability	The relation between sustainability aspects in the professional qualifications and the curriculum has been formulated explicitly.
External effect	Number of sustainability related conferences, organized in the current year	The organization contributes actively to enlargement of knowledge and insight about sustainable development in society and to the public opinion.
Internal environmental management	CO_2 emission per FTE per annum	Annually an environmental report is published.

Considerations
Using quantitative criteria can only be meaningful, if the indicated quantities can be defined and measured in an exact way, and if there is an objective method to agree upon limits for them.
This is a problematic point of all above-mentioned quantitative examples.

- The mentioned percentage of students, for example, can only be measured if it is possible to determine for each module if it is related to sustainability. But, how can this be determined? According to some people, nuclear energy is essential for a sustainable system of energy, while others combat this opinion; does a module on nuclear energy count for the above percentage?
- How does one determine whether a certain conference is sustainability related? Is, let's say, a conference on waste processing sustainability related?
- For which kinds of CO_2 emission will the educational institute be held accountable, and which will not? And: how exactly will the measurements be done to establish the numbers?

On top of all this, for all the above examples the decision of choosing a limit value is subjective and normative, and so each measured quantity will always be questionable. In other words, the disadvantage of quantitative criteria is that they suggest a fictitious level of exactness that in real cannot be made true.

The "right" percentage of credits
A characteristic example of this fictitious exactness is the - in some places ongoing - discussion about the "right" percentage of the curriculum that should be dedicated to sustainable development (expressed in a percentage of the credit points). According to some this should be 5%; others claim the optimal value should be higher or lower. In fact every concrete percentage is fundamentally wrong. In the first place because of the fictitiousness of the exactness: does a module handling, say, environmental law, fall within this percentage of sustainable curriculum parts? And what about the earlier mentioned module on nuclear energy?
In the second place, quite a lot of modules have nothing or hardly anything to do with sustainability when viewed on their own, but are very relevant for sustainability when viewed in a larger framework. A characteristic example is a module in a mechanical engineering course dealing with connection technologies (gluing, screwing, welding, clamping, etc.): on their own these techniques are not clearly more or less sustainable. But when a product consisting of several components is to be designed, subjects appear like design for disassembly, reuse and recycling, which are very relevant for sustainability; and a thorough knowledge of connection technologies contributes to a good designing process. Such a module doesn't belong in a direct sense to the percentage of sustainable curriculum parts, but it certainly does in an indirect way.

Decision
Many aspects of the level to which sustainability has been integrated in education and in the organization have fundamentally no exact nature. This does *not* imply that they cannot be measured; but usually they have to be expressed on an ordinal scale, instead of a quantitative interval or ratio scale.
Therefore, with respect to the AISHE method a qualitative approach has been adopted; and the results are expressed on ordinal scales."

Decision 3: Prescriptive versus descriptive criteria

"Criteria can be designed as obligatory prescriptions, as is usual with many of the customary instruments for quality and environmental management. In the table below in the left column a number of examples are shown, derived from ISO 14001, EMAS and BS7750. The alternative is a descriptive character. This may take the form of an ascending progression of descriptions, together constituting an ordinal scale; an organization can compare itself with this scale and determine which organization development stage it is in. A good example of this is the

EFQM-INK method: for a series of criteria five "stages" are discerned. The table below shows some examples in the right column, taken from the HE version of the EFQM model (Expertgroep HBO, 1999).

Decision 3	Prescriptive	Descriptive
Staff development	The organization shall (…) require that all personnel whose work may create a significant impact upon the environment, have received appropriate training. *(ISO 14001: 4.4.2)*	Stage 1: Staff counseling, training and development are dependent on individual initiatives. *(EFQM-HE: 3.5)*
Policy	The company environmental policy shall be adopted and periodically reviewed. *(EMAS: appendix 1, A.2)*	Stage 3: The policy is evaluated on the basis of a systematic analysis (...). *(EFQM-HE: 2.4)*
Communication	The organization shall establish and maintain procedures for receiving (…) communications (internal and external) from relevant interested parties. *(BS7750: 4.4.1)*	Stage 4: Interested parties are actively involved in discussions about policy development and implementation. *(EFQM-HE: 2.3)*

Considerations

The use of prescriptive criteria has several disadvantages.

A main problem is that the prescription of criteria is *normative*. True enough, the actual designing of sustainable education is fundamentally normative, because the goals and the contents are strongly related with the personal view of those who are responsible for the ideal future society and for their ethical norms. But exactly because of this, it is impossible to construct a measuring instrument based on normative prescriptions and then receive a general acceptation.

Besides, imposing external obligatory criteria would contradict one of the most important cornerstones of sustainable development: the own individual responsibility of each person and institution involved in the process of sustainable development.

Another problem with forceful prescription is of a more practical nature. Prescribing criteria offer exactly two possible states: *either* the organization satisfies the requirements, *or* it does not. Such an on-off criterion makes it impossible to describe a situation in some details. So, such a measuring instrument is not very discerning. It will not offer much insight in the situation in an organization, and it won't offer many starting points for choosing priorities with respect to the policy.

A final argument is that it isn't always evident that an educational organization will have to strive for the highest quality demands in all respects: the maximum isn't always the optimum. An organization may decide deliberately to aim at another stage for certain aspects, on the basis of internal or external reasons. If a measuring instrument would be based on on-off prescriptions, an organization doing so would automatically disqualify itself.

Decision

Criteria for sustainable education should place the responsibility for choosing limits with those who take care of designing and implementing education, i.e. with individual organizations (universities or parts of universities).

Besides, criteria should be practically applicable and contribute to the organization policy.

For these reasons AISHE is decided to consist of descriptive criteria, enabling the formulation of auditing results in more than two possible values."

Regarding these three fundamental decisions, there was an excellent candidate to use as a starting point for the development of the assessment instrument: EFQM-HE, the higher education version of the EFQM model (Expertgroep HBO, 1999), and so it was decided to base AISHE on this model. All in all, the background of the new instrument is shown in figure 32. As a name for the instrument, 'Auditing Instrument for Sustainability In Higher Education was chosen, or in short: AISHE. After some years of applying AISHE it became clear that the term 'audit' raises some resistance in some universities, and so it was later decided to use the term 'assessment' instead, which has the same initial. This is why in older reports, e.g. in chapter 6 of this dissertation, the term 'audit' is used, and elsewhere 'assessment'.

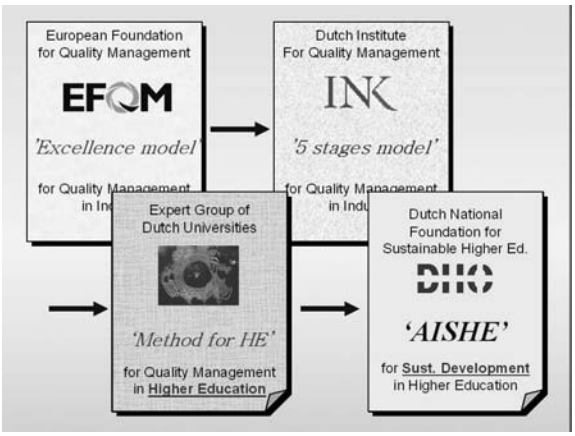


Figure 32. From EFQM to AISHE

The five stages model

Following the INK management model, the EFQM-HE version makes use of an ordinal scale of five stages. AISHE uses the same stages. A general description of these five stages is shown in table 24.

Table 24. General description of the five stages of AISHE

***Stage* 1: Activity oriented**	***Stage* 2: Process oriented**	***Stage* 3: System oriented**	***Stage* 4: Chain oriented**	***Stage* 5: Society oriented**
- Educational goals are subject oriented. - The processes are based on actions of individual members of the staff. Decisions are usually made ad hoc.	- Educational goals are related to the educational process as a whole. - Decisions are made by groups of professionals.	- The goals are student oriented instead of teacher oriented. - There is an organization policy related to (middle)long-term goals. - Goals are formulated explicitly, are measured and evaluated. There is feedback from the results.	- The educational process is seen as part of a chain. - There is a network of contacts with secondary education and with the companies in which the graduates will find their jobs. - The curriculum is based on formulated qualifications of professionals.	- There is a long-term strategy. The policy is aiming at constant improvement. - Contacts are maintained, not only with direct customers but also with other stakeholders. - The organization fulfils a prominent role in society.

The range from stage 1 to stage 5 actually represents several dimensions. For the AISHE model, these dimensions may be characterized as follows (indicating only the extremes of stage 1 and stage 5):

Dimension: goes from ….. - ….. till:

- ***Concerns:*** individual … - … society
- ***Scale:*** organization itself … - … outside world
- ***Policy:*** ad hoc decisions … - … strategic, pro-active
- ***Time perspective:*** this year … - … long term
- ***Quality:*** incidental evaluation … - … systematic evaluation by all stakeholders
- ***Result assessment:*** once at most … - … comparison with the best

A more thorough overview is shown in table 25. Graphically, the five stages may be depicted as in figure 33.

Table 25. Dimensions of the five stages

Dimension	***Stage* 1: Activity oriented**	***Stage* 2: Process oriented**	***Stage* 3: System oriented**	***Stage* 4: Chain oriented**	***Stage* 5: Society oriented**
Concerns	Individual staff member	Team, study program, research institute	Whole organization	Chain: Secondary education – university – direct stakeholders (e.g. professional field)	All of society
Scale	Organizational identity	Organizational staff and processes	Organizational staff & students	Organization and its direct stakeholders	Organization and the entire world
Ambition	Good according to own opinion	Good according to the management	Good according to the organization	Good according to the customers	Excellent in comparison with colleague institutions
Policy	Ad hoc decisions	Operational policy	Tactical, passive policy	Strategic, active policy	Strategic, pro-active policy
Time perspective	Now (= e.g. this semester)	Short term (1 to 2 years)	Middle long term (up till 5 years)	Long term (up till 10 years or more)	Long term (up till 10 years or more)
Quality	Incidental evaluations	Beginning of quality management	Systematic evaluations plus feedback: Policy circle	Evaluation involvement of customers (students, professional field, other direct stakeholders)	Evaluation involvement of all external stakeholders
Result assessment	Performed maximally once	Performed several times, trends are known	Result comparison with targets posed	Result comparison with colleague organizations: *Benchmarking*	Result comparison primarily with excellent colleague organizations

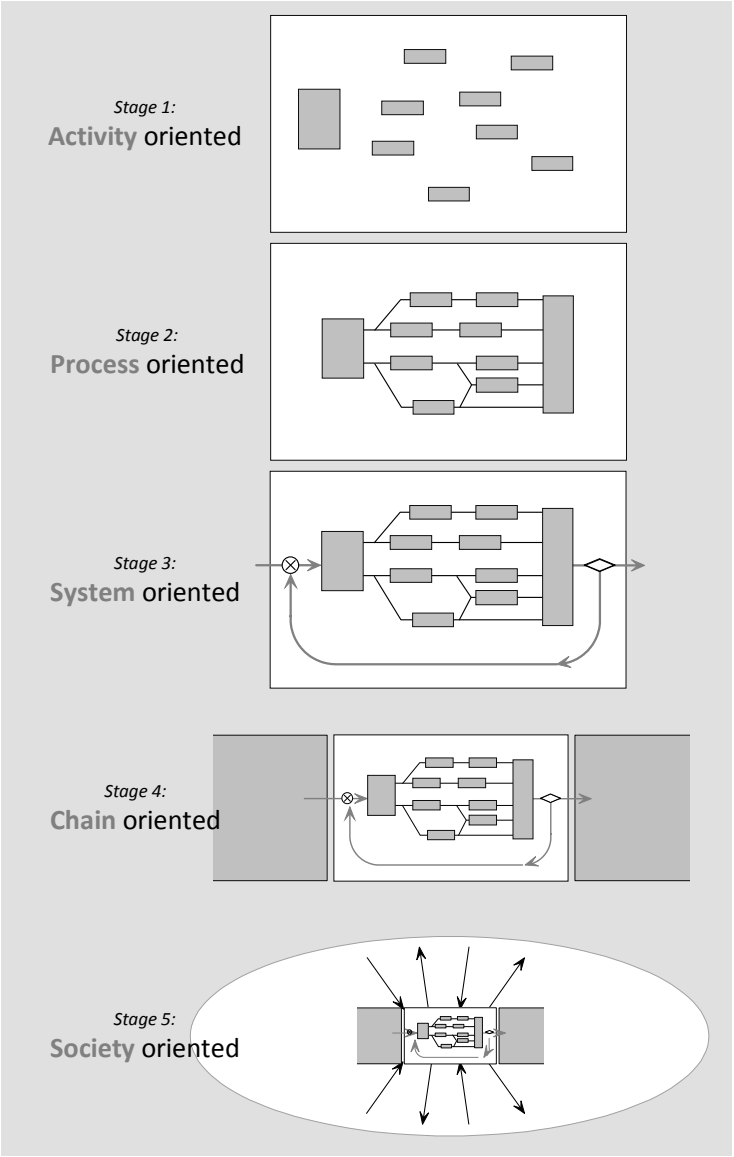


Figure 33. The five stages of AISHE

Compared with the INK- and the EFQM-HE model, one aspect of the five stages was changed: the name of stage five. In the INK- and EFQM-model this stage is called 'Total quality management'. In Expertgroep HBO (1999), this stage is explained as follows: "Typical for an educational organization in this stage is that the organization also takes into account other than its immediate customers. (…) It recognizes its role in society." As, from a viewpoint of sustainable development, this societal role is seen as pivotal, a new name was chosen for stage 5 of AISHE, 'society oriented'. The name change does not imply any kind of change of meaning of this stage.

The Stakeholder Forum

Besides a structured ordinal scale, the assessment instrument also needed a well-defined set of criteria that would describe the characteristics of ESD. It was vital to design this set in such a way that it could be generally accepted. In order to achieve this, a group of experts from higher education, sustainability science and elsewhere had to be formed that would be able to perform a peer review.

For this goal, first a stakeholder analysis was made. Based on this, a 'Stakeholder Forum' was formed of experts, who commented on the development of AISHE. The members of this forum participated in a private capacity. Nevertheless, the list of the organizations they were related to (box 13) illustrates the level of expertise that was present.

Box 13. Organizations from which experts participated in the AISHE stakeholder forum

Government:
Ministry of Agriculture
Ministry of Business Affairs
Ministry of Education and Sciences
Ministry of Environment
Inspection of Higher Education
Scientific Council for the National Government (WRR)
Council for the Ministry of Environment (VROM-Raad)

NGO's, Expert Centers:
Advisory Council for Research on Spatial planning, Nature and the Environment (RMNO)
Brabant Environmental Federation (BMF)
Dutch Normalization Institute (NNI)
Program Office of Sustainable Technology Development (STD)
SME Environmental Consultants

Companies:
DSM
Rabobank Netherlands

Education:
Delft Polytechnic University
Eindhoven Polytechnic University
Free University, Amsterdam
Groningen University
Hoge Agrarische School (HAS) Den Bosch
Open University of the Netherlands
Saxion Hogeschool (formerly Hogeschool IJselland)
University of Amsterdam
Utrecht University
Van Hall Institute
Wageningen University of Agriculture
Association of Dutch Universities (VSNU)
HBO Council
CRE Copernicus
Essence, Network for Environmental Education
Expertgroep HBO
LHUMP

The members of the Stakeholder Forum commented on several moments to the draft results of the consecutive development steps of the instrument: the selection of the criteria, the descriptions of the five stages for each criterion, and the practical tests. The flowchart of the development process is shown in figure 34.

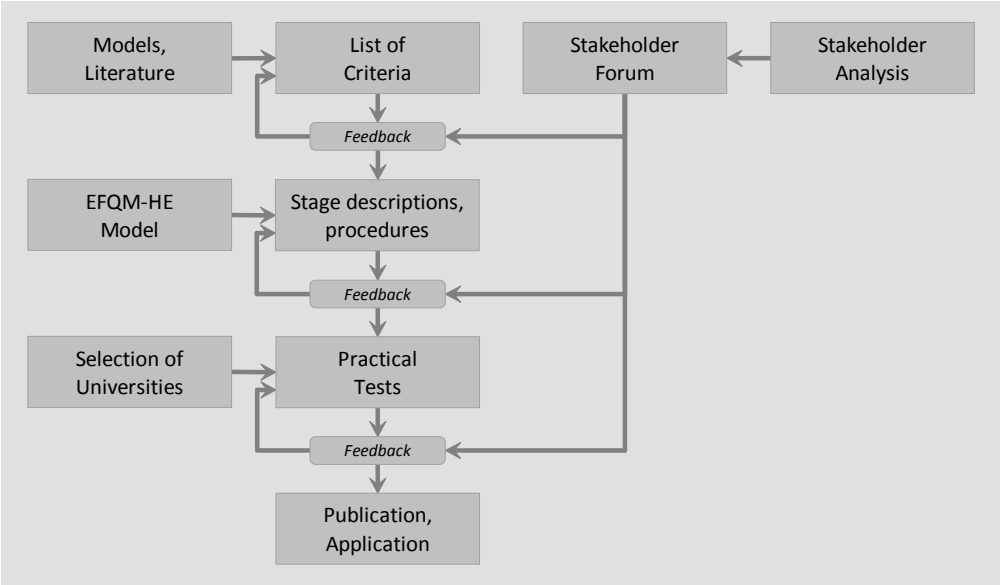


Figure 34. Flowchart of the AISHE development process

In the first draft of AISHE, a list of 28 criteria was designed. This was put forward to the Stakeholder Forum. Based on their comments, the list was shortened to 24 criteria. Next, the draft descriptions of the five stages for each criterion were designed. Besides, a first version of a standardized procedure for the application was made. Both were presented to the Stakeholder Forum, which proposed some adaptations. After this, a series of practical tests were performed in seven universities: four in the Netherlands, and three in Sweden. The latter was possible thanks to the fact that the model was designed simultaneously in Dutch and in English.
After the practical tests, the experiences were evaluated and discussed with the Stakeholder Forum. One of the results was that the list of criteria was again shortened, this time to 20. The result is shown in figure 35, which may be compared with figure 29, showing the structure of the EFQM model.

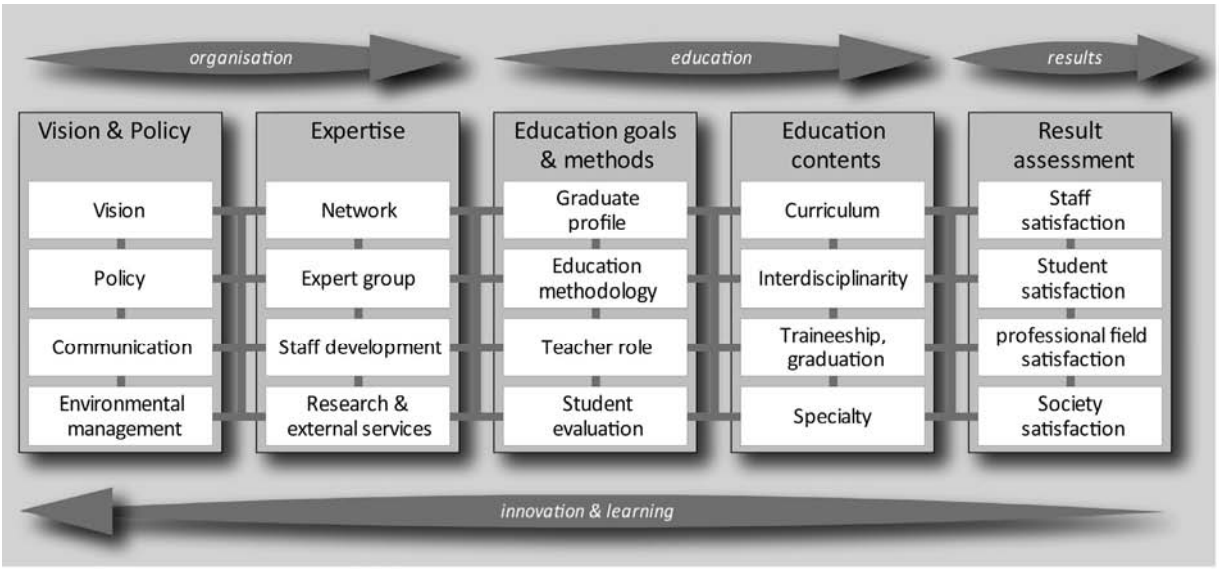


Figure 35. The structure of the AISHE model

Validation

The feedback from the Stakeholder Forum and the practical tests both were parts of a carefully designed validation process. Tested were:

- *Validity:* concept validity, representativity
- *Reliability:* internal consistency
- *Applicability:* unambiguousness, practicability, investments, efficacy, acceptability.
- *Equivalence* between tests.

Details about the validation process are described in Roorda & Martens (2008), which is reprinted in this dissertation as Appendix 5.

While using AISHE in the test phase, one of the early experiences was that it is vital to have a well-structured report of the assessment results. In the first assessment reports, it was not always clear to which criteria certain notes referred, or whether they were related to the present or the desired situation. For this reason, a computer application was made, 'AISHE Reporter' (see figure 36). The program is used during the assessment, and it forces a clear report structure. It also enables the user to view the results of an assessment immediately after completion, and to export the results to a word processing application, a spreadsheet, a graphical or a presentation program.

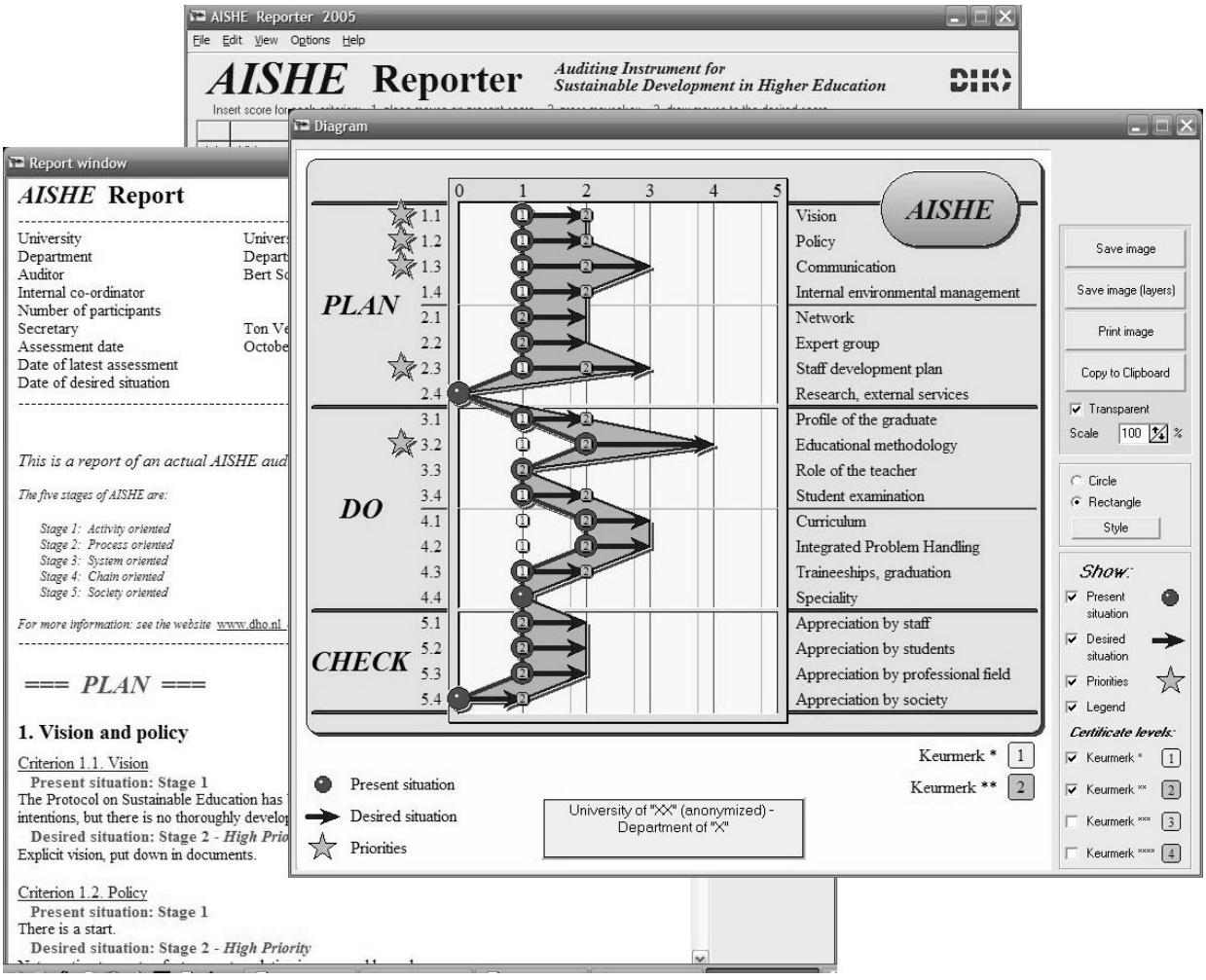


Figure 36. AISHE Reporter

An important aspect of AISHE is that the assessment renders a realistic description of the present state concerning the integration of ESD. It is about real life instead of about a theoretical description 'on paper'. This is due to the fact that the assessment is based on finding consensus of opinions by a representative delegation from the investigated study program(s): the management, the teachers, the non-teaching staff and the students, who all participate on an equal level. If it is expected that high stages will be scored, representatives from the professional field (stage 4) or from society at large (stage 5) will also participate.

Appendix 5 describes the assessment procedure as it was formally regulated, and an overview of the results of the assessment. Box 14 illustrates the results by showing a small part of the report of an assessment that took place in 2007 in the Marnix Academie, a university for teacher education in the city of Utrecht.

Box 14. Example of a (small) part of an assessment report

"Criterion 4.3. Traineeships, graduation

Present situation: Stage 1 going to 2
Students don't consciously recognize demands concerning sustainable development, as they are not mentioned explicitly in our graduation regulations. We should have described more explicitly what we expect from them. Practical tasks have been integrated into our curriculum: the student proves through practical achievements that he/she has acquired the competences. In many cases this includes SD, but since themes are not described explicitly as SD, the student does not realize that he/she is actually contributing to it.

Desired situation: Stage 2
Through study coaching and disciplinary groups we will see to it that explicit attention is given to sustainability aspects as a part of the practical tasks. *Action*: we start in September, during the first meeting of the study coaches."

Source: AISHE Assessment Report, June 18, 2007, Marnix Academie, Utrecht: notes by V. Donker

The assessment results can be summarized as follows:

- *A report containing a real-life description of the present situation, in the form of a number (i.e. the stage) for each criterion plus a description for each criterion in words;*
- *A ditto description of the desired situation;*
- *A date on which this desired situation has to be reached;*
- A list of first priorities, that are considered to be crucial in order to be permitted to conclude that the policy will have been successful, and thus:
- All necessary elements of a policy plan for sustainable development for the coming years;
- Involvement, support and enthusiasm about the plans of the staff, the students and the management;
- And, if the scores suffice: the Certificate of Sustainability in Higher Education.

If the results of an AISHE assessment are indeed used to define a genuine policy plan for ESD, either as a separate plan or as a part of a more general policy plan, this can be used as a first step in a process of continuous improvement in the shape of a Deming Circle: *Plan* (the policy plan) – *Do* (activities to realize the plan until the date of the desired situation) – *Check* (a next AISHE assessment to evaluate the results and to design elements for a next cycle) – *Act* (decisions by the management for the next cycle). This enables the organization to embed the ESD strategy in its total quality management and, finally, into its identity.

7.2.2. The Certificate of Sustainability in Higher Education

In 2000, the Certificate of Sustainability in Higher Education became available, as was described above. It was based on the HBO Handvest, and in its first years it was assessed by SME Environmental Consultants, an expert organization. Among the disadvantages of this method was the fact that it measured a theoretical, 'paper' situation which might or might not have a strong correlation with reality. Besides, the method had not been validated. Another disadvantage, already mentioned in §7.1.3, was that the attempt to stimulate a continuous improvement of ESD in the universities through the Protocols appeared to work increasingly counterproductive for a number of universities.
In 2002, after AISHE had been tested, validated and published, it was accepted as the system for the certification.
Instead of a Protocol-based system of stimulation, a 'star' system was designed. In order to get the Certificate on the level of one star, a study program only has to prove through an AISHE assessment that, for a set of 11 (out of 20) criteria - those which were considered by DHO as the first priorities – the program has a score of at least stage 1, 'activity oriented'. This implies that the universities can acquire the one-star Certificate relatively easy: it does not have to prove that some real results have been realized concerning ESD, but just that the organization has started some activities on it. This gives the one-star Certificate a very low threshold. In quite a lot of cases, study programs acquire this Certificate in their very first assessment. The philosophy behind this is that the reward – being awarded with a Certificate – will be an incentive to double the efforts and to go for a higher-level Certificate. Real-life experiences have shown that this appeared to be a highly successful stimulus for continuous improvement.
For the two-star Certificate, real results on a process-oriented level have to be proved. In Appendix 5, the exact requirements for the various star levels are shown. The appendix also describes a number of practical experiences.
The three-star Certificate requires the realization of stage 3 (system oriented) for many criteria. There is a strong relation between this Certificate level and the system integration of sustainable development (SISD) which is a key subject to the present chapter. This relation will be discussed below.

Even a four-star Certificate has been defined. There is no high expectation that this level will ever be realized by any university. But if one would do so, it would enable it to prove that it is an excellent university or study program, even in an international comparison.
The Certificate is valid for three years. At the end of this period, it automatically loses its validity.

Guaranteeing the quality of the Certificate
If a university wants to apply AISHE all on its own, it is free to do so. In this case, the assessment has the character of a self-evaluation, as a part of the internal quality management. All necessary equipment can be downloaded (www.dho.nl/aishe) and used for free. It is even possible to make any kind of adaptations to the official procedures. There is one obvious limitation: a Certificate can never be awarded through this route.
In order to acquire a Certificate, the university has to request DHO to delegate an assessor. In that case the assessment will be an external evaluation that may be used as a part of an external quality control, related to the accreditation procedure, as will be described below. For such an external assessment, several conditions have been formulated in the certification regulations. Among them are:

- The external assessor must possess the AISHE Assessor Certificate;
- The assessor cannot be an employee of the university in which the assessment takes place;
- There is a minimum number of participants to the assessment;
- The management, the teaching and the non-teaching staff and the students all have to be represented;
- If more than one study programs are assessed together in a combined AISHE assessment, this is only allowed if the programs are sufficiently related to each other. In order to judge this there is a checklist; the final approval is given – or refused – by the assessor.

Figure 37. The Certificate for Sustainability in Higher Education (left) and the AISHE Assessor Certificate (right)

The AISHE Assessor Certificate
An essential element of the quality guarantee of the assessment is the qualification of the assessor. For this reason, an AISHE Assessor Certificate has been created (see figure 37). The first step to acquire this Certificate is the participation in a three-day training program which is organized annually by DHO. The next step is the participation in a series of actual AISHE assessments, in which the candidate plays an increasingly active role, receiving feedback from an experienced assessor. The final step is the examination, in which the candidate chairs the entire assessment, while a member of the examination commission is present who judges the achievements.

The certification procedure
One of the rules for an external assessment is that, during the assessment, no documents (apart from the AISHE book) are allowed. The main reason is that this restriction lowers the chances of getting a 'paper' description of the organization instead of a real-life one: the assessor wants to know what is present in the heads of the participants instead of in some official documents. It also stimulates a vivid discussion and a strong involvement of the partici-

pants. Besides, it increases the speed and efficiency of the assessment. There may be a risk that the participants will try to polish the results a little bit, from an optimistic viewpoint or even in an attempt to cheat. But if this occurs, in practically all cases other participants will immediately correct such opinions.
Nevertheless, for a Certificate more guarantees are required in order to prove that the assessment report gives an accurate and truthful description of reality. And so, the procedure for the acquisition of a Certificate is as follows:

1. An external AISHE assessment is done, meeting all the demands of such an external assessment.
2. If the requirements of a Certificate at a certain star-level are met, the organization sends a letter to the Certification Commission. In it, the organization requests the awarding of a Certificate at the appropriate star-level to the assessed study program(s), of which the official title(s) and the national registration number(s) (in the Netherlands: the CROHO number) are mentioned. Attached to this letter are:
    - The assessment report, signed by the external assessor;
    - A set of documents that together prove that all claims in the report are correct. Examples are:
        - If e.g. the report claims that sustainable development is mentioned in the university Mission Statement, this document should be appended to the letter.
        - If claims are made about the integration of sustainable development into the curriculum, then appropriate documents have to be sent, e.g. a study guide or an examination regulations document.
    - A number of reports of graduation projects, in order to show the output of the study program(s).
3. After reception of the letter plus appendices by the Certification Commission, this commission will investigate everything. If in doubt, the commission is entitled to request more documents, or even - if in serious doubt – to visit the university and interview managers, staff members, students. (This has never happened so far.)
4. If the Certification Commission decides positively, a letter is sent to the requesting university. Next, the Certificate is either handed over to the university in some kind of festive happening organized by the university, often by some celebrity, e.g. the mayor of the city, or sent by mail – depending on the wishes of the university.

7.2.3. System Integration of Sustainable Development (SISD)

Earlier in this dissertation, the term 'System Integration of Sustainable Development' (SISD) was introduced. This concept needs to be defined here, if it is to be used in a proper way below.
The concept refers not only to a *systematic* integration of sustainable development into an educational organization (or a functional unit within it, e.g. a faculty, a school, or a study program), but also, and even primarily, at integration at a *systems* level. The latter implies that sustainable development has become a part of the fundamental characteristics of the organization, of its very identity. If this is the case, it will be observed that sustainability has become a part of all or most activities, or at least of the thoughts and philosophies behind those activities.
The above description will be used in this dissertation as a basic definition of SISD. As an operational definition, it is not very concrete (as is, e.g., the Brundtland definition of sustainable development, as discussed in chapter 2). But with the help of AISHE, it is easy to design a more operational definition, enabling an observer to assess to what extent SISD has been realized in an educational organization.
It is no coincidence that stage 3 of AISHE is called 'system oriented', following its main sources, the INK management model (INK, 2000) and the EFQM-HE model (Expertgroep HBO, 1999). Each of the 20 AISHE criteria describes at stage 3 an aspect of SISD. This can be clarified by comparing this stage 3 with the levels of change described in the Sterling model.
Sterling's level 2 is called 'Reformation' (see §1.3.1). This level is described as '*building in* of sustainability', which carries the notion of system integration. It is therefore interesting to compare Sterling's description of level 2 with the demands of stage 3 for the various criteria of AISHE. This comparison is shown in table 26, where one quotation from Sterling (2004) is divided over several cells in the left column of the table. The right column consists entirely of quotations from stage 3 demands of AISHE criteria.
The two descriptions are not identical. In some respects AISHE stage 3 demands more than Sterling describes. For instance, 'attempts to green' (Sterling) is less than a 'functioning environmental management system' (AISHE). And 'more coherent coverage' (Sterling) is less than 'systematic implementation' (AISHE). On the other hand, Sterling is stronger when he mentions paradigm modification, where AISHE uses the term 'vision development'. As a whole however, the two descriptions are well comparable, which contributes to the claim that AISHE stage 3 offers an operational definition of SISD.
The lower stages of AISHE are comparable to the lower levels of Sterling. Stage 1, 'activity oriented', adds some ad hoc elements to the education but does not change the system at all, and so it has a similarity with Sterling's level 0, which implies 'no or weak change'. Stage 2, 'process oriented', has a resemblance with Sterling's level 2, 'accommodation'. On the high end of the spectrum, level 2 of the Sterling model is not its top level. There is also a level 3, 'transformation'. This goes beyond the demands of AISHE criteria or stages. Even the AISHE stages 4 and 5 don't deal with a fundamental redesign of an educational organization, and none of the six experiments of this dissertation has attempted to implement such a transformative process. This topic will come back in the closing chapter of the dissertation.

Table 26. Comparison between the Sterling levels of change and the AISHE criteria at stage 3	
Sterling model	***AISHE, stage 3***
"A *building in* of sustainability ideas into existing systems.	The organization vision on sustainable development and education has been expressed in the mission statement, and is translated in a concrete policy. (1.1)
More coherent coverage of content, …	Sustainability is implemented systematically in the entire curriculum, in accordance with the profile of the graduate. The relation between all education units with respect to sustainability has been made explicit. The educational modules have, wherever possible, been placed in a sustainable framework. (4.1)
… an attempt to teach values and skills perceived to be associated with sustainability, …	The education methodology and the learning setting are designed in such a way that the student regularly meets realistic situations in which a reflective attitude is demanded. (3.2)
… and attempts to 'green' the operation of the institution.	There is a functioning environmental management system. Annually an environmental report is published. The environmental management is used intentionally for the education, e.g. as an example of good practice and as an object for exercises. (1.4)
There is some critical recognition of the dominant educational paradigm, its inadequacies and contradictions.	Sustainability in a broad, multidisciplinary sense is recognizable in the profile of the graduate. Regular evaluations and adjustments of the profile take place. The staff and the students are actively involved in the determination of the sustainable elements in the profile of the graduate. (3.1)
The paradigm is modified …	Staff and students are involved in the vision development. (1.1) Staff and students are involved systematically in the development of the policy with respect to sustainability. (1.2)
… and this is expressed in some change in policy …	The ESD policy is translated in assessable goals, and evaluated and (if necessary) adjusted. (2.1)
… and practice."	Based on its policy, the organization sees to it that in a large percentage of its research and external services sustainability is a main aspect. (2.4) The systematic examination of sustainable subjects is spread over the curriculum in a carefully considered way, taking into account an increasing complexity, study- and examination methods, etc. (3.4) In at least one traineeship-, graduation or other practical student project sustainability is one of the main aspects. (4.3)
Sources: Left column: Sterling (2004). *Right column:* Roorda (2001b); *the numbers between brackets refer to the criteria numbers.*	

The Certificate of Sustainability in Higher Education, including the definition by DHO of the various star levels, adds a further operationalization to the definition of SISD. The three-star Certificate has a clear relation to stage 3, as it demands of a (group of) study program(s) that it is, at least for 11 determined criteria (see appendix 5), at stage 3. By deciding this, DHO implicitly determined which criteria, according to the DHO philosophy, are the most crucial to SISD (although the concept was not used at that time). This may be interpreted (perhaps not 100% correct, but intuitively easily understood) as the statement that, if a study program acquires the 3-star Certificate, it has proved to be a 'sustainable program'.
Thus, in the next section, where some practical cases will be discussed, the simple formula will be used:

3-star Certificate ≡ full SISD.

Comparing the AISHE philosophy with other models
The above comparison between AISHE and the Sterling model clarifies some aspects of the philosophy of AISHE. A comparison with the models of Bridges and De Caluwé & Vermaak sheds some more light.

The Bridges model describes the natural development of many organizations, in the form of a series of phases the organization goes through. The five stages of the INK management model and the EFQM-HE model, on which AISHE is based, also take a natural organizational development as their fundament, based on the notion of continuous improvement. So, it is interesting to compare the Bridges phases with the INK / AISHE stages. Indeed, there is a resemblance, although it is not a perfect match. Table 27 shows the parallels between two Bridges phases and two INK / AISHE stages. Parallels between Bridges' phases and the AISHE stages at higher levels are less evident. Nevertheless, the above similarities illustrate that at least at a basic level, both models partly share a common vision.

The typology of change processes by De Caluwé and Vermaak (§1.3.2) gives another important clue to understanding the philosophy behind AISHE, this time not focusing on the structure of AISHE but on the way it is applied.

Table 27. Comparison between the Sterling levels of change and the AISHE criteria at stage 3	
Bridges model	**INK / AISHE: general description of stages**
Phase 1, the dream: 'An idea or ideal is in someone's mind, nothing more than that yet.' *(This dissertation, §1.3.3)*	(Personal drives and creativity precede the individual actions that are characteristic of stage 1.)
Phase 2, the venture: 'Action is taken to realize the dream. This demands a lot of creativity and involvement of the (small) staff.' *(This dissertation, §1.3.3)*	*Stage 1, activity oriented:* 'The processes are based on actions of individual members of the staff. Decisions are usually made ad hoc.' *(Roorda, 2001b)*
Phase 3, getting organized: 'The success of the organization increases, and so does the size of the organization, which becomes more complex. This demands a set of fixed procedures and some standardization.' *(This dissertation, §1.3.3)*	*Stage 2, process oriented:* 'The production- or primary process is under control. The mutual dependence is visible. The separate process steps are identified, tasks and responsibilities are fixed. Achievement indicators are used as a control mechanism.' *(INK, 2000)*

An essential clue is that, during the assessment, decisions about present or desired stages are *never* taken by voting or by negotiations. In other words, *yellowprint* processes in the style of politics are not allowed. It is rather the opposite, as the assessment procedure prescribes a process in which all participants – students, teaching and non-teaching staff, managers, and possibly representatives of the professional field and of society – have an equal role. All decisions are taken by consensus. As a consequence, an appeal is made to everyone to be personally involved and carry responsibility (*greenprint*), and – especially when designing the desired situation – to be creative and inspired (*whiteprint*). In other words, an AISHE assessment is a typical *greenprint* and *whiteprint* process by its underlying philosophy. It expects and stimulates a learning organization.
The Certificate has a somewhat different philosophy. As one of its primary goals is the stimulation of and reward for those who have worked hard to get some real ESD results, this is a typical *redprint* tool.
The ESD consultancy by DHO, with AISHE and the Certificate at its center, is also based on red-, green-, and whiteprint processes. This consultancy is described in the next section.

7.2.4. Consultancy

Between 2002 and 2009, AISHE and the Certificate have been the cornerstones of the consultancy offered by DHO to the universities. In the later years of this period, a number of staff members were involved in the consultancy, structured around an account management. Table 28 offers an overview of the Dutch Universities of Applied Sciences that were involved. (Information about the consultancy in research universities and in foreign universities has been left out.)
The consultancy took place in several forms and at various organizational levels.

- Meetings with individual Board members or with entire Boards took place in which advice was offered, e.g. about the university mission and strategy about sustainable development, about the internal or external communication, or the enlargement of a network of expertise.
- Many meetings took place with managers of faculties, schools, study programs, etc. The focus in most of these meetings was on a tactical level, e.g. about the staff development concerning sustainable development, the educational methodologies, the goals of the study program (such as professional competences for sustainable development), the development of educational materials, and the assessment of ESD using AISHE.
- For groups of teachers, workshops and longer training programs were offered. Introductory presentations about sustainable development were given, either in-company or at conferences. Debates were chaired, education development processes were coached, feedback was given to developed education.
- In a number of universities, lessons to students were given as a visiting teacher. In those cases, always the condition was that own teachers of the university would also be present, in order to transfer the expertise. Teachers who did so were given extra coaching in order to enable them to take over the lessons in the next year.

In order to illustrate the consultancy, the case of Fontys Hogescholen will be described in some detail.

Table 28. Consultancy for ESD in Dutch HBO, 2001 – 2009 *

HBO institution **	Size ***	Consultancy ****	AISHE audit(s)	Certificate(s)
Fontys Hogescholen	3	3	+	+
Hogeschool Inholland	3	3	+	+
Hogeschool van Arnhem en Nijmegen	3	2	+	+
Hogeschool Rotterdam	3	2	+	
Hanzehogeschool Groningen	3	2	+	+
Hogeschool Utrecht	3	2		
Saxion Hogescholen	3	2	+	+
Hogeschool van Amsterdam	3	1		
Avans Hogeschool	2	3	+	+
Haagse Hogeschool / TH Rijswijk	2	2	+	
Hogeschool Zuyd	2	2	+	
Hogeschool Windesheim	2	2		
Hoge Agrarische School Den Bosch	1	3	+	+
Marnix Academie	1	3	+	+
Christelijke Agrarische Hogeschool Dronten	1	2	+	+
Stenden Hogeschool	1	2	+	
Hogeschool Van Hall Larenstein	1	2	+	+
Hogeschool Zeeland	1	2		
Christelijke Hogeschool Ede	1	1		
Stoas Hogeschool	1	1	+	+
Hogeschool Ipabo	1	1	+	
Noordelijke Hogeschool Leeuwarden	1	1		
Hogeschool Domstad	1	1		
Hogeschool voor de Kunsten Utrecht	1	1		
NHTV	1	1		
Gereformeerde Hogeschool	1	1		

* Only consultancy by the *researcher* is shown.
** Only Dutch HBO institutions (Universities of Applied Science) are shown. The 26 shown HBO institutions make up 63% of all Dutch HBO institutions, together representing 94% of all Dutch HBO students.
*** Size: 1: <10,000; 2: 10,000 – 20,000; 3: 20,000 – 40,000 students
**** Consultancy: 1: occasionally, 2: structurally, 3: highly intensive during at least 3 years.

7.2.5. The case of Fontys Hogescholen

Fontys Hogescholen is one of the largest Universities of Applied Sciences in the Netherlands – in fact, it is one of the largest Dutch educational institutions, with between 30,000 and 40,000 students. It is located mainly in the south of the country, in cities like Eindhoven, Tilburg, 's Hertogenbosch, Venlo and Sittard, but it has also some institutions in e.g. Amsterdam and Zwolle. The university was formed in the nineties of the last century through a series of mergers. Nowadays, it consists of more than 30 schools (which all carry the name of 'hogeschool'; Fontys calls itself in the plural, i.e. 'Fontys Hogescholen'). The schools offer a wide variety of disciplines in sectors such as technology, management and law, nursing, teacher education (for primary, secondary and vocational education), arts.

Some of the Fontys schools started working on ESD around 2000. Some years later, a 'Steering Group on SD' was installed by the chairman of the University Board, consisting of about 6 school managers, with the task of designing strategies and policies for ESD within Fontys. Since 2004 the *researcher* is an external advisory member of this Steering Group.

The integration of ESD in the Fontys institutions may be divided into four phases, as described in an advisory report to the Steering Group (Roorda, 2006b): that is, two of these phases had taken place in the past, and two more phases might be scheduled for the future. The phases are shown in table 29, in which the division into the four roles of educational institutions (§1.2.4) is used. Indeed, in 2006 Fontys entered phase 3: broadening and deepening.

Table 29. Four phases of ESD of Fontys (description & proposal)

Phase	Operations	Education	Research	Society
Phase 1: – 2003. **Orientation**	Introduction of environmental management	Institute for Environmental Technology; Pilots on ESD		
Phase 2: 2003 – 2006. **Forerunner projects**	Environmental management. Participation in National Energy Covenant ('MJA2')	ESD Forerunners: TNW, MER, Wtb, PTH. Minor on Triple P.	Forerunners: Sustainability lectorates	SD in Fontys mission; internships, e.g. together with Humanitas Foundation
Nov. 7, 2005	'Big bang': Fontys management meeting on sustainable development			
Phase 3: 2006 – 2010. **Broadening and deepening**	Broadening: from environmental management to people – planet – profit. Deepening: functional EMS	Broadening : Towards 70% participation. Deepening : Certificates at level 1 to 3.	Broadening : SD as an aspect of 70% of lectorates and PhD's. Deepening : More SD experts	Broadening : Active in society. Deepening : Corporate Social responsibility (CSR); transparency through annual CSR report
Phase 4: 2010 – 2015. **Completion and anchoring**	Certified EMS (Environmental Management System)	Towards 100% participation; SD in mainstream; At the end the Certificates are unnecessary	Fontys = expertise centre on SD; Cooperates with (inter)national expertise centres	Fontys = trendsetter in CSR; cooperates with NGO's
Jan. 1, 2015	At the end of the United Nations Decade of Education for Sustainable Development: System Integration of SD in Fontys University			

Source: Roorda, 2006b

The phases may be compared to those of the Sterling model, as they describe not only a quantitative increase of activities but also a qualitative change, as ESD increasingly becomes a part of the character of the university. This is apparent e.g. through the remark in phase 4: 'At the end the Certificates are unnecessary', as ESD has become an intrinsic element of the university identity:

Fontys	**-**	**Sterling model**
Phase 1 (orientation)	-	Level 0 (no or weak change)
Phase 2 (forerunner projects)	-	Level 1 (green gloss)
Phase 3 (broadening and deepening)	-	Level 2 (serious reform)
Phase 4 (completion and anchoring)	-	Level 3 (whole system redesign)

Phase 1: The orientation period (- 2003)

In the nineties, Fontys (or its predecessors before the mergers) mainly focused on environmental aspects, for which an expert centre (the Institute for Environmental Technology) was set up by some of the schools. This institute participated in the design of the environmental management of some of the campuses of Fontys, and contributed to education development.

The first consultancy activities by DHO took place in August 2001, when a workshop was organized on sustainable development for the management and the teachers of the School of Applied Sciences ('Toegepaste Natuurwetenschappen', TNW). Another institute, the School of Management, Economics and Law ('Management, Economie en Recht', MER) had its first AISHE assessment a few months later, in October 2001, as a part of the test phase of AISHE that belonged to the validation process of the tool.

Both schools had an AISHE assessment in September 2002; for MER this meant that for the first time a quality cycle on sustainable development was completed, as it was their second assessment. For MER, too, workshops for management and teachers were given by the *researcher*, in which a basic understanding by the teaching staff was created of the concept of sustainable development and of its consequences for education. Both in TNW and MER, these workshops preceded the assessments, in order to guarantee that the discussions during the assessment would be meaningful.

Phase 2: Forerunner projects (2003 – 2006)

The two schools, TNW and MER, continued their efforts towards sustainable development in later years, and the AISHE assessments were repeated several times. MER (assessments in 2001, 2002, 2005 and 2008) possesses the 2-star Certificate. TNW (assessments in 2002, 2005 and 2008) acquired the 3-star Certificate in 2008, being the first ever.

Besides these two institutes, other Fontys schools joined them in their efforts on ESD. Between 2003 and 2006, four schools were the forerunners within Fontys. Besides TNW and MER these were the School of Mechanical Engineering ('Werktuigbouwkunde', Wtb) and the School for Teacher Education for Secondary Technology Education ('Pedagogisch-Technische Hogeschool', PTH). They both also followed a process of teacher training and assessment (PTH: 2004, Wtb: 2005). In 2004, the Tilburg School of Primary Teacher Education ('Pabo Tilburg') had an internal AISHE assessment, without the help of consultancy by DHO.
The Board of Fontys stimulated the integration of sustainable development. In January 2004 it organized a conference, entitled 'Fontys goes sustainable', where the four forerunners were able to present their results in an attempt to inspire other schools.
Besides the formal stimulation of ESD by the Board and the Steering Group, there was also another, informal group, initiated by and consisting of individual staff members with a strong involvement on ESD. This group, which called itself the 'Atelier', operated roughly between 2002 and 2005, and it had a series of meetings with the Board, with the Steering Group and with school managers, stimulating communication, creativity and involvement. Thanks to this, the stimulation of ESD within Fontys was a combination of top-down and bottom-up efforts.
Sustainable development received attention in the research and the operations as well. Several sustainability focused lectorates were set up. Plans for sustainable buildings and for environmental management were introduced.
On an individual level, two Fontys staff members acquired the AISHE Assessor Certificate. The assessments they chaired in other universities contributed to their personal expertise on ESD development processes.

Phase 3: Broadening and deepening (2006 – 2010?)
The University Board introduced sustainable development into the Mission Statement of the University, describing it as one of the main strategic focuses. However, the first attempt by the Board, early in 2004, to broaden the ESD activities to other schools, was not very successful. It is important to note that the Board (or the Steering Group) did not use any force, i.e. it never attempted to get the schools to work on ESD based on regulations or obligatory requirements.
A second attempt to broaden the subject to more schools was proposed by DHO in 2005. In November of that year, this resulted in a 'Big Bang' (as it was described, see table 29), in the shape of a meeting in which the managers of all Fontys schools, each assisted by one or more of their team members, came together. They were invited to design plans on ESD for their own institutions for the next years, and to present them to a 'Jury', consisting of the members of the Fontys Board. Assistance was given to the managers by a group of DHO staff members. Although it was clearly stated that the process was voluntary (thus consistently following the policy of non-force), nearly all managers handed in a plan. Some of these focused on operations aspects (e.g. a stimulation to use bicycles), others were dedicated to education and had more serious consequences. Both the managers and the members of the 'Jury' signed the plans, which were filled in on forms that were designed to have the appearance of highly official documents. Although this signature did not have any formal meaning, it put some extra weight on the plans. Everything was carefully designed to inspire the managers and to give them a sense of urgency (and some public pressure). After the 'Big Bang', the plans were taken together and published in a booklet that was distributed within Fontys.
In the next years, not all plans were fully realized. But a part of them were, and this tactic through which many Fontys managers were moved to start or increase their efforts for ESD has been copied to other universities afterwards.
In the next years, several Fontys schools initiated ESD initiatives. For instance, the School of ICT and Electronics started the process with a study day for the staff in January 2006, to which DHO contributed; the School for Nursing did the same in September, and the Tilburg School of Economics ('Fontys Economische Hogeschool Tilburg', FEHT) did so in April 2007.
In 2006, the Steering Group signed an agreement with the organization of the Festival Mundial, a massive cultural event which took (and still takes) place annually in the city of Tilburg. In this festival, which is dedicated to the Millennium Development Goals, music-, dance- and other cultural groups from all over the world contribute to connecting people and creating understanding for cultures. Fontys is now a partner in the organization, and staff and students contribute to its operational activities. Several Fontys schools, e.g. the Conservatory and the School of Arts, also contribute to it at a content level. The participation of Fontys in the Festival Mundial is an excellent example of the fulfillment of the university's societal role towards sustainable development.
In the meantime, the Steering Group continued to think of other ways to strengthen the ESD process. In 2006, DHO was requested to write an advisory report to assist the Group in its thinking about what had been achieved so far, and how to proceed from there. The above table 29 was a part of this report.
One year later, again requested by the Steering Group, DHO proposed a number of realistic targets for the years 2007 – 2010 that could be worked on by the schools, while being stimulated and coached by the Steering Group. A part of this discussion paper is shown below as table 30.

Table 30. Sustainable development at Fontys University: proposed targets for 2007 and 2010

Category	Subject	Methods and tools	Targets (end of 2007)	Targets (end of 2010)
Management	Vision development	Presentations for management and staff Consultancy Conferences and symposia	University-wide symposium dedicated to SD 40% of managers has an explicit vision on ESD	All managers possess a vision and practical experiences concerning ESD
	Policy development	SD in management contracts Feedback to policy plans	SD in management contract structure Feedback on plans by DHO consultant	
	Evaluation, anchoring	AISHE assessment Certificate of Sustainability in Higher Education National accreditation: special recognition	Assessments in 10 Fontys schools Certificate, 1 star: 8 schools Certificate, 2 stars: 3 schools	Certificate for all schools 2 stars: 50%,. 3 stars: 20%. Special recognition: 3 schools
Expertise	Core group of SD experts	Participation in knowledge circles of lectorates Self study Authoring, presenting & publishing papers	30 staff members nearing SD expertise; at least 1 presentation about own research	Each expert has published in peer-reviewed journal
	Basic knowledge for all teachers	Basic book on SD * Workshops	30% of all teachers participated in workshops on SD basics	Al teachers possess basic knowledge on SD Integrated in vacancies policy
	Specialist knowledge	Teacher internships Additional training of teachers by students Education development (learning by doing)		
Operations	Sustainable staff policy	Anti discrimination policy Anti harassment policy		
	Environmental management	EMAS, ISO 14000	5 Fontys campuses started with an integrated EMS	Full EMS on all campuses
	Sustainable investment strategy	Sustainable architecture Allow longer financial regain periods		
Education	SD in the competences	RESFIA+D model **	20% of Fontys schools integrated SD in their professional competences	70%
	Introduction to SD in 1st year	Basic book on SD *	20% of all students follow a basic course on SD	70%
	Integration in curriculum	Workshops based on disciplinary reviews of DHO Minor on Triple P	Workshops for 20% of all teachers 5% of all students selects minor on Triple P	70% participated in at least 1 workshop 25% of all students selects minor on Triple P
	Integration in internships, graduation	Book: Working on SD ** Checklist of SD internship requirements **		
	Transdisciplinary education	Workshops for teachers & students		
Research	SD in lectorates	Coordination by present SD oriented lectors		
	SD in PhD projects	Guiding lines for SD for PhD candidates		
Society	Participation in societal programs	Festival Mundial		
	Support of societal discussions	"Sustainability shop" for citizens, NGO's, SME's		

Source: Recommendations to the Fontys Steering Group on SD (Roorda, March 2007)
* Roorda, 2005a (see chapter 8); ** Roorda, 2007 (see chapter 9)

The above goals should not be taken too literal. The Board and the Steering Group intentionally followed the policy of non-force. Earlier enterprises, such as the Cirrus Project in Avans Hogeschool (see chapter 6), had shown that it is essential to put the responsibility for the ESD process, and even for the goals, with the individual institutes. Consequently, both the Board and the Steering Group made it clear to the schools that some ESD actions and results were

expected from them, but not which. This strategy implied that it was impossible to treat the Fontys ESD strategy as a straightforward *project*, including measurable goals and trajectories in a *blueprint* approach. Rather, the ESD strategy might be described as a *quest* or an *adventure*, certainly envisioning a desired situation in the end – system integration of SD throughout the university – but not an exact route to get there. The approach was rather a combination of *redprint*, *greenprint* and *whiteprint* styles. The targets of table 30 are intended as such, and that is why many boxes were left empty, in order to leave ample room for further creativity.
The structure of table 30, at least as it is shown in the first two columns (the categories and the subjects) may be suitable to be used for a strategy development in other universities as well. The lower four rows (operations, education, research and society) correspond to the four roles of a university, depicted as the four pillars of a 'temple' in figure 4 (§3.4). The other two rows (management and expertise) together correspond with the fundamental vision, mission or identity of the university (i.e. the fundament of the temple).
Based on the 2007 recommendations and table 30, the Steering Group decided in 2008 to launch a university-wide initiative. The intention was to place AISHE in the centre of the ESD activities. The aim was that by 2015 all Fontys schools would have the Certificate of Sustainability in Higher Education at the level of at least 2 stars.
In order to make this possible, the Steering Group wished that a large group of staff members from all schools and departments, mainly teachers and quality coordinators, would acquire detailed information and insight about sustainable development, ESD and the use of AISHE. All schools were invited to delegate one or two persons to an intensive training program on ESD. This group, together with ca. 8 other staff members who already had a considerable expertise on ESD, were to form a permanent Community of Practice on ESD. The training program, consisting of three days, was designed and given by DHO, assisted by own Fontys ESD experts.
The 2008 initiative was rather successful. Not all schools delegated a team member to the program. But the resulting situation on March 1, 2009 was described in the final report (Roorda, 2009) as follows.

- 21 schools now had an active policy on ESD.
- 24 staff members had participated in the intensive training. Together with the earlier ESD experts, the Community of Practice now consisted of about 30 people.
- 4 staff members possessed the AISHE Assessor Certificate. 4 others were on the way to the assessor examination.
- AISHE assessments now had been done in 7 schools. Assessments were scheduled to take place within a few months in 8 more schools.
- 4 schools possessed valid Certificates of Sustainability in Higher Education. The expectation was that, before the end of 2009, this number would be at least 12.

This overview shows that, in 2009, the desired broadening of the ESD process within Fontys is certainly taking place. The deepening is also apparent, as MER, PTH and several other schools posses the 2-star Certificate, while TNW even has 3 stars. The process may perhaps not lead to the targets of 2010 that were described above, but as they were only indicative, this is no real problem.
The Fontys Community of Practice on ESD presently is searching for its role within Fontys University, which is far from clear yet. The Steering Group is also investigating its future role. Much has still to be realized. But the process has gained speed in more than half of the Fontys schools. No doubt this is in the first place the achievement of many people within Fontys University, including the Board, the Steering Group, the Atelier, individual managers, teachers and other staff members. But AISHE, embedded in the consultancy, has played a core role in this process, and probably will do so in the next years. Whether the consultancy towards Fontys may be continued in whatever way, after DHO abandoned this as a core activity, is uncertain yet.

7.3. Result assessment

At the start of this chapter, the central questions for experiment #4 were formulated: Can sustainable development become a part of the mainstream of the educational processes in a university, implementing system integration of sustainable development? And: Can a quality management approach contribute effectively to this system integration?
Five hypotheses were formulated that will be used to evaluate whether the applied quality approach may be called successful regarding the central question. They are shown in table 31. One other possible criterion shown in this table was not used to formulate such a hypothesis: #6, the contribution to sustainable development through higher education. The application of AISHE, the awarding of the Certificate and the consultancy may have a serious impact on sustainable development, e.g. thanks to the graduates of the involved study programs, but no way was found to measure this effect, as it is impossible to distinguish such an effect from all kinds of other effects.

Table 31. Experiment #4: Criteria for result assessment		
Experiment Criterion	X4 AISHE	Assessed hypothesis
Contribution to ESD within direct stakeholders		
Implementation of ESD in vision, policy	§7.3.1	1. Application of AISHE contributes to system integration of sustainable development (SISD).
Implementation of ESD in education	§7.3.1	
Customer demand	§7.3.2	2. AISHE attracts a sufficient number of users.
Customer appreciation	§7.3.3	3. Users appreciate the application of AISHE.
Contribution to SD within indirect stakeholders		
Indirect stakeholder appreciation	§7.3.4	4. External stakeholders appreciate the application of AISHE.
Contribution to SD through HE		
Transfer of expertise	§7.3.5	5. AISHE contributes to ESD implementation elsewhere.

7.3.1. System integration of sustainable development

In order to assess the effects that the use of AISHE, including the Certificate and the consultancy, may have on the implementation of ESD in the study programs, three cases will be investigated in detail. They have been selected from three different Universities of Applied Science, and also from three different educational sectors: technology, economics & management, and teacher education.
For each, several AISHE assessments have been done over the years. Their reports will be used for the investigation in this section. Besides, in 2009 a questionnaire has been filled in by a representative of each of the three study program: in two cases, this was done by the sustainability coordinator, in one case it was the school manager. The questionnaire, including the responses, is reprinted as Appendix 6, and will be discussed in §7.3.3.

The first case to be investigated is the already mentioned Fontys TNW ('Toegepaste Natuurwetenschappen'), the School of Applied Sciences of Fontys University. This is a highly interesting case, as this school was the first to acquire a 3-star Certificate.
Fontys TNW had started its activities on sustainable development around the year 2000, or perhaps even earlier. The first contacts with DHO took place in 2001, through a workshop by DHO which was meant to raise the awareness and knowledge of the teaching staff on sustainable development, as a preparation to a complete redesign of the curriculum, with project education as the major educational methodology. In each of the projects, sustainable development was to be clearly present. Some time later, a draft version of the redesigned first year of the program was finished, and another workshop took place in which DHO was invited to comment (after a thorough preparation) on the sustainability content of the newly developed first year. Although some recommendations for improvement could be given, for the larger part this appeared to be unnecessary, as most of the design was innovative, creative and a clear contribution to ESD.
In 2002, the first AISHE assessment took place, which brought the 1-star Certificate to Fontys TNW. In a second assessment, in 2005, 2 stars were acquired, followed by the 3-stars Certificate after an assessment in 2008.
The results of the three assessments are shown in figure 38. The top graph shows the results of the first assessment, with a median score of 1.25. The desired situation decided during this first assessment is shown in the second graph, together with the actual situation that was the result of the second assessment (which had a median score of 2). The comparison between these two lines is not perfect, as the date for the desired situation had been put in 2003, while the assessment only took place in 2005.
A better comparison is possible in the bottom graph, where the desired situation of December 2008 (resulting from the 2005 assessment) is compared with the actual situation, assessed in November 2008 (resulting in a median of 3).
The growing process from 1 star (2002) to 3 stars (2008) took Fontys TNW six years. In fact the growing process started even earlier, as the School started its sustainability efforts in 2000 or perhaps even earlier. In other words, it took a creative and innovative team, chaired by an inspiring manager and with a full support by the University Board, no less than eight years to grow to a full SISD.
The reports of the consecutive assessments will be used to study the growing process and the resulting situation in 2008. First, one criterion will be followed through the years, illustrating the growing process. Next, the realized situation in 2008 will be studied in more detail, in order to discover what a real SISD situation looks like.

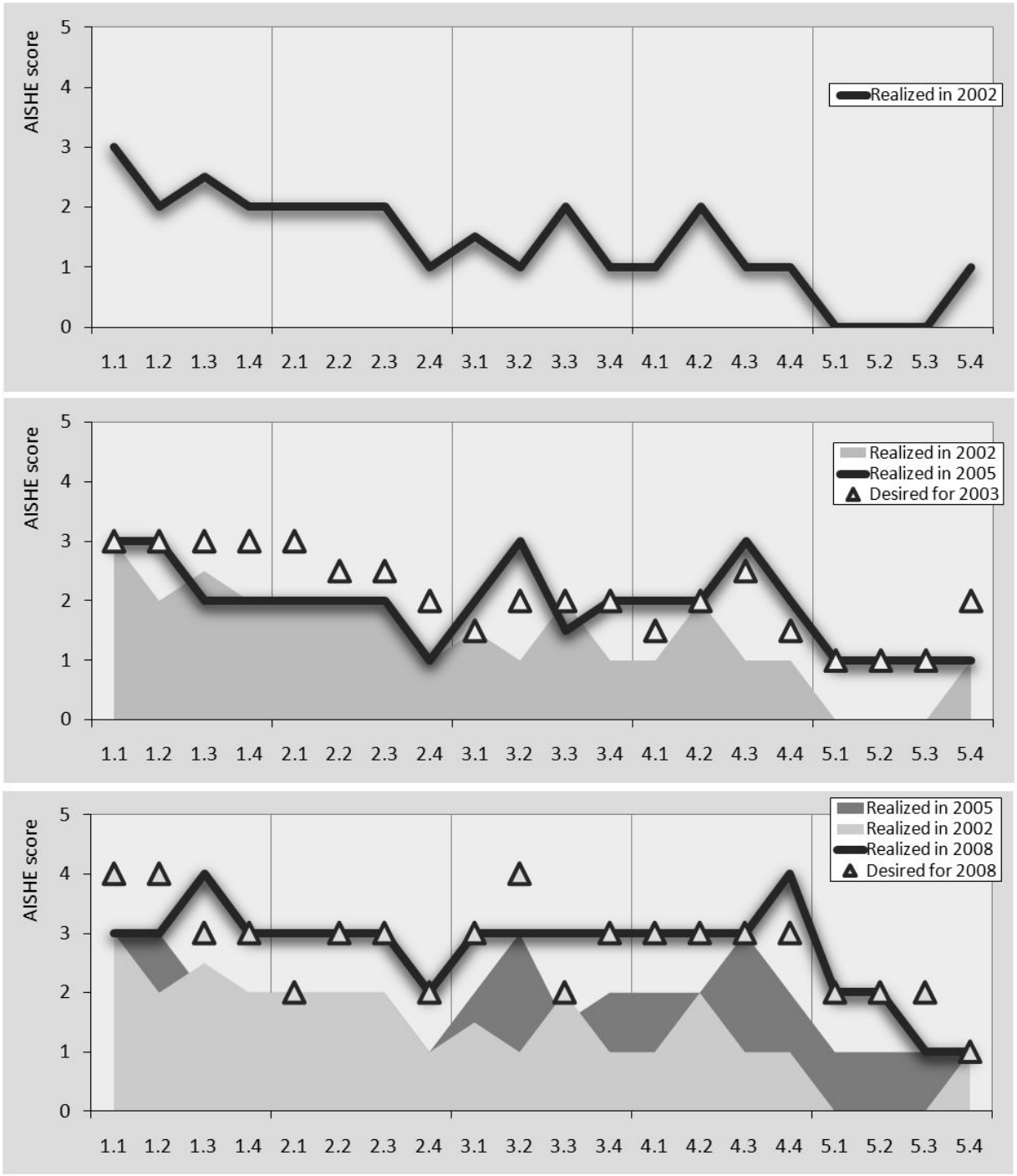


Figure 38. The results of three AISHE assessments of Fontys TNW

For the illustration of the growing process, criterion 4.1 was selected: the curriculum, as this is a pivotal criterion considering the implementation of ESD. The following are citations from the three assessment reports (2002, 2005, 2008):

Fontys TNW, AISHE assessment report, 27 September 2002. Criterion 4.1, Curriculum:

> ***"Present situation: Stage 1***
> Elements of basic knowledge about sustainable development can be found, distributed over the curriculum.
>
> ***Desired situation: Stage 1 going to 2***
> The redesigning of the curriculum has started. Sustainable development will be a part of the development. At the end of 2003 everything can be ready; basic knowledge about sustainability will then be present. It is a huge task."

Fontys TNW, AISHE assessment report, 18 November 2005. Criterion 4.1, Curriculum:

> ***"Present situation: Stage 2***
> A basic module is present in the first year. Although students indicate that SD is present, both in theoretical education and in practical tasks, they don't recognize a systematic integration in the higher years of the program, based on the basic module. Teachers claim that there is some systematic integration, but not recognizable in the separate modules, and not well visible for the students yet.
>
> ***Desired situation: Stage 3 - High Priority***
> The planned further development of our education will lead to full system integration. No extra efforts are needed."

Fontys TNW, AISHE assessment report, 20 November 2008. Criterion 4.1, Curriculum:

> ***"Present situation: Stage 3***
> All students agree that every part of the curriculum has been placed in a sustainability framework. Students are able to relate their professional competences to the 'Triple P'.
> SD throughout the study program is related to the introduction to SD in the early parts of the curriculum. SD is a clear criterion for the internships and the graduation project.
> In some projects, the SD description is not made explicit for the students: they have to do that themselves, based on their lectures. In the minor 'Smart Materials' too, they have to learn to discover the relevant questions and act accordingly."

This illustrates the growing process through the years. A more detailed look at the situation in 2008 gives insight in the results. Criterion 4.1 was shown above; here are some more citations from the assessment report of 2008:

Fontys TNW, AISHE assessment report, 20 November 2008, 'present situation':

> ***Criterion 1.1. Vision: Stage 3***
> "The Advisory Board and the Commission of the Professional Field have been consulted regularly. We have SD projects in Africa, e.g. projects with primary schools and projects about rain water. In cooperation with secondary vocational schools we developed a vision on this. Other activities in which the vision is expressed and improved are the Exchange projects, Eureka Club, opportunities for teachers to participate in SD-related lectorates, participation in the education development of physics in secondary schools.
> The interaction with the professional field is all right, but with the secondary education is somewhat less, but we are working on setting the direction. Conclusion: we are close to stage 4."
>
> ***Criterion 1.2. Policy: Stage 3***
> "We organized a study day for staff and students with the theme 'Cradle to cradle'. The minor PPP (People, Planet, Profit) was developed in interaction with the professional field. The strategic plan of TNW covers 5 years, and SD is an integral part of our policy."
>
> ***Criterion 1.3. Communication: Stage 4***
> "A large group of staff members visited a symposium ('Innovative technologies for a bio-based economy', Wageningen University). During internships, graduation and projects sustainability aspects are always present. This gets attention during the presentation of the diplomas, in the meetings of the Advisory Board and of the Commission of the Professional Field, etc."
>
> ***Criterion 2.2. Expert Group: Stage 3***
> "There is a permanent expert group with several SD experts within TNW. The SD-related minors of TNW, developed by the expert group - PPP, DAS ('Disciplines of Applied Science'), Smart Materials – all have a direct relation with the major. The group has structural contacts with the management."
>
> ***Criterion 2.3. Staff development plan: Stage 3***
> "Even in employment advertisements SD is mentioned in the competence profile. In the annual performance interviews the opportunity is offered to increase the level of expertise on SD. In the overall staff development plan SD is present, and the team realizes this plan."
>
> ***Criterion 3.1. Profile of the graduate: Stage 3***
> "Students are involved in the determination of the graduate profile. The competence 'development' was adapted last year, and at present there is a request from students to redesign another competence."
>
> ***Criterion 4.3. Internships, graduation: Stage 3***
> "In the examination regulations the relation with SD is explicit, as it is a part of the competences. In at least one of the practical projects SD is a main aspect. There is some discussion whether all students recognize this main aspect in the tasks that are mentioned.

The students are obliged to demonstrate the link between SD and their personal competences; if they don't, they will not meet the requirements of the competence profile."

Criterion 5.2. Appreciation by students: Stage 2
"Evaluations of the education in the first year of the program indicated that not all students were aware of SD throughout their education, implying that is was not fully embedded in the program. So, improvements have been made."

The above citations give a clear impression of the characteristics of a School in which SISD has been realized, and it sets a challenge for other institutions. This was recognized, not only by DHO, but also by the HBO Council and by the SD-related public media. This is illustrated by an article that appeared in the online news magazine "MVO Nieuws", see box 15.

Box 15. Public media attention to the three-star Certificate of Fontys TNW

"Attention to sustainability brings three stars to Fontys TNW
Fontys School of Applied Sciences (TNW) in Eindhoven is the first university that received a Certificate with three stars from the Foundation for Sustainable Higher Education (DHO). Manager Marthie Meester of Fontys TNW received this award last Wednesday from the hands of Doekle Terpstra, chairman of the HBO Council.
Fifteen people, representatives of students, staff members, management and in this case also the professional field, participated in an assessment, the results of which were used by DHO to determine the number of stars of the Certificate.

Involvement of partners
In order to grow from two to three stars, according to Ad Goossens, quality management coordinator of Fontys TNW, it is essential that the partners of the university, such as companies, secondary education and secondary vocational education, are involved in the vision on sustainable development. Wherever internships, graduation projects or other real-life tasks are designed, the university handles this principle as strongly as possible. 'Our students work on the development of innovative products and methods in the fields of chemistry, biology, physics, technology and nutrition. Thinking about sustainability cannot be missed there', he claims. 'Thanks to their projects, students are deeply convinced that whatever they make will have consequences for the future of children and grandchildren', Goossens adds. Another example is the minor 'People, Profit, Planet' that Fontys TNW developed. For this minor, students from other universities can subscribe as well."

Source: MVO Nieuws, December 7, 2008 (www.duurzaamnieuws.nl/mvo)

The other two cases that will be investigated here will be discussed more briefly. Both possess the 2-star Certificate, although one of them had not received the second star yet when, in 2009, the questionnaire was filled in (see §7.3.3). Both expect to acquire the 3rd star in the course of 2010 or 2011.

One of them is 'Inholland HTRO'. The Hogeschool Inholland is a large University of Applied Sciences, mainly in the western part of the Netherlands. HTRO ('Hogere Toeristische en Recreatieve Opleiding') is the study program of Tourism and Recreation, a part of the School of Economics in Rotterdam. HTRO had its first external assessment by DHO in June 2007, leading to a 1-star Certificate. This was followed by an internal assessment in 2008, and by a second external assessment by DHO in June 2009, bringing the 2nd star to HTRO. A next internal assessment is planned in June 2010, to be followed by a third external assessment in 2011, in which HTRO expects to acquire the 3rd star.
A few quotations from the 2009 assessment report illustrate the state of affairs (2 stars) at that moment. The program appeared to perform very good regarding most of the criteria, as they met the demands of 3 stars for four out of five groups of criteria. They only fell short concerning the last group, about the assessment of the appreciation by various groups of stakeholders.

Inholland HTRO, AISHE assessment report, 23 June 2009:

Criterion 1.1. Vision

"Present situation: Stage 3
Teachers and students indicate that they are involved in the vision development. Communication about it takes place through blackboard and *Insite*, where the mission is published. Mission and vision in relation to SD are discussed during class representatives meetings and kick-offs. Mission and vision are updated regularly. They are partly based on nationally determined competence profiles for this type of study programs.

Desired situation: Stage 3 - High Priority
The student involvement presently has an emphasis on implementation, and less on vision development. This will be improved. The professional field is involved through the Professional Field Commission (BVC). They will also be involved in the organization of a conference on SD by HTRO in 2009-2010.
Involving secondary schools in the vision development is not easy, because of the number of schools (more than 60) and the relatively low influx of students per school. Contacts with them are very important. The ambition to get them involved is there."

Criterion 3.1. Profile of the graduate

"Present situation: Stage 3
The nation-wide competence profile of the study program mentions CSR. The profile is discussed in the program commission (consisting of students and teachers.
All aspects of SD are described in our competences. Through his portfolio the student proves that he qualifies for all competences. During graduation the students experience that all SD aspects are to be combined, which is necessary to write the graduation thesis, as the graduating students explicitly indicate.

Desired situation: Stage 3
Through the regionally oriented BVC we will add more *couleur locale*. But at present the profile is already determined in a stage 4-like style by the central program commission.
Interdisciplinary projects are now located mainly in our broad minors. As not all students participate in them, we will consolidate stage 3 for the time being."

Criterion 5.2. Appreciation by students

"Present situation: Stage 1
Three times we did an appreciation quick scan from the AISHE book. But we did not analyze the data.

Desired situation: Stage 3 - High Priority
We will analyze the data, and use them for our policy development."

Here to, just as with Fontys TNW, several criteria indicate the realization of SISD; only the last criteria (e.g. the cited criterion 5.2) show that the relevance of stakeholder appreciation was underestimated.

The third case to be discussed has a somewhat larger distance to the 3-star Certificate. The Marnix Academie is a small University of Applied Sciences in the city of Utrecht. It has only one study program: teacher education for primary education ('Pabo'). In 2006 the university had its first external assessment, leading to 1 star. One year later, another assessment took place through which the institution acquired 2 stars. The quotations below are from this second assessment report.

Marnix Academie, AISHE assessment report, 18 June 2007:

Criterion 1.3. Communication

"Present situation: Stage 2
SD in education development is a regular subject in (reports of) teacher meetings, publications through '*Marnix Mix*', intranet (e.g. SG, renovation process, annual report). A systematic reporting takes place, but the communication plan still has the nature of a publication overview. This can be designed and implemented more carefully.

Desired situation: Stage 3
Short term intended actions are publications on our website (internet). The communication plan will be strengthened and systematized, not only regarding SD. First we will determine which message we want to communicate with which target group, how and when."

Criterion 3.1. Profile of the graduate

"Present situation: Stage 2
In the new competence descriptions, SD aspects are described explicitly, including indicators, translated into e.g. practice book, and assessed just like all other competences, e.g. through portfolio files. Everything is ready, and it will be used from the study year 2007/08. It is developed by our innovation platform, with contributions from the project group "Education in the school" and from coordinators from primary education. On the national level of teacher education it has been typified as a unique, inspiring document. Nevertheless, the content is not yet known to everybody within the university, the information flow has just started: it is a very recent document. That is why stage 3 has not yet been realized.

Desired situation: Stage 3
We will involve all stakeholder groups actively in the determination of sustainable elements in the graduation profile. Multidisciplinarity is present in e.g. the subject of 'Being the Teacher' and the minor 'Humanities', but this will be improved. The guidelines have been determined; the development teams will now get the responsibility to translate this to the curriculum. The innovation platform will set the next step to get the teachers and the students involved."

Criterion 5.4. Appreciation by society

"Present situation: Stage 0
Which are the societal organizations that are relevant for us? Which have sufficient expertise on SD to make a judgment about us? The first question is: how do we want to make use of an appreciation assessment by representatives of society. Since we use the EFQM-HE model for our general quality management, we already had the wish to put societal appreciation on the agenda of next year.

Desired situation: Stage 1
We make an explicit list of societal representatives. First we make it an internal discussion subject, to think carefully about what we want. The SD task group will formulate a proposal."

All three cases illustrate the way in which AISHE helps to structure the ESD development in the direction of SISD.
It is interesting to make a comparison between a number of ESD development projects that have been done in recent years.
The Cirrus Project, described in chapter 6, took place between 1998 and 2002. AISHE could not be used as a guiding tool throughout the project, as AISHE was only published shortly before the project ended. It was however used to assess the final results after 4 years, and these showed that the study programs that were involved in the Cirrus Project still were far from SISD.
The Fontys School of TNW started its sustainability development process somewhere around 2000. It took the institute about 8 years to get to the level of SISD, as was proved through an AISHE assessment in 2008.
Both were pioneering projects, starting at a time when – at least in the Netherlands, but probably also in other countries – hardly any universities had started trying to systematically integrate ESD into the existing study programs.
Projects that started later seem to realize a faster progress. The above cases of Marnix Academie and Inholland HTRO started considerably later than Cirrus and Fontys TNW, but are both nearing SISD. This is an interesting phenomenon, which perhaps might be explained by the fact that in recent years much more experience has been gained with ESD implementation processes than was available around 2000.

7.3.2. Application of AISHE

It is hard to make a solid estimate of the number of times AISHE has been used. On the one hand, many universities have performed internal assessments without the help of DHO. On the other hand, the external assessments by DHO through the years have not all been accurately registered by the DHO secretariat. Based on the available data, the number of external assessments in the Dutch HBO is estimated to be around 80. In most external assessments, 2 to 3 study programs are assessed together – sometimes less, sometimes more. On the other hand, a number of programs were assessed more than once. All in all, the number of externally assessed programs in Dutch HBO will be somewhere between 120 and 200.
The number of internal assessments is even harder to estimate. Based on contacts with Universities of Applied Sciences, the number of internal assessments is probably somewhere between 50 and 150.
Added together, the internal and external assessments have taken place in a considerable number of programs. It must be said, however, that they still are only a rather small minority of all study programs in the various HBO institutions, and so only a small (but increasing) percentage of HBO students benefit from AISHE assessments.
Nearly all of these assessments in the Netherlands took place in HBO. Dutch research universities don't show much enthusiasm about the use of AISHE, as just one of them has applied the tool: the Open University of the Netherlands. A case report about it is published (Roorda and Pérez Salgado, 2007). Other case reports are described in Roorda (2004) and in Roorda, N. & P. Martens (2008). Some hypotheses exist about the lower enthusiasm about the use of AISHE within the research universities. As these hypotheses have not been tested, this dissertation will not discuss them, in order to avoid speculations.
In 2003, Wageningen University planned to have an AISHE assessment. WUR (2003):

> "Through the signing of the Copernicus Charter Wageningen University has committed itself to the stimulation of environmental ethics in education and operations. The present situation regarding sustainable development in education can be assessed with the Auditing Instrument for Sustainable Higher Education (AISHE). In 2003 it was investigated whether the AISHE audit is a suitable instrument for Wageningen UR. The results of the investigation are positive. A pilot in 2003 was possible. The Labor Circumstances & Environment Department made a

> proposal for this to the University Staff Department of Education. It appeared to be impossible to realize the pilot in 2003. The planning is that it will be started in 2004."

The planned AISHE assessment however never took place. In May 2008, Maastricht University designed a sustainability policy plan. According to this plan (de Bruijn et al, 2008), a series of AISHE assessments will take place before the end of 2010. And in 2010, an analysis based on AISHE was made of the situation concerning ESD in the Radboud University Nijmegen (Schellekens, 2010).

AISHE has been used in several other countries. In Belgium, two Universities of Applied Sciences have used AISHE intensively. One of them, the Katholieke Hogeschool Leuven, assessed all its departments in the course of a few years, and based its university-wide sustainability strategy on the results. An 'AISHE Reflection Group' has been set up by the Belgian ESD network organization 'DHO Vlaanderen', assisting Belgian universities that want to apply AISHE. The group organizes regular meetings. In 2009, the group reported that 9 Flemish universities (research universities and hogescholen) are interested in performing AISHE assessments.
In Sweden, the application of AISHE is coordinated by an NGO which is comparable to the Dutch DHO, HU2 ('Högre Utbildning för Hållbar Utveckling', 'Higher Education for Sustainable Development', www.hu2.se) which was founded in 2006. In 2008, the Swedish translation of AISHE was published (ISBN 978-86135-17-1).
In Spain, a series of AISHE assessments were performed in the University of Santiago de Compostela. In Ukraine, the National University of Kiyv - Mohyla Academy applied AISHE. Furthermore, AISHE was also applied in universities in Germany, Finland and Austria.
In Belarus, universities are interested in applying AISHE, thanks to a cooperation of them with the Dutch ngo Nuffic in a Tempus project. Van Oijen (2008):

> "It is remarkable how open our partners in Belarus are for the involvement of students and alumni in the educational evaluation, and for our ideas about the integration of sustainable development in the curricula with the Auditing Instrument for Sustainability in Higher Education (DHO's AISHE)."

AISHE was described or mentioned in a range of publications, dedicated to ESD in e.g. Asia (Maguire, 2009), Africa (MESA, 2006), Canada (Cole, 2003), Belarus (Martsinkevich, 2008), Portugal (Fernandes Damião Madeira, 2008), Brazil (Santos da Silva, 2005) and Australia (Lang, Thomas & Wilson, 2006).
AISHE has not been applied so far in the USA, as far as is known. But a PhD study by Corrine Williams has started in 2009, taking the framework of AISHE as its fundament. The study investigates the relations between leadership styles and the implementation of sustainable development in American universities.
In September 2009, a workshop on the use of AISHE was given in Argentina. Representatives of universities in Argentina, Brazil, Colombia, Venezuela, Ecuador and Spain participated, with the aim of setting up a Latin American network for the application of AISHE.

7.3.3. Users' appreciation of AISHE

The appreciation of AISHE by its users will be assessed through the three cases that were mentioned above. For this purpose, questionnaires were filled in by representatives of the three university departments. The interviewed persons were:
Inholland HTRO: the interviewee is Arjen van Tol, one of the twelve teachers of the study program, who chairs a group of three teachers that have an official task of stimulating and implementing ESD in the study program.
Marnix Academie: the interviewee is Gerben de Vries. He is the coordinator of the Taskforce for Sustainable Development at the Marnix Academie.
Fontys TNW: the interviewee is Marthie Meester. She is the manager of TNW.
The full responses of the three interviewees are printed in Appendix 6. A short overview of some of the answers:

> "[The use of AISHE] was helpful in many ways. It gave us direction to create an own vision and some tools to implement this vision in our organization and curriculum.
> The method is very clear about the different areas which should be taken in account when you try to implement sustainability in your organization."
> "It helped to get clear development standards for working on ESD as part of the total academy, starting with the theoretical part (vision, policy, expertise) and slowly working its way into practice (curriculum, assignments, evaluations etc.)"
> "AISHE is very helpful. It forces us to look at the different aspects of the audit, how they fit with our vision, policy and education goals and to identify the 'gaps' in our curriculum. As a consequence we formulate goals for the next year in how to fill the 'gaps'."
> "Without AISHE it would have been a lot harder to convince the management of the importance of sustainability in our curriculum and in the way we behave. I think it would have taken a much longer time before we would reach our present situation in which sustainability is integrated in every part of our curriculum and in which we stimulate our students and give them the tools to come up with their own vision on the role sustainability

should play in our society."
"Without AISHE we would not have explicit statements in relevant documents as year reports, vision documents etc.
Without AISHE we would not have a structural stepwise 'building' of ESD in the total program, from first till fourth year.
Without AISHE we would not have an external board of advisors, who cooperate in lectures from time to time.
Without AISHE we would not have ESD as a 'weaving project' in our institute.
Without AISHE we would have had less pressure on the implementation of ESD and less reorganization in the direction of SD."
"Without the use of AISHE we wouldn't have got the task from our Board to develop the minor People, Planet, Profit. Because of our 'stars' we were known as a department interested in sustainable development within Fontys."

These reactions make clear that both the assessment instrument and the star-oriented Certificate made a real contribution to the ESD development within these universities.
Several other Universities of Applied Sciences have decided to use AISHE as a major element in their strategy on sustainable development. A good example is the Hogeschool Rotterdam (*not* related to the Rotterdam departments of Hogeschool Inholland), which wrote about its sustainability strategy (Brouwer, 2009):

"Central is the integration of knowledge about and insight in sustainability in the education. In all curricula sustainability will have its place. For the determination of the goals for the study programs, the future AISHE audits will have a major role. Through the AISHE audits insight is gained in the existing policy and activities, and next goals can be formulated. The aim is that within a period of 5 years all study programs will have integrated the subject of sustainable development at least at the process level (in AISHE terms this means that each program has acquired at least two stars). (…)
Central is the university program management which positions itself in relation to the institutes as a service department, reacting to their demands. The program management stimulates that within every institute a project 'Sustainable Institute' is started. A fixed element of this plan is a policy to audit all study programs using the AISHE method. The results of the audits will be integrated in the policy for the 'Sustainable Institute'. (…)
Nine teachers from various institutes are participating in an in-company training by DHO to become AISHE auditors, with the purpose of performing within the next two years a pilot audit in all study programs of the university."

This citation illustrates that the Hogeschool Rotterdam, just like Fontys Hogescholen, follows a strategy of non-forced stimulation of sustainable development in its institutes.

7.3.4. External stakeholder appreciation of AISHE

The first reactions from external stakeholders to AISHE appeared already during its development. The Dutch Ministry of Environment ('VROM') contributed to it financially, through a subsidy of *Dfl* 70,000 (€ 32,000) in 2000. This ministry went on supporting AISHE in its first years of dissemination: it contributed *Dfl* 170,000 (€ 77,000) in 2002, and *Dfl* 131,000 (€ 60,000) in 2003.
In 2000, the Dutch Advisory Council for Research on Spatial planning, Nature and the Environment (Raad voor Ruimtelijk, Milieu- en Natuuronderzoek, RMNO) wrote in an advisory report to the government about strategies for sustainable development, e.g. in higher education. At that time the development of AISHE had only recently started, and HBO still made use of a result-oriented strategy based on the 'Handvest Duurzaam HBO' and its Protocols. The Council wrote (RMNO, 2000):

"In a project 'Auditing Instrument for Sustainability in [Higher] Education' criteria are being developed (...) for the assessment of sustainable development in educational institutions. (...)
The Ministries of Education, Agriculture, Environment and Economics can (making use of the above, further to be developed criteria) agree on a covenant with the research universities and research centres (in line with the HBO Handvest) in which a protocol determines the progress of the operationalization and implementation of sustainable development in the institution."

The results of the recommendation were evaluated in RMNO (2008). This report describes a range of applications of AISHE within HBO, but hardly any concrete results in the Dutch research universities. In spite of the RMNO recommendation, such a Handvest-like covenant for the research universities was never developed or signed. But the citation illustrates that the RMNO, an important Dutch council, supports the idea of an approach along the lines of covenants and assessable results.
In 2004, the Dutch Social-Economic Council (SER) pointed at the availability of AISHE (de Hoog, 2004).

Reviews

An early evaluation of AISHE was written in 2002 by an American ESD researcher, Michael Shriberg, who made a comparison between several ESD assessment tools, most of which consisted of standardized questionnaires. Shriberg based his review of AISHE on information that he had received before the tool was finished and tested, and he wrote (Shriberg, 2002):

> "AISHE focuses on process over content, qualitative over quantitative measures, and descriptive over prescriptive measures. Thus, AISHE is both an auditing method and a policy instrument around which other sustainability tools, such as ISO 14001, can form. AISHE's process-orientation captures dynamic decisions involved in managing for sustainability.
> Moreover, the developmental stages encourage measurement of progress without forcing quantitative measures. Thus, AISHE provides for potential cross-institutional comparison.
> A significant weakness of AISHE is that the criteria are somewhat abstract and difficult to comprehend. However, the creators of AISHE are developing assistance tools, examples, reference lists, and a training program to make the criteria more tangible and comprehensible. Moreover, AISHE does not explicitly include indicators about motivations for pursuing sustainability. In other words, it seems possible to use the tool without explicitly addressing the reasons for moving a campus in a particular direction.
> Overall, AISHE is an excellent example of a process-oriented approach to sustainability assessment. The consensus-building approach to designing AISHE is creating a flexible platform upon which to stimulate and operationalize sustainability in higher education. Thus, AISHE has the potential for global reach and appeal."

Above, Shriberg describes two possible negative aspects of AISHE. In a later publication (Shriberg, 2004) he summarizes the positive and the negative aspects that he sees:

> "Major strengths:
> - Flexible framework for institutional comparisons;
> - Process-orientation which helps prioritize and set goals through developmental stages.
>
> Major weakness:
> - Difficult to comprehend
> - Motivations are potentially excluded."

The practical tests and the experiences have shown that both potential weaknesses don't actually play a role. In all places where words, concepts or sentences caused interpretation problems, explanatory texts have been added. Besides, in external assessments, the certified assessor is present and has the ability to explain any kind of interpretation problem or procedure uncertainty. This is not the case in internal assessments, but as many universities have done such internal assessments, it appears that they have the feeling to be able to use AISHE.
Regarding the motivations weakness: it is true that there are no explicit criteria assessing the motivations of people. However, the practical use has shown that their motivations and drives are amply discussed, and so it seems that this is also no real problem.
Some other authors however have signaled some weaknesses that have been confirmed by the practical experiences. One of them is Lozano-Ros. He published a study about ESD (Lozano-Ros, 2003) in which he dedicated a chapter on the use of assessment and reporting tools. In this chapter, two examples are studied: GRI (the Global Reporting Initiative) and AISHE. After describing the structure and application of AISHE, Rozano-Los …

> "… finds this method a good start for the assessment of the university, but it does not present, with enough detail, the different aspects that could appear in an institution. It lacks the evaluation of the campus operations and its outreach to the community. In matters of reporting, its performance is good and it could be used satisfactorily in a benchmarking process against other institutions or with the same institution, over time.
> The main advantage of the method is that it is relatively easy-to-use and the results of its application can be easily seen and understood by the different stakeholders."

Indeed, AISHE focuses on the educational role and on the underlying vision of the university, and does not pay much attention to the other three roles: research and operations, both mentioned by Lozano-Ros, and societal activities (or community outreach). This lack of attention was one reason why in recent years a new project has started, aiming at the redevelopment of AISHE (see chapter 9). A second reason for the current redesign is related to another problem with the use of AISHE, described by Cole (2003). She wrote:

> "The tool is very interactive, and directly involves decision-makers and those affected by decisions in measuring performance. It is engaging and helps to build capacity and understanding of participants in campus sustainability issues. The assessment results are visually stimulating and useful for decision-makers. The tool requires workshop participants to describe desired future states of performance, and to define implementation plans on how to reach these future states. Thus it is firmly grounded in action and improvement.

> The tool only works with small groups, and it is focused on assessing sustainability in terms of educational performance of individual departments only. It misses many campus sustainability issues in terms of operations, research, finance, governance, etc. It has a very limited, although important scope, and can only assess one academic department at a time. The results rely entirely on the subjective experiences of those participating in the workshop. This limits the ability to compare performance across campuses, and even across departments on the same campus. Thus to assess a whole campus' state of sustainability in terms of education issues only, would take a very long time and require a great deal of human resources. It currently requires the involvement of an expert facilitator, of which there are only currently three in the world, to run an effective workshop and assessment."

One of Cole's objections have been disproved. Instead of delivering subjective results, the assessments render intersubjective results. This has been proved during the validation process (see Appendix 5), when in one University of Applied Sciences (Hogeschool Larenstein, now a part of Wageningen University) an assessment was done twice for one and the same study program. The two groups of participants were composed identically, which was possible thanks to the fact that there was a dual management: each manager participated in one of the groups. The two assessments took place on two consecutive days, and there was no communication between the members of the two groups. The results for the 'present situation' were nearly identical for the two groups. The description of the 'desired situation' was also very similar but had some more differences, which is natural, as this was not based on a realized situation but on the imagination and creativity of the persons involved.
The intersubjectivity of the results that the AISHE assessments delivers is very important, as it proves that the results can be trusted and compared between departments and universities.
Another objection by Cole, the existence of just three expert facilitators, has been removed through the annual assessor trainings. At the moment there are more than 10 certified assessors, which suffices for the Netherlands. Plans for international assessor training programs are in preparation.
A more serious problem that Cole signals is the fact that AISHE can only assess one academic department at a time. This fact has been a reason for much discussion, and it was the second reason for a redevelopment of AISHE, this time in an international context, which started in 2007. This project, called 'AISHE 2.0', has not yet been finished. It is described briefly in chapter 9.

Other ESD authors wrote about AISHE, e.g. Van Dam-Mieras, Lansu & de Kraker (2007):

> "The use of a well-designed assessment tool, developed according to quality management principles, helps to integrate a commitment to sustainable development in higher education in several ways. The assessment enables those responsible to find out what has been achieved and to plan the next steps. Experiences with the assessment tool AISHE (Assessment Instrument for Sustainability in Higher Education) made clear that assessment can also be used as a means of rallying the support and enthusiasm of the teaching staff and students involved in the implementation process. Another advantage of a systematic assessment is that it leads naturally to a situation in which fostering sustainable development becomes part of a university's mainstream activities, rather than being an isolated activity. Other interesting outcomes of a series of audits with AISHE are that the universities tend to have neglected to evaluate stakeholder appreciation of their contributions to sustainable development, and usually select improvement of communication about these contributions as one of the highest priorities."

Jansen (2008):

> "Meanwhile standards, like the AISHE (Auditing Instrument for Sustainability in Higher Education) certificates (Roorda, 2001, 2004), may serve to measure the comparative progress on integration in institutes of HE."

Perhaps the most recent review of AISHE is published in a comparative study of tools for the environmental management system (EMS) of universities (Clarke & Couri, 2009). Actually this is somewhat surprising, since AISHE was never meant to be an EMS tool. Not surprisingly, the authors conclude:

> "AISHE is called an auditing instrument, but it is in fact an EMS development model, as well as an environmental education auditing tool. It indirectly outlines the components of a campus EMS. AISHE significantly differs from the content described in the ISO 14001 model. It has a completely different focus, different categories, different components, and a different layout. (...)
> AISHE in particular has a category on result assessment which is based on the awareness, understanding and environmental stewardship of staff, administrators, faculty members and students, as well as on the perception of companies and other societal actors who work with the university in relation to their environmental record. This is a type of ''checking'' of the results of the planning and implementation, though it is not based on targets or measurable indicators. Rather, it tries to measure the intangible outcomes of environmental education. Instead of measuring processes such as 'how many graduates have taken an environmental course' it tries to measure the actual outcome of changes in awareness. AISHE does call for measurement of pledges from graduates to pursue sustainable careers, and of certifications, publications, and awards for internal environmental manage-

ment, sustainability research and sustainability education. These types of measurements are definitely distinct to this sector."

The accreditation of Higher Education

The first contacts between DHO and the NVAO, the Dutch & Flemish accreditation organization of higher education, took place in the years when the structure of the accreditation system was being developed. The proposal was discussed to integrate the concept of sustainable development within the accreditation structure. After the accreditation structure and procedures were defined, this appeared to be impossible, as the structure was designed in such a way that subjects like sustainability, CSR, ethics etc. could not have a suitable place in it. Besides, the NVAO board argued, sustainability is an aspect of the content of education and not of its quality, and so it should not be a part of the accreditation system.

A few years later, a second opportunity became available, when NVAO opened the option for study programs to prove that they possess a 'special characteristic'. Programs that succeed in this, receive a 'NVAO certificate'. After a second series of discussions, followed by a thorough investigation by NVAO, at the end of 2006 DHO and NVAO agreed on the following:

- NVAO recognizes sustainable development as a suitable 'special characteristic' in relation to the accreditation, and opens the possibility for the awarding of the 'NVAO certificate on sustainable development'.
- NVAO recognizes AISHE, including the Certificate of Sustainability in Higher Education as a validated instrument for the assessment of the NVAO certificate.
- NVAO recognizes DHO as the organization that performs such assessments.
- Study programs which possess the DHO Certificate of Sustainability in Higher Education at a star-level which is at that moment state-of-the-art, will automatically receive the NVAO certificate from the NVAO, i.e. without NVAO doing any further assessments.
- At the moment of the agreement, the state-of-the-art level is two stars. Together, NVAO and DHO will annually determine if this level has to be raised to three or four stars.

A few weeks after the agreement, NVAO awarded its very first certificate. It was dedicated to sustainable development, and it was awarded to the Fontys School of TNW, early in 2007. After the news about the NVAO certificate was spread, this proved to be an important stimulus for universities to perform AISHE assessments.

In 2008, an interview was published with Carl Dittrich, the chairman of the board of NVAO. When asked why sustainable development is a separate and optional NVAO certificate instead of an integrated and obligatory part of the accreditation system, Dittrich answered (DHO, 2009):

> "NVAO is clear: study programs have to decide for themselves, we don't want to impose anything. CSR or sustainable development will never be a criterion within the accreditation procedure. NVAO just handles the quality of the education. The connection between quality and CSR has not been made and this will not happen soon. Quality is a consequence of ambitions, content and quality of teachers. Some do this in a sustainably responsible way, others don't. But both still go for quality."

Discussions with NVAO are still going on, especially about the question whether sustainable development should be considered as an integrated element of quality.

7.3.5. Transfer of expertise

AISHE was developed for the target group of higher education, as the last two letters of its name indicate. Nevertheless, it has inspired some organizations to use or adapt it in other sectors.

In 2002, an AISHE assessment was performed in the ROC Wellant College, an institution for secondary vocational education. Although a few criteria had to be reinterpreted in some ways, this appeared to be well possible.

In 2010, a request was received to apply AISHE in a lower-level school, a part of the Penta College, for professional education ('VMBO-school') as a starting point for the development of a sustainability strategy.

A Dutch ngo was founded in 2005, called the Foundation for Sustainable Teacher Education for Primary Education ('Stichting Duurzame Pabo'). In 2006 – 2007, a working group of this organization, chaired by Gerben de Vries, adapted AISHE to be used in primary schools, called 'AISHE BAO'. ('BAO' stands for 'basisonderwijs', primary education). In 2008, pilot assessments took place in six primary schools. In 2010, more than 20 schools are planned to have an AISHE BAO assessment.

The Dutch organization Nuffic is the Netherlands Organization for International Cooperation in Higher Education. One of its activities is the financing, on behalf of the Dutch government, of cooperation projects between educational institutions in the Netherlands and in Third World countries. Nuffic studies on the possibility of designing an adaptation of AISHE in order to enable them to assess the quality regarding sustainable development of these cooperation projects. For this goal, three Nuffic staff members participated in an AISHE assessor training in 2008.

In 2009 a project started to adapt AISHE in order to make it suitable for commercial companies, especially SME's. The project is coordinated by a working group of the Rotterdam School of Economics of Inholland University, chaired by Peter Lemming.
Stern (2009) used an abbreviated AISHE audit to assess the education department of Aalborg Zoo (Germany).
The three fundamental decisions about the structure of AISHE (content oriented vs. process oriented; quantitative vs. qualitative; and prescriptive vs. descriptive) are quoted by Shamsuddoha (2005), who applied AISHE's basic philosophy for an analysis of the sustainability strategy of the University of Chittagong in Bangladesh.

7.4. Conclusions

Putting all conclusions together, the following result arises (table 32).

Table 32. Experiment #4: Evaluation

Criterion \ Experiment	X4 AISHE	Assessed hypothesis	Evaluation	Judgment
Contribution to ESD towards direct stakeholders				
Implementation of ESD in vision, policy	§7.3.1	1. Application of AISHE contributes to system integration of sustainable development (SISD).	Results show that AISHE contributes to ESD on all levels of integration, including the realization of SISD.	++
Implementation of ESD in education	§7.3.1			
Customer demand	§7.3.2	2. AISHE attracts a sufficient number of users.	In the Netherlands, most Universities of Applied Sciences have used AISHE; many of them have acquired one or more Certificates of Sustainability in Higher Education. However, the percentage of HBO students who benefit from this is still low. Dutch research universities hardly use AISHE. The use outside the Netherlands is increasing.	–
Customer appreciation	§7.3.3	3. Users appreciate the application of AISHE.	Institutes that used AISHE are highly enthusiastic about the application, the easiness of its use, and the effects.	++
Contribution to SD towards indirect stakeholders				
Indirect stakeholder appreciation	§7.3.4	4. External stakeholders appreciate the application of AISHE.	Reviewers see the positive effects of AISHE but also are critical to some aspects. The NVAO officially recognized AISHE.	+
Contribution to SD through HE		*(not applicable)*		
Transfer of expertise	§7.3.5	6. AISHE contributes to ESD implementation elsewhere.	A derivative of AISHE is used in primary education. Other derivatives may be developed but don't exist yet.	+

Strong points of AISHE and the Certificate are: They are successful as a means to develop, implement and evaluate an ESD policy; they are easy to use and appeal to the users; the basic philosophy is well-defined. In some cases it contributed significantly to the realization of SISD. It raises involvement and enthusiasm with the participants. The assessment results are realistic.
Weak points are: only a low percentage of study programs make use of AISHE. It pays hardly any attention to the university research, operations, and community outreach. Only one or a few study programs are assessed at once, so the evaluation of an entire (large) university is very time-consuming.

The questions with which experiment #4 started, are:

- Can sustainable development become a part of the mainstream of the educational processes in a university, implementing system integration of sustainable development?
- Can a quality management approach contribute effectively to this system integration?

The application of AISHE, partly as a main tool for the consultancy by DHO, and partly as a tool for internal and external assessments, has proved to be a valuable contribution to the process of ESD development in Dutch HBO, as well as in higher education in other countries. It has also proved to enable universities to define, and help them to implement, ESD at a systems level, realizing SISD. This implies that both questions can be answered positive.

8. Experiment #5: An instrument for the introduction of sustainable development

One of the learning experiences of the DHO consultancy during the last decade is, that many teachers find the concept of sustainable development difficult to grasp. This impression was confirmed by an investigation that was made by DHO among its network members in 2004. Teachers gave the concept qualifications like: 'vague', 'not very scientific', 'container concept'.
For this reason, the consultancy resulted in many workshops with teachers in higher education, focusing on the introduction and clarification of the concept, aiming not only at an increase of knowledge but also at an intuitive understanding of the concept. Nevertheless, the lack of understanding among teachers appeared to be a major bottleneck for the integration of ESD in the Dutch universities. One of the complaints by many teachers was:
"Literature about sustainable development is abundantly available; but none of them seems to explain the general concept at a beginners' level in a balanced way. We need a basic introduction to sustainable development, which we can use as study material for our first year students. But we cannot find it."
This general complaint was the reason for the start of the next experiment.

Question:

- Can an instrument be developed for the introduction to sustainable development that is applicable in study programs of many different educational sectors?

In chapter 5, the introduction of new educational methodologies in HBO was described. In problem-based learning (PBL), for instance, students have the freedom to define their own learning goals, thus carrying a part of the responsibility for their own learning process. In project education, it is often a part of their responsibility to design the project process.
A logical next step for HBO was the development of education in such a way that the students would carry the responsibility for the design of their own curriculum, on an individual basis. In the years around and after 2000, attempts were made in many HBO institutions to realize this, supported by several trends, like an increasing role for computer-aided education and a process of internationalization of higher education.
In the same period, the structure of higher education was redesigned, based on an agreement on a European scale, made in Bologna.

Context (§8.1):

- Increasing flexibilization of higher education
- Increasing availability of innovative applications of ICT
- Internationalization of higher education
- New educational structures, resulting from the Bologna Agreement

In this context, the need for an introductory instrument to sustainable development was expressed repeatedly.
In cooperation with a large Dutch educational publishing company, the question was investigated, what the characteristics of an introductory instrument should be. Such an instrument, aiming at HBO, consisting of a book, the 'Basisboek Duurzame Ontwikkeling' ('Basic book on sustainable development') and a series of other tools, was made.

Action (§8.2):

- Development and application of an instrument for the introduction of sustainable development for HBO teachers and HBO students, consisting of a text book, a website with accessories and a teacher manual

The instrument consists of much more than just a book, which was published in 2005, because a series of online tools was designed, varying from spreadsheets, computer applications, supporting texts, and a teacher manual. As chapter 8 will show, the instrument was developed and evaluated in cooperation with experts on sustainable development, with HBO teachers and with students.
User experiences of teachers and students will form part of the answer to the key question of chapter 8, whether the approach that was used was an effective one.

Result assessment (§8.3):

The question of the present experiment will be assessed by testing the following hypotheses:

1. The instrument meets the demands of ESD.
2. The instrument is used by a sufficient number of teachers and students.

3. Teachers and students appreciate the instrument.
4. External stakeholders appreciate the instrument.
5. The instrument contributes to SD implementation elsewhere.

8.1. Context

8.1.1. Flexibility of education

In chapter 4, a process was described in which, in the last decade of the 20th century, HBO went through a reformation. In this process, a shift of focus took place from teacher centred education to student centred education, or from teaching to learning. A major change in the university structure, enabling this change process, was the toppling of the organization, from expert teams to study program teams. One of the major reasons for this process was the desire to create 'activating education' (van Woerden, 1997), in which a personal commitment of the students is stimulated and the responsibility for the learning process shifts from the teacher to the student.
Following this route in a consistent way, new educational methodologies were developed, as described in chapter 5. Problem based learning (PBL), for instance, put the responsibility for the learning goals (within certain boundaries) with the students (see §5.1.2). An important aspect of the new didactical approach was the concept of 'learning to learn' (Lowyck & Vermunt, 1997).
This development was of great importance to ESD. As table 6 (§2.3) shows, concepts like 'learning to learn', 'responsibility' and 'commitment' are key aspects of ESD. Hence, the logical continuation of the above process was equally relevant for ESD. This continued process mainly took place in the course of the first decade of the 21st century. Around 2000, many HBO universities attempted to increase the personal responsibility of the students even further by offering them the opportunity to design their own learning process. This was done by creating a flexibility of the education, aiming at individual learning routes. This 'demand driven education' was the final consequence of the development of 'process oriented education' (Vermunt, 1997).
New options for learning routes were created thanks to technological innovation in the area of ICT, enabling educators to design new kinds of computer aided education (CAE), as will be described in §8.1.2. The growing international cooperation between universities gave the students the freedom to perform a part of their study abroad, as §8.1.3 investigates. And the flexibility even gained a legal character when a new educational structure resulted from the Bologna Agreement, e.g. creating the major-minor structure, which increased the opportunity of all students to select parts of the study program themselves; see §8.1.4.
Flexibility was also realized through the adaptation to a flexible inflow of students, of which the heterogeneity increased in the last decades, e.g. differing in the earlier acquired competences or qualifications (Kessels & Ehlen, 2006; e.g. dual learning), age (e.g. as a part of lifelong learning), or background (e.g. immigrants).
The educational philosophy of the individual learning routes was described by the Hogeschool Windesheim (2009):

> "The individual wishes of the student form the starting point for the determination of his learning route. This goes beyond just the selection of study elements. The student has the opportunity to indicate how he wants to develop certain competences and which form of assessment is suitable.
> All bachelor programs of Windesheim have a position within one of our ten Schools. Programs with related contents within a School offer a common major. A university-wide framework has been determined, which enables flexible learning. As a consequence, the traditional concept of 'study program' has vanished.
> Students have a maximum freedom to design their learning program either broadly or deeply. They have the opportunity to learn beyond the boundaries of study programs (broad bachelors)."

The organizational consequences are far-reaching. One of the major problems in realizing the ideal of total and absolute freedom is related to the fact that the HBO education prepares students for their professional life. As a consequence, there has to be some way to guarantee that the professional quality of the students is sufficient to meet the needs of the professional field. A part of the solution to this problem is looked for through 'competence based education', which will be the subject of the next chapter.
Another problem was the threat of a far too low educational efficiency, as the work load for a teacher will increase tremendously if he can no longer act as a teacher for groups of tens or hundreds of students but rather as a coach for individuals. Besides, the practical organization may become impossibly complex. "Educational programs seem, at this point, unable to meet the needs of increasingly different categories of students and allow for self-directed learning of individual students, as long as they are defined in terms of fixed time schedules, fixed student cohort groups and predetermined activity schedules." (Schellekens, 2004)
Consequently, the universities designed several ways to find a compromise between an optimal freedom for students, and a practical solution to the demands of feasibility and efficiency. In many cases this resulted in a situation where a variety of educational modules or streams were offered out of which the students could make a selection. An example of such a solution is shown in box 16. The Design Academy is a small University of Applied Sciences (ca. 700 students) in the city of Eindhoven, dedicated entirely to Arts Education.

Box 16. Flexibilization of education: the Design Academy, an example

"Design Academy Eindhoven approaches design not as product design based on separate disciplines, but rather as an element of general human needs. With this more contemplative form of education, a range of eight different research areas are presented, mapping the broad area of design for daily life: identity, well-being, living, leisure, activity, communication, mobility and public space. Each research area is linked to a *design department*. From these nearly unlimited possibilities the student acquires a personal position and working space, challenged by the study program. Right from the start of the program the focus lies on the personality of the student. Who is he? What can he do? What does he want? What are his dreams?

Design Academy Eindhoven knows a flexible curriculum based on two pillars: the eight design departments, and four *quarters of the compass*. Together they are like warp and weft. The eight design departments, described above, form the content domains within which the students graduate. The four quarters of the compass each represent an attitude and an interest of the designer: 'Atelier' (craftsmanship), 'forum' (culture), 'market' (economy), and 'lab' (research and experiment). During their study the students select out of each of the two pillars a combination as their final graduation profile. Thanks to the complementarity of the compass and the design departments, the academy is able to respond to the innumerable affinities and ambitions that the students develop in the course of their study. This flexibility is an explicit aspiration, as the personality of each student is the focus."

Source: De Vries, 2007

In the next subsections, the announced subjects of CAE, internationalization and the consequences of the Bologna Agreement will be described, together setting the stage for HBO around 2010 (apart from the introduction of professional competences, which will have its own chapter). After that, in §8.2, the relevance of them all will be described for experiment #5, the development and application of basic study materials for ESD.

8.1.2. Computer aided education (CAE)

Since the development of computers, information & communication technology (ICT) has found its way into the daily routine of society. "ICT is defined as: all electronic facilities, in which information technology and / or communication technology is used" (Wolf, 1998). For education, Lubberman (2001) discerns four main functions of ICT: (1) Learning about ICT; (2) Learning supported by ICT; (3) Learning through ICT; and (4) ICT as support for the organization and its management. The 2nd and 3rd functions are described as computer aided education (CAE), and they are relevant for this chapter.

According to Wolf (1998), a distinction can be made between different applications of ICT in education. The first three of them are the most interesting in the present chapter:

1. Communication: communication between one or more persons
2. Information: communication between persons and information sources
3. Application: using education application as courseware
4. Assessment: specifically aimed at assessments

Wolf's research describes that with the introduction of ICT the content of education and the education methods have changed. Education has become more flexible, because of the introduction of modules, tele-learning, more independence for the students and more room for differences between the study progresses of individuals. ICT also has become an education goal in itself and educational programs have become more practical, because new media give more possibilities for this (Wolf, 1998).

The introduction of ICT in higher education in the Netherlands

An early initiative of the Dutch government to give ICT a more central role in higher education was the so-called "Informatics Stimulation Plan" (INSP, 1984), introduced to stimulate the use of ICT in higher education (Onderwijsinspectie, 1985). During the first period of INSP the goal was to use ICT in existing educational programs and to develop new themes in order to create a better linkage to the labor market. Between 1983 and 1993 ICT was primarily used at a basic level, as most personnel and students used computers mainly for word processing. From 1994 onwards, after the World Wide Web was introduced, ICT was used by teachers to support the students via e-mail, and students could work together via internet. In the last decade of the 20th century, a part of the HBO institutions introduced computer based learning. The mostly used ICT sources were standard applications, sources on the web, e-mail and library search engines. ICT was not being used in the curricula at a large extent. One of the bottlenecks was that many teachers needed to develop their ICT-skills.

In 2001 a research report was published about the ICT in higher education (Lubberman, 2001). ICT was mostly used for communication and for searching information. Less used were discussion lists and electronic education materials. Most used were e-mail, library search engines and web browsing. ICT was also used for study tasks, and mostly used were standard applications, followed by educative simulation and specific tools for courses. However, groupware, computer conferencing and assessment programs were hardly used, Lubberman concluded.
In recent years, the importance of e-learning has grown considerably (Van Hout et al, 2006). Nowadays more and more institutes are using ICT extensively, mainly as a web-supplemented approach (Zemsky, 2004), e.g. in the form of video conferencing and virtual classrooms. More than 50% of the institutes of higher education are using electronic learning environments, which also gives way to a new practice: the peer review. Students comment on each other's assignments and the teacher becomes more and more a coach in this process.
The use of ICT in the Dutch higher education now has become very successful, as Schoonenboom (2006) concludes, and it also contributes to the flexibility of the learning process. Schoonenboom illustrates this with a case that is reprinted in box 17.

Box 17. ICT contributing to the flexibilization of education: Hogeschool Rotterdam, an example

"The teacher education program for nursery of the Hogeschool Rotterdam educates students in two years to a second degree teacher's license in the discipline of nursery. Graduated nurses are admitted to the program if they have at least one year of practical experience. This target group is highly inhomogeneous. So, the program has an explicit policy to use the differences between the students. Besides, the need was felt for a stronger match between learning and working. In 2001, this lead to the development of a flexible learning route, in which the student can decide on the route, the order and the starting moments of the various curriculum parts. Important elements in this flexible curriculum are: an electronic learning environment, a personal development and activity plan, a digital portfolio, a personal coach and three-monthly assessments. (…)
At the start of the curriculum, the teachers have followed a coaching program, assisted by an external coach."

Source: Schoonenboom, 2006

The use of ICT contributed not only to the flexibilization of higher education, but also gave a strong impulse to another important process which has taken place – and is still taking place – in higher education: the internationalization process. An example is the 'European Virtual Seminar' (EVS) which will be described below.

Serious games and simulations
"A serious game is a game designed for a primary purpose other than pure entertainment. The 'serious' adjective is generally appended to refer to products used by industries like defense, education, scientific exploration, health care, emergency management, city planning, engineering, religion, and politics." This is how the Wikipedia defines serious games (http://en.wikipedia.org/wiki/Serious_game, 2009).
Serious games can have a wide variety of types. Leemkuil (2006) mentions: action games, puzzle games, role playing games, adventures, strategy games, and simulation games. Subjects of sustainability in games can be e.g. ecosystems and natural habitats, economic systems, human civilizations, transport systems, etc. For instance, a well-known simulation game, 'The Sims", has a clear relation with sustainability through its 'environment score'. Lovink (2007) focuses on education, especially on the education of sustainable development, as he writes:

> "The term 'serious games' has been coined to describe games that have an educational purpose and non-entertainment goals. Educators are taking a hard look at one type of serious gaming, known as 'massively multiplayer educational games', and find strong potential for teaching and learning. These games are still time-consuming and often expensive to produce, but practical examples can easily be found. Interest is high. A sampling of massively multiplayer educational gaming applications across disciplines includes: studying foreign-language and culture; developing leadership and management skills; and, practicing strategy and applying knowledge competitively or cooperatively. (…)
> A focus on sustainability firmly links the field of serious games to our highly interconnected web of life in which all living things are interdependent functioning parts of a whole system. As such, serious games promoting sustainability would become participatory activities seeking to meet the needs of the present generation without compromising the ability of future generations to meet their own needs (Brundlandt). They could do so by developing capacity for creating organizations as living systems in alignment with nature so all life will flourish forever. Sustainability is at the core of reaching the Millennium Development Goals and thus helping alleviate poverty and realizing binding objectives of the international community. Sustainability is also about engaging responsible world citizens, including through games."

Lovink (2007) mentions several serious games related to sustainable development. Examples with more or less self-explaining names are:

- "Third World Farming" (shown in figure 39, http://www.3rdworldfarmer.com)
- "World without oil" (http://www.worldwithoutoil.org)
- "Adventure Ecology" (http://missioncontrol.adventureecology.com)

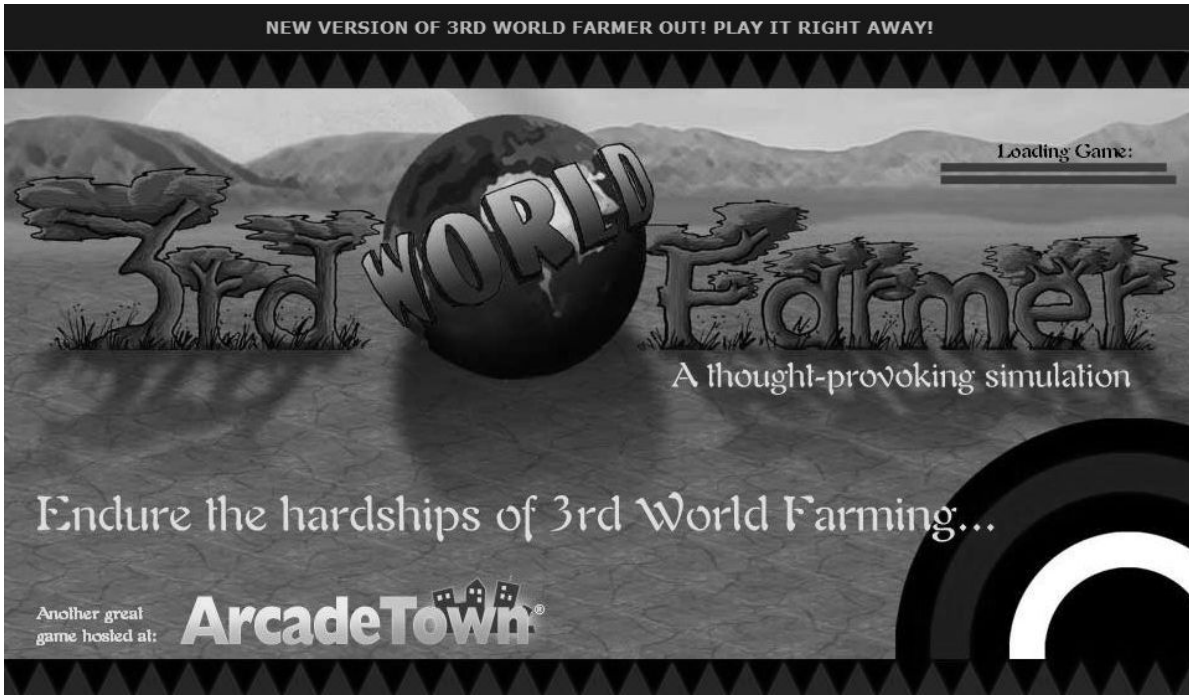


Figure 39. '3rd World Farming': an example of an online 'serious game' for sustainable development education

Education through gaming can have considerable advantages, as Leemkuil (2006) writes:

> "An important advantage of games in comparison with more traditional educational settings is that students within these environments are strongly involved and motivated and focus on long-term goals (Garris, Ahlers, and Driskell, 2002). Games on the one hand can motivate students to learn and practice something. On the other hand they can keep the students motivated in case they are well designed. Motivation is enhanced by several elements. By the appealing context and interface, and by the fact that players have a feeling of control over the (learning) process, because they can make their own decisions and by means of these can influence the outcomes of the activities, even if the actions are not instructionally relevant."

At the moment, a major barrier to a further introduction of games and simulations in the education is the lack of experiences with them of the teachers, as a survey showed (Sanford et al, 2006):

> "It is clear that there is still a generational divide between teachers and students in respect of computer games play, with 72% of teachers never playing games outside school in comparison with 82% of children reporting games play at least once a fortnight."

As this divide can be expected to diminish over time in a natural way, when the younger generations become teachers themselves, it is to be expected that the role of serious games will increase over the years.

8.1.3. The internationalization of HBO

Since the start of the Erasmus program, an exchange program for students launched by the European Community in 1987, internationalization of higher education has become an important subject on the political agenda in the Netherlands. Internationalization was seen as an important way to enhance the quality of the education and to improve the position of the Dutch institutes of higher education in Europe (Prins, 1996). "Internationalization of higher education can be defined as: the process of integrating the international dimension into the teaching, research and service functions of an institution of higher education" (Van der Wende, 1996).
In figure 40 this process has been visualized.

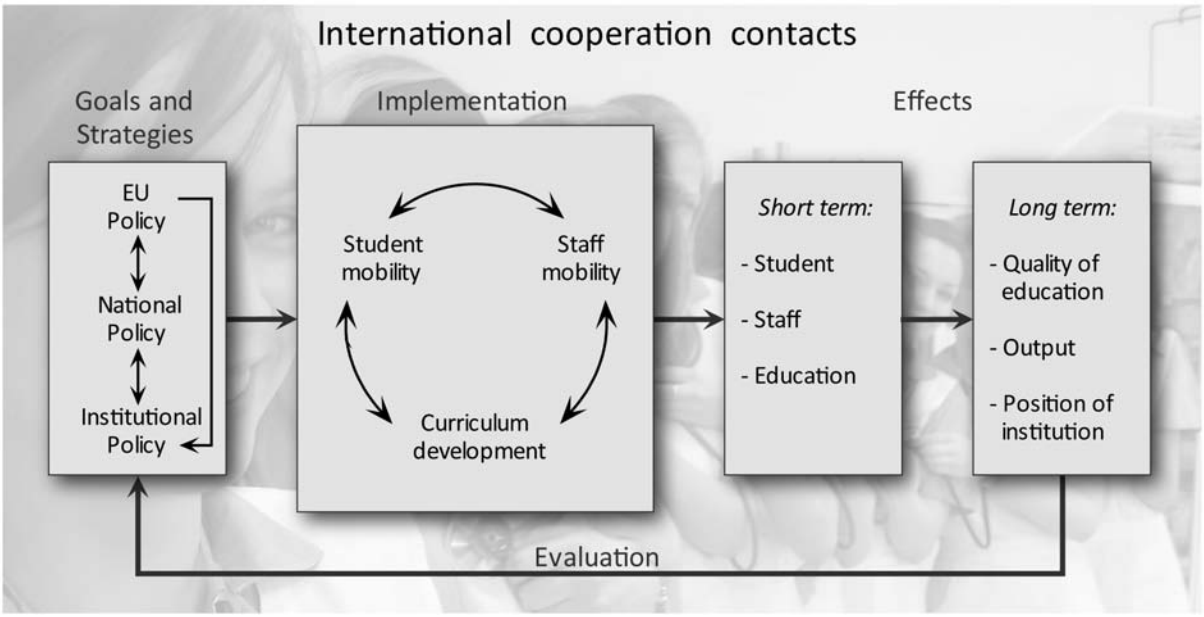


Figure 40. Goals and effects of international contacts. (Based on: Van der Wende, 1996, p. 8)

> "Three elements play a central role in the process of implementation: student mobility, staff mobility and curriculum development. As for the process effects, a distinction is made between short-term effects on students, staff and education (curriculum content and design, and the way in which the educational processes are organized), and long-term effects on the quality of education, on its output (the profile of the graduates) and on the position of the institute. The outer square of the model refers to the institutes international cooperation contact with foreign institutes (or companies)" (Van der Wende, 1996).

Stages in the internationalization process

Internationalization has been increasingly important in the past twenty years. The Dutch government tried to stimulate international cooperation between universities and an international orientation within the Dutch universities. In the eighties, student exchange was minimal. Some international educational programs were provided by Dutch universities, but not many foreign students came to the Netherlands to study there. One of the reasons was the lack of housing for international students. Besides, almost none of the educational programs was provided in English, and language skills of teachers were relatively poor, as the Dutch language was used as the medium of communication in courses. In most disciplines the use of literature was mainly in the Dutch language too. Foreign languages were only used when it was not possible to use Dutch. Besides, almost no possibility existed for students to develop foreign language skills within their educational program (Inspectie van het Onderwijs, 1992).

The stimulation by the government in the eighties mainly focused on strengthening an international orientation of Dutch higher education. In the nineties the aim of the government changed substantially, because "internationalization of higher education was placed within the context of wider policies for the enhancement of international trade relations, and it was perceived as a potential 'export product'. The major theme was the international economic and strategic position of the Netherlands on the long term." (Van der Wende, 1996).

In the so-called STIR-policy ("Stimulation Fund for International University Cooperation Relations"), started by the Ministry of Education in 1988, the Ministry tried to improve the quality of Dutch education through international contacts of students, teachers and researchers (SER, 1995). With STIR the institutions themselves had the responsibility to increase their international orientation and cooperation, and they had to finance a large part of these initiatives themselves. The STIR policy mainly focused on education, more than on research. Actually, two separate STIR-policies existed: STIR-SE ("Scientific Education" for the research universities) and STIR-HBO, because the internationalization in the universities and the HBO institutions were at different stages (Prins, 1996). The goals of the internationalization were:

- improvement of the quality of education
- enlargement of possibilities for graduates to find a job
- positioning of the HBO institutions nationally as well as internationally as an international organization
- an attitude change of students and teachers

Measures taken were:

- Stimulation of international internships for students as well as for teachers
- International guest lecturers

- Increase of international orientation of institutes related to the labor market.
- Stimulation of networks and cooperation between institutes
- Strengthening of infrastructure
- Stimulation of internationalization of curricula
- Increase of language skills of teachers and students

Actually there have been three stages in the STIR-policy (Prins, 1996):

1988-1990	Mobility of students and teachers as main goal
1991-1993	Realization of structural cooperation with foreign partners
1994-1996	Development of the curriculum in cooperation with foreign partners (structural cooperation networks are present and functioning)

These stages parallel the shift in orientation of individual institutes concerning internationalization, because institutes changed their orientation from a quantitative approach (focusing on the number of students exchanged as the main indicator of success) to a qualitative orientation, aiming at improving the quality of their education through internationalization. From around 1992 onwards, the development of internationalized curricula was increasing. First of all, the government policy stimulated this development. Another cause was the fact that more and more foreign students studied in the Netherlands. Internationalizing the curriculum has also been stimulated through the international labor market developments (Van der Wende, 1996). In this first period, most common internationalized curricula were the ones that focused on an international issue (like European Law) or curricula in which the traditional subject was being studied in an international comparative way (Prins, 1996).
In 1995, 85% of the institutions of higher education had formulated an internationalization policy. However, the quality management system wasn't yet adapted to monitor and evaluate the internationalization of the institutes.

Internationalized curricula
For a strong integration of internationalization into the education, the creation of internationalized curricula is necessary. The OECD defines such internationalized curricula as "curricula with an international orientation in content, aimed at preparing students for performing (professionally/socially) in an international and multicultural context, and designed for domestic students and/or foreign students" (OECD, 1994). This goes beyond just translating the existing programs and attracting foreign guest lecturers, because these actions do not lead to a change in the content of the existing programs. In these cases the content of the curriculum may not be international at all, they are just taught in a foreign language, according to Van der Wende (1996), who describes the goals of internationalizing the curriculum as follows:

- "strengthen the professional preparation of domestic students
- increase the breadth/depth of a subject area
- modify the curriculum to accommodate the heterogeneous population resulting from the inflow of foreign students
- develop special programs for foreign students
- strengthen students' chances in the labor market through internationally recognized (double or bi-) qualifications
- improve the quality of education
- social or humanitarian aims
- enhance the profile and reputation of the institution"

In the nineties it became clear that although internationalization was improving thanks to increasing mobility of students and teachers and more cooperation networks, the focus remained on student mobilization instead of internationalizing the curriculum. Besides, many HBO institutions were not able to finance the internationalization activities themselves. The STIR policy therefore was extended, and a deadline was set by which the HBO had to be independent from external financial support. Subsidies could no longer be used for incidental mobility of students, only in the context of structural projects (Prins, 1996).
In the late nineties the number of international educational programs increased, especially in the economical, behavioral and social sciences, agriculture, law, and the language and cultural sector. These sectors started to develop internationalized curricula in the mid-eighties, whereas e.g. medical, health, nature and technical sciences usually only started to develop internationalized curricula in the period after 1990 (Van der Wende, 1996).
In recent years, internationalization becomes more and more important. New economic powers, like China, India and Brazil are rising, which leads to a higher demand of highly educated people in these countries. There are also growing numbers of students from e.g. Pakistan and Turkey who wish to study in the EU.
The Dutch Minister of Education underlined the importance of a further internationalization of Dutch higher education (Inspectie van het Onderwijs, 2008), aiming not only at a national but also at a European level. In Lisbon in

March 2000, the member states of the European Union agreed that within ten years 50% of the working people should have a degree in higher education. In this way the European Union wants to develop itself as the most competitive economy of the world (Van Hout et al, 2006). Future years will show if this target will be reached.
The combination of the internationalized higher education and the application of ICT offers a range of interesting options for ESD. Examples are: virtual meetings, seminars, classes, campuses, consultancies; and digital study materials and tools.

Virtual meetings, seminars, classes, campuses, consultancies
The internet provides a whole range of different opportunities for people to meet in a virtual way. Many technical options exist, e.g. cameras and streaming media for virtual meetings and classes, chat sessions for virtual seminars, web portals, shared documents and virtual working spaces for cooperating documents production, e-mail for feedback, etc.
An early program that made use of the new technology was the European Virtual Seminar (EVS) on Enlargement and Sustainable Development, coordinated by the Open University of the Netherlands (Van Dam-Mieras, Cörvers, Winkelmann, 2002). In the program, started in 2001, twelve universities in six European countries participated. Teachers and students from a variety of disciplines were active, trying to develop study materials on sustainable development in the context of an enlarged European community.
Such a 'virtual seminar' is defined by Cörvers et al (2007) as "a didactic concept that promotes an international, multidisciplinary dialogue between students on authentic and current issues, using modern ICT and the internet to overcome the constraints of place and time." "The ultimate goal", the authors add, "of a virtual seminar is to create a dialogue between a learning community of geographically distributed students." Besides the EVS, Cörvers, Leinders & Van Dam-Mieras (2007) also discuss some other examples of such virtual seminars: EES, the 'European Environmental Science: Towards Sustainability course', and GS, the 'Global Seminar on Environment and Sustainable Systems', and illustrate them with a series of case descriptions.
Practical experiences of online coaching by teachers of virtual classes of students indicate that they can have much value, although they should not be entirely replacing face-to-face (f2f) meetings (Giesbertz et al, 2008).
One step further is the formation of a virtual campus. An interesting example is the Virtual Campus for a Sustainable Europe (VCSE), which is described in VSCE (2009). Instead of developing individual online cooperation programs, such a campus attempts to build a permanent academic community "which surpasses the gates of the academia and invites relevant societal actors in a public dialogue on how 'e-learning' may serve as a new, interdisciplinary and intercultural instrument in dealing with the particularly complex issue of sustainable development at a European level." The VCSE applies a wide variety of tools and methods, e.g. knowledge maps, story telling, knowledge café, encyclopedias and dictionaries, virtual helpdesk, virtual companies, e-journals.
A description of one such method is offered in Ivens (2002): the Virtual Environmental Consultancy Agency (VECA). This is not a role playing game for students but an actual company: "Students working in the VECA address real orders on behalf of real external customers, and deliver real products", as Ivens writes. In a 2007 publication about this (where the shorter name 'VEC' is used, leaving the word 'Agency' out), examples are given of such consultancy: e.g. risk assessment of soil pollution (client: TNO MEP); health risks of enlargement of Eindhoven Airport (client: Municipality of Eindhoven); energy use of food transport (client: De Kleine Aarde, an NGO) (Ivens et al, 2007).

The above examples illustrate that modern ICT technology offers ample opportunities to use new tools and methods for education. Many of them enable the realization of the characteristics of ESD, as described in table 6, and so these new kinds of education can contribute not only at a content level but at the same time at a methodological level. Besides, the use of e-learning can lead to a reduction of the environmental impact of education, especially if it leads to a reduction of travelling, as Pérez Salgado (2008) showed.

Digital study materials and tools
Many educational materials for ESD are available online. Some examples of such tools and methods were mentioned already, e.g. encyclopedias and dictionaries. A 'wiki'-like approach to such sources is especially interesting, since it allows many people to contribute, thus stimulating active learning tremendously. Such a 'wiki' bears the risk of dubious information, and so besides this kind of sources, encyclopedias authored and peer reviewed by experts, are equally important. A good example of the latter is the Encyclopedia of Life Support Systems (EOLSS, www.eolss.net). Its website describes the EOLSS (in 2009) as "an integrated compendium of twenty encyclopedias. It attempts to forge pathways between disciplines in order to show their interdependence and helps foster the transdisciplinary aspects of the relationship between nature and human society. It deals in detail with interdisciplinary and transdisciplinary subjects, but it is also disciplinary as each major core subject is covered in great depth, by world experts."
ESD is one of the many sustainability subjects that the EOLSS deals with. One of the ways to disseminate the results of the Cirrus project (see chapter 6) was a contribution of two chapters to the EOLSS (Roorda (2005b, 2005c).
Other materials are distributed through CD-ROMs. An excellent example is a CD-ROM for teacher education developed by UNESCO (2001/2005).

8.1.4. Consequences of the Bologna Agreement

Early in the 21st century, the processes of internationalization and of flexibilization of education reinforced each other, after the Bologna Agreement was signed.
The origin of this agreement was in another international treaty, the Lisbon Recognition Convention. This convention, elaborated by the Council of Europe in cooperation with UNESCO, was signed in 1997 by nearly all 47 member states of the Council of Europe, and also by e.g. Australia, Canada and the USA. It aimed at the mutual recognition of academic titles and study periods, and this naturally formed an important stimulant to the internationalization of graduates and students. The convention entered into force on 1 February 1999.
As a consequence of the Lisbon Recognition Convention, the European countries felt the need to make their systems of higher education more comparable, and this resulted in the Bologna Agreement, signed in 1999 by the Ministers of Education of 29 European countries (later to be expanded to more countries). The agreement created the so-called European Higher Education Area (EHEA), not only aiming at a comparable higher education structure but also a comparable external quality control system.
Some of the consequences of the Bologna Agreement will be discussed here: the Bachelor – Master system, and the Major – Minor structure, including the opportunities they created for ESD. Other consequences will be discussed later: the Dublin descriptors, which were an important source for the creation of competence based education, will be described in chapter 9. And the Leuven Declaration of 2009, an important follow-up of the Bologna Agreement, will be one of the subjects of chapter 10.

Bachelor – Master (BaMa)

The most visible consequence of the Bologna Agreement was the introduction of the Bachelor-Master (BaMa) structure. According to this structure, higher education consists of three 'cycles'. They are defined in terms of qualifications and of credit points, the so-called European Credit Transfer (and Accumulation) System, ECTS, where 60 ECTS stands for one year's fulltime studying:

- 1st cycle: 180 till 240 ECTS, usually awarded with a Bachelor's degree;
- 2nd cycle: 60 till 120 ECTS, usually awarded with a Master's degree;
- 3rd cycle: not expressed in ECTS, awarded with a Doctor's degree.

In the Dutch research universities, the first cycle consists of 180 ECTS (i.e. 3 years), followed by a second cycle of 60 or 120 ECTS. The situation in the Universities of Applied Sciences is different. The bachelor's degree there takes 240 ECTS (4 years), which has a logical background, as students are allowed to HBO with a HAVO diploma after five years in secondary education, instead of a VWO diploma after six years (see §3.2). Since 2002 the HBO institutions are allowed to offer a so-called HBO Master, but the Dutch government does not financially support these, and so, the HBO institutions don't offer a lot of such programs (HBO Council, 2006a).
The HBO titles differ from those of the research universities. The National Education Council saw this as an important distinction (Onderwijsraad, 2000):

> "The Commission emphasizes the distinction between bachelor- and master programs in HBO and the research universities, which should be expressed in the titles. This distinction concerns the applied character of the HBO programs compared to the academic-scientific nature of the programs in the research universities."

In 2009, as described in §4.1, the official title of 'Bachelor of Applied Sciences' (BASc) was introduced for technical, economic, and agricultural HBO studies, and 'Bachelor of Applied Arts' (BAA) for other HBO studies.

Major – Minor

After the Bologna Agreement was signed, the Dutch universities started to restructure their curricula. Many of them used the opportunity to strengthen the demand-driven orientation and flexibility of the education. Important instruments were the 'broad bachelor' and the major-minor structure. The main part of such a redesigned study program, the 'major', is obligatory, while a smaller part, usually 30 or 60 ECTS, consists of one or two minors, selected by the students out of a range of options offered by the university or even found in another university.
In 2005, the HBO Council and the Dutch Ministry of Education signed an 'achievement agenda' ('prestatieagenda'), agreeing (HBO-Raad & OCW, 2005):

> "The HBO institutions continue on their way to offer more demand-driven study programs. This is realized e.g. through the introduction of major-minor-systems. In order to offer to the students more custom-made education, the HBO institutions are to create more differentiation in the programs they present."

In 2005, 80% of the HBO institutions had redesigned their curricula into major-minor programs. In some cases, varying between universities or even faculties or schools, these minors can be selected completely free, while other minors are restricted to e.g. the own discipline.

Flexibility in the sense of individual learning routes is not the only reason for the introduction of minors. Another reason is the ability to react in a flexible way to developments outside the university. As e.g. the Hogeschool Arnhem-Nijmegen wrote (HAN, 2009):

> "Minors: going through your study in a flexible way. Minor coordinator Gisela Albers: 'The good thing of a minor is that the program can always anticipate on the latest developments within a professional field or within society. It is very difficult to adapt a bachelor program, as in many cases education units have to be cancelled. With a minor you can develop new education quite fast.' As a consequence of such developments within a professional field or within society, the availability of minors changes constantly. 'At present the focus is shifting towards minors in the English language, and towards themes like sustainable development.'"

Sustainability minors

The above citation already illustrates that the major-minor structure offers special opportunities for ESD.
In itself, the option of offering students the opportunity to more or less specialize in sustainable development already existed in certain universities, even before the introduction of minors. An example is the special sustainability certificate which was – and still is – offered by the Center of Technology for Sustainable Development (Technologie voor Duurzame Ontwikkeling, TDO) of the Eindhoven Polytechnic University.
"Each student, regardless of the department, is able to obtain a so-called TDO certificate if desired." (TUE, 2002). Box 18 gives some more details.

Box 18. Eindhoven Polytechnic University (TU/e): a special sustainability certificate

"The Eindhoven University of Technology believes that sustainability and environmental aspects belong in any engineering curriculum. We think that environmental problems and sustainable development can best be dealt with by specialists who in their own field of expertise are well aware of the methods for integrating environmental aspects in the design process. Therefore, the certificate of Technology for Sustainable Development (TDO) has been introduced. Students who choose certain courses and projects in the field of sustainability and environment will receive the TDO-certificate together with their Master of Science diploma. With the certificate the TU/e declares that the owners are also experts of sustainable development within their field of expertise.
The TDO-certificate shows that, within your own field of expertise, you are very well equipped to deal with 'multidisciplinary' environmental and (sustainable) energy-technological questions that confront engineers more and more. A lot of (mostly large) companies developed a strategy focusing on 'societal responsible enterpreneuring', also known as the triple P approach (people, planet, profit). Students who possess a TDO-certificate can show that they are already familiar with this field and that they developed themselves in a broader sense than just their own technical background.
The TDO-certificate shows that you:

- can reflect on the essence of the most important environmental problems and the solution of these problems in a sustainable manner;
- can indicate some important environmental problems and some research areas within your own field of expertise concerning sustainable technology;
- are capable of integrating environmental aspects in the design process in your own field of expertise;
- recognize the multidisciplinary character of sustainable technology;
- are capable of indicating which other disciplines are of importance in design problems;
- are capable of working in multidisciplinary teams."

Source: http://w3.ieis.tue.nl/en/groups/aw/programs_and_courses/tdo_certificate, 2009

However, only after the introduction of the major-minor structure by almost all Dutch universities, options like this became available on a wider scale. At the moment, most HBO institutions offer at least one such minor. Examples are: the minor 'People, planet, profit' of the Fontys Hogescholen and the minor 'Corporate Social Responsibility' of the Hanzehogeschool. Another example is described in Box 19.
This is the context in which the 5th ESD experiment started in 2004, trying to develop an introduction instrument to sustainable development that would be applicable - and indeed be applied - in HBO.

Box 19. Hogeschool Arnhem-Nijmegen: the Minor 'Management of Sustainable Development'

"In this minor students learn to advise companies about their sustainable strategy.

Approach
Thanks to this minor the student discovers the importance of sustainable and socially responsible entrepreneurship (SSRE), both for non-profit and profit organizations. This enables the student to advise organizations when they design and implement their sustainable strategy. Highly relevant is a good balance between the three P's.

Concrete results
After doing this minor, the student is able to:

- formulate a strategic and tactical policy in the field of sustainable and socially responsible entrepreneurship, and translate it within the company;
- apply the knowledge and understandings from various disciplines in a multidisciplinary approach. The applied disciplines are: management, economics, ethics, environmental management, law, HRM and business administration.

The minor aims at students of the Faculty of Economy and Management and the Faculty of Technology. Students following a program in another faculty, who deal with some management aspects, are allowed to join this minor (perhaps after an introductory program).
The minor counts 30 ECTS) and consists of three education units:

- Introduction to SSRE
- SSRE Scans
- Consultancy, implementation of SSRE and reflection."

Source: http://specials.han.nl/focus/duurzaamheid/content/people/overzicht/minor-duurzaam-en-maatsch/index.xml , 2009

8.2. Action: Development and use of an SD introduction instrument (2004 – 2009)

8.2.1. Demands of the instrument

One of the main aspects of the consultancy by DHO in the last decade was the experience that many people working in higher education find it hard to understand the concept of sustainable development. In 2004, DHO investigated the most important problems that teachers and managers in higher education reported in their efforts to integrate sustainable development into the education. One of the most prominent problems appeared to be the concept itself. Qualifications like 'vague', 'not very scientific', 'container concept' were attributed to it (Schaafsma, 2004).
Another problem that was reported several times was the lack of usable learning materials. There was no lack of all kinds of information about specific, discipline-related and detailed information. However, teachers complained that a general introduction to sustainable development, which might be used both for teacher training and for the regular learning process of the students, was not available.
During the Cirrus project, described in chapter 6, the project team was already aware of this problem. One of the main results of the project therefore was a basic module, offering an introduction to sustainable technology. This module was freely shared with other HBO institutions, and used by several of them. But a disadvantage was that it focused on the technological aspects of sustainable development, although it also paid some attention to sustainable development in general. Besides, it did not make use of, or stimulate, a range of modern educational methodologies or technologies like ICT. So, it was not suitable to be used as an introduction to sustainable development in all or most disciplines.
A series of preconditions was formulated that an instrument for the introduction of sustainable development would have to meet.

- It should be applicable in many disciplines and study programs, thus forming a common basis for their interdisciplinary cooperation;
- It should describe sustainable development at a systems level, meeting the demands of ESD described in table 6;
- It should offer a balanced approach to sustainable development, without a heavy emphasis on e.g. ecology, prosperity, development, or technology;
- It should be easily accessible, aiming at beginning students;
- It should have a strong didactic fundament, offering the opportunity to be applied in a range of modern educational systems and methodologies, such as the ones described in chapter 5;
- It should make use of a multimedia range of tools and accessories, partly web-based, offering even more and richer educational methodologies than the ones described in chapter 5;
- It should allow for flexible or individual learning routes;

- It should be applicable both by students coached by a teacher and by independently operating students;
- It should be applicable both as a source for study and as a work of reference;
- It should offer a coherent and clear explanation of the concept of sustainable development.

Several of these conditions could best be realized by using a study book as the core of the instrument. Contrary to the impressions of some, the use of study books is still highly appreciated in higher education, at least in Dutch HBO. Many teachers and students have difficulty in finding appropriate information, not due to a lack of it, but due to the abundance of it. Much of this information is fragmented, contradicts each other, or is not sufficiently reliable. The use of the basic module of the Cirrus Project in several universities had shown that one 'storyline', avoiding the above disadvantages, was met with enthusiasm.
On the other hand 'just' a book would not suffice to enable teachers to use it with a wide range of educational methodologies. Therefore, there were several options to realize the desired instrument: through an existing book, perhaps already equipped with a range of accessory tools, which could be expanded to meet the demands; or through an entirely new instrument.
Several books were investigated that might be suitable. Some of these books claimed to present a balanced introduction to sustainable development, others did not. An example of the first category was Miller (2003), which was indeed used as such in some Dutch research universities. However, a careful inspection learned that all of its 14 chapters are almost entirely dedicated to ecological and environmental subjects, which is not in accordance with the demand of a balanced sustainability approach.
Other study books had comparable biases. Another book that was used by some Dutch universities as an introduction to sustainable development, Allenby (1999), focused mainly on a combination of ecology and technology. The same was true for Von Weizsäcker (1997), which had been used in the Cirrus project as an introduction to sustainable development for the project team members.
Several other sources were not yet available at the time, but were published shortly after. But Mulder (ed., 2006) was mainly dedicated to sustainable technology, and Moratis & van der Veen (eds., 2006) to CSR. Both books did not claim to be a general introduction to sustainable development. Other books did, however. Examples are Rogers et al (2008), Elliott (2006), and Dresner (2008). All three of them are probably more successful in their attempts to treat sustainable development in a balanced way and at a systems level, but still they all dedicate a relatively large attention to one of the three main aspects of the Triple P: respectively planet (Rogers et al, with an emphasis on environmental issues), people (Elliott, with a focus on development issues) and profit (Dresner, focusing relatively strongly on economic models). Another book, Blewitt (2008), offers an exceptionally well balanced description of the main sustainability aspects, approaching the theme from a systems view. It is however not a full educational instrument, as the textbook only contains a number of 'thinking questions' at the end of each chapter, offering no variety in educational methodologies; extra materials around the book don't seem to be offered.
A recent survey of books in the Dutch, English or German language did not discover even one book that combined the two demands of treating sustainable development in its entirety in a balanced way, and being a method with a well-designed didactic approach.
When, in 2004, a publisher working for one of the largest Dutch educational publishing companies asked whether there were any suggestions for possible new study books related to sustainable development, the development was proposed of an educational instrument for the introduction of sustainable development. After ample discussions it was decided that such an instrument would be developed. The core of the method would be a book with the title 'Basisboek Duurzame Ontwikkeling' ('Basic Book on Sustainable Development'). The project to write the book and to develop a range of accessory materials was started by the *researcher* in 2004, and the results were completed and published in 2006.

8.2.2. The educational philosophy

For the instrument, the preconditions mentioned above were taken as a starting point. Some of these are confirmed by UNECE (2005), explaining the concept of 'multi-methods' (see table 6, the ESD checklist):

> "[To be effective ESD should] use a wide range of participatory, process- and solution-oriented educational methods tailored to the learner. Apart from the traditional ones, these should include among other things discussions, conceptual and perceptual mapping, philosophical inquiry, value clarification, simulations, scenarios, modelling, role playing, games, information and communication technology (ICT), surveys, case studies, excursions and outdoor learning, learner-driven projects, good practice analyses, workplace experience and problem solving. (…)
> [To be effective ESD should] be supported by relevant instruction materials, such as, methodological, pedagogic and didactic publications, textbooks, visual aids, brochures, cases studies and good practices, electronic, audio and video resources."

Scope
The above conditions all are in accordance with the developments in higher education that were described in the first section of this chapter, and with other developments described earlier. The next condition however was different. The topic of internationalization was discussed between the author and the publisher, and in the end it was decided to aim the method specifically at Dutch students, making use of relatively many cases derived from the situation in the Netherlands, and to use the Dutch language. More specifically, the main target group was decided to be the teachers and the students of HBO, the latter preferably early in their study program. The main reason for the Dutch scope was that the publication had a high pioneering character. No comparable SD introduction instruments were found, and so there was no model that could be used as a reference point. Besides, there was no indication that the instrument would be used by many universities. Consequently, the following extra preconditions were agreed:

- Netherlands (and Flanders) oriented, Dutch language;
- Main target group: beginning HBO students;
- Perhaps also applicable in top years of secondary education and other groups (no priority).

In the introduction of the book, the scope was described further:

> "The method aims equally to all disciplines, i.e. to social, technical, economic, and law programs, to teacher education, arts education, etc. The subject of sustainable development lends itself for this especially well, as it demands an interdisciplinary cooperation. This implies that it is highly important that professionals from a range of disciplines possess a common basis from which they can realize this cooperation. Hence the name: Basic Book.
> The text of the book offers examples and cases that are relevant for all disciplines. The same is true for the exercises. A part of them are 'neutral' regarding the disciplines, and so can be used by all students. Another part has an interdisciplinary character, and can optimally be made by students groups composed from various disciplines. Some exercises are specifically suitable for one or some disciplines."

Didactics
Besides, the following demands were defined:

- Didactics of the instrument have a high priority;
- Nevertheless the instrument should be scientifically correct, and validated as such;
- The instrument should contain a teachers' guide, e.g. describing the learning goals.

The preface explains these decisions as follows:

> "The book is not meant as a work with a strict scientific approach. It's a *study book*. This is e.g. clear from the fact that it does not, as many books and articles about sustainable development, start with a historical overview of the origins of the concept, right from the very first awareness of the environmental problems, through the end-of-pipe solutions and clean technology, to the integrated thinking since the Brundtland Commission. Besides, there is no chapter containing a critical discussion about the several hundreds of definitions of sustainable development. These subjects are not treated explicitly, because in most cases the students will not need them. It is much more important that they develop an intuitive feeling for what sustainable development is, which threats and opportunities exist, and above all which contributions they themselves will be able to deliver. So, the studiability of the book has the highest priority. In each case where a choice had to be made between a strict scientific treatment or didactical considerations, didactics won. Nevertheless, it stands to reason that the book is scientifically correct, or at least it tries to be so. The scientific verification of the book has been taken care of by a Scientific Advisory Board consisting of seven scientists of international fame, who each are authoritative on a sector of sustainable development."

ESD characteristics
Regarding the relation with sustainable development and ESD, a whole range of principles was defined. In order to enable an easy comparison with table 6 (§2.3), which describes the main characteristics of ESD, the principles are presented here more or less in the same order. Below, in §8.3, table 6 will be used to evaluate whether all these principles were realized. The principles were:

- Systems oriented. e.g. describing:
  - weaving faults in global or regional systems;
  - global, regional or local power sources to amend those weaving faults;
  - levels of change, varying from product improvements to systemic changes and transitions.
- A balanced approach concerning human aspects, ecology and economy (the Triple P);
- A balanced approach concerning an optimistic versus a pessimistic view (or, as it is called in the book, 'pink glasses' versus 'dark glasses');

- A fundamentally multidisciplinary approach, and offering a range of opportunities to treat the subjects in inter-disciplinary groups;
- An integrated life cycle approach;
- Based on two dimensions: 'Place': comparing situations in various regions, and studying the interactions and transfers between them, and 'Time': future oriented, based on lessons from the past.
- Multi-methods: based on a combination of many different methods and approaches;
- A strong link to real-life situations, e.g. through case descriptions;
- Confronting the readers with their own personal and professional responsibility;
- Stimulating independent and critical thinking;
- Raising commitment to sustainable development, challenging the readers to be active on sustainability within their personal and professional life.

Several of the above principles were described in the preface of the book:

> "While writing a book about sustainable development, various dilemmas arise. Such as the question, to what extent the information in the book should be objective or subjective. This is relevant, as the subject of the book is important and raises strong emotions. Wherever the information is subjective, this should at least be clear from the text, in order to enable you as a student to form your own opinion, without being pushed by the book. Whether this was successful, can be judged by you yourself. This implies that it is advised to be constantly critical about what you read in the Basic Book.
> Another dilemma is the choice between an optimistic and a pessimistic approach, between the 'pink' and the 'dark' glasses, as you will read in the book. It is easy to write a book which presents a somber view of the present world and its future expectations. It is just as easy to write a cheerful book in which the attention primarily goes to the successes and opportunities we have towards a sustainable world. But both extremes would not be realistic. An attempt has been made to find a good balance. It is not the intention that you end up in a depression after reading the book, and fall into passivity. But at the same time it is not the intention that you conclude there is nothing wrong, and do nothing for that reason. The book aims at showing you that with profound efforts – by you and others – excellent results can be realized in the direction of a sustainable world. The book calls for action.
> In this sense the book is not impartial or neutral. The decision alone to write the book – and publish it – means taking the position pro sustainable development. The development of this educational book means balancing on a thin line between complete neutrality and a too strong involvement or bias. Several groups of experts were asked to comment to the texts, with the request to see to it that the balance stays on that thin line. Professors, teachers and other experts had their say in it. The final judgment is up to the reader, i.e. to you."

8.2.3. The tree model

In §6.2.2 the 'Tree Model' was introduced as a way to describe the integration of sustainable development in education. It was first applied to the Cirrus Project, for which it was designed. The model was also used as a basis for the SD introduction instrument. The model is described here in some more detail. It consists of the following elements, referring to the parts that a tree consists of:

- Roots: Vision, mission, educational goals
- Biochemistry & physiology: Educational methodologies
- Trunk: Basic module or introduction to sustainable development
- Branches: Disciplinary integration
- Forest, ecosystem: Interdisciplinary integration
- Fruits: Output: effect on professional field and society
- Growth process: Development and maintenance of the study program

The model is shown graphically in figure 41. The 'branches', i.e. the disciplinary integration, will not be discussed here in many details. The first reason is that the present chapter aims at another aspect of ESD, the basic introduction. Another reason is that a detailed discussion would require a lot of space, as there are many different disciplines. However, it is interesting to have a look at a few examples, offered by Orr (1992), here reprinted in table 33.

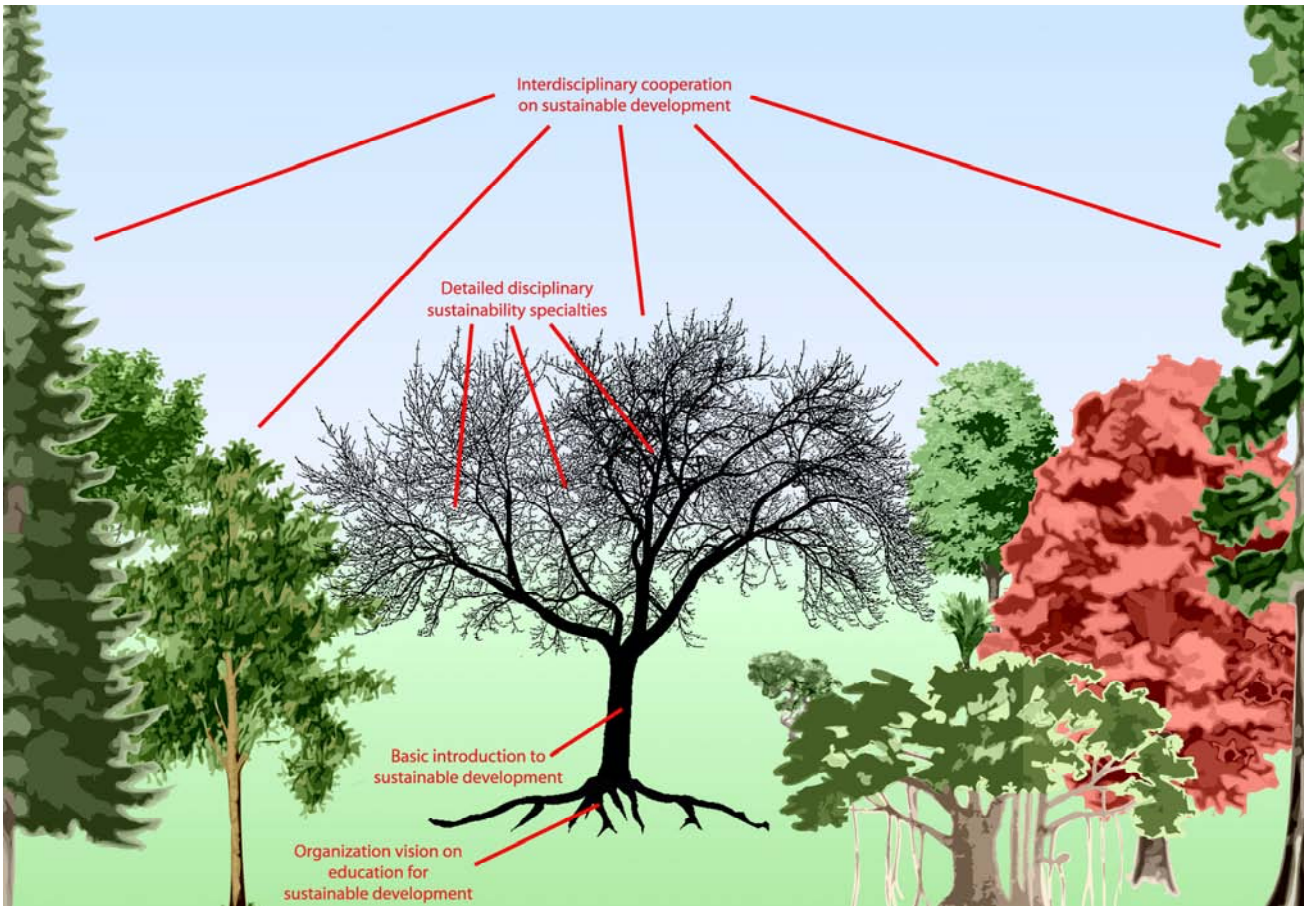


Figure 41. ESD: The 'tree model'

Table 33. Examples of disciplinary integration of sustainable development subjects	
Discipline	**Environmental focus**
History	The effects of resource mismanagement, technological changes, effects of new sources of energy
Ethics	The philosophical basis of sustainability; environmental ethics, animal rights
Sociology	The structure of sustainability; values, behaviour effects of overshoot
Political science	Politics as a resource distribution system; political structures of sustainability; balance between centralization and decentralization, freedom versus order
Anthropology	Adaptive behaviour of societies and cultures; alternative values; models of sustainability
Economics	Steady-state economics, alternative pricing systems, alternatives to capitalism and communism
Architecture	Design with nature, use of vernacular materials
Biology / agriculture	Ecosystems management, ecological agriculture, urban food systems
Source: Orr, 1992, p. 135-136 *(simplified)*	

A further support for the disciplinary integration can be found in the already mentioned disciplinary reviews that were published by DHO. All disciplinary reviews are in Dutch, except 'Health', which is in English. In 2009, the series consists of: Biology (van Hengstum, 2001), Chemistry & chemical technology (Nieuwdorp, 2004), Civil engineering (Bras-Klapwijk, 2002), Economy (van den Bergh & Withagen, 2001; de Groene, 2003b), Fashion (Hupperts, 2005), Health (Barten & van den Gulden, 2002), History (van Zon, 2002), ICT (Egyedi & Peet, 2003), Law (Schrijver, 2003), Management (Jonker & Grollers, 2001), Mathematics (Alberts, 2002), Mechanical engineering (Kirkels, 2002), Philosophy (Kuipers, 2003), Physics (Bras-Klapwijk, 2001), Psychology (Steg & Buijs, 2004), Religion (Derkse, 2007), Sociology (Tellegen, 2006), Spatial planning (Bus, 2004), Technology Management (Severijn, 2003).
It was the explicit intention of the SD introduction instrument to realize the 'trunk of the tree', thus:

- preparing the students for the disciplinary and the interdisciplinary integration of sustainable development ('from the trunk upwards'). That is why the method aims at students early in their study program, preferably in their first year;

- offering assistance to education developers to define or improve their vision on ESD and the educational goals ('from the trunk downwards', i.e. to the 'roots of the tree').

Learning goals: the KISA model
For the definition of the learning goals, the 'KISA' model was used (in Dutch: 'KIVA'). The letters stand for 'Knowledge, Insight, Skills, Attitude' (in Dutch: 'Kennis, Inzicht, Vaardigheden, Attitude'). This is a model that is used by many educational institutions to define learning goals, in Dutch HBO e.g. by Saxion Hogeschool, Hanzehogeschool and Hogeschool van Amsterdam. In recent years, the four types of goals have been used to describe professional competences, e.g. by Dankers-van der Spek (2006) and by Agten (2007), who writes:

> "A competence is a whole of knowledge, insights, skills and attitudes which a professional is setting in when critically intelligent ripe handling in different professional situations."

However, the KISA model was already in use long before the introduction of competence-based education. The model is also used in theories and practices of change management, see e.g. Kleijn & Rorink (2009).
An example of the way the KISA model was used for the SD introduction instrument will be shown below.

Structure
In the introduction of the 'Basic Book', the structure of the book is explained.

> "The book consists of five chapters. The first chapter is exploratory. In it, you will get acquainted with basic concepts like People, Planet and Prosperity (or: Profit). With the distribution of prosperity between the present people ('here' and 'there': the dimension of 'place'), and between them and the future generations ('now' and 'later': the dimension of 'time'). With the approach of the Brundtland Commission, that was pivotal in the thinking about sustainable development.
> The other chapters belong to each other in pairs. In chapter 2 you will study the weaving faults that are hidden in the system that mankind has constructed around himself: fundamental weaknesses that are the causes of the major problems in the present world: e.g. the degradation of environment and nature, poverty and prosperity diseases, war and terrorism. Opposed to this, chapter 3 introduces a series of means, 'power sources', that we can utilize to find solutions for these problems. These powers consist of natural resources, but also of inner strength of people and organizations. Chapters 4 and 5 proceed on the two dimensions you read about in chapter 1: 'place' and 'time'. In chapter 4 you study the first of these two. You discover the present sustainability problems in a number of regions of the world, among which Western Europe. You will see how the rich countries transfer their problems to the poor countries. In chapter 5 you deal with the other dimension, 'time'. There you will discover ways to say something meaningful about future expectations, e.g. using computer models and scenarios, among which the famous model of the Club of Rome."

The introduction to the Basic Book also illustrates the structure graphically, see figure 42.

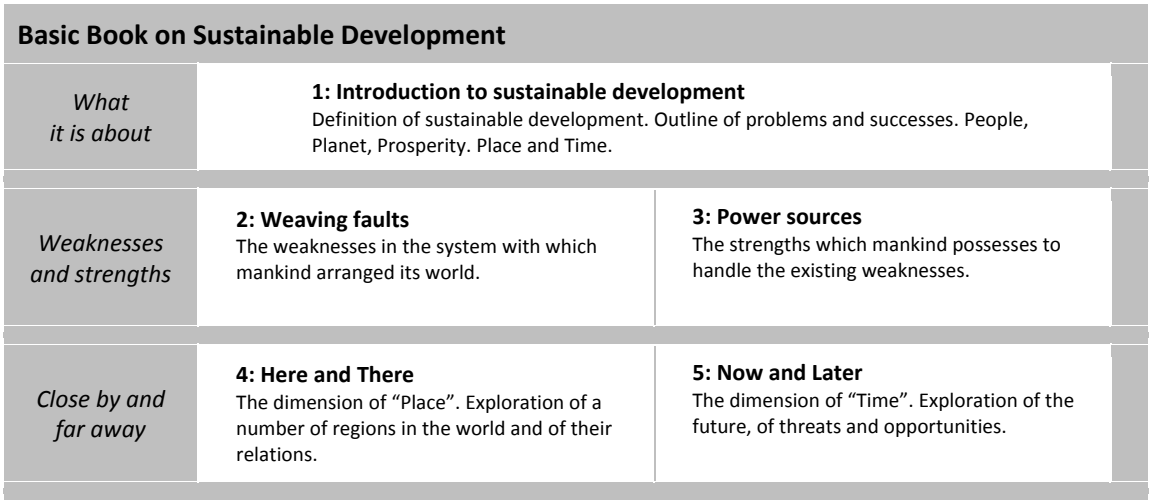


Figure 42. The structure of the 'Basic book on Sustainable Development'

Because the SD introduction instrument is written in Dutch, it will not be applicable to those who don't speak or read the Dutch language. For this reason, some parts are translated into English. They can be found in Appendix 7. The first part is a translation of the table of contents of the book. The second part consists of the first pages of chapter 2, as a sample of the style in which the entire book is written. The sample illustrates e.g.:

- the systems approach;
- the description of how one principle (in this sample: 'one way traffic') underlies a range of different phenomena (in this sample: exhaustion and erosion, overfertilization, climate change, resource depletion, waste and pollution), calling for similar solutions (closed cycles);
- the introduction of key sustainability concepts: weaving faults, transfer, transition.

8.2.4. Educational methodologies

The applicability of the methods is clearly visible through the tasks and exercises at the end of the chapters. Each chapter offers a series of six types of exercises (on average about 3 exercises for each type):

- Processing exercises;
- Calculation exercises;
- Research exercises;
- Discussion exercises;
- PBL exercises;
- Project exercises.

Many of these exercises are supported by ICT tools, e.g. spreadsheets, computer programs or movie clips, which are all available on the website. The introduction to the book explains each of the six types of exercises. These explanations are cited below, and for each of them, one characteristic example is shown, in Box 20 till 25.

Processing exercises

> "These are exercises in a 'traditional' style, which you can perform rather easily, with as its goal to get acquainted with the subjects in the chapter. This does not always mean that it is not much work …"

Box 20. Exercise 3.4: Art and music as power sources *(an example of a processing exercise)*

"Do you know a singer / rapper / music group / artist / filmmaker who is a power source for sustainable development? Give examples of his / her / their work and explain why you think it contributes to sustainable development. In doing this, make use of the Triple P."

Calculation exercises

> "These exercises vary from rather simple calculations to tasks for which you need a thorough experience with mathematics, e.g. making use of differential equations. For some of the exercises you will use a spreadsheet as a tool for calculations and graphs. These spreadsheets can be downloaded from the website of the Basic Book."

Box 21. Exercise 2.4: Education in India and the Netherlands *(an example of a calculation exercise)*

"Suppose that India would increase its expenses for education, in such a way that per capita the same amount of money would be spent on education as in the Netherlands. Calculate for this situation:

a. What percentage of the GDP of India would then be spent on education?
b. With what percentage would the total GDP of India have to be raised?

(Make use of data as recent as possible. You can e.g. use the online database of UNDP.)"

Research exercises

> "For these exercises you will perform a small research. In most cases this will be a literature investigation, in which you use books, articles and internet sites. For many of those exercises you can find suitable sites on the website of the Basic Book, www.duurzaam.wolters.nl, as a starting point for your research."

Box 22. Exercise 1.6: Risks of biotechnology *(an example of a research exercise)*

a. "Certain scientists fear for an undesired gene dispersion, in which the genes that were added to golden rice could migrate uncontrollably to other crops or plants in nature.
   Find out if there are any signs that this fear, related to golden rice or to other genetically modified crops, is real. In other words, are there any examples where such dispersion really took place?
b. Another risk that has been signaled is that GM crops might appear to be unexpectedly toxic for other organisms, e.g. insects.
   Are there any real-life examples where this happened?"

Discussion exercises

"In principle these are group exercises, as you are expected to take a position on a certain subject and discuss it with others. In this type of exercises, usually there are no right or wrong answers. Much more important is that your opinions are well-founded.
If you are not a member of a group, the discussion exercises can still be meaningful. You can always formulate your own opinion, and found and describe it. Besides, you can find out about opinions of others through the internet."

Box 23. Exercise 5.13: Science fiction *(an example of a discussion exercise)*

"Below you find a part of an (imaginary) science fiction novel.

> He looked at his face in the mirror. In the old days, a hundred years ago, mirrors were made of glass and silver, he had heard somewhere, and not of a combination of a webcam and a screen. The patterns painted on his face identified him as a Knower, for 3 years the property of Somny UniProctor. Thanks to the round shapes above his eyes everybody could see he possessed Knowledge at level 15. For the present job that was not enough.
> Clumsily he grabbed a sprayer and drew with a shaking hand two extra lines above his right eye. For the first time now he wished that he had learned Writing! Then this would certainly have been an easy thing. But come on, who learned that nowadays? Right! Now he was worth a Knowledge Level of 21. Of course it was highly illegal, what he had done. If anybody would have seen what he just did, he would be sublimized, after which his molecules would be spread over at least three continents. As a warning to others.
> He gasped with anxiety. This was really too heavy for him. He needed more courage! Fortunately this was possible. Carefully he removed a small computer chip from the interface in his neck. From his dress pocket he took another chip, looking identical but being far from identical. He had paid a huge sum for this thingy! Bought it on the black market for over 100 giga-euro, from the now prohibited Dutch Government in Hague. He fumbled it into his interface and took a deep breath. Ah! The courage flowed through his body. Immediately he felt relaxed and self-assured. This was going to work!
> He rose. The door swished open, as the house computer understood his desire. He went outside. Pity that the Town would immediately see where he was going, but that could not be avoided. For a moment the advertising movie clips on the pavement distracted his attention, and he almost missed passing two Neighbors. Just in time he greeted them wordlessly with the Courteous Gesture of Awe. They nodded at him formally with Bland Amiability.
> Confidently he passed the square towards the Palace of the Workers. The Knowledge Bomb in his belly pocket felt heavy.

a. Study the text, and try to discover in which ways this future world has changed in comparison with our present world. Not only look at changes in science and technology, but also at societal changes: lifestyle, human rights, economy, communication and perhaps more.
b. Discuss the question, which of these changes are to be considered as positive or enjoyable or even as a 'dream', and which as negative or undesired, or even as a 'nightmare'.
c. Which of these changes do you think to be realistic or even likely? Which are to your opinion unlikely or even totally impossible, both now and in the future?"

PBL exercises

"PBL stands for Problem Based Learning. PBL exercises often look different from other exercises. In many cases you will not even find a question or a task, but just a short story, a sentence, or even only a photograph. The exercise is preferably performed by a group of e.g. eight persons, coached (but not chaired) by a teacher who acts as a 'tutor'.
One of the characteristics of a PBL exercise is that the participants themselves decide on the learning goals they want to realize using the exercise. This means that one group may use a PBL exercise very differently from another group. If this exceeds certain boundaries, the tutor may interfere. (See: Moust et al, 1997.)"

Box 24. Exercise 4.13: The AIDS medicine *(an example of a PBL exercise)*

"Dear Gerard,

I write to you, because I have no idea who else I can address. I have a very serious message, that may ruin us, I'm afraid. From research that I did, it appears that it is rather likely that the massive mortality of flowering plants in Nigeria is caused by the use of our medicine TPF (Transgenic Pentobenzo-three-Fosfaldecryd, but you know that, don't you?), our fantastic aids inhibitor.

If this is really true, it means that we can forget our giant market breakthrough, which has already been announced in the newspapers! And besides: think of all those HIV infected Africans, for whom we finally had a well affordable drug. Shit, shit! What can those poor devils do, if they cannot get our medicine?

It seems that some bodily waste of our stuff, leaving the body of the aids patients through urine and feces, has a lethal effect on phanerogamous (flowering) plants. I don't know the details yet. I am still not sure that it is our medicine that is the cause, but I fear the worst.

I don't dare to inform the management! I cannot predict what they are gonna do. Maybe they will keep my entire research secret! So nobody knows about it but you and me. I hope we can keep the press out of it, for the time being. What would happen to our share prices?
You are a staff member of the Department of Marketing, Gerard, and I know you as an intelligent and conscientious person. Can we talk?

Anton"

Project exercises

"These exercises will usually take more time, e.g. a period of some weeks till some months. How long the exercise will take depends on the amount of time you can spend on it every week (a couple of hours? Fulltime?), how detailed you want or have to do the exercise, and with how many people you work on it. Because of the longer period and size of a project exercise, ir is recommended to make use of a well-structured project design, including agreements about planning, division of tasks, responsibilities and reporting."

Box 25. Exercise 3.21: Micro credits *(an example of a project exercise)*

"Investigate the microcredit system, and prepare a PowerPoint presentation about it. See to it that you create or find a good occasion for presenting the PowerPoint, for a suitable audience. Present it to this audience. Pay attention in the presentation to (at least):

- a comparison between large loans to developing countries and micro credits
- a comparison between a top down and a bottom-up approach to development
- a number of practical examples (cases) of successful enterprises that started thanks to a microcredit
- the meaning of micro credits to the emancipation of women
- the meaning of micro credits to the economy of a poor country
- a critical analysis of the advantages and disadvantages of the system."

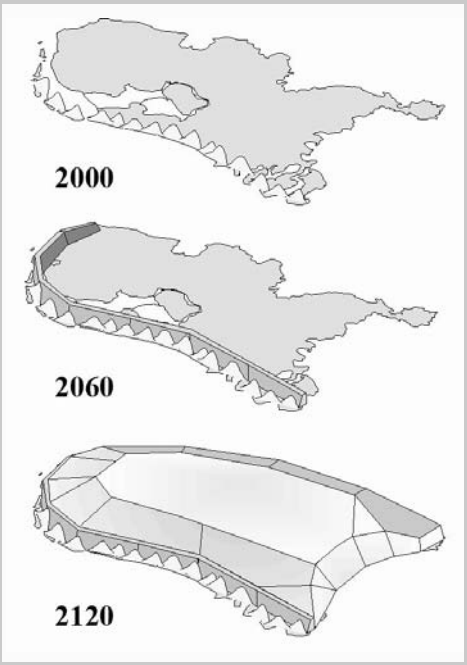
Questions and columns within the text

The exercises are all at the end of the five chapters. But there are also several kinds of reflective elements within the texts. Some of them are questions, which are distributed over the texts of the various chapters. Some examples of such questions are shown in Box 26.
Such questions aim at raising the awareness and a feeling of personal responsibility and involvement of the students. Another way to do this are the 'columns', which have a satirical and sometimes an absurdist style. Box 27 shows an example.

Box 26. Examples of questions within the text

- "Do you have any idea about the kind of nature that existed at the place where the house is built that you live in? Forest perhaps, or swamps, moors or open water?" *(chapter 1: introduction)*
- "What do you expect, when you calculate your personal ecological footprint: is it larger or smaller than that of the average Dutchman? What if your footprint is larger than your fair share. Would you be prepared to decrease you footprint? How could you do that?" *(chapter 2: weaving faults)*
- "Did you ever think about the fact that there is no war between EU countries? Do you think it is likely that the situation might eventually change in such a way that war would start again between Western European countries? Do you see it as realistic to expect that war might disappear from the rest of the World? If so, in how many years could that happen? If not, why not?" *(chapter 3: sources of power)*
- "Suppose: you are standing on the bank of a river. Close to you someone falls in the water. This person appears not to be able to swim. You just watch and do nothing. The person dies. Are you liable to punishment? Suppose: in Sierra Leone, every day people die of starvation. You do nothing. Are you liable to punishment?" *(chapter 4: here and there)*
- "Who are right, to your opinion, the pessimists or the optimists? Or both, partly? If so, how? Do you think you wear colored glasses, either dark or pink ones? Or do you see yourself as neither pessimistic nor optimistic but realistic?" *(chapter 5: now and later)*

Box 27. An example of a 'column' in the Basic Book



"My Fellow Countrymen and women!
"The citizens of this country are worrying about the rise of the sea level around our territory, as a consequence of the so-called 'greenhouse effect.' Particularly the predictions that are going around that all subjects of our nation should flee our country in thirty years, stirred trouble amongst the population.
"Consequently your government has decided to start a thorough investigation concerning this phenomenon. At present this investigation is completed, and I have the authority to present the major conclusions to you.
"I can comfort your minds. First of all, let me assure you: The complete inundation of our country will, as Science has informed us, take place no sooner than around the year 2120. Before that point in time no Dutch citizen will have to leave our beautiful country. But neither after that moment.
"Building on the achievements of Technology, your government has prepared a plan that will allow us to save our nation and our people from death by drowning.
"In a first phase of this rescue plan, the dunes at the western and northern sides of our country will be fortified and heightened with the aid of dykes. These dykes will be completed in the year 2060.
"But that is not all.
"The ability to heighten the dykes more and more will, as you no doubt understand, come to an end, even in our highly experienced Netherlands. When, accordingly, the sea water will rise above this maximum achievable dyke level, we will be ready for it. Even earlier, a start will be made to enlarge the greenhouses in our famous Westland. In accordance with the governmental plans, by 2120 these greenhouses will have reached the size of our entire nation: just in time to prevent a flooding of the dykes. In that year, the Netherlands will be fully covered with glass.
"Even then, my fellow countrymen and women, the Netherlands will not be totally isolated in the world. For a considerable number of years after the closure of the national greenhouse, our country will fall partially dry during the low tides. Only after 2150 our country will be emerged 24 hours a day, after which the contacts with foreign regions of the world will have to be maintained by submarine.
"For this purpose, in its energetic style, the government has issued an order to some of our largest shipyards to construct several dozens of luxury submarines.
"As you see, there is no reason for worries whatsoever. The government has taken the matters firmly into its hands. You can all safely go to sleep."

8.2.5. Web-based accessories

The additional materials of the method are all available on the website. Most of it is freely admissible. However, some elements are exclusively aimed at the teachers, and in order to be admitted, the teacher needs a password which can be asked with the publishing company. For students the website offers:

- Web links: a long list of websites, including a description indicating how they relate to the subjects in the book chapters;
- A series of internship reports, produced by graduating students, which are relevant for sustainable development and suitable as examples for present students;
- Additional information about certain subjects, of which the details would be too much for the book;
- Accessories for exercises, like spreadsheets, texts, powerpoints;
- A number of computer applications, e.g. serious games, specifically made for the SD introduction instrument;
- An explanatory list of terms in alphabetical order;
- A list of abbreviations.

Serious games

Most computer applications are *serious games*. Two examples are shown as illustrations. Figure 43 is a game with which the Lotka-Volterra model can be investigated, which describes the interaction between a predator and its prey (Lotka, 1925; Volterra, 1926). The game is intended to illustrate two principles at the same time: the use of computer simulations (preparing for e.g. the World3 model of the Club of Rome, see Meadows et al, 2004), and the effects of overuse and exhaustion.

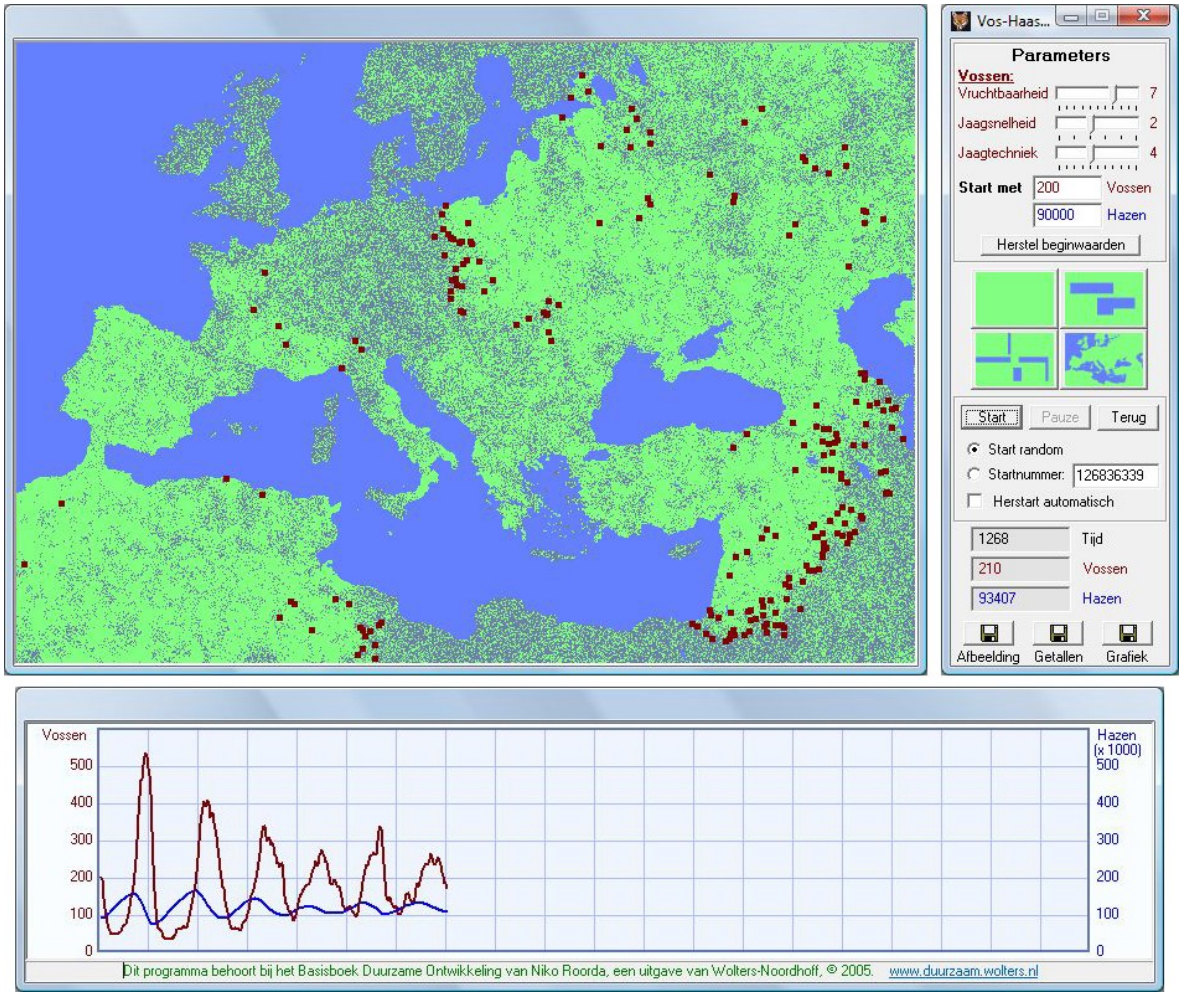


Figure 43. 'VosHaas' (English: 'FoxHare'), a serious game illustrating the Lotka-Volterra model of predator-prey simulation.

The second example of a serious game is called 'PopSim', short for 'Population Simulation'. Several kinds of situations can be simulated, studying the effects on the population size on an island of e.g. positive or negative feedback, an immigration wave, a 1-child policy, or an epidemic. Figure 44 shows a relatively 'realistic' scenario, as is explained in chapter 5 of the book.

Both serious games are the subject of several exercises.

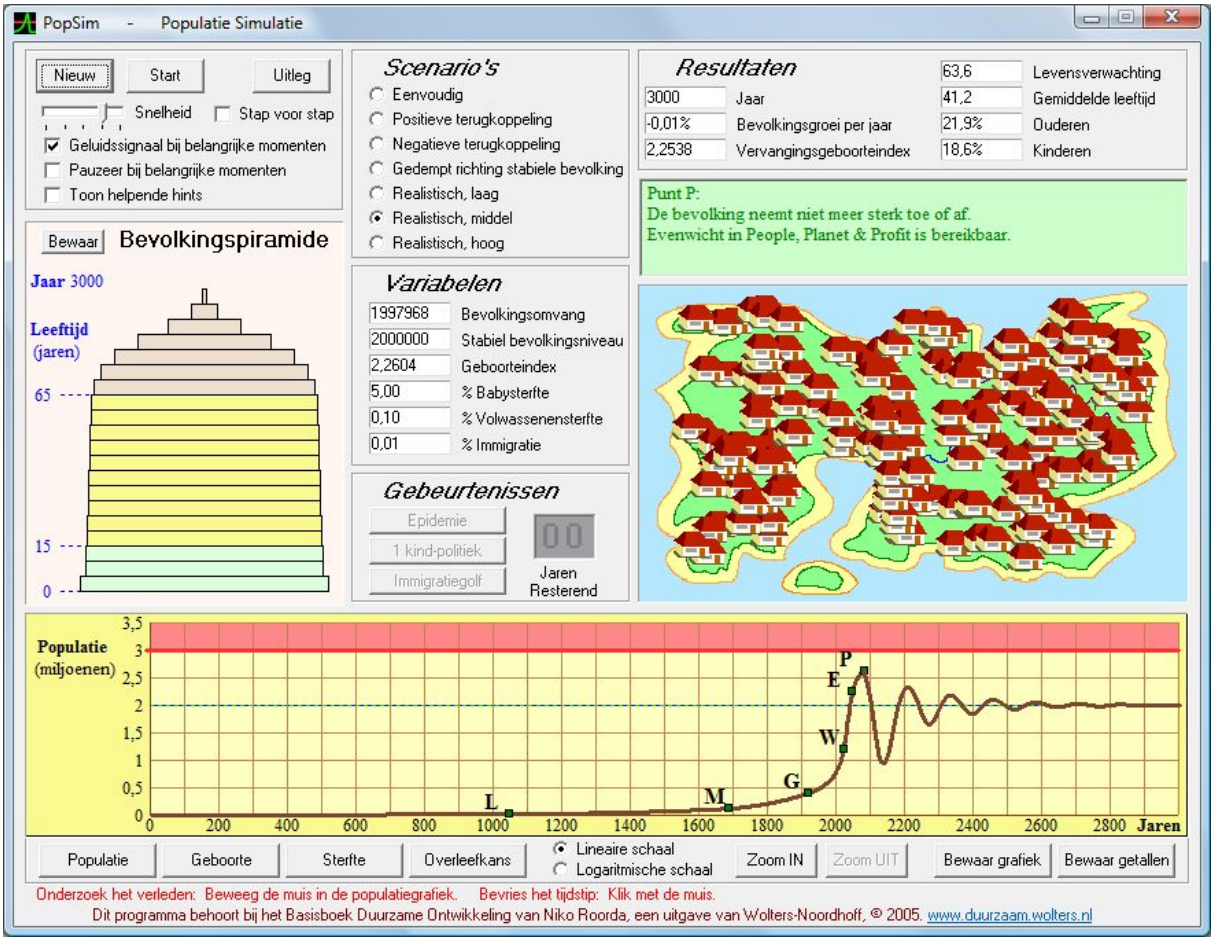


Figure 44. 'PopSim', a serious game for the study of population growth.

For teachers

The password protected part of the website that is available to the teachers contains the Teachers' Guide. This manual offers, for each chapter:

- An overview of all educational goals of the chapter, based on the KISA model;
- The answers or explanations of most of the exercises.

The last part of Appendix 7 shows the educational goals of chapter 2, as an illustration to the way in which the KISA model was applied. The protected part also offers materials made by teachers who make use of the method, made available for their colleagues. Examples are:

- Added exercises;
- Exams;
- A description of a minor that is based on the SD introduction instrument.

8.2.6. Validation

During the development of the SD introduction instrument, it was tested for its scientific correctness and completeness, for its relations to societal developments, and for its applicability in education.

Scientific validation

Immediately after the decision was taken to develop the method, a number of sustainability researchers in Dutch universities were invited to become a member of a Scientific Forum. When this Forum was complete, it consisted of seven members, all authoritative scholars on the subject of sustainable development. Each represented an important aspect of sustainable development:

- Prof. dr. Th.A.M. Beckers, Tilburg University *(SD and social sciences)*
- Prof. dr. J. Grin, University of Amsterdam *(SD and policy & transition science)*
- Prof. dr. ir. J.L.A. Jansen, Delft Polytechnic University; STD Program *(SD and technology)*
- Prof. dr. P. Martens, Maastricht University *(SD and development studies)*
- Prof. dr. ir. R. Rabbinge, Wageningen University and Research Centre *(SD, agriculture and food)*

- Dr. ir. M.A. Slingerland, Wageningen University and Research Centre *(SD, agriculture and food)*
- Prof. dr. J.F.D.B. Wempe, Erasmus University Rotterdam *(SD and economic science)*

The Scientific Forum commented on the draft structure and preconditions of the instrument, and in a later stage on the chapters of the book. Their recommendations and feedback were an important source for improvements of the draft texts. When the method was finished, all members of the Scientific Forum gave permission to put their names on the title page of the book, thus signifying that they agreed with the scientific correctness of the method.

Societal validation

The need was also felt to validate the methods from the perspective of society, represented by ngo's and expert organizations dedicated to sustainability related subjects, e.g. environment, human rights and development. A Societal Forum was formed, consisting of 24 persons who represented 12 organizations:
Amnesty International, Amorion, Jongeren Milieu Actief, Milieudefensie (Friends of the Earth), Ministry of Agriculture, Motivaction, Oxfam Novib, Pré, Programma Leren voor Duurzame Ontwikkeling, SenterNovem, Stichting Duurzaam Hoger Onderwijs (DHO), Stichting Milieubewustzijn.
These persons commented on draft parts of the instrument, mostly individually, and a few times as a group. The feedback and recommendations were used for improvements.

Educational validation

A very important kind of test focused on the question whether the method would be applicable in higher education. For this purpose, a third group was formed, the Teacher Forum. In this Forum, 38 persons participated, all teachers, lectors or professors. Together they represented 21 universities, most of them HBO institutions. The universities that were represented were:
Avans Hogeschool, Christelijke Agrarische Hogeschool, Christelijke Hogeschool Noord-Nederland, Fontys Hogescholen, Hanzehogeschool, HAS Den Bosch, Hogeschool Domstad, Hogeschool Drenthe, Hogeschool Larenstein, Hogeschool van Utrecht, Hogeschool Windesheim, Hogeschool Zeeland, Hogeschool Zuyd, Ipabo, Marnix Academie, Radboud Universiteit, Saxion Hogescholen, Technische Hogeschool Rijswijk, Technische Universiteit Delft, Universiteit Leiden, Van Hall Instituut.
The Teacher Forum met on average every two or three months, and discussed the latest drafts of the book and the accessories. Relevant questions discussed were e.g.:

- Does the instrument offer sufficient clarification of key concepts, in the first place the concept of 'sustainable development' itself?
- For which kinds of methodologies can the instrument be applied?
- How much time would it take to treat the subjects of the instrument, depending on the applied methodology, and depending on the chosen time schedule (e.g. all at once or longitudinal, i.e. for some hours a week during a semester)?
- Is the level appropriate for the main target group, beginning HBO students, or could it be too easy or too difficult?
- Is the method also applicable as a reference work?
- Are the exercises usable?
- When the method is ready, would you start using it with your students?

The feedback was used continuously for improvements and additions of the drafts.

Practical tests

In order to investigate the practical use more deeply, a series of practical tests was planned and performed in three universities. In these tests, teachers who were members of the Teacher Forum applied the draft version of the instrument with student groups. The results were satisfactory, as only a few minor adaptations had to be made on the basis of the results.

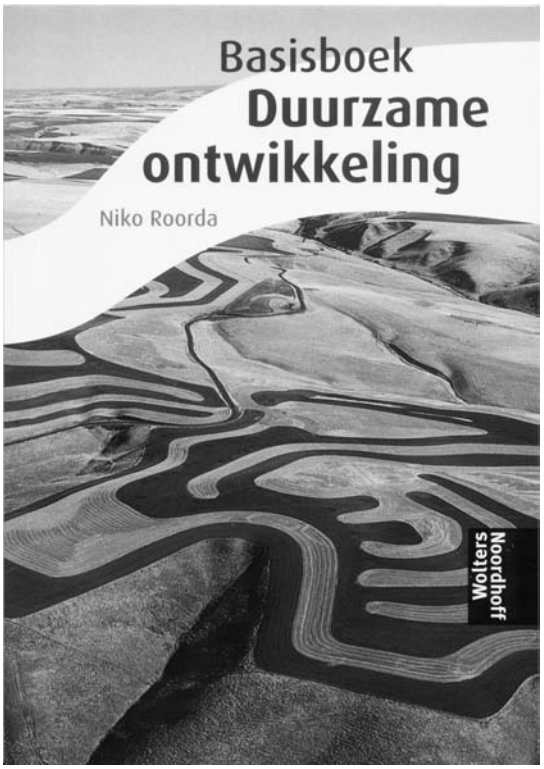


Figure 45. The Basic Book on Sustainable Development

8.2.7. Application

Although the formal publication year of the SD introduction instrument is 2005, it was officially launched on April 12, 2006 during a symposium that was organized especially for the occasion. The first copy of the book (see figure 45) was received by the chairman of the HBO Council, Doekle Terpstra. From that date, teachers started using the instrument. It appears to be used by teachers with their students in a variety of ways. Differences concern e.g.:

- either as an independent module or as an integrated part of a larger educational unit;
- either as one fulltime block in e.g. a week, or spread across a longer period, parallel to other education activities;
- the study year, varying from year 1 to year 3;
- the amount of time / ECTS spent on the subject;
- the programmatic structure, i.e. as a compulsory part of the major or as an optional part, e.g. as a minor;
- extra materials, added by the teacher;
- the rate to which ICT and the website tools are used;
- the examination.

Box 28. The Minor of Corporate Social Responsibility (Hogeschool Utrecht)

"Description

The student learns the meaning of corporate social responsibility and how he/she can deal as a professional with problems and opportunities that occur in the area of sustainable development. By studying a number of problem areas, the student develops a consciousness for societal questions. This helps the student to make decisions in the future professional life.

The student studies, or acquires the following competences:

- oversees the domain of the concept 'sustainable development' and is aware of the complexity of the problem field
- oversees overlapping and related domains (with an emphasis on economy and environment)
- knows in general terms the historical development of the study of sustainability and of en corporate social responsibility
- is aware of personal ethics in the area of corporate social responsibility
- is able to involve problems concerning corporate social responsibility in personal decision making
- understands the consequences concerning sustainability of decisions made by companies, governments and societal organizations
- is able to assess and evaluate decisions made by companies, governments and societal organizations in the context of a sustainability policy

Elements

1. The three P's: People, Planet, Prosperity
2. Balance and imbalance
3. Different viewpoints, approaches and implementations
4. Globalization and international cooperation
5. Future scenarios
6. Sustainability policies of organizations

Methodology

The program makes use of several methodologies, e.g. lectures, application of cases and articles, individual tasks and group tasks. During the entire module the students cooperate in groups on the performance of their masterpiece: the organization of a debate, which takes place in the final project week.
Use is made of group meetings, self study, tasks, project work.

Learning materials

Literature: Niko Roorda, 'Basisboek duurzame ontwikkeling', Wolters Noordhoff, ISBN 90 0126 709 2.
Besides: handouts, task descriptions, (internet) publication. See: Blackboard.

Assessment

The assessment of the minor CSR consists of two elements:

1. Individual evaluation through an exam, containing open questions. The result of this exam makes out 60% of the final grade.
2. Group evaluation of the project: organizing a debate. The evaluation concerns:
   - the gathered relevant background information about the theme of the debate;

the organization and implementation of the debate with external presenters and invited guests."

Source: Timo ter Berg, teacher of Hogeschool Utrecht

The methodology

Two examples will be shown of how teachers make use of the method. The first example, shown in Box 28, is a minor dedicated to corporate social responsibility, aimed at students in the study program of economics in the Hogeschool Utrecht, in their second year of the program.

The second example is an 'arrangement', a part of the major of the study programs of the School for Teacher Education for Secondary Technology Education ('Pedagogisch-Technische Hogeschool', PTH) of Fontys Hogescholen. This example is shown in Box 29.

Box 29. A role playing game, part of the 'arrangement' of Sustainable Development (Fontys PTH)

"The students take part in an advisory commission for the government with the task of judging how many hectares of agricultural area in the Netherlands can be applied for the production of rape (coleseed).
The purpose is to meet the EU standard of 2010 concerning the mixing of biofuels in petrol and diesel. The expectation is that the Netherlands will not be able to meet this standard.
The commission represents 4 stakeholder groups:

1. The Dutch government, i.e. the Ministry of Environment (VROM) and the Novem (Dutch Organization of Energy and the Environment) of the Ministry of Economic Affairs.
2. The farmers represented by the Agricultural Organization (LTO).
3. The environment (biodiversity) represented by the Foundation of Nature and the Environment (Stichting Natuur & Milieu)
4. The ANWB, representing the car owners.

Investigate how many hectares of agricultural area is necessary for the cultivation of rape, in order to grow on Dutch soil an amount of bio fuels sufficient to guarantee that at least 2% of the used fuel is not of a fossil origin. Every stakeholder group investigates which amount of surface they think is acceptable, and how – if necessary – they are prepared to change their priorities regarding spatial planning. This might e.g. include less space for the enlargement of the road system or of distribution areas, or of decrease in the planned conversion of agricultural areas to nature.
Advise the government about how much agricultural area in the Netherlands is available to produce bio fuels in a sustainable way.
Make use of the balancing system of sustainable development, especially to investigate whether any transfer of our problems to other countries may be an acceptable option.
See to it that you can prove your assertions with figures, i.e. don't talk about 'much' or 'hardly' but indicate quantitatively how many hectares are acceptable for the production of bio fuels in relation to the other major needs, such as areas for housing, food production, infrastructure for mobility, recreation, nature and conservation of biodiversity, water buffering, industrial areas, etc.

Literature: 'Basisboek Duurzame Ontwikkeling', chapter 1, plus some short articles and internet sources.
Assessment: Evaluation of a report of the role playing game by each group, plus an exam."

Source: Luud Fleskens, teacher of Fontys Hogescholen

The examination

The above two examples illustrate that in several universities exams appear to be a part of the student evaluation. This is also the case in the study program of Technical Management of Avans Hogeschool in Den Bosch. The SD introduction instrument is used there in the 2nd year of the program. The evaluation consists partly of the construction by groups of students of a website on which they elaborate some aspects of sustainable development, and partly of an exam. This exam partly consists of a number of statements of which the students have to discuss whether they are true, as Box 30 shows.

Box 30. Avans Hogeschool, study program of Technical Management in Den Bosch: part of an exam

"Discuss whether the following statements are true:

- Development aid through loans is a good idea.
- www.ebay.com is a good example of recycling products.
- The EU is a main cause that there are no wars anymore in Europe.
- The environmental situation in Europe is improving, mainly as a consequence of transfer.
- The use of imported livestock feed is a good example of a long-term solution to unsustainability."

Source: Esther van der Ham, teacher of Avans Hogeschool

8.3. Result assessment

The question leading to experiment #5 was, as formulated at the beginning of this chapter: Can an instrument be developed for the introduction to sustainable development that is applicable in study programs of many different educational sectors? In order to investigate this question, five hypotheses were formulated, as table 34 shows, each of which will be assessed in the present section.
One possible criterion shown in this table was not used to formulate such a hypothesis: #6, the contribution to sustainable development through higher education. The SD introduction instrument may have a serious impact on sustainable development, e.g. through the graduates of the involved study programs. But, just as in the former chapter, describing AISHE, no way was found to measure this effect, as it is impossible to distinguish such an effect from all kinds of other effects.

Table 34. Experiment #5: Criteria for result assessment

Experiment / Criterion	X5 SD Intro	Assessed hypothesis
Contribution to ESD within direct stakeholders		
Implementation of ESD in vision, policy	§8.3.1	1. The instrument meets the demands of ESD.
Implementation of ESD in education	§8.3.1	
Customer demand	§8.3.2	2. The instrument is used by a sufficient number of teachers and students in many educational sectors.
Customer appreciation	§8.3.3	3. Teachers and students appreciate the instrument.
Contribution to SD within indirect stakeholders		
Indirect stakeholder appreciation	§8.3.4	4. External stakeholders appreciate the instrument.
Contribution to SD through HE		
Transfer of expertise	§8.3.5	5. The instrument contributes to SD implementation elsewhere.

8.3.1. Education for sustainable development

For the first hypothesis, which is about the level to which the SD introduction instrument contributes to ESD, the checklist of table 6 is again suitable. The results are shown below, in table 35. As the table shows, in many respects the SD introduction instrument meets the demands of ESD. In some aspects the instrument performs less than optimal, however. The main cause for this is that the instrument is the result of a change of plans. Originally, when the instrument was set up in 2004, the book was designed to consist of eleven chapters, not just five. In 2005, the publisher proposed to split the book into two separate volumes. The main reason was that this made it possible to publish the first of these two one year earlier. As a result, the SD introduction instrument, only containing the first half of the subjects to be described, became available in 2006 (although the official publication year is 2005). The sequel, called 'Werken aan Duurzame Ontwikkeling' ('Working on Sustainable Development"), was published in 2007. (It will be discussed in the next chapter.)
In order to make this possible, a number of subjects were moved from the second to the first half of the complete text, i.e. to the first volume, because a natural demand was that this Basic Book should offer what the title suggested: a rather 'complete' introduction to sustainable development (although no book on sustainable development can really ever be complete). Table 35 shows that this attempt was mostly successful, although some elements are less than optimal.
In 2010, the second edition of the Basic Book will be developed, as it was agreed between the author and the publisher that such a redevelopment of the book takes place every 4 or 5 years, because of two reasons: the rapid development of the broad subject area of sustainable development, and the equally rapid development of didactics and methodologies of the education within the Dutch HBO.

8.3.2. User numbers

The second criterion for the rate of success of the SD introduction instrument approach concerns the number of users, plus the variation among the educational sectors they represent.
The most obvious indicator for the number of users is the series of sales figures through the years. This may appear to be an easy and clear indicator, but in reality it is much less so.
First of all, it is not certain how the number of sold books is to be compared with the use in education. Firstly, all teachers who want to use the instrument – or want to investigate the possibility of doing so – can apply for a free

Table 35. The SD introduction instrument and its ESD characteristics

Principles	Characteristics	Details	Judgment
Connectivity, complexity	Systems thinking	Systems thinking is emphasized in the method philosophy, and realized throughout the instrument.	++
	Multi-, inter- or transdisciplinary	The method is intrinsically multidisciplinary. It invites for interdisciplinary action, mainly through the exercises.	++
	Life-cycle approach	The topic of non-closed cycles is described as one of the weaving faults, and used repetitively. Solutions are studied.	++
	Intercultural, international	Comparisons are made between regions of the world, and concepts are studied like transfer and global unequity. However, relatively many examples and cases are Netherlands-oriented, and the perspective tends to be based on a European culture and philosophy. The language is Dutch.	+
	Future orientation	Future orientation is described as one of the pillars of sustainable development. One of the five chapters is dedicated entirely to future thinking.	++
Innovativity	Openness to changing conditions	The relevance of dealing with uncertainties and flexibility of mind is studied, and practiced through a series of exercises.	++
	Openness to new solutions	Although this principle is implicitly present in many parts, an explicit study of the topic in relation to e.g. the subject of sustainable business is absent. *	+
	Function orientation	The topic of function orientation is not studied. *	-
Action learning, social learning	Application of knowledge	Relations are made continuously between theory and practice, e.g. through the cases and many exercises.	++
	Multi-methods	The method makes use of a wide range of methods	++
	Real-life situations	Nearly all exercises are based on real-lfe situations. Students are invited to investigate real-life situations or act in them.	++
	Commitment	In the introduction, the importance of personal commitment is explicitly described, and it is explained that the instrument is not neutral with respect to SD. Throughout the instrument, the personal commitment of the student is stimulated, e.g. through the questions and the exercises.	++
	Cooperation	The research, discussion, PBL and project exercise are explicitly intended at cooperation through teams of students. Only a few of them also stimulate cooperation with experts and professionals.	+
Reflexivity	Learning to learn	Throughout the instrument, reflection on the own learning process and on the personal attitude is stimulated.	++
	Responsibility	Discussion, PBL and project exercises allow for the definition of personal learning goals. However, the rate to which the students are personally responsible for their learning process depends on the teacher and the educational method used.	+
	Value-driven	Typical SD values, e.g. equity, solidarity, sustainability and the importance of nature & biodiversity, are pivotal to the instrument.	++
	Critical thinking	In the introduction, a critical attitude is emphasized. Several exercises call for a critical evaluation of the texts in the book.	+
	Robustness of information	In many places, especially, the uncertainty of information and of expectations, and the limitations of models and scenarios, are emphasized. However, the precautionary principle is not mentioned. *	+
Overall			+

** This was a conscious decision, as these subjects are studied intensively in the sequel to the Basic Book, 'Werken aan duurzame ontwikkeling', which is described in the next chapter.*

copy of the book, and so the sales figures offer no real indication about the rate of enthusiasm of the teachers. Secondly, it is certain that some of the books were sold to people outside of education, but the percentage of this of the number of sold books is unknown. And thirdly, an unknown percentage of the books bought by students is sold by them to younger students, who use them second-hand; the number of these is probably increasing through the first years, as more copies become available. Thus, the number of students who use the book cannot be exactly estimated. This is all the more true because the instrument is also used in HBO in several other ways, besides the 'proper' use as an introductory method for students:

- as a way for teachers to prepare their lessons, without prescribing the book to the students themselves;

- as a source for collections, anthologies or readers, for which only selected parts of the book are copied;
- as a reference work, available to students in university libraries, etc.; and even:
- as a summary, made by students, published through the internet (against the wishes of the author and the publisher, and without their cooperation).

Table 36. Sales figures of the Basic Book

Year	Sales figures
2006	1834
2007	1268
2008	1451
2009	1157

Nevertheless, the data of table 36 give some relevant information. The first, obvious conclusion is that by no means the majority of HBO students is reached through the Basic Book, as every year more than 100,000 students enter an HBO institution. However, this was never expected. Actually, the sales figures are above the original expectations of the publishing company, as this planned a sale of around 750 copies in 2006. The sales figures of the years 2006 – 2009 are sufficient for the publisher to be prepared to invest again in the method, aiming at the second edition, which will be developed in 2010 and published in the first months of 2011.

Considering the several ways in which the SD introduction instrument is used (as described above), and making an estimate of the percentage of students who use a second-hand copy of the book, a rough indication of the annual number of students who make use of the instrument – directly or indirectly – will probably be somewhere between 2000 and 10,000. This number is not a splendid achievement, if it would be the desire that *all* students should get acquainted with sustainable development. The conclusion is that the book delivers not a major, but nevertheless a significant contribution to ESD in HBO.

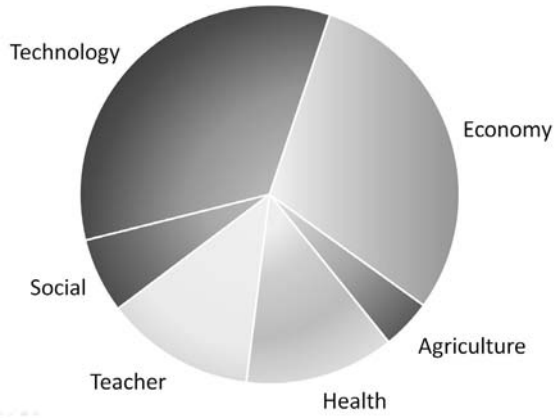


Figure 46. Educational sectors of the respondents of the teacher questionnaire

The distribution of users among the educational sectors of HBO was assessed in November 2009 with the help of a questionnaire among teachers who use the SD introduction instrument. After a search, assisted by the publishing company, for teachers using or at least knowing the SD introduction instrument, 207 HBO teachers were found. Reacting to a request to participate in the assessment, 79 of them consented, 52 of whom really filled in the questionnaire and returned it.

The respondents work as an HBO teacher in the sectors of technology (34%), economy (30%), health (13%), teacher education 13%), social sciences (6%) and agriculture (3%). The only missing HBO sector is the arts sector. This gives some indication of the sectors in which the instrument is used (see figure 46), showing that the intention of making the instrument applicable in many educational sectors has been realized.

8.3.3. Users' appreciation

The direct stakeholders of the SD introduction instrument are considered to be two groups: the teachers and the students of HBO. The level of appreciation of the instrument was assessed in several ways for both groups.

Appreciation by teachers

During the development of the instrument, a group of teachers commented on the draft results, as described above. These comments were used to improve the draft version, and so they will not be used here as a method to assess the final result. In the years after the instrument was published, comments were sent by teachers to the publishing company through the years. Between April 2006 and February 2008, they were gathered by the publisher, and a representative selection is reprinted here:

> "It is good that sustainable development is positioned in a global (and also historic) perspective. The book is going beyond sustainable development. It is also about globalization, and that is exactly what is needed."
> "It demonstrates the deep relations between society, environment and organizations. It might have offered some more cases about small-scale applications. For the rest it is ok."

"Very clear on CSR. In my opinion, it's a good manual for the optional program that we might begin to develop around this issue."
"A good and applicable book."
"Excellent structure in terms of content but also didactically."
"Clear and understandable, though I cannot find criticism from some scientific disciplines, which might make this book more objective. I miss some more detailed information about the consequences of loss of biodiversity and of epidemics."
"Clearly legible, broad, usable. But not enough models, concepts, tools."
"Very suitable for application within HBO. Didactically robust, with fantastic examples and cases."
"Within the field of sustainable development, this is a publication which everyone was waiting for. I am really very enthusiastic about it."
"Good book, very wide-ranging deployability, Good level, not too difficult but also not too superficial. The book is somewhat oriented towards Europe and the West, making it less useful for my lessons, for which my students find placements all over the world."
"Very good basic book, gives a clear description of the problems and solutions of sustainable development. A chapter about how to use this as a basis for CSR reporting of companies would make it complete. It is suitable for optional education modules."
"I find it very useful and enlightening for myself as a teacher. I see now much better the theoretical problems involved in decision making at different levels. It is useful above all for your personal opinion-forming process, both for teachers and students. For my students of the HBO program of primary teacher education, there are too few practical exercises."
"The different exercises are quite good."
"Clear and transparent. In a balanced way it gives attention to the many aspects of sustainable development."
"A very complex issue is explained in a comprehensible way, it is a fine introduction into the field of study. Because our students are strongly profession-oriented, we will need a few additions concerning the translation of the issues to the professional field of our program."
"Good-looking appearance, sometimes a bit childish language."
"Fine study and a clearly legible book."
"Wide-ranging and comprehensive set up. A thorough basic book."
"Fascinating book. Might offer a little more depth however."
"The book gives a huge amount of information on many subjects. The attempt to describe sustainable development in a coherent way is commendable. The book invites debate."

The comments are mostly positive, with some desires or negative remarks. Some of those remarks contradict each other, e.g. concerning the language use (too easy?), the level of detailedness, and the number and diversity of the exercises. These issues were therefore put among the items of the questionnaire that was designed and sent to HBO teachers in November 2009.

Results of the teacher questionnaire of November 2009

Some of the questions had the shape of statements that the respondents could react to with "certainly not true", "mostly not true", "partly true, partly not true", "mostly true" or "certainly true". The results are shown in figure 47.

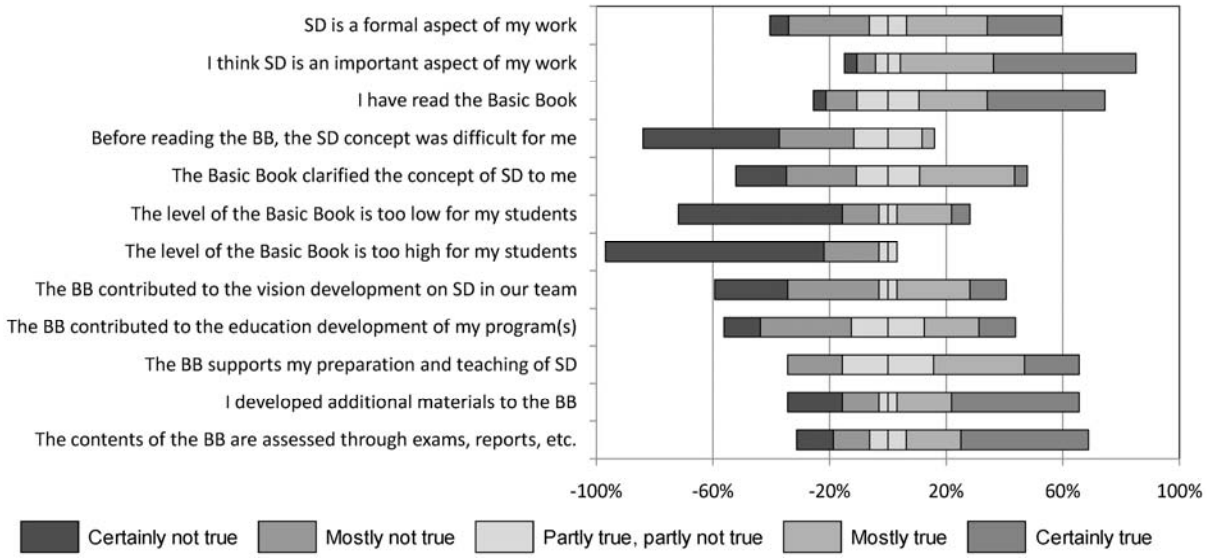


Figure 47. Some results of the 2009 teacher questionnaire about the Basic Book

The concept of sustainable development

As some of the respondents were not teachers, they have been left out, so figure 47 is based on the reactions of 47 respondents. An interesting result of this figure is the fact that a large majority of the respondents appeared to indicate that they did not find the concept of sustainable development difficult to understand, even before they studied the Basic Book. This contrasts with the findings of the 2004 investigation by DHO, which indicated that understanding the concept was one of the problems concerning ESD for many teachers. One possible explanation for this difference is that, in the period between 2004 and 2009, the average level of understanding by all HBO teachers has improved significantly. Another possible explanation is that one or both of the investigations suffered from a bias due to a lack of representativity of the respondents. In the case of the 2009 inquiry, this may e.g. be caused by the fact that – given the fact that all respondents were in some way more or less familiar with the Basic Book - they were probably more than average interested in sustainable development, a hypothesis that is strengthened by the fact that more than 50% of the respondents recognizes sustainable development as a formal part of their work (figure 47, top line). Whether the same was true for the 2004 respondents is not known, but seems unlikely.

Another questionnaire result is that less than half of the respondents indicate that the Basic Book helped them to understand the concept of sustainable development. At first glance this seems to indicate that the book is less than optimally suited for its purpose, which would be awkward, as the above quoted remarks by teachers gathered by the publisher seem to indicate the opposite. It might however also be explained by the fact that only a minority of the respondents felt a need for such clarification, as just concluded. To investigate which explanation is more likely, a comparison is made between two statements. The result is shown in a cross table (table 37). The table shows a correlation: the more the respondents experienced a difficulty in understanding the concept of sustainable development before reading the Basic Book, the higher they appreciate the clarifying effect of the book. (In other words, the lower right triangular part of table 37 is empty.) This is in accordance with the hypothesis that the book meets its demand of clarifying the concept; however, the support for the hypothesis is not very strong, as only a small number of respondents indicate having trouble in understanding the concept. Nevertheless, when the findings from table 37 are combined with the remarks gathered by the publisher (an example of 'across methods' triangulation, see §1.4.1), the conclusion is justified that the book meets its goal of offering clarity on the concept of sustainable development.

Table 37. Effect of the Basic Book on the clarity of the SD concept

"The BB clarified the concept for me"	**Totals**	**22**	**11**	**11**	**2**	**0**	**46 ***
	Certainly true			1	1		**2**
	Mostly true	3	5	6	1		**15**
	Partly true, Partly not true	2	4	4			**10**
	Mostly not true	9	2				**11**
	Certainly not true	8					**8**
		Certainly not true	Mostly not true	Partly true, partly not true	Mostly true	Certainly true	**Totals**
		"Before reading the BB, the concept of SD was difficult for me"					
** 46 teachers answered both questions*							

The level and the use of the book

In accordance with the remarks gathered by the publisher, some teachers think that the level of the book is too low for their students. However, nearly all of those teachers apply the book in higher years of the study program, while it is intended for the first year of the programs.

A majority uses the instrument for the preparation of the lessons, in many cases adding extra materials to it, e.g. exercises, project tasks, case studies, new or existing literature. Two thirds of the teachers assess the achievements of the students, for instance through exams or reports.

Another subject in the questionnaire was the application of the exercises. All kinds of exer-

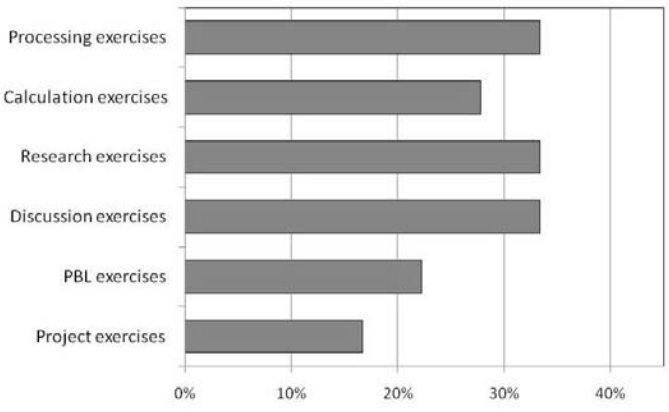


Figure 48. Types of exercises used by HBO teachers, according to the 2009 questionnaire

cises appear to be used by the teachers and their students, but not all in an equal amount, as figure 48 shows. Both the PBL and the project exercises are applied not as much as the other types. For the project exercises this may not be very surprising, as they take on average much more time than the other types. For the PBL exercises there seems to be no clear reason, apart perhaps from the experience that, in recent years, in several HBO institutions teachers have indicated to the *researcher* that they have stopped using PBL as an educational methodology, for a variety of reasons. It may be interesting to examine this process more carefully, but that is beyond the scope of the present dissertation.

Strong and weak aspects

The respondents were also asked to fill in, according to their personal opinion, the strongest and the weakest characteristic of the SD introduction instrument. Besides, there was an opportunity to add a general remark. The following answers were received:

"In my opinion, the strongest aspect of the SD introduction instrument is:"

"The triple-P philosophy is treated extensively in the book."
"The main themes all use the three P's in an integrated way."
"Clear view on the major issues."
"The broad theoretical basis."
"The applicability of the concept, by introducing weaving faults, power sources, and dimensions."
"The concept building."
"The complex concept is made accessible."
"The plain language and clear examples; the choice for these five chapters is quite clear"
"Legibility."
"A great social awareness."
"The cases of golden rice and the channeling of major rivers appeal to my students."
"The used examples are very appealing."
"The beautiful examples which support and clarify the theory."
"The satiric columns to stimulate the vision development of students are very attractive."
"The wide range of exercises is very useful for a teacher."
"Good for general development; excellent exercises; good classification of exercises in six types."
"Inspiring to start working on sustainable development."
"Good reference work."
"The instrument is a bible for sustainability education."
"The instrument transcends disciplines and study programs, and links them with each other."
"Strong studiability of the instrument."

"In my opinion, the weakest aspect of the SD introduction instrument is:"

"The structure within the chapters is less clear."
"I miss theoretical visions, conceptual structures."
"There is much generally applicable, non-disciplinary information."
"Few technological solutions."
"For 2nd year technology students some subjects are not challenging enough."
"My practically oriented students find the instrument too abstract, they associate it with social studies."
"Not all information is relevant to my study program (pedagogy)."
"Not sufficiently aiming at the economy program of my target group."
"For our business program it is a good and broad framework, but we need a supplement with more management focused literature."
"The 'educational' language (although my - mainly adult - dual students disagree with me)."
"Not directly applicable in our education, which has more to do with our curriculum-building than with the instrument."
"It tends to subjectivity."
"It is somewhat moralizing."
"I need it in English!"

General remarks:

"Sustainability should be embedded in the study program. That is why, for each project in our programs, attention is given to sustainability. I think that sustainability should not be a separate subject. Therefore, the instrument is suitable for educators, in order to coach the students."
"I have used the instrument to orient myself on the topic. Last year I used it with my lectures as optional."
"The book is a bible (an imperative) for each right-minded global citizen, with a lot of attention to knowledge

(objectives, essentials, consequences of choices, concepts, developments). Some more specific attention might be given to practical skills and behavior."
"I need English literature for my English-spoken Minor of International Sustainable Development Cooperation ."
"The seminar, during which the instrument was explained with the help of presentations about the implementation in the curriculum, has had an impact on the sustainability vision that we pursuit as a team. Thanks to the instrument, there is no debate anymore about why, but rather about how to implement sustainable development in our education."
"A similar work for secondary education is lacking…"

Again, some of the reactions oppose each other, e.g. concerning the presence or absence of a clear structure or a vision. Remarkable is the fact that one teacher complains that the language of the instrument is too easy, immediately adding that the students apparently are happy with the language used. A possible explanation for this, and for the opinions by others stating that the level or the language of the book is too easy, may be caused by a possible tendency of some teachers to overestimate the language skills and reading capabilities of their students: another interesting hypothesis going beyond the scope of the present dissertation.
The question about the reading skills of students makes it all the more interesting to address this other direct stakeholder group, the students themselves.

Appreciation by students
Following the three practical tests with students, two kinds of investigations among students were made before the instrument was published. For both investigations, the book and its accessories were used as educational materials in a Minor, at the end of 2005. For both, the publishing company made copies of the book available using a copying machine, as the printed version was only available in 2006.
On assessment took place in Saxion Hogeschool in the city of Deventer. After using the SD introduction instrument, coached by their own teachers, students of the Minor of Sustainable Development were asked to give comments in December 2005. The following remarks were made:

"I think that the book is well structured, the questions within each chapter make you stop reading and start thinking about the subjects you have been reading about. The summaries, and also the glossary of terms at the end of each chapter are useful."
"The book is remarkably clearly legible, without the use of complex formulae. The various cases included in the book are often very interesting and usually very topical."
"I find the book well readable. The many examples and tables make everything understandable. The use of language is also good to follow. It reads fine."
"The disadvantage of this book, I think, is that it offers too many details. In the more difficult chapters I can agree, but for other chapters it is too much. E.g. chapter 5, there are the two examples of Mesopotamia and Easter Island: Easter Island might have been left out."
"The subjects of the book are good. I think the last two chapters are the best. They were the chapters that offered me the best information, they are really very well and good to be used. The first three chapters might give me some more detailed information."
"The short columns between the texts, some about the past, others about more recent problems, make the reading of the sometimes quite dry matter more pleasant, sometimes even fun."

The other assessment was done by the teachers of the Minor of Philosophy & Ethics at the Hogeschool Utrecht, in October 2005. They asked their students to respond to a short list of questions. The results were as follows:

Do you think the level of the book is too easy / exactly right / too difficult?
15 times: Exactly right
6 times: The cases are very illuminating
2 times: Almost too easy, I had a lot of knowledge about this before
1 time: The structure, including summaries, source lists and lists of concepts, is great
1 time: The first part is ok, the rest is too difficult
1 time: The first part is too easy, the rest is ok

Do you think the book will be useful for you during the rest of your study program?
14 times: Yes
4 times: No
1 time: Don't know

Do you think that later, as a professional, you will make use of things you learned from this book?
15 times: Yes
2 times: Don't know
1 time: No

Do you expect to use the book again, some time later?
7 times: Yes, as a work of reference / for my research
6 times: Yes, to refresh my memory / to renew my awareness
2 times: Yes
2 times: Don't know
1 time: Yes, to let others read it
1 time: Yes, as a professional
1 time: No

Complete the following sentence: Compared to other study materials, the Basic Book is …
9 times: Well readable / good to understand
5 times: Interesting / fascinating
2 times: Broader /more interdisciplinary
2 times: Offering strong examples / cases
2 times: Totally different
2 times: Making me think
1 time: Something that should be compulsory in all schools of secondary education
1 time: Of direct relevance to your own life
1 time: A do-book
1 time: Topical
1 time: Finally: a book again!

The results of the investigations among the students are in accordance with those among the teachers. Most respondents are satisfied with the instrument and indicate that it is useful for them. The students too give some mutually contradictory answers, which may probably be interpreted as an indication that the book may be pretty well positioned.
The closing remark of one of the students, "Finally: a book again!" is an interesting one. Over the years, several people have commented that a disadvantage of the Basic Book is that is contains information that may lose its validity very fast, as the field of sustainable development is rapidly developing. This may be true, although the disadvantage can be countered by the teachers applying the book in their education by adding the latest developments. (Besides, as already indicated, the book will be renewed every four or five years.) On the other hand, the student's remark matches with other remarks that quite some students have uttered to the *researcher* in the last few years, indicating that they too appreciate having a book, including its structure and build-up, instead of a long series of websites. In other words, it seems that the thought that higher education could do without books at all, as is sometimes stated, is not 100% accurate.

8.3.4. External appreciation

Apart from the direct stakeholders, i.e. the HBO teachers and students, others have also given their opinion about the instrument. Mostly this was done in reviews in journals and magazines, but before citing them, first two other opinions will be shown.
The first is the preface to the Basic Book, which was written by Ruud Lubbers, former Prime Minister of the Netherlands, and former UN High Commissioner for Refugees (UNHCR). He wrote:

> "Sustainable development as an idea and an ideal is an issue of the final 30 years of the last century. The actual implementation of sustainable development however has only just begun - an extraordinary, highly important task for the generation which presently accepts its responsibility. The Basic Book on Sustainable Development is published at the right time, precisely at the beginning of the Decade of Education for Sustainable Development, which is coordinated by UNESCO at the request of the General Assembly of the United Nations. (…)
> Just some kind of ethical Charter will not suffice. The right mix of ethical passion and practical improvements is what we need. This book, the Basic Book on Sustainable Development, proves this in an appealing way."

Another sign of appreciation was shown by the Chairman of the HBO Council, Doekle Terpstra. During the official launch of the instrument on April 12, 2006, he was prepared to receive the first copy of the book. In his speech, he emphasized the importance of sustainable development for higher education, as well as the importance of higher education for sustainable development.
One of the first reviews of the instrument was written in June 2006 by Jan Bom, chief editor of a Dutch Journal on sustainable business called *People – Planet – Profit, the P+ Magazine* (Bom, 2006a):

> "[We give] all the available 'Michelin stars' to this Basic Book. [It is] a very thorough publication, meant to make the students develop 'an intuitive feeling' for the meaning of sustainable development. (…) For the editors of *P+ Magazine* too, the book is an excellent work of reference, which surpasses earlier explanatory publications about sustainable entrepreneurship."

In the 2006 December issue, he added (Bom, 2006b):

> "This work has a broad design, illustrated in a creative way. The text stimulates the thinking about large global issues. It makes the students think about why CSR is relevant for them. I will no doubt repeatedly take the book out of the bookcase to reread parts of it."

"De Kleine Aarde" is an (in the Netherlands) well-known NGO on nature and sustainable development. Its magazine is also called *De Kleine Aarde*. In the fall of 2006, one of its editors wrote (Nelissen, 2006):

> "The Basic Book describes sustainable development in a balanced way. It dedicates attention to People, Planet, Prosperity (!), Place and Time, with an eye for the global aspects of sustainable development and for its future aspects. The publication goes along with the societal development that companies, organizations and the government want to make use in a conscious and sustainable way of the available resources, the environment and the human capacities. (…)
> The Basic Book exceeds disciplines, showing clearly how complex the concept of sustainable development is. (…) [The author] wrote the book in cooperation with a scientific advisory board. For students and others it is a highly informative book."

ScienceGuide is a Dutch journal for higher education. This journal published a review of the Basic Book in August 2006 (Venselaar, 2006):

> "Usually the books about sustainable development assume that the reader is familiar with the concept and its backgrounds. They immediately focus on the implementation. But a lot of people don't have such insights, especially students. What they do know is usually highly anecdotal, full of misunderstandings. The Basic Book on Sustainable Development definitely succeeds in filling this gap. (…)
> The concept will certainly be effective. It offers many opportunities and clues for personal research, in combination with the website. It stimulates the development of personal opinions, and it challenges insights. The questions don't aim at checking whether the text was understood correctly but instead focus on issues like 'what is your personal opinion?' (…) The structure and the selection of the themes in the various chapters is well thought-out. It offers a general introduction through a wide variety of examples and cases: the 'weaving faults' with an explanation why things are as they are; the 'power sources' i.e. the 'enablers' that in principle offer the opportunities to correct those 'weaving faults'. Next it is studied how unsustainability can be seen as an imbalance in the opportunities of people 'here and there' and 'now and later', following the fundaments of sustainable development that were originally designed by Brundtland. (…)
> The huge variety in examples and illustrations is appealing. The variation in styles is wise. Some people like to see numbers and tables, while others prefer an image or a case study. To me personally the somewhat absurd 'columns' are attractive, showing what might happen if we go on sticking our heads in the sand: such as 'if the ticket vending machine could talk', 'the seven farmers' sons' and 'my fellow countrymen and women'. (…)
> The introduction of the book describes that no 'scientific structure' was selected, step by step studying the development of the concept of sustainable development and the consecutive phases it has gone through. I must say, I miss that. A good insight into how a concept was developed may often contribute to a good insight into what it means."

For the three-monthly DHO newsletter, an external expert on sustainable development was invited to review the Basic Book (Maas Geesteranus, 2006):

> "The biggest achievement of this innovative book seems to me that it indeed treats a broad spectrum of subjects, in such a way that they are explained in a very readable way (perhaps even in a too easy language; what do the modern students think of that?). (…) The issues are usually treated both from a spatial and a time perspective: the 'here and there' and the 'now and later'. Excellent! We can be very happy with this. (…)
> It seems to me that the reader is addressed alternatingly as a student or as a citizen. This can be seen in the exercises. Does the author try to 'raise' the students, besides introducing them to the subject? A valuable attempt, but not for the intended readers and under the given circumstances. (…)
> Important elements of decision making are the values of people and of cultures. The book is challenging, as the author, besides facts, also introduces various values, stimulating the students in many exercises to formulate their personal values and use them in the discussions. The former entails a certain risk. But the advantage of expliciting values is that choices and decisions are not only based on factual knowledge but just as well on related ethical standards, i.e. on conscience. In professional situations too. (…)
> All in all: A very enriching book that I recommend, even outside of higher education."

Maas Geesteranus appears to object against the formative aspect of the book, trying to 'raise' the students. It is interesting to compare this with the desire formulated by De Haan (2006) that ESD creates or strengthens 'Gestaltungskompetenze', as was described in §2.3. The controversy could be an interesting starting point for further debate.

The most recent review was published in 2008. MOS is a Belgian NGO dedicated to environmental issues in relation to all levels of education. In its Journal, the *Moskrant*, a review of the Basic Book was published (Moskrant, 2008):

> "[The book] demonstrates the interdependence [of sustainability issues] in an accessible way. [It] brings the issues close to the personal imagination. It becomes recognizable to everyone. The many questions within the text invite to reflect on the own personal role regarding sustainable development. The multiplicity and diversity in exercises pays attention to various disciplines and interests.
> The computer programs in the exercises are nice. The summaries and lists of concepts at the end of each chapter are useful."

It may be concluded that, apart from some critical remarks, the external reviewers are mostly satisfied with the Basic Book.

8.3.5. Transfer of expertise

Although the Basic Book and its accessories were intended to be used in higher education, especially in HBO, it was also used in some other fields. This subsection shows some of them, as an illustration of the way the book is used outside higher education.
For the HBO schools for primary teacher education ('Pabo's), an enhancement (De Hamer et al, 2008) was written to the Basic Book in order to enable their students to apply the book during their internships in primary schools.
SLO, the Dutch National Center of Expertise on Curriculum Development, developed several publications about the integration of sustainable development in primary and secondary education: Remmers (2007) and Bron et al (2009). Both used the Basic Book as a source.
Kennisnet ('Knowledge Net'), a Dutch website for primary, secondary and vocational education, recommends the Basic Book (http://duurzaamheidpodocent.kennisnet.nl/lezen).
An HBO study book on organizational management (Ten Berge & Oteman, 2009) spends a section on sustainable development, and bases this almost entirely on the Basic Book, citing several sections of it.
One of the goals of the Dutch national program of Learning for Sustainable Development (Leren voor Duurzame Ontwikkeling, LvDO) is to propagate the introduction of sustainable development in national and local governments through training of civil servants. In 2006, the possibility was discussed to make use of the Basic Book. One of the results was that such a training program, applying the Basic Book, was developed by Cailin Partners, an expert center on sustainable policies. The first local government to use this course was the Water Board of the Zeeland Islands (Waterschap Zeeuwse Eilanden), in 2006.
The Basic Book was mentioned in the Progress Report 2006 (Ministry of VROM and Ministry of Foreign Affairs, 2007, p. 24) of the Dutch national action program on sustainable development ("Duurzame daadkracht") that was mentioned in §2.2, as an example of this progress. It was mentioned in the same way in the 2006 progress report of LvDO.
The Basic Book offers a definition of sustainable development that was clearly derived from the Brundtland definition, trying to define the concept in an intuitively clear way. The definition states: "Sustainable development leads to a situation in which more and more people are able to lead an adequate life, which can be maintained for many generations on end." Several sources seem to find this definition attractive. For instance, the Program Office of LvDO offers two definitions of sustainable development: the one by the Brundtland Commission, followed by the one in the Basic Book (Van der Wielen, 2007, p. 7). Other organizations just use the Basic Book definition. One of them is the local council of the city of Delft (Gemeente Delft, 2008). Another is CE (Hueting, 2008, p. 27), an environmental consultancy agency, which used the definition in a report to the Dutch Water Boards.
From several sides the request was made to translate the Basic Book into English. Such an English version can never be a one-to-one translation from the Dutch book, as a relatively high percentage of cases and explanations is based on Dutch situations, as the publishing company required. But a translation, followed by an adaptation towards a more international orientation might well be possible. Such a request was made e.g. by education managers of study programs (majors) and minors with international student groups in several Dutch universities and in some foreign universities. In June 2010 the British publishing company Earthscan decided to publish this translated and adapted book, aiming primarily at the American market.

8.4. Conclusions

Putting all conclusions together, the following result arises (table 38).
Strong points of the instrument are: It meets most demands of ESD. The concept of sustainable development is successfully clarified for teachers and students. It is used in nearly all educational sectors.
Weak points are: The core of the instrument is a book, which means that the contents are fixed for a number of years (4 or 5 years in principle) and so cannot follow recent developments. A large majority of HBO students is still

not reached. Some subjects or aspects of sustainable development are missing or underexposed. Others than Dutch-speaking people cannot apply it.

Table 38. Experiment #5: Evaluation				
Experiment / Criterion	X5 SD intro	Assessed hypothesis	Evaluation	Judgment
Contribution to ESD towards direct stakeholders				
Implementation of ESD in vision, policy	§8.3.1	1. The instrument meets the demands of ESD (see table 6).	Most demands are met (see table 35). Topics like function orientation and the precautionary principle are missing. Other aspects of ESD depend on the initiative of the teacher.	+
Implementation of ESD in education	§8.3.1			
Customer demand	§8.3.2	2. The instrument is used by a sufficient number of teachers and students in many educational sectors.	The use is higher than the expectations of the publishing company, but still only a rather small minority of HBO students apply the instrument directly or indirectly. The instrument is used in most educational sectors.	–+
Customer appreciation	§8.3.3	3. Teachers and students appreciate the instrument.	As a whole, the instrument is highly appreciated. For some, the level is too low or insufficiently detailed. Some find it too subjective or moralistic.	++
Contribution to SD towards indirect stakeholders				
Indirect stakeholder appreciation	§8.3.4	4. External stakeholders appreciate the instrument.	As a whole, the instrument is highly appreciated. For some, the instrument should not try to 'raise' the students or should introduce the concept of SD in a more scientifically and historically based way.	++
Contribution to SD through HE		*(not applicable)*		
Transfer of expertise	§8.3.5	5. The instrument contributes to SD implementation elsewhere.	Some non-higher education organizations use or mention the instrument. As it is in Dutch, the external transfer is limited.	+

Looking at the SD introduction instrument from an ESD perspective, the instrument itself - the book, the website, the downloadable tools, the serious games, the exercises, the teacher manual, etc. - is not perfect, but it meets most of the demands of education for sustainable development.
The number of people who use the book in some way or other is another important indicator. For the direct stakeholders it is difficult, if not impossible, to make a sound estimate of this, for reasons that have been explained. The rough estimate of an annual use by HBO students - somewhere between 2000 and 10,000 - indicates that only a minority of HBO students uses the book. (In 2008, 94,000 students entered HBO at the bachelor's level (HBO Council, 2009a).) This is nor a good, neither a bad result, as it was originally expected that the number of users would be lower; a significantly higher expectation would have been unrealistic. The contribution to ESD in the Dutch HBO is therefore not magnificent but certainly significant.
This conclusion is supported by the opinions of the direct users, i.e. the teachers and students in HBO, who are fairly satisfied with the book. Some of the weaknesses of it, signaled by the users, will be improved by the 2010 revision. However, the questionnaires and remarks on which this conclusion is based may be biased, as the data come from teachers and students who use the instrument. It is possible that others, who don't use it, would be less positive if they would be able to judge the instrument.
The opinions of external experts are on average positive too, although some of them would have liked to have some changes in the concept. The external use, and thus the transfer of expertise outside of higher education, supports the conclusion that as a whole the Basic Book meets the demands.
The original question that this experiment started with was:

- Can an instrument be developed for the introduction to sustainable development that is applicable in study programs of many different educational sectors?
-

The SD introduction instrument has proved to contribute to the understanding by HBO teachers of the concept of sustainable development and its main aspects. It also proved to enable them to integrate these subjects in their education, thus helping students to lay the fundaments for their later, more detailed work on sustainable development. It is used in many sectors of HBO. This shows that the question of experiment #5, the development and use of the SD introduction instrument, has a positive answer.

9. Current experiments

The five experiments described in the chapters 4 till 8 are not the last ones performed by the *researcher*, together with colleagues and with teachers and students in HBO, around the strategy development and implementation of ESD. Several other experiments have started in recent years. They will be described in the present chapter. They are not finished yet, and so the structure of the next sections will differ from the earlier chapters. No systemized result assessment has taken place for them as yet, or at most a very limited partial assessment. Consequently, a critical analysis of the results of such an assessment cannot be presented.
Nevertheless it is relevant to describe them. Not only do they show the ongoing process of ESD development. More important, the description of these experiments, including the context in which they took place (i.e. the change processes in HBO), will be necessary for the synthesis and the overall conclusions and recommendations that the dissertation will end with.
Before discussing the current experiments, the context will be described within which they are taking place. It is important to describe one last major change process that took place within HBO in the last decade, the consequences of which are still developing: the introduction of education that is based on professional competences.

9.1. The context: competence based education

In earlier chapters of this dissertation, a lot of change processes in HBO were described. Several of them were related to subjects like student centred education, activating education, profession oriented education, etc. Key terms were e.g. learning to learn, learning by doing, realistic learning environments.
All such developments came together, when higher education started to focus on the acquisition by students of professional competences. Roughly since the year 2000, many universities in the Netherlands tried to redevelop their educational programs based on sets of competences.
The central question that gave rise to competence based education (CBE) was: what kind of qualifications should a graduate from higher education possess? Especially for strongly profession-related disciplines, this question was, at least partly, to be answered by the demands from the professional field. Such qualifications may be defined on several levels: generic qualifications, applying to all people who graduate at an institution of higher education, and discipline-specific qualifications.

9.1.1. Professional competences

The concept of 'competence', acquired as a result of educational or other learning processes, has been defined many times, and not all definitions are in agreement with each other. Many definitions refer mainly to the *behavior* of the professional or to the results of such behavior. An example is Nedermeijer and Pilot (2000):

> "A competence is the ability of an individual to show adequate behavior and therefore to act excellently e.g. as a researcher or a professional. The individual characteristics of the student are essential. Competences are combinations of (core professional) skills, knowledge, attitudes, standards and values. One student may be just as able as another, but personal characteristics like courage, perseverance and motivation determine which student is better suited for a certain function."

Other definitions put less emphasis on behavior, but instead directly describe competences as sets of skills, knowledge, etc.
A 'competence profile', i.e. a full set of competences, can be described using so-called 'critical professional situations', i.e. situations in which someone is confronted with a professional problem or dilemma which is exemplary for the profession that the study program aims at (Grotendorst et al, 2006). Essential for such a situation description is: (a) a context in which it is located; (b) a kind of role or function that the professional fulfils, or a kind of result that has to be reached; (c) the specific tools that are needed: i.e. not only physical tools (like a hammer), but also knowledge, skills, attitude. These concepts may be illustrated with the example of some competences of a plumber, as is shown in box 31. This box illustrates why a competence-based graduate profile may differ strongly from a traditional one, which was mainly subject-based. In a traditional set of end terms for a plumber, attention to e.g. social skills would be unlikely. It is easy to imagine how descriptions of critical professional situations, as in box 31, can be used to derive the contents and structure of a curriculum. The example makes clear that a list of competences, especially if it is made operational with the use of contexts, roles, behaviors and tools, offers a fundamentally different starting point for the development of a curriculum than a long list of separate knowledge elements and skills designed by teachers, as in more traditional education.

Box 31. Some competences of a plumber

Context (or critical professional situation)
My house. A few seconds ago the washstand in my bathroom has broken off of the wall. The water pipe has cracked into pieces, and all of a sudden I have a gushing fountain in my bathroom. I panic, I freeze, I don't know what to do. The only thing I can think of is: call the plumber!! When the plumber arrives, this is what he (or she) should do:

Role 1: Architect
Behavior:
First of all, the plumber immediately shuts down the water flow, as the water is already streaming down the stairs and into my hall, soon to reach the living room. So, without hesitation and without having to ask me, he finds the main water tap and shuts down the entire water system of my house.
Tools:
Knowledge and insight of the architecture of houses and their infrastructure.

Role 2: Social worker
Behavior:
Now that the water stopped flowing, the next thing he does is comfort me, thus enabling me to do more than just moaning. He may say things like "Ok mister, it is not as bad as it looks like. Now if you go and get some towels and a bucket, then I will …" etc.
Tools:
Knowledge of human nature. Social skills. Ability to keep cool. Caring attitude.

Role 3: Technician, repair man
Behavior:
Only now that the situation has become more or less stable, he starts thinking of making repairs in my bathroom.

In §6.2.2 the 'tree model' was introduced, which was described in more detail in §8.2.3 and illustrated with the image of a tree in figure 41. In this model, a curriculum was compared with a tree:

- Roots: Vision, mission, educational goals
- Biochemistry & physiology: Educational methodologies
- Trunk: Basic module or introduction to sustainable development
- Branches: Disciplinary integration
- Forest, ecosystem: Interdisciplinary integration
- Fruits: Output: effect on professional field and society
- Growth process: Development and maintenance of the study program

In competence based education (CBE), it is the competence profile that forms the 'roots of the tree'. The output, the 'fruits', form the check whether the roots are sound. In an ideal situation, the competence profile is designed in cooperation with the professional field, which formulates wishes concerning the 'fruits'. The competence profile is made 'operational', i.e. it is formulated in such a way that, as a next step, the curriculum can be deduced from it. The development and implementation of both the competences and the curriculum then form an iterative process, as the results of the curriculum (the 'fruits') are used to improve the competences in a continuous quality cycle (Wesselink et al, 2005). In real life, however, the situation is not always ideal. In several universities, situations exist in which the professional competences were completely designed by the teachers of a study program, who claimed that 'they did not need help from the professional field, because they perfectly knew what the companies wanted'. In one case, the teachers of a study program admitted (during a meeting with the *researcher* in 2009) that first they had developed the curriculum, and next a suitable set of competences was written 'proving' that the curriculum was right.
In spite of such cases, CBE has introduced real changes in many study programs. Some of these changes opened the opportunity to integrate many earlier educational innovations into one structure, as table 39 shows.
According to Meriënboer e.a. (2002), a major new aspect of CBE is a new role for the assessment of the student achievements. Knowledge, skills and attitudes are not assessed separately but combined, and integrated in the whole learning process. For the assessment, many study programs make use of portfolios. Each student has his/her own portfolio, in which a record is kept of the competences that the student has proved to have acquired. It is the student who is the director of the assessment process: he or she indicates when a certain competence level is to be proved. It is also the student who critically reflects on the own learning process, both in a deep and a broad sense, as Van Hout et al (2006) explain (see also Van Alebeek & Kouwenhoven (2006)):

Table 39. Differences between traditional and competence based learning	
Traditional learning	**Competence based learning**
Knowledge and disciplinary skills are the starting point of the curriculum	Realistic practical situations are the starting point of the curriculum
Education process is central	Learning process is central
Control by teacher	Teacher as coach
Passive student	Active student
Separate disciplines	Interdisciplinary
Separate skills	General skills integrated in the entire curriculum
Assessment is only a teacher task	Self reflection and self assessment are fundamental
Source: Schlusmans & Slotman, 1997	

> " 'Deep' reflection concerns the underlying meaning of your actions, e.g. What do I want to reach? When am I effective as a professional? 'Broad' concerns reflection about the moral, emotional and political dimension of the work field, e.g.: Why do I do the actions that I do? On which norms and values do I base my actions? Who takes advantage of my work?"

Students are allowed to prove that they acquired certain competences in an earlier context, e.g. in a job or in another study program: the so-called 'earlier / elsewhere acquired competences' (EAC; in Dutch: 'eerder / elders verworven competenties', EVC). If they do, they don't have to acquire these same competences again in the present study program. Therefore students can either finish their study in less time, or acquire more competences and specialize themselves in certain areas.
For the assessment, many programs make use of 'competence levels'. Students can make use of assessments to prove that they acquired certain competences at certain levels. Such sets of levels vary greatly. For instance, Vernhout (2004) describes four levels:
Level 1: Some experience, effective professional behavior with some mentoring
Level 2: Ample experience, effective professional behavior without mentorship, based on personal initiatives
Level 3: High experience, effective professional behavior, stimulating others
Level 4: Creating an environment in which others can optimally develop their competences

Many study programs make use of a system in which the levels simply refer to the phases of the curriculum:
Level 1: First study year.
Level 2: Bachelor: major.
Level 3: Bachelor, graduation.

The disadvantage of the latter system is that these levels cannot be used to define the curriculum contents based on it, as this would be a circular reference. To a certain level, the same is true for the above system described by Vernhout, as terms like 'some experience' are not directly assessable.
For the Dutch medical study programs, a set of four levels was defined (CCMS, 2004). This system is in contrast with the thought that competences are defined as combinations of knowledge, skills and attitudes:
Level 1: Knowledge
Level 2: Application of theory in (simulated) practice
Level 3: Practical skillfulness
Level 4: Integration of competences in daily work

A system that is used by Fontys School of Nursing will be described below in more detail, as it is used as a starting point for experiment #6. It defines four competence levels:
Level 1: Apply
Level 2: Integrate
Level 3: Improve
Level 4: Innovate

9.1.2. Generic competences

A distinction can be made between generic competences, which are applicable to all disciplines and sectors, and more specific competences, which are applied to a sector, a discipline or even to one individual study program in one university. Several attempts were made to develop a set of generic competences. These attempts are interesting from a viewpoint of ESD, as they appear to have a remarkable resemblance – but also some significant differences – with sets of competences designed by ESD developers, as will be described next (§9.1.3).

In 1999, the HBO Council published a list of 10 generic competences for the HBO graduates, to be applied to every discipline and study program within HBO. The competences are shown in box 32.

Box 32. Generic HBO competences

"1. Broad professionalization
The graduate is demonstrably equipped with current knowledge which is in line with recent (scientific) knowledge, insights, concepts and research findings and recent (international) developments in the professional field in order to qualify for:
- independently performing the tasks as a beginning professional
- independently functioning within an organization
- shaping the own professionalization

2. Multidisciplinary integration
Integration of knowledge, insights, attitudes and skills of various disciplines.

3. (Scientific) application
Application of - from (basic and applied) research available - knowledge, theories and concepts and research results on issues that graduates are faced with in their professional capacity.

4. Transfer and versatility
Application of knowledge, insights and skills in varying professional situations.

5. Creativity and complexity in actions
Defining and analyzing issues in which the problem is not clear in advance and for which no standard procedures are applicable.

6. Problem oriented working
Independently defining and analyzing complex issues concerning problems in the professional practice, based on relevant knowledge and (theoretical) insights, developing and applying (new) solution strategies, and judging the effectiveness of new solutions.

7. Methodical and reflective thinking and acting
Setting realistic targets, structurally planning the own work, and reflecting on the own professional activities, based on gathering and analyzing relevant information.

8. Social and communicative competence
Communicating and cooperating in a multicultural, international and multidisciplinary environment, meeting the demands of participation in a professional organization.

9. Basic qualification for management functions
Performing low-level leading and managing tasks.

10. Awareness of societal change
Developing understanding and involvement in ethical, normative and societal issues related to the professional practice."

Source: HBO Council, 1999

In the same year, 1999, the HBO Engineering Sector Council formed a working group, 'Competent HTNO', with the task of designing a set of generic competences for engineering education. An attempt was made to insert some aspects of sustainable development, for which purpose the *researcher* was added to the working group. An overview of the results of the working group is shown in table 40.

The Dublin descriptors
In several European countries, a strong impulse for the definition of generic graduate qualifications came from the Bologna Agreement of 1999 (see §8.1.4). Around 2001, Flanders and the Netherlands were preparing their accreditation system of higher education (see §7.1.1). As a consequence of the Bologna Agreement, they needed a clear distinction between the first, second and third cycle (in many countries equal to the Bachelor, Master and Doctor level). A 'Joint Quality Initiative' was set up, together with several other European countries. During a meeting in 2004 in Dublin, the so-called 'Dublin descriptors' were agreed (also called the 'Bologna Qualification Framework'). This set of qualifications defines the differences between the three cycles, as box 33 shows.
The Dublin descriptors were used by many universities and study programs as one of the starting points for the definition of professional competences of their graduates. In the Netherlands, the national accreditation system of exist-

ing and new study programs in higher education was defined through an 'Evaluation Framework' ('Toetsingskader'). One of the demands in this framework deals with the end terms of the programs, which are explicitly based on the Dublin descriptors (NVAO, 2003a).

Table 40. General competences for the HBO engineer

Segment	Key competence	Key terms
Engineer (HBO)	Thinking in models, systems, processes	Find solutions through models, systems, processes Analyze, evaluate, synthesize, solving problems Transfer of knowledge and information
	Working with innovation cycles	Applied research Phases in design or innovation cycle
	Role fulfilment	Making: project leader Translating: salesman, consultant Managing: manager, entrepreneur
	Professional	Awareness to use societal, ecological and economic boundaries Awareness to transcend disciplinary boundaries Strategic thinking Sustainable development Acting from relevant physical and business concepts, methods and tools
Self guidance	Learning to learn	Attitude aimed at life-long learning Independently decide and implement learning goals and -strategies, evaluating the results Reflect on own behaviour to give and receive feedback
	Take own responsibility	For professional and ethical dilemmas, make a decision based on solid societally accepted standards and values
	Take initiative	Adapt quickly to changing labour circumstances intrinsically motivated Result oriented working based on perseverance
Social-communicative	Functioning independent or in a team	Carry out tasks according to planning, which contribute to a chosen result As an expert, alone or as a team member, act according to customer wishes As an expert, alone or as a team member, give advise about disciplinary or professional issues Pay responsibility about own acting to oneself and to others
	Interdisciplinary communication	Function socially and communicatively effectively in a multidisciplinary environment within the professional context Good oral and written expression within the professional context
	Leadership	Based on own leadership style, encourage employees to persevere, accept and learn from mistakes Stimulate employees to take personal initiatives Be a role model for employees Show confidence and self-assuredness Give a feeling of shared responsibility to employees
Profession-specific		To be detailed by separate disciplines

Source: Competent HTNO, 2000

All three examples of generic competence profiles shown in this section show a remarkable resemblance with the characteristics of ESD that are described in chapter 1 of this dissertation. More specifically, table 6, which is used throughout the dissertation as a checklist for ESD characteristics of higher education, shows many parallels with the generic competences. This resemblance becomes even stronger when attempts are described to focus on specific ESD competences.

9.1.3. Competences and ESD

In discussions and meetings of the *researcher* with teachers in higher education, many times the same question was asked by them: "What do you think – should 'sustainability' be added as an extra competence to our existing competence profile?"

Such a question shows that a lot of teachers find it hard to make a connection between ESD and competence based education. If a 'sustainability competence' is formulated as 'the ability to think and act in a sustainable way' (as has been proposed by some), that does not really meet a desired characteristic of a competence profile, i.e. that the curriculum can be deduced from it. What exactly would 'think and act in a sustainable way' mean? In which critical professional situations is it expressed, in what roles and with which tools?

Box 33. (Selection of) Dublin Descriptors

"Qualifications that signify completion of the first cycle are awarded to students who:
- have demonstrated knowledge and understanding in a field of study that builds upon and extends their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study;
- can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study;
- have the ability to gather and interpret relevant data (usually within their field of study) to form judgements that include reflection on relevant social, scientific or ethical issues;
- can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences;
- have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy."

"Qualifications that signify completion of the second cycle are awarded to students who:
- (…)
- can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study;
- have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements;
- can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously;
- (etc.)"

"Qualifications that signify completion of the third cycle are awarded to students who:
- (…)
- have demonstrated the ability to conceive, design, implement and adapt a substantial process of research with scholarly integrity;
- are capable of critical analysis, evaluation and synthesis of new and complex ideas;
- (…)
- can be expected to be able to promote, within academic and professional contexts, technological, social or cultural advancement in a knowledge based society."

Source: Joint Quality Initiative, 2004

Several more appropriate approaches to 'SD competences' are possible, as De Kraker et al (2007, p. 105) describe. One is the 'instrumentalist' approach, offering lists of knowledge, skills and values. Opponents advocate an 'emancipatory' approach, putting an emphasis on raising a critical attitude of the students.
In chapter 2 (§2.3), the concept of 'Gestaltungskompetenz' ('shaping competence') was described (introduced by De Haan, 2002, and De Haan & Harenberg, 1999). According to De Kraker et al (2007) this concept offers a combination of the instrumentalist and the emancipatory approach. The concept was detailed by De Haan (2006) as a set of key competences:
1. competence in foresighted thinking;
2. competence in interdisciplinary work;
3. competence in cosmopolitan perception, transcultural understanding and co-operation;
4. participatory skills;
5. competence in planning and implementation;
6. capacity for empathy, compassion and solidarity;
7. competence in self-motivation and in motivating others; and
8. competence in distanced reflection on individual and cultural models.

This list is an example of the development of competence-based thinking in a different line than the one described in §9.1.2. This line has its roots not in the process of educational developments – as they have been described in several chapters of this dissertation - but in the development of the science and philosophy of sustainable development. It is striking that the above list of SD competences shows a strong resemblance with the various sets of generic competences that were described in the last section. The two concurrent developments, within education and within sustainability science, have lead to conclusions that are remarkably similar. It appears that SD competences are not far from general competences that one might expect from any graduate, whether sustainable development is in mind or

not. In other words: actually, sustainable development is mainly a matter of common sense and sound professional behavior.
Nevertheless, there is a difference between the sets of generic competences shown in §9.1.2 and the above set by De Haan. Where most of De Haans competences are value-free, describing desired professional behavior in a 'technical' way, just as the generic competences of §9.1.2, there is one competence which is normative and not value-free, and which refers to an attitude or to personal emotions rather than to behavior: #6, the capacity for empathy, compassion and solidarity.
Not all ESD developers add such values to their sets of SD competences. One such set is published by the Commission on Education and Communication of the IUCN, which states (Hopkins & McKeown, 2002):

> "To be successful, ESD, like all good education, must blend knowledge and skills. ESD must provide practical skills that will enable people to continue learning after they leave school, secure sustainable livelihoods, and live sustainable lives. These skills will differ with community conditions. The following partial list of skills will help initiate discussions about the types of skills students will need as adults in those communities. Note that these skills, while totally consistent with good basic education, also fall into one or more of the three realms of sustainable development:
> - the ability to communicate effectively both orally and in writing;
> - the ability to think about systems (both natural and social systems);
> - the ability to think in time – to forecast, to think ahead, and to plan;
> - the ability to think critically about value issues;
> - the ability to comprehend quantity, quality, and value;
> - the capacity to move from awareness to knowledge to action;
> - the ability to work cooperatively with other people;
> - the capacity to use various processes – knowing, inquiring, acting, judging, imagining, connecting, valuing, questioning and choosing; and
> - the capacity to develop an aesthetic response to the environment."

In this set, values are mentioned several times, but there is no clear indication of a desire of the authors that the professionals act based on a set of ethical or normative values, let alone compassion. This may be a consequence of the characteristics of professional profiles in general, which usually are formulated in terms of behavior rather than on attitudes or internal motivations or emotions. Another author however, Van der Woude (2008), expressly includes such elements. He describes SD competences as a set of professional roles:

- The global citizen / steward
- The professional
- The equilibrist
- The forward thinker
- The connector
- The steersman
- The function oriented innovator
- The creatively involved

Each of these eight roles is explained by Van der Woude. As an example, the 'global citizen / steward' is described as follows:

> "The global citizen / steward cares for himself, for others and for the physical reality. He is convinced that we should carefully deal with the finite stock of resources and that we should prevent environmental pollution and damage to nature in order to preserve our planet. He understands that this is only possible if we do not transfer our problems to others, don't live at the cost of others, but share prosperity and well-being equally among the world population. North cannot over-consume at the cost of South. To reach a global balance, the global citizen / steward thinks we should be prepared to listen to each other, and that, instead of competition, we should seek cooperation and that we should work on a safe environment in which it is good to live and work."

Such a description is clearly value-driven, and goes beyond the generic competences described in §9.1.2. Other proposed sets of SD competences seem to be somewhere in between, e.g. Heideveld (2003) and De Groene (2003a, p. 26). The same is true for the ESD competences defined in the Barcelona Declaration of 2004 (see: Segalàs, 2009).
The various sets of descriptions of SD competences or roles differ to a certain degree. But an analogy comes up with the way in which the continuous spectrum of visible light is split up into a discrete number of colors: where western civilization is used to discern 7 colors (ranging from red to violet), other cultures use different sets of colors, but they all refer to the same spectrum. Analogously, the various discrete sets of competences seem to refer to about the same continuous spectrum describing a professional that is effectively able to contribute to sustainable development.

This is even true, when a specific aspect of sustainable development is studied: transitions, and more specifically: transition management. Andringa & Weterings (2006, 2008) designed a competence profile for transition professionals. Jansen, Weaver & Van Dam-Mieras (2008) added more details, out of which table 41 was formed.

Table 41. Competences of transition professionals

Cluster	Role	Competence	Methods & techniques
Pattern recognition	Manager	• Integral thinking • Frankly interviewing • Analytical skills • Conceptual power	Integral system analysis Actor and network analysis Historic regime analysis Fact finding
Reorientation	Innovator Researcher Team worker Manager	• Vision and inspiration • Guts and Power of persuasion • Creativity and new ideas • Consciousness of history	Scenario analysis Future explorations Backcasting Reframing
Experimenting	Innovator Net-worker Manager Team worker	• Alliance management • Mobilizing power • Organizational skills • Second order learning	Actor and network analysis Strategic niche management Flexible design
Anchoring and scaling up	Net-worker Researcher Manager	• Anticipation skills • Entrepreneurship • Power of persuasion • Lobby and networking skills	Actor and network analysis Integral system analysis Strategic niche management
Monitoring	Researcher Team worker	• Observation skills • Reflection skills • Anxiousness • Self consciousness	Transition monitoring Evaluation techniques Learning histories Reflection sessions
Transition management	Researcher Team worker Manager	• Systems thinking • Feeling for timing • Balance contents, process and result	

Sources: Andringa & Weterings (2006, 2008); Jansen, Weaver & Van Dam-Mieras (2008)

Sets of competences for ESD may offer a lot of clarity to teachers wanting to integrate sustainable development into their competence-based education. Nevertheless, in the eyes of many HBO teachers they are not sufficiently operational, as meetings in the years around and after 2005 made clear. The repeated questions that the *researcher* received from teachers about the relations between CBE and ESD gave rise to an experiment with the aim to set up a series of tools that might be of help to those teachers. The experiment nears completion, and is described in the next section.

9.2. Experiment #6: Competences for sustainable development (2005 till present)

In chapter 8, the development and use of the Basic Book on Sustainable Development was described. This book was originally meant to consist of eleven chapters. After about half of this book was completed, the publisher proposed to split the book into two volumes, and so the Basic Book ended as a book with five chapters, and a sequel was published one year later, called 'Werken aan Duurzame Ontwikkeling' ('Working on sustainable development'). This turned out to be a very good decision, as it allowed to make some important differences between the two volumes. First of all, it made it possible to write the two books at different levels of difficulty: the Basic Book aims at first-year students and is relatively easy to comprehend, while 'Working on sustainable development' aims at advanced students. Secondly, the separate sequel opened the possibility to dedicate this second volume to two important questions, which were to form the leading theme of it:

Questions:

- Which competences does a graduate need in order to contribute effectively to sustainable development?
- How can such a set of competences be operationalized to form a basis for curricula development?

As said above, such questions were asked by a lot of HBO teachers, who tried to find out the consequences of competence based learning for sustainable development education and vice versa. Should there be separate sustainabil-

ity competences? Or should sustainable development rather be 'embedded' in other competences; and if so, how? The education instrument around the book 'Working on sustainable development' (Roorda, 2007) tried to give an answer to such questions.

9.2.1. Working on sustainable development

The didactic formula for the sequel to the 'Basic Book on Sustainable Development' is exactly the same as for the Basic Book itself. It is not just a book, it is a complete instrument to be used in education, consisting – besides the book, called 'Working on Sustainable Development' – of a website, computer applications, movie clips, documents with extra information, a teacher's manual, etc. The table of contents of the book is reprinted in this dissertation as Appendix 8.

The book itself consists of the same elements as the Basic Book, e.g. cases, columns, exercises for all kinds of educational methodologies, etc. There is however an important extra. The book is structured around a continuous thread of competences for sustainable development. In the course of the book, every separate SD competence is described. Each of them is illustrated with concrete cases from the professional life, or from a project that was performed by a student during an internship or a graduation project. This latter is done in order to show to the readers that young people, students, don't have to wait until they have a formal job or have built up a lot of expertise, before being able to deliver a significant contribution to sustainable development (as is also shown powerfully by Corcoran & Osano (eds., 2009)). To the contrary: each of the student cases proves that students, already while they are doing their study program, can be highly meaningful for sustainability. An example of such a case, which is an illustration of one of the SD competences, is shown in Box 34.

Box 34. Consumer values in China – an example of a sustainable graduation project

"Why do certain people buy sustainably produced Foods and others don't? That is a question asked by HanQing Lin, a student of the Christelijke Hogeschool Nederland, a University of Applied Sciences in Leeuwarden. Is the customer behavior perhaps influenced by the values of the individuals?

She found answers through an investigation among consumers in 2005, not in the Netherlands but in her home country China, in Fuzhou, a city in the south west of China with nearly six million inhabitants. The sales of 'green food' are increasing rapidly: Foods meeting the demands of a sustainability standard related to food safety, nutrition value and environment. These articles can be recognized by the 'Greenfood' label.

In her investigation HanQing Lin posed a number of theses to some hundreds of customers, e.g.: 'Green Foods are more nutritious than ordinary foods', 'Green foods fit with a modern lifestyle of eating and drinking', and 'The development of green foods contributes to preserving the environment for future generations'. For each thesis the respondents could indicate to what extent they agreed. She also investigated how many green Foods each respondent bought. Thanks to a statistical comparison of the two sets of data should could deduce information about the values that stimulate sustainable customer behavior. Strong motivations appeared to be: a higher nutritional value; the pedagogic effect on children; and lower risk for health damage. The care for the environment did not score high.

The research by HanQing Lin helps to get insight in the reasons of people to choose for sustainable behavior, enabling governments and companies to encourage such behavior. The report of HanQing Lin's project can be downloaded from www.duurzaam.noordhoff.nl under the name of 'Studentenproject – Consumentengedrag in China.pdf'."

Source: Roorda (2007), based on HanQing (2006)

The case of Box 34 is followed first by some explanations about the significance of the case, and next by the following SD competence description:

> "Where is the future world heading? Where do we want sustainable development to take us? Some people will think very different about this than others. Where for certain people nature and quietness have a great value, for others a dynamic and entertaining life will be more attractive. Sustainable development is a matter of choices, in many cases out of alternatives that cannot be weighed against each other. If, as a professional, you want to contribute to such decision making, you will first have to be able to recognize and respect the values of others. This concerns the values of individuals in your personal environment (neighbors, colleagues, pupils, patients, customers). Besides, it also concerns the value systems of other cultures, in far away parts of the world as well as in your own neighborhood, e.g. of immigrants (or of autochthones if you are an immigrant). At the same time a professional demand is that you are aware of your own personal values, and respect them too.
>
> *The competence: A sustainable professional can…*
>
> - Recognize and respect the values of him/herself and of other people and cultures.
>
> *Assess your own competence. Give yourself a score in the spreadsheet 'personal competence score', in box E1*."

The above mentioned competence is one of a series of competences that is built up during the book. The complete set of competences is based on the sources that were mentioned in §9.1, and is shown below as table 42. The section numbers in the table refer to the sections in 'Working on sustainable development'.

Table 42. RESFIA+D : Professional competences for sustainable development			
Competence R: Responsibility A sustainable professional takes responsibility for the own work. *I.e.: the sustainable professional can …*	*See:*	**Competence E: Emotional intelligence** A sustainable professional projects him/herself on the values and emotions or others. *I.e.: the sustainable professional can …*	*See:*
R1. Make a stakeholder analysis	§6.1.4	**E1.** Recognize and respect values of him/herself and of other people and cultures	§3.3
R2. Take personal responsibility	§6.1.4	**E2.** Recognize and respect action perspectives or him/herself and or other people and cultures	§4.2
R3. Render personal account to society	§6.2.2	**E3.** Listen to opinions and emotions or others	§4.4
R4. Critically evaluate own actions	§6.2.2	**E4.** Distinguish between facts, presumptions and opinions	§6.2.2
Competence S: System orientation A sustainable professional thinks and works from a systems vision *I.e.: the sustainable professional can …*		**Competence F: Future orientation** A sustainable professional thinks and works from a future oriented perspective. *I.e.: the sustainable professional can …*	
S1. Cooperate in an inter- and transdisciplinary way	§1.4.3	**F1.** Recognize and understand non-linear processes	§1.3
S2. Think in systems, zoom in and out, i.e. alternately think analytically and holistically	§5.2.2	**F2.** Think in varying timescales; distinguish between short and long term approach	§3.1.2
S3. Think function oriented, innovative, creative, out or the box	§5.4.3	**F3.** Estimate consequence reach and consequence period or decisions	§4.5.3
S4. Think chain oriented	§6.3.1	**F4.** Think future oriented, anticipate	§5.4.3
Competence I: personal Involvement A sustainable professional dedicates him/herself personally for sustainable development. *I.e.: the sustainable professional can …*		**Competence A: Action skills** A sustainable professional acts decisively and competently. *I.e.: the sustainable professional can …*	
I**1.** Consistently involve sustainable development in the own work as a professional (sustainable attitude)	§2.1.3	**A1.** Weigh unweighable aspects and make choices	§2.2.3
I **2.** Keep own knowledge and expertise up to date, even outside or the own discipline	§2.3.3	**A2.** Act when the time is ripe, not against the flow: 'do without doing'	§4.4
I **3.** Work with passion on dreams and ideals	§4.1	**A3.** Deal with uncertainties	§4.5.3
I **4.** Apply the own conscience as the standard	§6.1.4	**A4.** Take decisions	§4.5.3
Plus: **Disciplinary competences** for sustainable development (varying per education program or professional group)			

This model of competences for sustainable development is named the 'RESFIA+D' model (in Dutch: 'VESTIA+D'), named after the initials of the six main competences, to which is added '+D' which refers to the disciplinary competences. The RESFIA+D model explicitly contains a number of normative elements. Examples are E1 and E2, and to a certain level also R2, I3 and I4.
Table 42 is reprinted in Córvers et al (2009), who comment:

> "Although the [RESFIA] competences focus on higher education and the professional practice, perhaps a translation can be made to primary and secondary education and to suppliers of informal educational activities in the area of sustainable development and nature & environment education. An example may be the development of key goals and key competences, as learning for sustainable development not only aims at knowledge in a traditional sense, but primarily about developing and transferring a new attitude with respect to nature and environment, economy and society."

The competence that was explained using the case of Box 34 is to be found in table 42 as competence E1. The spreadsheet that was mentioned is a diagnostic tool that can be downloaded from the website (www.duurzaam.noordhoff.nl). The readers are requested to fill it in, one by one, while going through the book, based on a personal estimate of the own competence level - or on reflection by friends, colleagues and teachers. For each competence, a high priority for improvement can be appointed. At the end, this results in an image like figure 49.

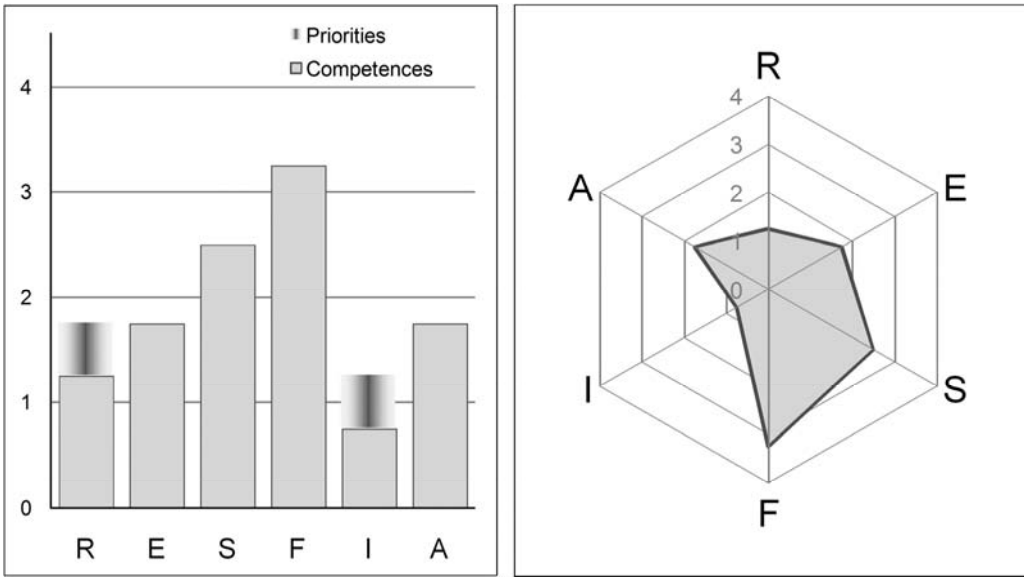


Figure 49. An example of a self-diagnosis of personal competences for sustainable development

This diagnostic tool is one way in which the RESFIA competences have been made operational, albeit in a rather intuitive way. A second way is the translation of a selection of the RESFIA competences into a set of demands that can be used for internships and graduation projects. They are placed in a table in the final chapter of 'Working on sustainable development', and shown in table 43.

Table 43. Checklist for sustainability demands for an internship or graduation project

Explicit preconditions to the project:	**Besides, judge final report on:**
R1: Make a stakeholder analysis	R4: Own actions critically evaluated
R3: Give account of personal responsibility for own work and conclusions	E1: Respect for values of self and of others
S2: Zoom in and out: both analytical and holistic approach	E2: Id.: action perspectives
F3: Determine consequence reach and consequence period of the project and the conclusions	E3: Weighed opinions of others
F4: Make a future analysis, anticipate	S3: Function orientation, innovativity, creativity
A1: Weigh 'unweighable' aspects against each other, make decisions	F1: Non-linear processes not treated as linear
A3: Determine the rate of (un)certainty of information and conclusions	F2: Used various time scales; made distinction between short-term and long-term
	I1: Sufficiently considered consequences for humans and nature
	I3: Applied own conscience as standard
	A4: Showed decisiveness

9.2.2. Competence levels

A third attempt to make the RESFIA+D model operational, next to the above mentioned diagnostic tool and the checklist, is based on the idea of formulated competence levels. As figure 49 shows, the students are, when reading the book 'Working on sustainable development', invited to fill in a spreadsheet that enables them to diagnose themselves. In principle, this can be done just in an intuitive way. But there is a possibility of making the diagnosis more intersubjective, by applying a system of competence levels.

In order to realize this, several systems of such levels have been compared, as was described in §9.1. An essential demand to the applicability was that such a set should enable the members of a team of a study program to derive practical consequences for the curriculum from them. The system used by the Fontys School of Nursing met this demand, and it was selected.

The four ascending competence levels of this system are the increasing capabilities of *apply*, *integrate*, *improve* and *innovate*. A general description or the four levels is shown in table 44. For each of the 24 competences, the four levels are described. Every description is formulated in such a way that it indicates concrete behavior of the involved person: a student or a graduated professional. The result, 'Competence Cards for Sustainable Development', is shown in Appendix 9.

The competence cards can be applied in several ways by educational institutions. This is described in a short manual that was made, which contains the following explanation:

"It is certainly *not* intended that:

1. ... all 24 competences, each with their 4 levels, are added completely and unchanged to the existing competences of an education program in higher education. Not only would this probably lead to a considerable

overlap with the existing competences, also the total number of competences would become uncontrollably large.

2. ... education programs start demanding from students that, at the moment of their graduation, they prove to have acquired the highest level for each of the 24 competences. The creation of such 'wonder people' does not, and should not, belong to the task of higher education.

Instead, the competence cards may be used:

1. ... to serve as a source of ideas and inspiration for the improvement of the existing competences of an education program.
2. ... if a selection of the RESFIA+D competences is added to the competence description of an education program, to determine for each of them the demanded minimum final level for graduates, based on the character, the level and the educational vision of the education program.
3. ... to create a concrete elaboration of a series of sustainability demands of internships, graduation- and other practical projects by students, as they are derived from the RESFIA+D model. An example is shown in table [43]."

Table 44. General description or the four competence levels

Apply	***Integrate***	***Improve***	***Innovate***
On a practical level, you perform activities belonging to the usual demands or your (future) profession. Your vision, your ideas and your activities are mainly limited to the area of your own discipline, your own working environment and the usual work methods.	During your professional activities you combine and integrate a complex set of subjects, work styles, people and/or cultures. You do this e.g.: beyond the boundaries of your own discipline considering other cultures, value systems, traditions beyond the usual expectations and working methods of your (future) profession in varying roles, e.g. as a manager	You oversee, both at a detail level as at a systems level, your work and the system in which you perform your activities. You judge your own work and the work of others with whom you cooperate critically and estimate its effects in the widest sense. Based on that, you work continuously or regularly on the improvement of the work to which you contribute, and you get proved results.	You apply innovative insights on your work, e.g. considering: • the formulated goals • the applied means and methods • the effects of the work • the scope of those effects in space and time • the underlying vision • the relations within and outside of the own working environment or the own discipline, e.g. with society as a whole These innovations are expressed demonstrably in your professional activities and in their results.

In order to make the competence cards practically usable for curriculum developers, a spreadsheet was created called 'Competence score card (see table 45). In this table, curriculum developers are able to fill in for each competence: the ambition, the reality concerning their present set of competences, the reality concerning the actual curriculum, and the level of priority for improvement.

Table 45. Competence score card

Competence	Ambition	Competences		Curriculum		Policy priority	Comments
		Reality	Distance to ambition	Reality	Distance to ambition		
R1							
R2							
(etc.)							

The structure and the texts of the RESFIA+D model were proposed as a draft to a number of teachers and ESD experts, and improved based on their comments, before being published in 'Working on sustainable development'. Such a reviewing process has not yet been performed for the detailed level descriptions.
Some first experiments with the draft instrument were done in the last months of 2009. The results are promising, as the test users – groups of teachers and managers of a study program on technology management, and of a program of teacher education – indicated that the tool was helpful, and the results will be used for the improvement of their competences and curricula. More such tests will be done in 2010. Based on the comments of the test users, the level descriptions will be adjusted, after which the instrument will be published. Next, a period of practical use will follow, after which a result assessment can be performed along the lines of the experiments #1 till #5, making it possible to answer the question that §9.2 started with.

9.2.3. The Pledge

There is one other extra element in 'Working for sustainable development' in comparison with the Basic Book. This is a proposal to students, teachers and study program managers. It appears at the end of the book, in the final section. The proposal is:

> "In many cases, after some years graduates from universities will arrive in a position in which they have a high responsibility. Think of the responsibility for pupils, patients or elderly people. Or for personnel, valuable equipment, large investments or hazardous experiments. Not nearly every student is aware of this future responsibility.
> With students graduating in a medical study, the awareness has existed for many years that, as professionals, they are going to have a profound impact on the lives of people. When graduating, they make a pledge, Hippocratic Oath. A comparable pledge might not be a bad idea for graduates in other disciplines."

Next, the proposal is made concrete in the form of such a pledge. This pledge was designed, making use mainly of four examples that already existed. One is of course the original Hippocratic Oath (Hippocrates, ca. 400 BC). Another was a modern version of this oath, developed by the Dutch Association of Physicians (KNMG, 2003).
Besides, two pledges were used as sources of inspiration that don't have their origin in the medical world: the 'Pugwash Pledge' (Student Pugwash USA, 1995) and the 'INES Appeal to Engineers and Scientists for Global Responsibility' (INES, 1995). Other sources that were consulted were:

- The Mount Carmel Declaration on Technology and Moral Responsibility (Haifa, 1974)
- The Biologists Pledge (MIT, 1987)
- Hippocratic Oath for Scientists (Nuclear Age Peace Foundation, (1987)
- The Buenos Aires Oath (Buenos Aires, 1988)
- The Uppsala Code of Ethics for Scientists (Uppsala, 1984)
- Hippocratic Oath for Scientists, Engineers and Executives (Inst. for Social Inventions, 1987)
- Scientists Pledge Not to Take Part in Military-Directed Research (SANA, London, 1991)
- Appeal to Scientists (Wittenberg, 1989)
- A Pledge for Scientists (Berlin, 1984)
- The Toronto Resolution (Toronto, 1991)
- Declaration of Geneva (World Medical Association, 1948)

None of these texts was found to be satisfactory. Most of them contained important aspects, but none covered the whole area of sustainable development, including subjects like personal responsibility, accountability, dreams and ideals, and the concept of sustainable development itself. Therefore, a new text was designed. This 'Pledge for Graduates of All University Disciplines' is cited in Box 35.

Box 35. Pledge for Graduates of All University Disciplines

"I pledge that, in my work, I will consistently consider the present and future consequences for society and the environment. Before and while making decisions, I will conscientiously make considerations. I will not perform work that is aiming at harming people or nature. I will use my education, my talents and my experience in order to contribute to the realization of a better world through sustainable development.
I accept my personal responsibility for my decisions and my actions, and I pledge that I will openly give account of my work to everyone for whom this work has consequences. I will not appeal to the fact that I have acted following instructions of others.
I pledge that I will not just dedicate my work to my own interests and my career, but also to my dreams and ideals. Doing so, I will respect the values and interests of others.
I realize that, in the course of my career, there will be moments on which it will be hard to persist in what I promise now. Even then I will keep this promise."

Source: Roorda, 2007

After the publication of the book, the pledge has been cited several times on various websites and forums, and the proposal has been discussed informally. A more structured discussion might be set up in the coming years, as a kind of an added 'experiment'.

9.3. Experiment #7: Scanning the curriculum (2007 till present)

"Don't you have some kind of a list of subjects for us?"

This question was asked many times in the last ten years, during AISHE assessments, individual coaching discussions or group meetings, by teachers and managers in HBO institutions. The idea was that a list of sustainability subjects could be used by the education developers to adapt the curriculum, preferably a detailed list, tailor-made for their specific discipline. The usual answer was: "If you first start building sufficient expertise on sustainable development in relation to your discipline and curriculum, then you would refuse such a list if I would offer one: you will want to design it yourself, as a part of your professional responsibility and pride."
During AISHE assessments, another remark that was made several times was that AISHE does not investigate the contents of the curriculum. This is true, as AISHE looks at the processes that lead to the (re)design of the curriculum but not at the exact results, as was explicitly decided when AISHE was developed (see §7.2.1).
Several requests were received to construct an instrument that does look at the results of an educational development process. Actually, the SD Competence Cards of §9.2 are such an instrument, as it assesses the resulting set of competences and the rate to which they are implemented in the curriculum. But even this doesn't look at the details of the curriculum itself.
The issue can be compared with the 'tree model' that was introduced in §6.2.2 and described in more detail in §8.2.3 as a metaphor for an educational program. For the roots of the tree, as well as for the fruits, the SD Competence Cards are intended: see table 46. For the trunk, the SD introduction instrument is available. During the M2 redesign process, explicit attention was given to the 'biochemistry & physiology' of the tree, i.e. to the educational methodologies. AISHE deals with the overall growth process of the tree. The subject of the educational content aims primarily at the branches, i.e. at the subjects that the curriculum consists of. For this, there was no instrument yet.

Table 46. The tree elements, the links with education, and the separate experiments of the ESD research program

Tree elements	Education elements	Experiment
Roots	Vision, mission, educational goals	X6: SD Competence Cards (§9.2)
Biochemistry & physiology	Educational methodologies	X2: M2 redevelopment (Ch. 5)
Trunk	Basic module or introduction to sustainable development	X5: SD introduction instrument (core: Basic Book on SD) (Ch. 8)
Branches	Disciplinary integration	X7: SD Curriculum scan (§9.3)
Forest, ecosystem	Interdisciplinary integration	X3: Experiments within Cirrus Project (Ch. 6)
Fruits	Output: effect on professional field and society	X6: SD Competence Cards (§9.2)
Growth process	Development and maintenance process of a study program	X1: M2 (Ch. 4) X4: AISHE (Ch. 7)

The lack of an instrument that could be used as a checklist of sustainability subjects caused two dilemmas. The first was already mentioned at the start of this section: isn't the design of such a list the professional responsibility of the program team itself? In other words: perhaps it should not be made too easy or too comfortable for the teachers. And the second dilemma: how can a useful checklist be developed for a whole range of educational sectors and disciplines, if – at the same time – it should be possible to keep it condensed? The risk is that the final result will be a document with the size of a book, with lots of chapters, one for each sector, and sections, one for each and every kind of study program. Besides, such a 'book' would soon become obsolete, as both the educational insights and the theory and practice of sustainable development change continuously.
The answer to the second dilemma appeared to deliver an answer to the first one as well. The solution could be a generic list of subjects, applicable to all or at least many different sectors and disciplines. This would keep it small, practicable, and to some extent 'timeless', while at the same time leaving ample space for the members of a study program team to make selections and interpretations, and define weights and priorities.
Such an instrument was in a certain way complementary to the SD competences instrument of §9.2, as there is – ideally – a one-to-one relation between the competences and the curriculum contents. If the SD-aspects of the competences are assessed, this may raise questions about the realization of them within the curriculum. Using the curriculum instrument may help to answer these questions, in its turn rendering new information and insights for the competence profile in an iterative way.
So, the key question was:

Question:

- Can a set of sustainability-related subjects be designed that is applicable to study programs of many disciplines as a checklist for the curriculum, in such a way that each discipline can put its own weights and preferences, making it fit to their needs?

When the *researcher* proposed to start an experiment in this direction in 2007, the decision was made by DHO to try to develop an SD Curriculum Scan. The development was performed by a DHO team, in which Susan Cornelissen had the main part, assisted by a HBO bachelor graduate student and supervised by the *researcher*.

9.3.1. The selection of SD themes and subjects

After ample discussions between the developers of the curriculum scan and a number of external ESD experts, a preliminary decision was made to use the Triple P as a starting point for the instrument. Themes that could not be fitted into one of the three P's, being fundamental to each of them or having a holistic character, would be placed in a fourth, or rather a 'zero-th' group, 'Basics'.
For each of the three P's, four main themes were selected. The theme of 'technology' was decided to belong primarily to the 'Profit' group, which is not undisputed; but it was concluded that it had more strong relations with 'profit' than with the other two main groups. The current result of the discussions is shown in figure 50, which is not considered as final.

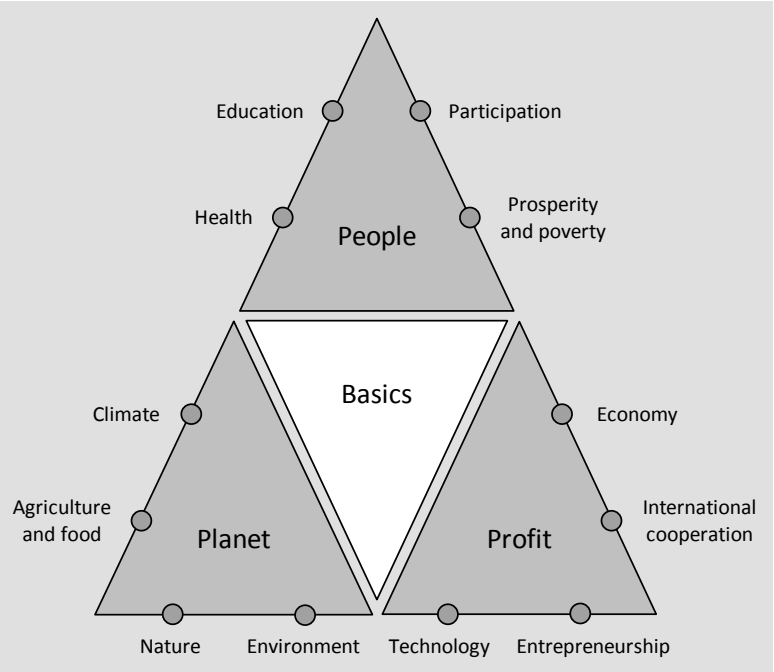


Figure 50. The themes of the SD Curriculum Scan

The Basics group received themes like:

- Ethics
- The principles behind the Triple P
- The *place* or *space* dimension and the *time* dimension

As a next step, for each theme a series of subjects was selected. This was not intended as an exact or forcing checklist for the curricula, but only as a source of inspiration for education developers, to give them some impression of how the themes might be interpreted. As an example, for the 'Participation' theme the following subjects were selected:

- Participation vs. exclusion
- Social cohesion vs. segregation
- Freedom vs. solidarity
- Civil society
- Cultural values & differences
- Democracy
- Equal opportunities
- Gender issues
- Human rights
- Minorities
- Fugitives
- Immigration, integration
- Unemployment

Many sources were consulted for the discussions about these lists of subjects. Major sources were e.g. the Millennium Development Goals, Agenda 21, the reports of the World Summit on Sustainable Development (WSSD, Johannesburg 2002) and the Earth Charter. This investigation made clear that it is impossible to define a set of themes and subjects that could be objective or even fairly intersubjective. Besides, it will probably be impossible to define it in such a way that it can be used in all parts of the world. So, it was decided to focus on higher education in the Netherlands, and thus define an instrument that may be applicable in countries in Western Europe but perhaps not, or less appropriately, in other regions. The lists of themes and subjects are not seen as 'right' but just as practical aids for the discussions with or between members of study program teams. Whether the lists are correct or suitable is left for them to decide.

9.3.2. The Scan

The draft subject lists for every theme were designed and then discussed with experts and higher education teachers. This lead to revisions of both the subject lists and the underlying themes, in an iterative process until consensus was reached.

A practical tool was designed in the shape of a spreadsheet in which spaces are available (the white boxes in figure 51) to fill in all kinds of curriculum elements that exist in an actual study program. When filled with the details of a curriculum, the result is what was called an 'SD Curriculum Map'. Armed with this tool, a series of practical tests was started, that took place in 2008 and 2009.

Period	Basics		People		Planet		Profit	
First Year								
Sem.1	Triple P		Education		Agriculture and food		Economy	
	Place		Health		Climate		Enterpre-neurship	
	Time		Participation		Environment		International cooperation	
	Ethics		Welfare and poverty		Nature		Technology	
Sem.2	Triple P		Education		Agriculture and food		Economy	
	Place		Health		Climate		Enterpre-neurship	
	Time		Participation		Environment		International cooperation	
	Ethics		Welfare and poverty		Nature		Technology	
Second Year								
Sem.1	Triple P		Education		Agriculture and food		Economy	
	Place		Health		Climate		Enterpre-	

Figure 51. A (still blank) SD Curriculum Map

The tests were performed in 5 study programs in 4 Universities of Applied Sciences: Stenden, Fontys, Avans, and Van Hall Larenstein. The 5 programs belong to 4 of the 7 sectors of HBO:

- Economics and business administration (programs: Small Business & Retail Management; Tourism Management)
- Engineering and technology (program: Building & Living)
- Agriculture (program: Animal Management)
- Social welfare (program: Pedagogic Management of Day Care Centers)

Four of the above study programs were existing programs; one was in development, and was about to start about six months after the scan took place.

After the first few tests, a standardized procedure was developed, making a distinction between two versions: a 'full scan' and a 'quick scan'. The full scan consists of the following steps:

1. Investigation of study materials (curriculum guides, study books, intranet, etc.);
2. First draft of SD Curriculum Map, which is input for:
3. Interviews with groups of teachers;
4. Second draft of SD Curriculum Map, which is input for:

5. Interviews with groups of students;
6. Final SD Curriculum Map;
7. Presentation to and discussion with program management and/or with program team.

The result of such a full scan is a report, presented in step 7, in which the SD Curriculum Map is filled in with every element concerning sustainable development that was found. Besides, suggestions for improvement are filled in (the so-called 'white spots'), which are based on the interviews with the teachers and the students.
This procedure takes quite some time: around one week for an experienced ESD researcher. So, when this service is delivered to a university, it will be quite a financial investment. In order to be able to deliver tailor-made services, a simplified procedure was developed for a quick scan, which leaves out the student interviews, the recommendations for improvement, and the final discussion with the manager and/or the team.
The first results are promising. The teachers and managers involved in the tests judged the instrument as informative and worthwhile the efforts, time and finances spent. In several cases, the scan caused significant changes in the curriculum, one of them being the newly developed program.
The scan is still not in it a definitive shape, as more discussions and experiences are needed for the fine-tuning and the definitions. The experiment will proceed in 2010, after which it will be possible to answer the question that was posed at the beginning of this section.

9.4. Experiment #8: Assessment of all roles of a university (2007 till present)

While AISHE, the assessment instrument that was developed in experiment #4, was used more and more in universities, requests came from different directions to enhance the instrument. As AISHE was directed mainly at the educational role of a university, some people asked for the opportunity to start using it for the operations of a university or a campus. Others requested an adaptation to enable them to apply it to the research of a university. Therefore, it was decided to redevelop AISHE, paying attention to all of those roles, and also to the fourth role, i.e. the direct societal activities of a university. The new instrument, 'AISHE 2.0', was developed by an international team, trying to make it a modular tool. A main problem that was tackled was the question, how to avoid that such a modular approach would deliver a fragmented view of the sustainability efforts of a university. In other words, how a holistic view can be achieved. The answer was given in the form of a basic 'Identity' module.

Question:
- Can an integrated quality management approach be applied to the education, the research, the operations and the societal activities of a university in a coherent way?

9.4.1. The development process

When the first version of AISHE, now called 'AISHE 1.0', was developed, in 2000 – 2001, the process of internationalization was not yet as strong as around 2007, when the AISHE 2.0 experiment started. In 2007 it was, much more than in 2000, logical to set up the development process in an international context. This was all the more true as AISHE was at that time being introduced in several countries outside the Netherlands. So, an international group was formed. The leading organizations in this group were the Forum Umweltbildung in Austria, Mälardalen University in Sweden, Tampere Polytechnic University of Applied Sciences in Finland (later replaced with the University of Santiago de Compostela in Spain), and DHO in the Netherlands, doing the project management. Other universities and ESD organizations joined the project group, in countries like Belgium, Germany, Poland, Lithuania, Russia, Czech Republic, Greece and more. The group met once or twice a year, e.g. in Amsterdam (Netherlands), Barcelona (Spain), Vilnius (Lithuania) and Graz (Austria).
Twice an attempt was made to apply for a European subsidy: first in the Seventh Framework Program, next in the Erasmus Program. For several reasons, both attempts failed, which caused a considerable delay. The main budget for the project was made available by the four leading organizations.

The following goals for the AISHE 2.0 project were defined:
- An assessment instrument which was applicable to all four roles of universities in - at least – all European countries, and - possibly – all over the world, consisting of
  - A structure derived from the AISHE 1.0 instrument, including the five-stage model;
  - A set of application procedures, distinguishing between internal and external assessments;
  - A manual;
  - A computer application comparable to AISHE Reporter (see §7.2.1)
- A website, from which all materials needed for an assessment could be freely downloaded;
- An international Certificate of Education for Sustainable Development;

- A system of quality assurance, including an Assessor Certificate and an training program for potential assessors;
- Publications and presentations in international journals and forums;
- Scientific research based on the results of AISHE 2.0 assessments.

The development procedure follows the same lines as that of AISHE 1.0. After a draft of the instrument is designed, the result will be presented to a stakeholder forum, or an 'extended peer community' (see §1.4.2), which will be asked to comment on it. After improvements based on these comments, a series of practical tests will be done in several countries, which will probably lead to more improvements, after which the instrument will be published and applied.
The philosophy of the four roles of a university within society, which was introduced in §3.4 and illustrated in figure 4 in the shape of a 'temple' with four pillars, was taken as the starting point. A modular structure was decided, which was seen as a good compromise between conflicting user demands: some of them wanted the AISHE assessment to comprise more aspects – which was the main reason for the development of AISHE 2.0 – while others wanted an assessment instrument which would take even less time than AISHE 1.0 did. For this reason, one of the preconditions for AISHE 2.0 was that an assessment of e.g. only the educational role would be less time-consuming than with AISHE 1.0.
The discussions lead to the conclusion that not four but five modules would be needed: one module for each university role, plus an underlying module dealing with the fundamental visions of a university – or a department of it – towards sustainable development. This module was called the 'Identity' module (see figure 52).

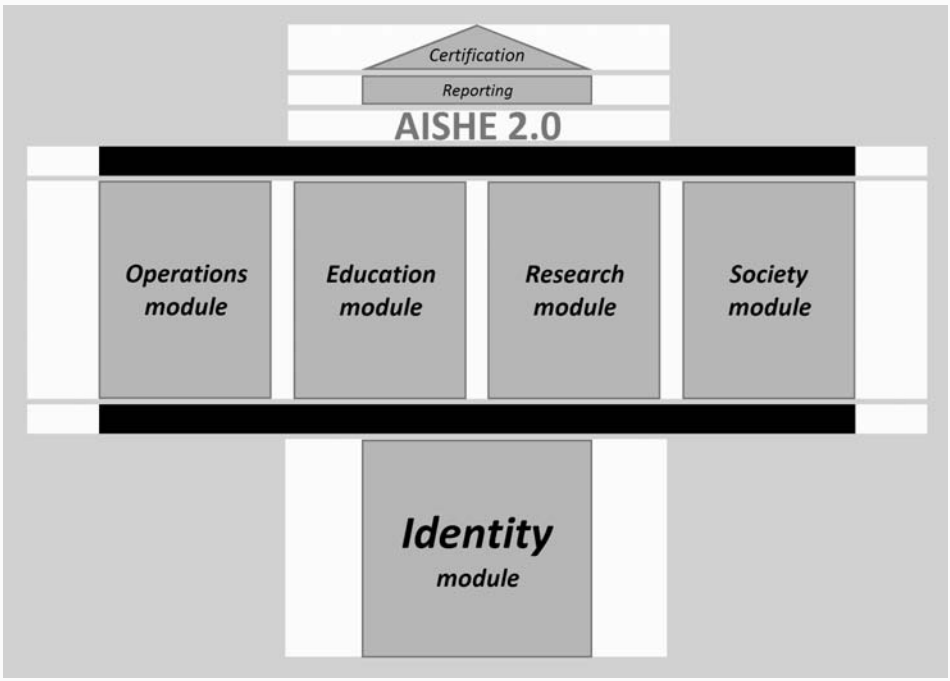


Figure 52. The modules of AISHE 2.0

9.4.2. The structure of AISHE 2.0

For the definition of the individual criteria for each module, the 'tree model' (see §6.2.2 and §8.2.3) was used. This is visible in e.g. the education module, as the following criteria were selected:

- Roots: Criterion E1: Goals.
- Biochemistry & physiology: Criterion E2: Methodology
- Trunk: Criterion E3: Awareness and basic concepts
- Branches: Criterion E4: Thematic integration
- Forest, ecosystem: Criterion E5: Interdisciplinary integration
- Fruits: Criterion E6: Output assessment

It appeared to be possible to define the Research and the Society Module in a comparable way, and the Operations and the Identity Module partly so. The structure that was designed made it possible to make use again of the structure of the Deming cycle of continuous improvement, just as AISHE 1.0, defining criteria for 'plan', 'do' and 'check', and closing the cycle with 'act'. The resulting structure is shown in figure 53.

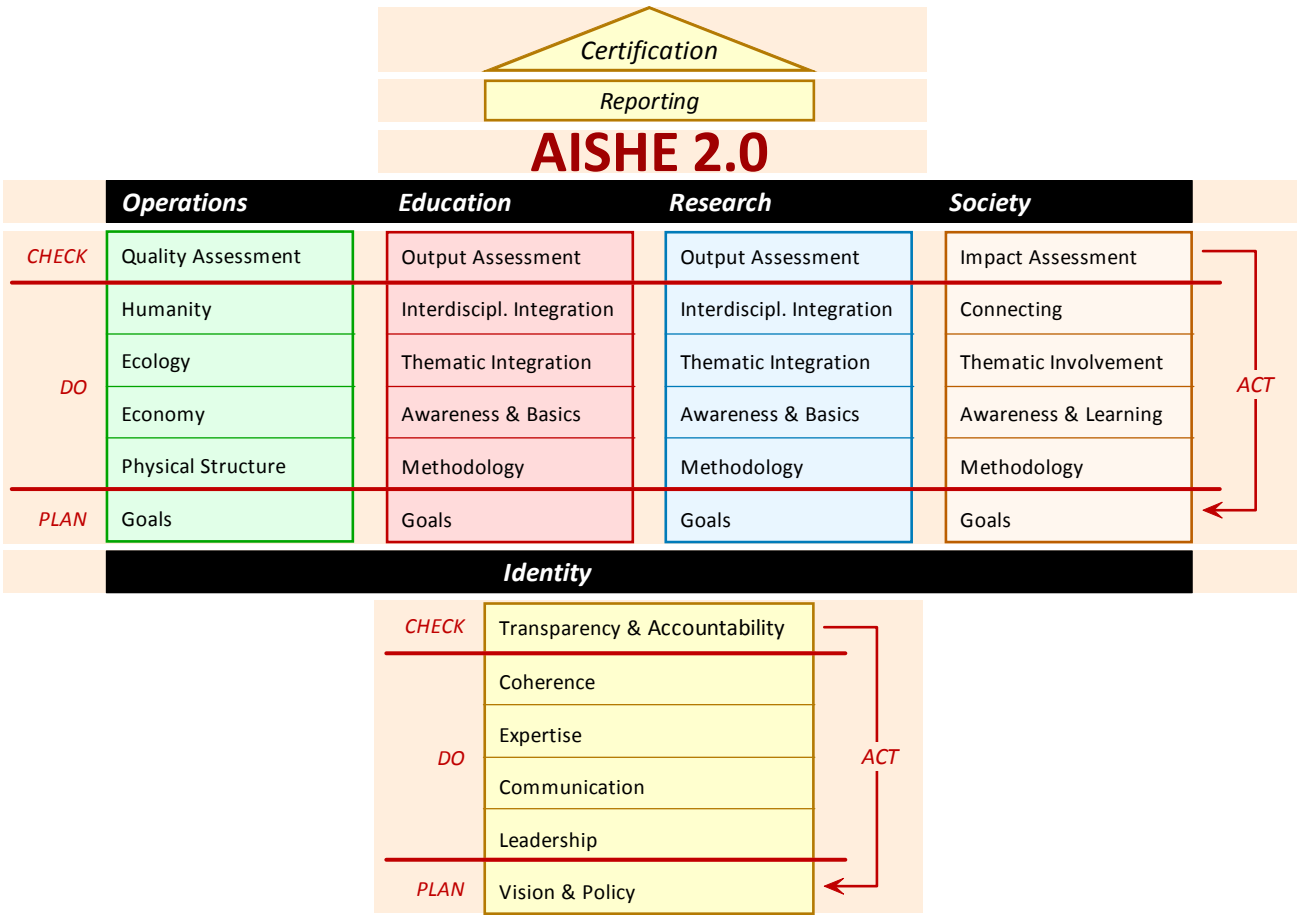


Figure 53. The detailed structure of AISHE 2.0

For the definition of the five stages, the same variety of dimensions is used that was described in §7.2.1, and explicated in table 25. One of these dimensions is 'scale', ranging from the university itself (in stage 1) to the entire world (in stage 5). It is interesting to see (as shown in figure 54) that, using this dimension, there is a certain correlation between the five stages (on the horizontal axis) and the five modules of AISHE 2.0 (on the vertical axis). The Identity Module clearly relates strongly to the university itself, or to a department of it: 'Who are we?' The Operations Module focuses mainly on the internal affairs of a university or a campus, but in doing so assesses the interactions with the outside world. Whether education or research is more externally oriented may be disputed. But the position of the students of a university is somewhere between that of an external customer and a member of the internal staff, as they stay within the university for quite some years and often contribute to the education development. For this reason, the Education Module is seen as more internally oriented than the Research Module. The Society Module is certainly the most externally oriented of all modules.

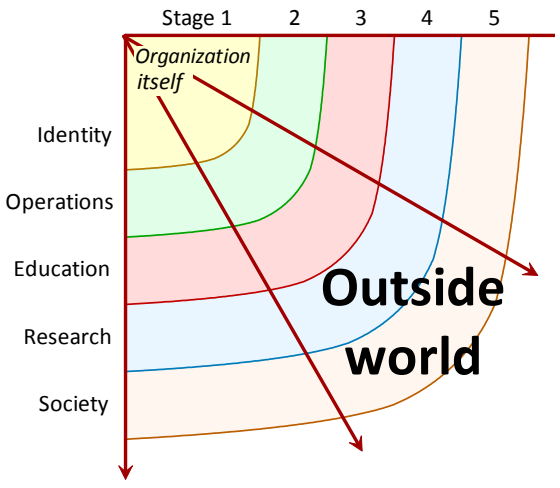


Figure 54. The correlation between the five stages and the five modules, based on the 'scale' dimension

The scheme of figure 54 is not highly relevant for the application of AISHE 2.0. Yet, it gives some insight in its fundamental structure.

Just as the experiments of §9.2 and §9.3, this one too is not yet finished. The draft descriptions of the five stages for each criterion have been made. A sample of them is reprinted in Appendix 10, which shows the Identity Module.

The computer application and the website are being developed. The stakeholder forum will receive the draft texts soon and comment on them.

Although AISHE 2.0 is not yet finished, it has some visible results already. The AISHE training program that was given in Argentina, as mentioned in §7.3.2, made use of AISHE 2.0, and test assessments are being prepared in the Latin

American countries that were represented there. The sustainability strategy of the Katholieke Hogeschool Leuven uses the four roles model as its fundament, explicitly referring to AISHE 2.0 (Lambrechts et al, 2008).
It is expected that AISHE 2.0 will be finished, validated and published before the end of 2010. Next, after some years of applying the instrument, it will be possible to answer the question that this section started with.

9.5. Summary: overview of developed ESD instruments

Many subjects have passed in the above chapters. In the next and final chapter, the results of the various experiments will be analyzed, compared and synthesized. Before that, it may be useful to shortly summarize the results of the experiments and of the theoretical study in the first chapters. Many of these results can be described in the shape of tools that can directly be applied by ESD developers. Other experiments mainly delivered lessons to be learnt. An overview:

Chapter 1: ***Tool:*** ESD checklist (table 6)
Chapter 4: Lessons learnt from designing a special SD-related study program
Chapter 5: Description of modern educational methodologies and their SD relations
Chapter 6: Lessons learned concerning management styles
Chapter 7: ***Tools:*** AISHE assessment; Certificate of Sustainability in Higher Education
Chapter 8: ***Tool:*** SD introduction instrument, incl. 'Basic Book on SD'
§9.2: ***Tool:*** SD Competence Cards, incl. book 'Working on SD'
§9.3: ***Tool:*** SD Curriculum Scan
§9.4: ***Tools:*** AISHE 2.0; international Certificate of Education for Sustainable Development

Not all of these instruments appeal to all ESD developers, teachers and managers. E.g. some managers stated that they think that AISHE is too formalistic for their kind of discipline (mostly this message came from programs in the Arts sector.) Perhaps they may benefit from one of the other tools: the set offers all kinds of styles and approaches. Hopefully, everybody can find something of his/her liking.

10. Evaluation and synthesis

After the evaluation of five experiments in the chapters 4 till 8, and the description of three more in chapter 9, it is time to compare the results and to draw conclusions from them. In the end, this conclusion will lead to an evaluation of the central hypothesis of the dissertation, to which its title, 'Sailing on the winds of change', refers.
In the first section of this chapter, the separate outcomes of the experiments #1 till #5 will be compared. This *analysis* is the preparation for a *synthesis* in the second section, which will make it possible to finally test the 'sailing' principle, i.e. the central hypothesis. In sections 3 and 4, with which the dissertation ends, the conclusions of the earlier sections will lead to the final conclusions, to a number of recommendations, and to a series of theses.

10.1. Analysis: the separate experiments

As a start, the conclusions of the chapters 4 till 8, dedicated to the experiments #1 till #5, will be summarized. Each of the five chapters started with one or two questions. After a description of the context in which the experiments took place, i.e. the relevant change processes within Dutch HBO, and a series of actions that together formed the action research, the results of each experiment were assessed, followed by a short overview of the strong and the weak points of the applied strategy, and ending with answers to the questions the experiment started with.
In the present section, the relations with the context will be ignored for a moment; this context, including all of its essential change processes, will return in the next section. The other elements – questions, actions, evaluation and answers – are summarized her.

Experiment #1 (chapter 4): A new study program (1991 – 1994)

Question:
Can higher education contribute effectively to sustainable development through a separate education program dedicated to (main aspects of) sustainable development?

Actions:
- Formulation of the professional profile of a 'sustainable engineer';
- Development and deployment of an HBO bachelor program for sustainable technology ('M2')

Evaluation:
Strong points of the first M2 program are: the innovative character of the program, being one of the first to be based on the fundaments of sustainable development; and the enthusiasm of the managing trio, the teachers, the students and the professional field.
Weak points are: the limited multidisciplinarity; the use mainly of traditional educational methods; a low number of students; and uncertainty about the employability of the graduates.

Answer:
The history of M2 was not successful. After an existence of about fifteen years it stopped, as the number of students was too low. All kinds of various reasons or excuses for this may be found, but they cannot deny that M2 simply did not prove the answer to the above question to be positive. The same is true for other serious problems the program met, especially that of the low employability of the graduates. Given more time, it is possible that this problem might have been solved or reduced, but this too was not proved.
The main importance of M2 therefore is, retrospectively, that of a pilot for higher education in general, for which the lessons learnt can be seen as modestly positive. But as a whole, the answer to the question of chapter 4 has to be: 'The experiment gave no indication that it can'.

Experiment #2 (chapter 5): Introduction of new education methodologies (1994 – 1998)

Question:
Can an educational program optimize its contribution to sustainable development through a careful selection of educational methodologies?

Actions:
- Formulation of criteria for educational methodologies in order to contribute effectively to sustainable development;
- Selection of (existing or new) educational methodologies based on the criteria;

- Redevelopment and deployment of the existing HBO bachelor program for sustainable technology ('M2'), integrating the selected educational methodologies

Evaluation:
Strong points of the second M2 program are: the innovative character of the program, not only focusing on sustainable development, but also realizing sustainability goals through a range of educational methods; and the enthusiasm of the management team, the teachers, the students and the professional field.
Weak points are: just a multidisciplinary approach, no interdisciplinarity; a too low number of students; a serious lack of employability of the graduates within the M2 field; and a low transfer rate of the experiences to other universities.

Answer:
The M2 study program as such has failed, i.e. it did not survive, as student numbers were too low. It also did not show to be successful with respect to other indicators, especially the contribution to sustainable development in the professional field and elsewhere. But those subjects are not the issue of the central question of experiment #2. The redesign of the M2 program, introducing a wide variety of new educational methodologies, was proved to be a success, as the second M2 program met the demands of ESD to a high degree, as table 18 shows. Besides, both internal and external stakeholders were mostly happy with the resulting curriculum. This implies that experiment #2 proved that its central question can be answered positive.

Experiment #3 (chapter 6): Integration of sustainable development in existing programs (1998 – 2002)

Question:
Can existing study programs, not yet giving much attention to (aspects of) sustainable development, be reformed in order to effectively increase their contribution to sustainable development?

Actions:
- Adaptation of the professional profiles of the study programs of a Faculty of Technology, integrating aspects of sustainable development;
- Increasing awareness, knowledge and skills of the teaching staff of these study programs;
- Integration of sustainable development in the study programs

Evaluation:
Strong points of the Cirrus Project are: its pioneering character, and the daring approach which aimed at an entire faculty with 13 study programs; the external support and appreciation; the learning process, based on both the successes and the failures; the lessons learnt and the transfer of results to other universities.
Weak points are: the lack of acceptance of the importance of sustainable development for higher education by a part of the management and the university board; the lack of real and deep internalization of ESD within the vision and policy of a part of the study programs and into their curricula; and the low level of organizational change that resulted.

Answer:
The Cirrus Project proved that the integration of sustainable development into an existing study program is possible. In the FTN programs this was realized at a low level, but – given the circumstances, and given the pioneering character of the Cirrus Project – this is a good achievement. It suggests that, under better circumstances, or with more experience, a deeper integration might have been realized, at the level of system integration, although Cirrus did not prove this. The answer to the question therefore is, apart from all kinds of remarks and conditions as described, a modest 'yes'.

Experiment #4 (chapter 7): Assessment of sustainable development in higher education (2000 – 2009)

Questions:
- Can sustainable development become a part of the mainstream of the educational processes in a university, implementing system integration of sustainable development?
- Can a quality management approach contribute effectively to this system integration?

Actions:
- Development of a system for standardized assessment and certification of study programs regarding the integration of sustainable development
- Application of the assessment system as a major element in the consultancy and coaching of managers and teachers in universities;
- Certification of successful study programs or university departments

Evaluation:
Strong points of AISHE and the Certificate are: They are successful as a means to develop, implement and evaluate an ESD policy; they are easy to use and appeal to the users; the basic philosophy is well-defined. In some cases it contributed significantly to the realization of SISD. It raises involvement and enthusiasm with the participants. The assessment results are realistic.
Weak points are: only a low percentage of study programs make use of AISHE. It pays hardly any attention to the university research, operations, and community outreach. Only one or a few study programs are assessed at once, so the evaluation of an entire (large) university is very time-consuming.

Answers:
The application of AISHE, partly as a main tool for the consultancy by DHO, and partly as a tool for internal and external assessments, has proved to be a valuable contribution to the process of ESD development in Dutch HBO, as well as in higher education in other countries. It has also proved to enable universities to define, and help them to implement, ESD at a systems level, realizing SISD. This implies that both questions are to be answered positive.

Experiment #5 (chapter 8): An instrument for the introduction of sustainable development (2004 – 2009)

Question:
Can an instrument be developed for the introduction to sustainable development that is applicable in study programs of many different educational sectors?

Action:
- Development and application of an instrument for the introduction of sustainable development for HBO teachers and HBO students, consisting of a text book, a website with accessories and a teacher manual

Evaluation:
Strong points of the SD introduction instrument are: It meets most demands of ESD. The concept of sustainable development is successfully clarified for teachers and students. It is used in nearly all educational sectors.
Weak points are: The core of the instrument is a book, which means that the contents are fixed for a number of years (4 or 5 years in principle) and so cannot follow recent developments. A large majority of HBO students is still not reached. Some subjects or aspects of sustainable development are missing or underexposed. Others than Dutch-speaking people cannot apply it.

Answer:
The SD introduction instrument has proved to contribute to the understanding by HBO teachers of the concept of sustainable development and its main aspects. It also proved to enable them to integrate these subjects in their education, thus helping students to lay the fundaments for their later, more detailed work on sustainable development. It is used in many sectors of HBO. This shows that the question of experiment #5, the development and use of the SD introduction instrument, has a positive answer.

Analysis of all five experiments
Each of the five experiments made use of a particular strategy for the implementation of ESD. The rate of success of the various strategies was assessed using a set of seven success indicators, that were introduced in §3.5.7 (table 8). The rate of success of each of the five strategies was thus compared with a set of seven hypotheses – or less, if not all of the seven indicators were applicable to the experiment.

Table 47. Overview of the results of five experiments

Experiment / Criterion	X1 M2 program	X2 M2 method.	X3 Cirrus	X4 AISHE	X5 SD intro
Contribution to ESD towards direct stakeholders					
Implementation of ESD in vision, policy	+	++	–	++	+
Implementation of ESD in education			+		
Customer demand	–	– –		–	–+
Customer appreciation	+	+		++	++
Contribution to SD towards indirect stakeholders					
Indirect stakeholder appreciation	+	+	+	+	++
Contribution to SD through HE	–	–			
Transfer of expertise	–	–	++	+	+
Positive answers to the questions	**No**	**Yes**	**Modest yes**	**Yes**	**Yes**

For all of the experiments, the results of the actions were used to test the hypotheses. Finally now, it is possible to take all results together and fill them in, using table 8, which results in table 47. Most columns in this table were directly taken from the result tables of the various chapters (i.e. table 19, 21, 32 and 38). The exception is experiment #1, because the conclusions at the end of its chapter (in table 15) were only preliminary, as the results of experiment #2 influenced those of experiment #1. For that reason, in table 47 the column referring to experiment #1 is an adapted copy of table 15. To table 47 are added, in the bottom row, the conclusions about the answers that were summarized in the present section. The table allows for two kinds of comparisons: *vertical* (drawing conclusions about strategies), and *horizontal* (drawing conclusions about criteria).

Vertical comparison: strategies
The strategies that were used in the course of the research program can be divided into three categories: 'not proven successful', 'success depending on the situation', and 'successful'.

Not proven successful:
One strategy was certainly not successful: the one of experiment #1, the development and deployment of a special SD study program. As argued in chapter 4, other attempts, in several Dutch universities, also were unsuccessful. Every time, the low number of students was a major cause of the failure.
This does not prove that such attempts can never be successful. In recent years several new attempts have been started, either aiming at specific sustainability related subjects, e.g. climate & energy, or to sustainable development in general. It is quite possible that these initiatives will succeed. Some of the circumstances are certainly more favourable: sustainable development, including topics like climate change and integral chain management (popularized by the concept of Cradle to Cradle), is by far more popular in the media, the companies, the governments and the main public than in earlier years. Besides, there is much more experience now with ESD development and implementation. Maybe the lessons learned from M2 and comparable experiments will contribute to a future success.

Success depending on situation:
The rate of success of another strategy appears to depend on certain circumstances. This concerns the adaptation of existing study programs in an attempt to integrate sustainable development throughout the curriculum.
Several such attempts were described in the chapters 6 and 7. The pioneering Cirrus Project, the subject of chapter 6, was modestly successful, but the results were lower than planned and expected. In chapter 7 the case of Fontys University was described, which was more successful, especially the School of Applied Sciences ('TNW'), which was able to realize SISD, i.e. system integration of sustainable development. Other cases discussed in chapter 7 were also successful. This difference in the rate of success can be explained by several factors.
The main reason for the disappointing results of the Cirrus Project was discussed in chapter 6, making use of the management theory of De Caluwé and Vermaak. The project suffered from a problematic combination of management styles: on the one hand, a *yellowprint* and *blueprint* approach in the contacts with the faculty management, the board and the program managers; and on the other hand, a *greenprint* and *whiteprint* process with the members of the Cirrus team. Compared to this, the successful processes described in chapter 7 all shared a common character typified by a *redprint*, *greenprint* and *whiteprint* character. The lesson learned is that it is vital for ESD development processes – and probably for many other processes in higher education (but they were not studied in this dissertation) – to make use of *red-*, *green-* and *whiteprint* processes, i.e. a combination of stimulation, intellectual freedom, inspiration and creativity. *Yellow-* and *blueprint* management styles, making use of negotiations, political play, fixed targets and enforcement, appeared to work counterproductive.
This is not a surprising discovery, as all universities are organizations of highly educated and independently thinking professionals. But the conclusion implies that the so-called 'primordial conflict' that De Caluwé and Vermaak (2006) describe (see chapter 6), is highly relevant, and board members and managers should be aware of it if they want ESD, and especially SISD, to be successfully implemented within their institutions. One of the consequences is the fact that it is at least problematic, and probably unwise, to treat such attempts as projects with defined targets, timelines and budgets. Rather, they should be treated as voyages of exploration, as 'odysseys', or – considering the engaging, exciting and creative aspects – as quests or adventures.
The above conclusion leads to a second determining factor for the rate of success of the strategy of adaptation of existing study programs. The natural worry of managers, being one of the two sides of the 'primordial conflict', is that without targets or forcing, no guarantee will exist that desired results will be reached. For ESD implementation this is a realistic worry, as in many universities the academic independence implies that the success of the ESD implementation depends on the presence or absence of voluntary cooperation and involvement of professors and disciplinary groups, and thus in a way on coincidence. That is why the process of toppling the organization, that took place in the nineties in many HBO institutions, as described in §3.1.4, was a highly important development. The program teams that were thus formed had the opportunity to act as 'result responsible teams', together being and feeling responsible for the quality of an entire curriculum. Their relations with the professional field, which in the profession oriented Universities of Applied Sciences naturally tend to be stronger than in research universities, supported this process and helped it to focus on sustainable development. This toppling process, which was much stronger in

most HBO institutions than in most Dutch research universities, is probably a main reason for the successes of ESD integration into the education of HBO, which on average seems to be more successful than in the research universities in the Netherlands (Van Drunen, 2009).
A third determining factor was already discussed in chapter 7. In the nineties, not much experience existed with the ESD development process. Cirrus, which was designed in 1998, had a strong pioneering character. A lot of mistakes were made and lessons were learned. The ESD process of Fontys TNW started around 2000, and it took the school about eight years to realize SISD, as was proved by their three-star Certificate of Sustainability in Higher Education in 1998. Other programs, starting several years later, were able to profit from earlier experiences, and they are progressing much faster.

Successful strategies:
An important and successful strategy has appeared to be the quality management approach, based on the AISHE assessments and the Certificate of Sustainability in Higher Education. Embedded in the consultancy by DHO, it has proved to encourage schools, faculties and study program teams to work on ESD, leading from activity oriented approaches to a systematic integration. The AISHE philosophy is based on the same principles that were just mentioned, i.e. *green*- and *whiteprint* assessment processes supported by a *redprint*-style stimulation through the Certificate. The quality management strategy enables ESD developers to move sustainable development into the mainstream, i.e. to let it become a part of the core activities and even of the very identity of a university or a department.
Another successful ESD strategy is the application of a wide variety of educational methodologies. It was in the nineties when the redesign of M2 applied methods like PBL and project education. The later introduction of ICT made even more methodologies available, and together they make it possible to design and realize education that meets all or at least most of the demands of ESD that are formulated in table 6.
A third strategy that was proved to be successful is the design and application of an instrument for a balanced and multidisciplinary introduction of sustainable development, suitable for university teachers and students. The instrument that was developed around the 'Basic Book on Sustainable Development' is now used in study programs in nearly all sectors of HBO, as was the intention, and the responses by teachers and students indicate that it is successful in taking away an important bottleneck for ESD: the lack of understanding of the complicated subject of sustainable development.

Horizontal comparison: success indicators
When, instead of the columns, the rows of table 47 are studied, it is possible to discover another conclusion. It is remarkable that the third indicator, 'customer demand', scores low in all (relevant) experiments. This reflects a more general conclusion: that the Dutch HBO is still far from a wide-ranging and thorough integration of sustainable development into its education and organization. The fact that, at the moment, only a few thousands of students – out of hundreds of thousands of HBO students – study in a program of which is known that it has realized or even just neared SISD, indicates that HBO is far from contributing as strongly to sustainable development as it might. (This does not mean HBO is lagging behind in comparison with other educational sectors, because no indications were found that ESD integration has advanced more successfully in most Dutch research universities or in higher education in other countries.) However, the 'customer demand' of ESD is rising. An increasing number of Dutch universities have concrete strategic plans involving sustainable development. One visible indication of this is that DHO expects that the number of AISHE assessment in 2010 and 2011 will be significantly higher than in previous years.

10.2. Synthesis: the Odyssey of HBO, a transformative process

The conclusions summarized in §10.1 were all based on the application of triangulation of different sources of information, as described in §1.4.1 (based on e.g. Yin 2009). For instance, theory triangulation was used to create an understanding of the failures and successes, using different theoretical models of change processes. Investigator triangulation was used to combine the assessments by and opinions of several institutions – e.g. visitation commissions and the Inspection of higher education – and of several groups of direct stakeholders, like teachers and students. Quantitative data, e.g. student numbers and sales figures, were used together with qualitative information, such as answers to questionnaires, to find aggregated results about the rate of success of the various strategies, making use of methodological triangulation 'within methods' and 'across methods'.
All these combined results will now lead to a last step, combining the results of all five experiments, and comparing them with the long series of change processes in HBO that were described in the consecutive chapters of this dissertation as the 'context' of the experiments. This 'grand triangulation' will lead to a remarkable insight.

10.2.1. The development of HBO in twenty years
The long range of change processes of HBO dates from several centuries ago, as was described in chapter 2. But the developments in the last ca. 20 years form a coherent and intensive process. Starting around the year 1990, a series

of changes took place that were briefly introduced in §3.3, numbered as change processes #1 till #16. All of these 16 processes were described in more detail in §4.1, §5.1, §6.1, §7.1, §8.1 and §9.1. The present section will show that, together, these changes tell the story of a profound transformation.
In chapter 7, the five stages of AISHE were introduced, that were originally developed by INK based on the EFQM model for quality management. They describe a natural development of organizations, the first stage describing an activity oriented organization, the fifth a fully society oriented organization. Looking at the development of HBO in the twenty years between 1990 and 2010, it appears to be possible to fit all HBO change processes into the scheme of the five INK-AISHE stages. The result gives a deeper understanding of the recent history of HBO. The scheme is shown in figure 55: the 'HBO Transformation Map'.

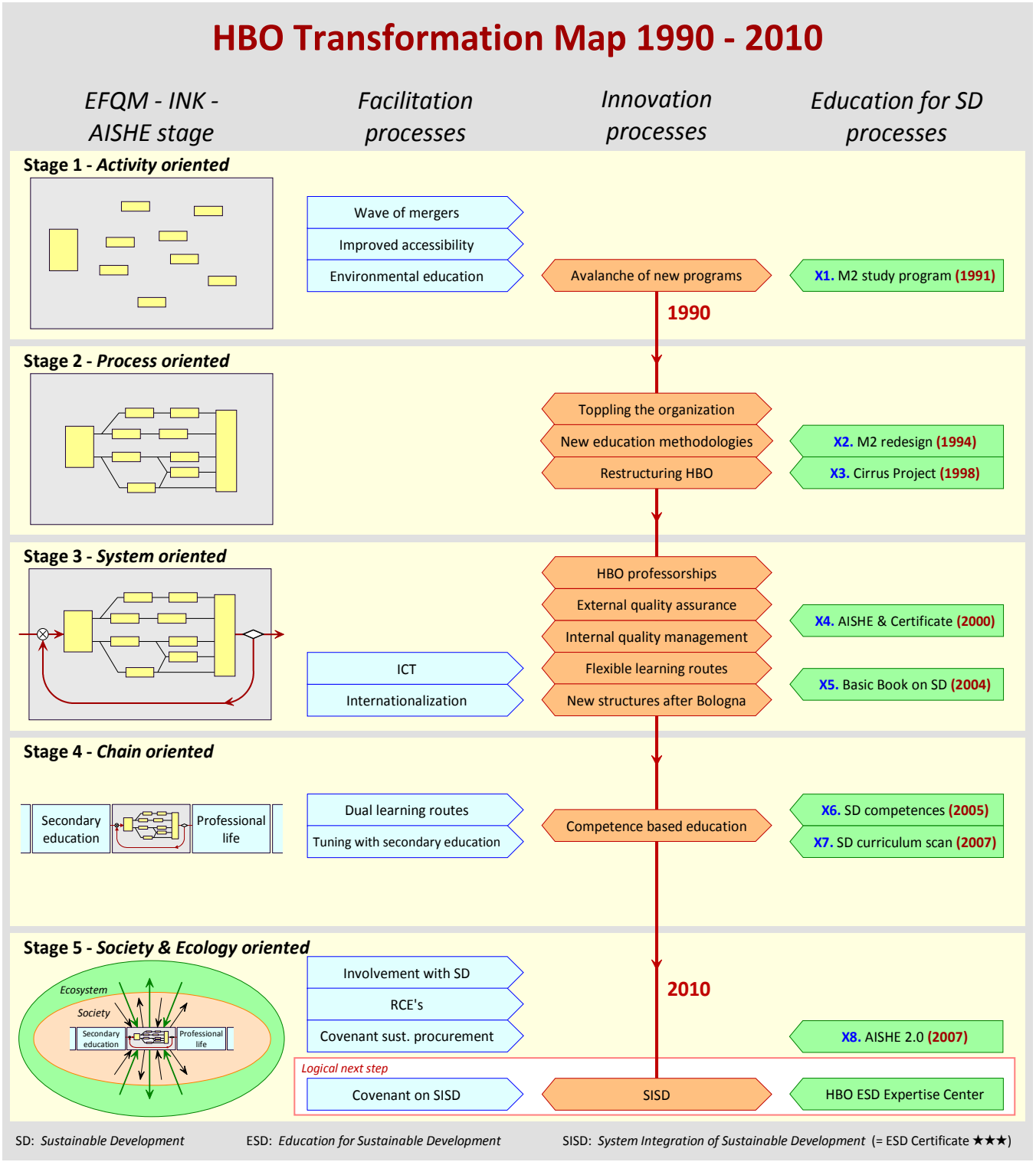


Figure 55. The Transformation Map of HBO, 1990 - 2010, including the input from the experiments described in this dissertation

The name of this map, 'transformation', is chosen for a very good reason, as will be shown soon. Before conclusions are drawn from figure 55, some elements of it will be explained.
First, there are two small differences with the set of five stages as they were introduced in chapter 7. The graphic representation of stage 4 ('chain oriented') in figure 55 differs from the one in figure 33. This is for a good reason, as the image representing stage 4 in the original figure refers to all kinds of chain orientations, from the life cycles of industrial products till those of animals, companies, or humans. Here, in figure 55, the model is applied specifically to HBO, which means that the core 'products' are its graduates. For this reason, the chain is specified as the life cycle of students.
Secondly, stage 5 has been altered more seriously. In the AISHE model, the name of this stage is 'society oriented', and the matching image (in figure 33) is made from the chain of stage 4, surrounded by the environment in which it is embedded: society, represented as an oval. For figure 55, both are expanded to the ecosystem, based upon the insight that society is not the final environment of education, as the whole of society is embedded in the ecosystem of our planet. The growing awareness and recognition of this fact in HBO implies a grave change of vision, a paradigm shift. Roorda (2007) described a comparable paradigm shift in the vision about the relations between man, nature and the economy. Traditional economic thinkers will probably depict this relation as in figure 56A, where the economy is seen as a system that carries the interactions between man and nature. In this case the paradigm shift is a change to the vision that the economy is nothing more than a part of the various activities and systems that mankind has designed, all of which are a part of the ecosystem of our planet, as figure 56B illustrates. The three aspects – mankind, nature, and the economy – correspond to the Triple P – people, planet, profit –and this paradigm shift is an essential one in trying to find a sustainable balance between them.

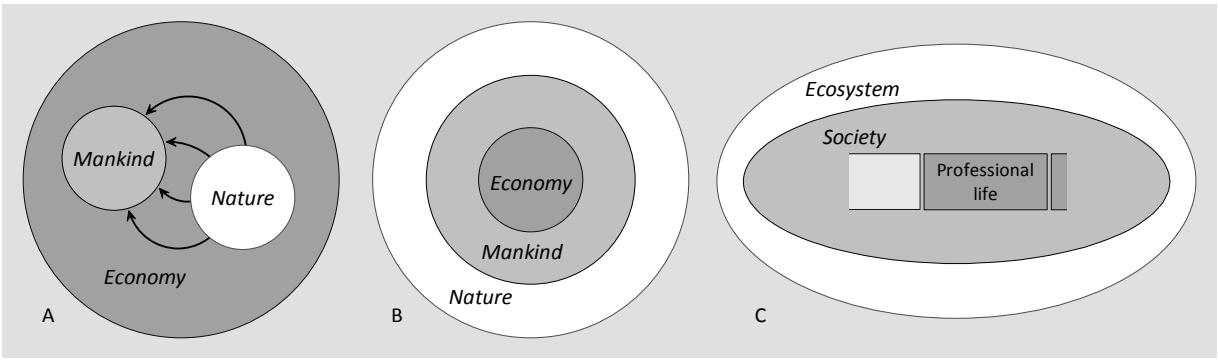


Figure 56. A paradigm shift (from A to B), and its realization in higher education (C). Source (figures A & B): Roorda, 2007

In fact, the above mentioned paradigm shift of HBO is a comparable shift, and the resulting figure, shown in a simplified form as figure 56C, is comparable to figure 56B, the professional life corresponding with the economy and so with 'profit'. In other words, the shift from a chain oriented education institution (stage 4 of AISHE) to a society & ecology oriented institution (stage 5), i.e. embedment within the 'universe', is an essential development for HBO in order to find and contribute to a sustainable balance.
The HBO Transformation Map (figure 55) makes a distinction between 'facilitation processes' and 'innovation processes'. This is not a very strict distinction. But the general idea behind it is that the innovation processes changed the education itself in a profound way. Examples are: new programs, new methodologies and new structures. The 'facilitating processes' did not in itself change the education, but were enablers for such changes. Examples are: the wave of mergers and the introduction of ICT. The distinction is not very strict, as some might perhaps argue that e.g. the introduction of environmental education should take the place of the avalanche of new programs and vice versa. But such changes would not alter the overall meaning of the map, and so discussions about the exact locations of its elements are not very relevant. Much more important is the fact that all of these change processes can easily be positioned in one of the five stages of AISHE. And that is not all, because, roughly seen, *the positioning of the HBO change processes within the five stages matches with the chronological order in which they occurred*.
This correspondence is not a perfect one, just as the distinction between facilitating and innovation processes is not an exact one: just as any model, the map is a simplified representation of reality. For instance, many of the change processes did not start or end all of a sudden within one year, and so there is no exact order in which they occurred. Besides, the fit between the stages and the chronology is stronger for the innovation processes than for the facilitating processes, which implies that several of the facilitating processes only realized their full implications some years later. Nevertheless, the match between AISHE stages and chronology is striking, and it leads to an important conclusion: the long series of changes within HBO are not independent from each other. HBO as a whole is going through the natural development stages that are described by the EFQM and the INK models for quality management:

- The map shows that, around 1990, HBO was generally in stage 1. The avalanche of new study programs was a clear examples of ad hoc policies, producing new isolated 'islands' within the 'ocean' of HBO study programs. The

programs themselves were equally in stage 1, as the curricula largely consisted of separate subjects that were designed by disciplinary groups.
- The process of toppling the HBO organizations was a very important step towards stage 2, as for the first time it became possible to treat a study program as a process, with all its internal relations. It enabled to think about this process and optimize it. This optimization took place on two levels. Within the separate programs or faculties, new educational methodologies were introduced. For HBO as a whole, the process was improved by cutting away a part of the abundance of study programs; this restructuring process raised the efficiency and clarity of HBO.
- HBO entered stage 3 when the quality management, a core element of system orientation, was developed in a more structural way. Before this happened, around 2000, quality management as such was not new for HBO, as the visitation commissions existed already in the nineties. But the accreditation made the external quality assurance system much stronger, also inducing a stronger internal quality management that was not 'glued' to the organizations but became the core of it. This had several other consequences, like the need for an improved system of professionalization: of the education itself and its teachers, resulting in the HBO professorships which fortified the input of expertise, and of the students themselves, which resulted in flexible learning routes. The entire system of higher education was redesigned as a consequence of the Bologna agreement, which itself was a part of the internationalization process.
- In recent years, with a strong emphasis on competence based education, the focus of the innovations in HBO is on the relations with the professional field, strengthening the chain of the life cycle of the students, and thus it is in stage 4.

Figure 55 contains all 16 change processes that were described in this dissertation. It also contains some others, which were not yet discussed, as they have been less drastic for HBO as a whole:
- *Dual learning routes: in the years before 2000, HBO created the possibility for people who were already working in companies or with other employers, to start a higher education program as a part time student, combining it with their jobs. These dual programs were one way to realize life-long learning, and it contributed to the relations between HBO and the professional field. For that reason, although chronologically incorrect, the process is placed in stage 4.*
- *Tuning with secondary education: As quite some students find the transition from secondary education to HBO difficult, resulting in a too high dropout of first-year students (according to policy makers), many HBO institutions have set up intensive relations with secondary schools, cooperating in developing a better fit between the two layers of education. This is also a typical stage 4 facilitating process, as it is based on an altered view of the core tasks of HBO teachers: from delivering education, to contributing to the life cycles of students.*
- *RCE's: As a consequence of the UN Decade of Education (DESD, see chapter 2), a global network of Regional Centers of Expertise has been set up, supported and officially recognized by the United Nations University. The RCE's have the task of contributing to the implementation of the DESD goals by translating its global objectives into the context of the local communities. This is realized by the RCE's through cooperation between institutions for formal and for informal education (such as museums and libraries), local or regional governments, companies, and local ngo's. The first RCE in the Netherlands is the RCE Rhine-Meuse, with operates in an international region in the Netherlands, Belgium and Germany. This RCE was founded as an initiative of the Open University of the Netherlands and the Hogeschool Zuyd.*
- *Covenant on sustainable procurement: In 2008, a covenant was signed by the Dutch Minister of Environment, the chairman of the HBO Council, and the chairman of the VSNU, the association of Dutch research universities. In this covenant, both branches of higher education promised that, at the end of 2012, at least 50% of their procurement will be sustainable.*

The map of figure 55 may seem to indicate that the development process of HBO is a linear process. But this is certainly not the case, as several threads can be discerned of recurring improvement processes, together forming iterative processes. An example is the thread consisting of the introduction of new educational methodologies in the nineties, naturally developing into the definition of flexible learning routes and by the introduction of competence based education. The connecting themes are: 'student centered' and 'learning to learn' (see figure 57). This thread is an example of a paradigm shift: from 'education' (teacher- and university centered) to 'learning' (student centered). Another example of a recurring theme is the curriculum structure, which received a strong first improvement with the toppling of the organization structure in the nineties, followed by the new structures of bachelor – master and major – minor in the new millennium. A third iterative process is the development towards total quality management, which started with restructuring HBO and with the first visitation commissions, followed by the accreditation system with its implications for the external and internal quality management.

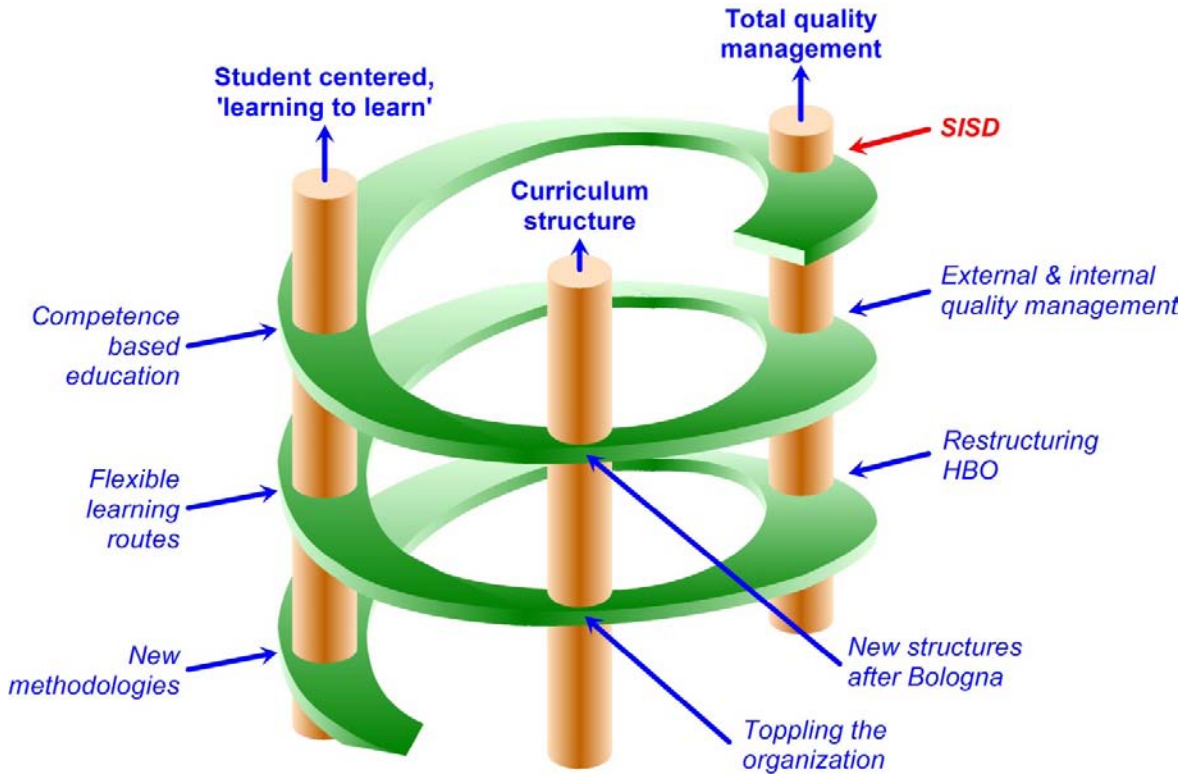


Figure 57. Several iterative processes in the development of HBO

10.2.2. The transformation

In chapter 1, a theory of change was introduced, described by Sterling (2004). This model distinguishes four levels of change: no or weak change; accommodation; reformation; and transformation. The highest level, transformation, implies a complete redesign of the education.

The Sterling model was used in several chapters, to interpret and understand the various change processes and ESD experiments. For instance, in chapter 5 the conclusion was drawn that the introduction of a wide variety of new educational methodologies was a typical example of a reformation. And in §7.2.3 even the realization of SISD within a group of study programs appeared to be no more than a reformation process, if studied just in itself, as it does not change any fundamental structures. Generalizing from this, the conclusion is that each and every change process that is shown in figure 55 is, when seen separately, a reformation process or less. But if the whole range of these processes is studied, a more profound change comes into view, showing the typical characteristics of a deep transformation or transition of HBO. This is made clearer when the main characteristics of such a transformation, distinguishing them from a less drastic reformation, are compared with the HBO developments. They are (Sterling, 2004):

1. "A deep, conscious reordering"

If the HBO of 1980-1990 is compared with the HBO of 2010, significant differences in structures and contents are visible. The number of institutions has decreased nearly tenfold while the number of students more than doubled. Instead of being an incoherent set of subjects, the curricula now are consisting of a well-structured and coherent program, finding its base in a close connection with the professional field through the set of competences. A didactic view has taken shape through a consciously selected range of educational methodologies. The quality is maintained and continuously improved, both by an external quality assurance system and an internal quality management.

2. "A paradigm shift"

The major paradigm shift has been the transition from a teacher oriented to a student centered education system. Not the teaching but the learning is central in modern HBO. A second paradigm shift concerns the awareness of the position of HBO within the embedding environment: society, which in its turn is embedded in the ecosystem. HBO institutions have changed from subject-driven, disciplinary oriented organizations to pro-active institutions that operate fully in society, in a constant interaction with governments, companies and the civil society.

3. "Moving through consecutive stages"

Figure 55, the HBO Transformation Map, shows a long series of consecutive development stages, each of which in itself has the size of an accommodation or a reformation.

4. "Not a simple linear process of discrete stages but nesting levels"
Figure 57 illustrates that various threads of development took the shape of recurring, iterative processes.

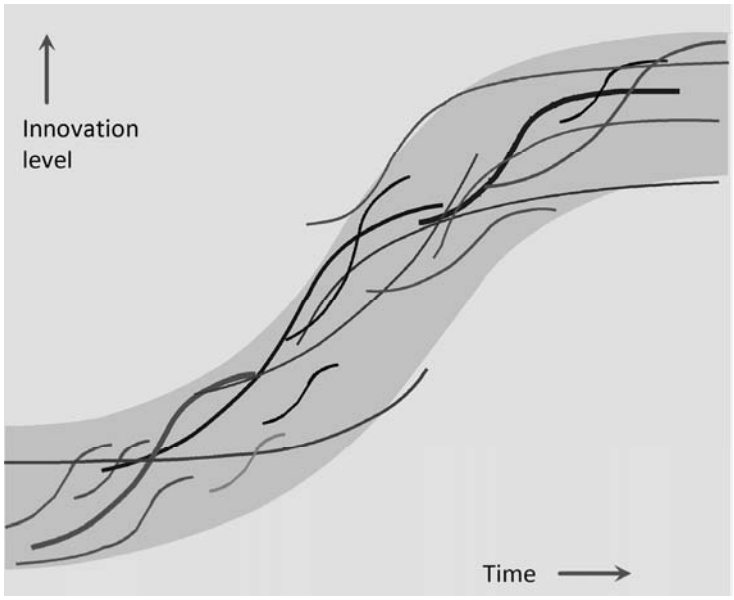


Figure 58. A long series of accommodations and reformations results in a transformation. *Source:* Roorda (2007)

Each of the separate innovation processes of HBO did not have the character of a transformation, as it started where an earlier innovation ended. But taken together, they do form a transformative process, in other words, a transition of HBO. The cumulative effect of a long series of accommodations and reformations has resulted in a genuine transformation of HBO (see figure 58).

An incomplete transformation
The HBO transformation process is however incomplete, for two reasons. The first is that not all HBO institutions, or - within them – all schools and study programs, have embraced and fully realized all the above mentioned change processes. A striking example was given in §9.1.1, where it was told that the teachers of a certain study program admitted (in 2009) that first they had developed the curriculum, and next a suitable set of competences was written 'proving' that the curriculum was right. In other words, reality does not look as nice as theory. It will be interesting to investigate how far the various HBO institutions and their departments have progressed along the developments shown in figure 55; but this is beyond the scope of the present research program. Anyway, the present situation is one of 'early adopters' and 'laggards'. This is common to this kind of large-scale innovation processes, as Rogers (2003) describes in his theory of 'diffusion of innovations', stating that such processes follow a 'Bell curve' (see figure 59; the numbers are more or less symbolic, and not based on empirical data about HBO).

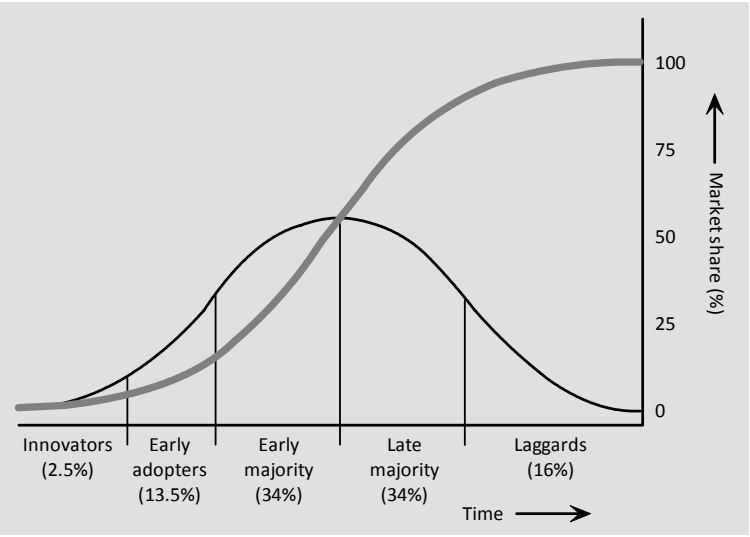


Figure 59. The diffusion of innovations. *Source: Rogers (2003)*

The second reason why the transformation of HBO is incomplete can be seen in figure 55. The most recent major innovative development of HBO is the introduction of competence based education, which is in stage 4. The logical next step would bring HBO into stage 5. Such a next step would lead HBO to a state in which the embedment in society and the ecosystem is realized.
Both kinds of incompleteness show that the Dutch HBO has travelled a long way in its Odyssey of twenty years, but is not yet in 'Ithaka', its home destination. This is not to imply that the realization of stage 5 in HBO would lead to a final situation after which HBO never would have to be changed anymore. As long as it exists, HBO will no doubt continue to change in a dynamic way. But the transformation of the past twenty years may be completed with the fulfillment of stage 5. The transformation may be seen as a voyage of exploration, an 'odyssey' or an adventure; and every good adventure should at some time come to completion, making space for a next adventure.

An autonomous process
The fact that it is possible to apply the INK 5-stage model to the developments in HBO in the last twenty years is remarkable, since the INK model was not at all designed for such a large sector, consisting of scores of separate organizations without any powerful coordinated management. The model was developed to be applied to single organizations, originally aiming at e.g. industrial companies. Later it was adapted for e.g. hospitals, municipalities and uni-

versities, but they still are compact organizations with a clearly recognizable united management. The thought behind the model is that these organizations tend to go through a natural development process going from stage 1 till stage 3 or even higher, a development that can be stimulated purposefully. Now, it appears that the entire sector of HBO follows this same natural development.
When viewing figure 55, it may seem as if the complete series of change processes was designed on beforehand and controlled while taking place, as if the entire transformation was planned as such. This is not the case, as nobody around 1990 or even ten years later was able to foresee the outcomes in ca. 2010. In 1990, no-one had the five INK stages in mind, and nobody was trying to plan a transformative process for HBO in the next twenty years along the lines of the five stages. It was an autonomous process, a process largely of trial and error, in which many actors had their roles and influences in a combination of top-down and bottom-up steering. In terms of transition management: it was a process that was managed by many in a complicated network. It started – although no exact starting moment can be appointed – with a long-term vision about higher education, actually in a process of backcasting, although this concept was not referred to. Just as in other transitions, it had no fixed or measurable targets, and the long-term vision was adapted or replaced repeatedly. This raises the question, on which vision the completion of the transition, entering stage 5, might be based, and by whom this vision might be shared. In other words: what does 'society and ecosystem oriented' mean to HBO?

10.3. HBO, society and ecosystem

10.3.1. The eight ESD experiments in relation to the HBO transformation

The HBO Transformation Map shows that all eight ESD experiments of the research program have been placed on the Map as facilitating processes. Here, too, the chronological order matches with the stages of INK and AISHE. This means that the consecutive experiments, when taken together, form a learning process bringing ESD within HBO as a continuous process of improvement, in a close relation with the other developments of HBO:

- As already concluded in chapter 4, the development of the first M2 program was a typical accommodation process in terms of the Sterling model. Its result was a new 'island' in the 'ocean' of study programs, and therefore it was also a typical example of a stage 1 process.
- The redesign of M2, and the Cirrus Project, both tried to improve the learning processes of the existing education. So, they are stage 2 processes.
- AISHE, the Certificate of Sustainability in Higher Education, and the consultancy by DHO were based on the integration of quality management within HBO, and so they are stage 3 processes, contributing to systemized and structured curricula. The experiment of the SD introduction instrument, based on the 'Basic Book on Sustainable Development', did the same, but from a different starting point: the structured and systematic approach to the integration of sustainable development in the education, described in §6.2.2 and §8.2.3 as the 'tree model'. As the experiment tried to realize an essential part of this systems model, the 'trunk', it also belongs to stage 3.
- Experiment #6 aims at the development of competences for sustainable development, and so it is a facilitating process for competence based education, which is in stage 4. The curriculum scan of experiment #7 is complementary to the sustainability competences, as it fills in the details of the curricula that the SD competences don't specify, making the set of competences more complete and applicable in an iterative process. For that reason, experiment #7 is also facilitating to the realization of stage 4.

This positions the experiments #1 till #7, all fitting within the transformation stages 1 till 4. What about stage 5? In the course of this chapter, this stage is redefined as 'society and ecology oriented', and described as realizing the complete embedment within the 'universe'. Looking at the definitions of sustainable development and of ESD described in chapter 2, it becomes apparent that realizing stage 5 is equal to realizing the systematic integration of sustainable development in HBO. For the education institutions this means: integration within all of its four roles - education, research, operations, and community outreach - and in its very identity. This reminds of figure 52 (showing the AISHE 2.0 modular structure), and it implies that experiment #8, the development of AISHE 2.0, is facilitating for this final transformation step, as it aims at all of these four roles of universities. The fundamental wholeness of a university behind their four different roles is expressed in AISHE 2.0 through the basic 'Identity' module.
Realizing stage 5 thus means: realizing SISD, system integration of sustainable development, throughout HBO. Applied to the current ESD integration process in HBO, the study programs and schools that presently have realized or are nearing SISD can be seen as the 'innovators' that Rogers (2003) describes. In the present ESD developments in HBO, the emphasis is on the next group, the 'early adopters', which is coherent to the conclusion of §10.1 that the 'customer demand' of the various ESD experiments is low but increasing. The possibility to implement stage 5 in the coming years implies that SISD is to be realized by many more universities, i.e. by an 'early majority' followed by the rest. In other words, completing the transformation renders a state in which SISD is to become the standard instead of the exception.

As far as the educational role is concerned, a concrete vision already exists about what the situation within HBO would look like after stage 5 is realized. The necessary concepts and instruments have been developed, such as SISD, AISHE and the Certificate of Sustainability in Higher Education. Case descriptions exist, e.g. presented in this dissertation, that offer a vision of what the completion of the transition might look like. Concerning the other three roles towards ESD: the AISHE 2.0 tool is nearly finished, widening the scope of AISHE from education to the other university roles. Besides, all kinds of experiences exist all over the world, e.g. thanks to 'greening the campus' projects etc.

10.3.2. SISD transition management

The earlier four stages of the HBO transformation have been realized thanks to a 'grand coalition' of many parties, multi-actor and multi-level (see §2.1.3), such as the universities of Applied Sciences themselves, the HBO Council, the students, the professional fields for which HBO educates, the Ministry of Education, and the NVAO, responsible for the accreditation of higher education. This transition management network proved to be successful: partially, that is, as the four stages have so far only been realized incompletely. Nevertheless, much has been accomplished, thanks to their cooperation. So it is likely that, in order to change SISD from being the exception to becoming the standard in HBO, a comparable coalition will be needed. That this is a realistic option is proved by the existence of a covenant with the Dutch higher education on sustainable procurement: this shows the willingness of the Dutch universities concerning sustainable development. Perhaps it is the right time for a second covenant, this time aiming at SISD. Concerning the topics involved – orientation on society and ecosystem – it is likely that other parties will also be relevant for the implementation process. Each of these parties will briefly be investigated.

The universities of Applied Sciences

There are many universities of Applied Sciences in the Netherlands that have serious plan with ESD. Examples of such universities, who are (in 2010) in the middle of defining ESD as a key element of their strategic plans or have already done so, are e.g. Avans Hogeschool, Hogeschool Arnhem-Nijmegen, Hogeschool Leiden, Hanzehogeschool, Hogeschool Utrecht, Hogeschool Rotterdam, Hogeschool Zuyd, Hogeschool Zeeland, Design Academy, Saxion Hogeschool. Together they represent several hundreds of thousands of students. Most of them literally use the term 'sustainable development' in their plans. Others don't explicitly use the term but refer to e.g. CSR or to societal involvement or responsibility. In other words, the natural tendency to enter stage 5 of the Transformation Map is already widely present.

The motivations for these developments differ strongly. They can be understood by comparing them to Maslow's theory of motivations (Maslow, 1954). The relation between Maslow's model and sustainable development has been made before, for instance by Lozano (2006), who applies the motivation theory to individuals working on ESD. But it is also possible to apply the model to sustainable development and CSR of organizations as a whole. Roorda (2007) translated the model from individual to organizational motivations: see figure 60. This figure shows that organizations such as educational institutions derive reasons for their efforts concerning sustainable development and CSR on all five levels of the pyramid, ranging from 'physiological' and 'safety' reasons, aimed at sheer survival, to self-actualization, based on the wish to give the institution its rightful position within society as a leading and an excellent organization. Private meetings with a series of Board members and managers within HBO showed that many of the motivations mentioned in figure 60 are present.

Figure 60. Maslow's pyramid, applied to organizational motivations for SD and CSR. *Source:* Roorda (2007)

The HBO Council

It is not only the wish of many separate HBO institutions to commit themselves to sustainable development or to related subjects like CSR or societal involvement. The subject can also be found in their branch organization, the HBO

Council. Two recent documents published by the HBO Council prove this: the paper 'Quality as Task' ('Kwaliteit als opdracht', HBO Council, 2009c), also called the 'white paper', and its preparatory document, the 'green paper' (HBO Council, 2009b). Both documents form a discussion paper, both for the future of HBO as an educational sector, and for the future of the HBO Council as the association of HBO institutions. The 'green paper' shows that the HBO education is much more than 'vocational' education aiming solely at the professional field, as p. 16 states:

> "An (…) element that in recent years has been emphatically added to the bachelor standard is citizenship and *Bildung*."

The term 'Bildung' reminds of the word 'Gestaltung', described by De Haan (2002) as a key element of ESD (see §3.2.1). Both terms indicate that education is more than just the acquisition of knowledge and skills, but is also aiming at shaping an attitude of the future professionals. Again, the thoughts about 'good' eduction from two directions - educators and thinkers about sustainable development – converge. The 'white paper' adds to this (p. 18):

> "HBO bachelors are not one-sided practitioners, but professionals that have to make relations with societal and sometimes ethical topics, who possess a cultural luggage, who – in the true sense of the word – have enjoyed academic shaping. It is increasingly important to educate social professionals who can reflect critically on the dignity of life, to educate economists who ask themselves questions about the relation between short-term profit maximalization and long-term trust in the economic system, and to prepare engineers for a professional career in which sustainability is more central. This is about the consciousness of the relevance of acquired knowledge and skills in their societal context. Students may be expected to possess the ability to judge knowledge critically based on moral standards."

The recognition by the HBO Council of the importance of societal responsibility and sustainable development is further emphasized by the fact that since a number of years its chairman is a member of the Board of DHO. Besides, the same chairman wrote in his already cited preface to the Basic Book on Sustainable Development (Roorda, 2007):

> "Schools and universities have the obligation to answer the call from young people and from society as a whole to work on sustainable development. This means that knowledge transfer must take place in the context of sustainable development."

All in all, it seems that not only many HBO institutions but also their branch organization is ready to cooperate on SISD.

The students

In 1998, the student organization LHUMP was one of the driving forces behind the start of DHO (see §7.1.3). The organization is still active, albeit with another name: 'M()rgen', which may be translated as 'Tom()rrow'. In recent years, the organization has stimulated several initiatives for ESD, both concerning the educational and the operations roles of universities. Another organization, the students' labor union LSVb, repeatedly supported ESD initiatives.
Individual students also play significant roles on ESD. E.g. a student of Hogeschool Leiden, Jordi Strörman, is developing a minor 'sustainable development' for his faculty. Marcel Schellekens, a student of Radboud University Nijmegen, is investigating the present situation concerning ESD in his university, making use of AISHE (Schellekens, 2010), aiming at designing a proposal for the ESD strategy for the university Board. Lichi Ukbaslssie and Vivian Bittin of Fontys Hogeschool MER are designing a CSR assessment tool. And Milou van Drunen of the same school investigated ways to increase the involvement of students in ESD development (Van Drunen, 2009), requested to do so by M()rgen. These examples show that students can form an influential partner in a SISD coalition.

The professional field

In §6.1.2 a description was given of the growing awareness and involvement of Dutch businesses with sustainable development. This process has even increased in recent years. This is illustrated by an open letter to the Dutch government that was written by 80 CEO's and board members of the largest businesses in the Netherlands (Albrecht et al, 2006):

> "World wide, ecosystems are vanishing with an enormous speed, caused primarily by human interactions. (…) We, people working in national and international companies and organizations, are deeply concerned about this (…). We think that the protection of our natural environment needs a high priority. The Dutch businesses should be stimulated to show leadership and to contribute to sustainable development (…). The Netherlands should develop a strategy in which innovation aiming at eminent sustainable technologies, knowledge development, and societal involvement with the natural habitat are central."

During the preparation of the Cirrus Project in 1998, many companies were prepared to support the ESD project both with their know-how and their finances. Around 2010, the economic situation is much less favourable, and strong financial support for ESD processes is not to be expected, as became clear during an assessment of this in 2009 by the *researcher*. On the other hand, many companies were interested in supporting ESD with their expertise. Board

members and managers expressed their interest, focusing on several themes, e.g. the opportunity for the companies to participate in designing professional competences of study programs, which is in their own interest; the option of experimenting with interdisciplinary internship teams; a possible membership of advisory councils for faculties or schools; and the opportunity of transferring their knowledge and experiences to teachers or to students, which many experts outside of education describe as an attractive personal development.

The Ministry of Education

In april 2009, the Ministers of Education of the European Higher Education Area (EHEA) came together to sign the 'Leuven Declaration', which was building upon the Bologna Declaration of 1999. This declaration states the following:

> "16. We call upon European higher education institutions to further internationalize their activities and to engage in global collaboration for sustainable development. (…)
> 23. Higher education institutions have gained greater autonomy along with rapidly growing expectations to be responsive to societal needs and to be accountable."

Although having signed this declaration, since many years the Dutch Ministry of Education explicitly refuses to have an active role towards ESD. Since at least ten years this refusal is explained by pointing at the fact that the Ministry cannot be involved in the contents of the education, because of the Dutch 'freedom of education', guaranteeing that the educational institutions themselves (either separately or together) decide about the educational contents (see: Cörvers et al, 2009). It is true that the Dutch Ministry of Education has a program dedicated to sustainable development, 'LvDO' (Learning for Sustainable Development), which is partly meant to support ESD processes. But many Dutch universities did not experience any support from this program. The ministerial position is illustrated by their absence in the cabinet-wide sustainability strategy ('KADO': 'Kabinetsbrede Aanpak Duurzame Ontwikkeling'), launched by the Dutch government in 2008. Seven Ministries try to tune their sustainability activities in order to create a coherent and synergetic strategy. Among them are the Ministries of Economic Affairs, Foreign Affairs, Development, Agriculture, and Environmental Affairs; but not so the Ministry of Education. Also, the covenant on sustainable procurement in higher education was signed in 2008 by the minister of environment, but not by the minister of education.

Recently the viewpoint of the Ministry of Education was repeated in a private meeting with the Ministerial Program Manager of Innovations in Higher Education (April 2010), who again confirmed that the ministry cannot actively work on sustainable development as this is a matter of education content. This raises the question whether ESD is solely a matter of education content, or just as well a matter of educational quality.

The NVAO

Meetings with the chairman of the NVAO about the relation between sustainable development and educational quality were already mentioned in §7.3.4, where discussions were described in which the chairman confirmed the viewpoint of the Ministry of Education, indicating that there is no relation between quality and sustainable development. Besides, he indicated that the NVAO has no freedom to make its own definitions, as it operates along the lines defined by the Ministry.

This viewpoint may be compared with discussions about this topic within the study of quality management itself. In recent years, the opposite viewpoint appears to be taken, pointing at sustainable development and related subjects (such as CSR, corporate governance) as essential elements of total quality management. An example of this development is the most recent version of the EFQM model. In this redesigned model, called the 'EFQM Excellence Model 2010', a set of eight so-called 'enablers' is defined that together form the basic philosophy of the model. They are shown in figure 61. Several of them have an evident relation with aspects of sustainable development. One of them even explicitly refers to it: 'Taking Responsibility for a Sustainable Future'. In EFQM (2009) this enabler is explained: "Definition: Excellent organisations embed within their culture an ethical mindset, clear values and the highest standards for organisational behaviour, all of which enable them to strive for economic, social and ecological sustainability." This definition mentions not only sustainability, but also the Triple P. Where earlier versions of the EFQM model referred to corporate social responsibility (CSR), the key changes to the 2010 version are described (EFQM, 2009): "The concept now focuses on actively taking responsibility for the organization's conduct and activities and managing its impact on the wider community."

Another well-known quality management model is ISO. Already in 1996, one of its standards, ISO 14000, was dedicated to environmental management (ISO, 1996); in 2006, ISO 14040 about lifecycle assessment was added. But at present the relation with sustainability related subjects is becoming even more explicit with the development of ISO 26000, dealing with social responsibility, which is described as (ISO, 2009, definition 2.1.18):

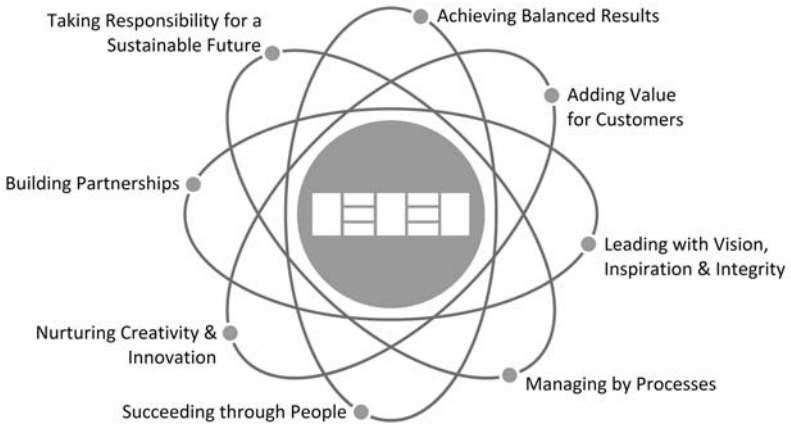


Figure 61. The enablers of the EFQM Excellence Model 2010. *Source:* EFQM (2009)

> "Responsibility of an organization for the impacts of its decisions and activities on society and the environment, through transparent and ethical behaviour that:
> - contributes to sustainable development, including health and welfare of society
> - takes into account the expectations of stakeholders
> - is in compliance with applicable law and consistent with international norms of behaviour
> - is integrated throughout the organization and practised in its relationships"

The citations of EFQM and ISO illustrate the change in the philosophy of quality management that has taken place in recent years: sustainable development is now widely seen as an essential and indispensable aspect of TQM. When both the Ministry of Education and, following it, the NVAO state that this is not the case, it seems that they consider quality management from a viewpoint dating from several years ago, but nevertheless basing the current accreditation system on it. In other words: an accreditation system of higher education in which the demands concerning the quality management do not explicitly incorporate essential aspects of sustainable development is out of date.

Professional demands, but no societal demands

In April 2010, the Ministerial Program Manager of Innovations in Higher Education explained the departmental viewpoint in more detail. She described that the Ministry does apply quality standards based on demands from the professional field, but not from society as a whole. The formal accreditation standard confirms this (NVAO, 2003b):

> "The end qualifications of the study program are coherent with the demands formulated by (foreign) disciplinary colleagues and the professional practice."

The accreditation standard does not mention terms like 'societal' or 'sustainable'. This shows that the Ministry agrees that the professional field is allowed to put demands to higher education; but at the same time does not agree to a comparable role from society as a whole. Whether this position can be maintained can be considered as doubtful, concerning e.g.:

- the fact that the Dublin descriptors (signed by the Dutch Ministry of Education) explicitly refer to "reflection on relevant social, scientific or ethical issues" (see Box 33, §9.1.2);
- the fact that the generic HBO competences, designed by the HBO Council, speak of "understanding and involvement in ethical, normative and societal issues" (see Box 32, §9.1.2);
- the fact that the general competences for the HBO engineer, formulated to the wish of the HBO Council, mention "sustainable development" (see table 40, §9.1.2);
- the fact that the Leuven Declaration, signed both by the Ministry of Education and by the HBO Council, use the phrases "global collaboration for sustainable development" and "responsive to societal needs" (see this section);
- the fact that the 'white paper' of the HBO Council speaks of "societal and sometimes ethical topics" (see this section);
- the fact that the Dutch higher education is primarily publicly funded, much more so than by the professional field.

So the ministerial acceptance of demands for higher education from the professional field, combined with the refusal of accepting such demands from society, seems at least paradoxical, and perhaps outdated. It is therefore recommended that a fundamental discussion about this subject is started, in which many parties participate, perhaps as an aspect of a SISD program for HBO, implementing the final stage of the HBO transformation. In such a discussion, NGO's representing the interests of society and the ecosystem will naturally have a relevant role.

NGO's

A possible reaction to a proposal for the above discussion may be that this might lead to a situation in which the Ministry of Education would impose certain ideologically based ideas on higher education, especially if certain NGO's would be involved, such as environmental or human rights action groups. If such ideas would be formulated in the shape of explicit demands within the accreditation standards, this might even make higher education a tool of certain political orientations, which would clearly be undesirable. In this sense, the constitutional freedom of education is essential.

This risk can however easily be avoided by formulating regulations within the accreditation standards on a meta-level, as has been done with AISHE (§7.1.2). The first principal decision about the definition of this instrument was about the choice between content oriented criteria (e.g. "Photovoltaic cells are a part of the curriculum") versus process oriented criteria (e.g. "Decisions about sustainable subjects in the curriculum are made explicit"). For AISHE, the latter was selected; one of the reasons was the desire to leave room for the own responsibility of an individual education institute, i.e. for its freedom of education. In the same way, process oriented criteria concerning societal and ecological demands might be integrated in the accreditation standards without violating the freedom of education.

If NGO's are to be involved into a fundamental discussion about the societal and ecological aspects of education, it is important that they realize what their role in this process is to be: not trying to impose their favorite subjects, but instead participating at the above described meta-level.

10.3.3. The 'ninth' experiment

Several parties are able to participate in the implementation of stage 5, SISD, of the HBO transformation, together forming the transition management just as they have done so far. If SISD is to be realized throughout HBO, or at least in significant parts of it, such shared and coordinated management is essential, as otherwise the integration of sustainable development into HBO will always remain limited, i.e. at the lower levels of change as defined by Sterling. "If ESD is seen as yet another isolated societal issue to be squeezed into the curriculum, or yet another topic to be given as an elective, then little progress will be made." (Hopkins & McKeown, 2002).

A shared responsibility of many partners is important: earlier ESD experiences (described in several chapters of the dissertation) have shown that, in terms of the model of De Caluwé & Vermaak (see §1.3.2), a combination of *redprint*, *greenprint* and *whiteprint* change processes has the best chances for success. This conclusion matches with the theory on transition management, especially if some upscaling is done from individuals to organizations, and from organizations to networks of organizations. Table 48 shows the meaning of each of the five different types of change for the transition of HBO, including its finalization towards SISD.

Table 48. Transition management in HBO, compared with the types of change according to De Caluwé & Vermaak

Name	Characterization (see table 3)	Transition management, including SISD
Yellowprint	Focus on power play and negotiations Create coalitions, win-win situations Only 'those who matter' are involved	*No power play*. SISD in accreditation: only after sufficient support
Blueprint	Focus on clear, measurable targets (the 'blueprint') Stepwise implementation plan Adjust, stabilize, reduce complexity	*One overall target* as inspiration (e.g. 30% SISD in 2015)
Redprint	Focus on human resource management (HRM) Stimulate and motivate people Offer social setting, rewards, status, attention, trust, health program	Focus on support for & coaching of *organizations & individuals* Stimulate and motivate organizations & individuals Offer Certificates, accreditation, publications, organizational & personal growth
Greenprint	Focus on learning organization Stimulate awareness of new viewpoints, involvement Motivate learning, personal responsibility	Focus on learning *network of organizations & individuals* Stimulate awareness of new viewpoints, organizational & personal involvement Motivate learning, organizational & personal responsibility
Whiteprint	Focus on creativity Offer space for individual energy, inspiration, drives Create dynamics, complexity, chaos	Focus on institutional & personal creativity Offer space for organizational & individual energy, inspiration, drives Create dynamics, complexity *(chaos?)*

This has an important implication for the above statement about the accreditation system, saying that such a system, as long as it does not incorporate sustainable development, is out of date. At present this is the case in the Netherlands. But if such an incorporation of sustainable development into the accreditation system would be inserted top-

down, e.g. imposed by the Minister of Education, this would probably be counter-productive, raising all kinds of resistance. Such a change should not be the result of power play but of sufficient support within the field of HBO, in consensus with many societal partners, as is illustrated in figure 62. If this leads to a process of further integration of sustainable development within HBO, it will be a development with no exact targets or pathways; in other words, it will be an adventure rather than a project.

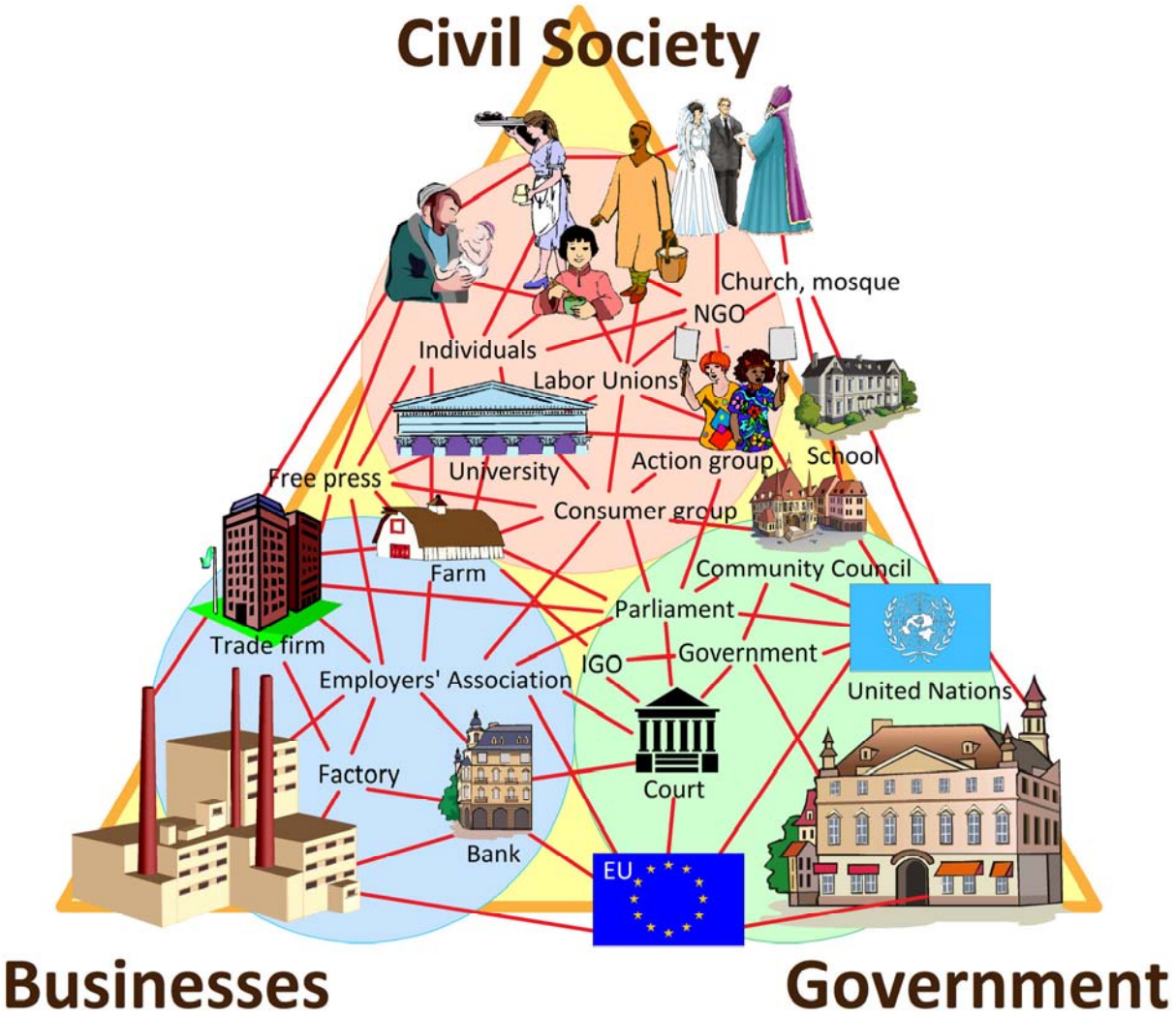


Figure 62. The network of businesses, governments and the civil society in which HBO may cooperate to realize SISD.
Source: Roorda (2008)

Self-reflection

As a part of such an adventure, it would be advisable that HBO discovers more about itself. The 'white paper' (HBO Council, 2009) emphasizes the importance of a reflective attitude of students (p. 17, 18, 40). Surprisingly, it appears that the Dutch HBO itself does not excel in such reflective behavior. One indicator for this conclusion is that, when several visitation reports produced in the '90s under the supervision of the HBO Council were needed for the present dissertation, it appeared extremely difficult to find them, as neither the HBO Council, nor the NVAO, the Ministry of Education, the Inspection of Higher Education or the NQA (Netherlands Quality Agency) still possessed them. Besides, several HBO institutions could not produce them either. (They were found in the end.) Another indicator is the fact that this dissertation seems the first that attempts to write a coherent history of HBO in the last twenty years; this certainly should not have been necessary. Although studies of separate developments within HBO do exist (e.g. evaluations of the introduction of professorships), and at least once a number of them were discussed together (Van Hout et al, 2006), a complete overview was not available, as was confirmed by several HBO Council staff members. This leads to some more recommendations.

- The first recommendation is that HBO, and especially the HBO Council, pays more attention to the preservation and study of its own history, enabling itself to learn lessons from it that can be used for future developments. More specifically, it is recommended that a search is started for as many visitation reports as can still be found.

Another recommendation is related to the fact that the HBO Council pleas for a considerable enlargement of the number of HBO professorships (lectoraten). If this is realized, it creates an opportunity for the implementation of stage 5 of the HBO transformation:

- The Dutch HBO should apply its own principle of a self-reflective attitude to itself, and invest much more in applied research with itself as the object of study, e.g. by HBO professorships.
- An essential subject of such self-reflective research should be the past and future integration process of sustainable development into the HBO education.

Proposal: the 'ninth experiment'

In chapter 1, three models were introduced for the management of change processes. Two of them, the models of Sterling and of De Caluwé & Vermaak, have been applied to understand the transformation process of HBO in the last twenty years. The third, the Bridges model, aims specifically at the natural development of organizations. It is interesting to try and apply it to the large group of organizations as a whole that HBO is.

The first of the stages through which a typical organization goes, according to Bridges, is the *dream*, described in chapter 1 as: "An idea or ideal is in someone's mind, nothing more than that yet." In the case of HBO, many change processes have followed each other, and many of them started with such a dream, followed by the next stages: the '*venture*', '*getting organized*' (well recognizable in e.g. the restructuring of HBO and in the quality management), and '*making it*', which is visible in the massive increase of HBO students over the years, and also in a significant increase of the recognition of HBO as an important sector of society.

The next Bridges stage, 'becoming an institution', is not yet visible, or at least not one of its aspects: "In this phase, the urge to renew the organization or its products and services may shrink, since the organization 'knows' what the customers want." To the contrary: HBO is still in the middle of a process of renewing itself, in close contact with its customers. That is why the final two Bridges stages, 'closing in' and 'death', are not to be expected soon. For HBO it is true what chapter 1 already stated: "Organizations may be revitalized and start a 'second life', perhaps even entering an iterative process of repeated rejuvenation." The next iteration may lead to SISD, as the next step towards the realization of total quality management, as figure 57 illustrates. If this is to be successful, it will probably have to proceed along the guiding lines of transition management, as shown in table 48.

One of the main conditions is the cooperation in networks. Several such networks exist. The HBO Council is one of them, and perhaps the most important one. DHO is another suitable network organization, as is the 'Netwerk Duurzame Pabo', a network of primary teacher education programs dedicated to sustainable development. Besides, there are regional networks, like NDBB (Netwerk Duurzaam Brabants Beroepsonderwijs) in the province of Noord-Brabant, and the already mentioned RCE Rhine-Meuse.

In the past years, a key role was played by the consultancy of DHO towards the Dutch universities. In 2009 the decision was made to stop this consultancy, as was described in §7.1.3. Table 48 however mentions, as one of the strategies for the transformation towards SISD, the focus on support for & coaching of organizations & individuals (*redprint*). Earlier, it was concluded that a wide-range realization of SISD is unlikely to happen if no organized stimulation takes place. A logical strategy in order to realize the last step of the HBO transformation is therefore the following recommendation:

The HBO institutions, coordinated by the HBO Council, should support a renewed concultancy for sustainable development in higher education. This consultancy should have as its task to assist and coach the universities and their employees in their efforts towards SISD. This consultancy could benefit from all experiences of the eight experiments described in this dissertation, as well as from all other ESD experiments that have been done by many, in and outside of the Netherlands. The proposal might be described as the 'ninth experiment', and it could take the shape of a covenant. It is shown in the HBO Transition Map (figure 55) on the right side of stage 5.

10.4. Conclusions and recommendations

The title of the dissertation mentions the 'winds of change'. What this means for HBO has been made clear in the last sections. A conclusion can now be drawn concerning the 'sailing'.

Main conclusion: the strategy of 'Sailing on the winds of change'

In §1.2.2 the central hypothesis for the dissertation was defined as follows:

A strategy of 'sailing on the winds of change', i.e. adapting to and using already occurring processes of change in the field of higher education, will under suitable circumstances be highly effective for the process of integration of sustainable development in higher education.

About the 'suitable circumstances', §1.2.2 remarked that they may only exist if a section of higher education can be found which has the necessary characteristics of a long-lasting, profound process of change. HBO has proved to meet

these demands. The positions of the experiments that were described in chapters 4 till 9 within the HBO transformation have been made clear, as figure 55, the HBO Transition Map, illustrates. These positions, together with the detailed descriptions of the experiments, show that each of them was inspired by, and made use of the developments within HBO at that time, i.e. indeed they 'sailed on the winds of change'.
That this is a potentially successful strategy, is confirmed by experiences described by Kessels & Ehlen (2006; see also Geurts, 2004 and Willems & Ehlen, 2005):

> "On the basis of experiences within various universities, it became clear that it is impossible to use a top-down approach for such a dramatic educational innovation. It is important to join the innovations trends that already exist. The pioneers in this innovation may be the key players for finding an adequate way and for creating support. A gradual change can accommodate those who are involved to orient themselves on their new roles and positions, and give time for the learning process that accompanies it.
> The role of the central organization is particularly to view and listen to the rhythm of the change. This is more important than setting targets or keeping a tight timeline. It appears to help when the parties concerned develop a common vision that they use as a guiding policy framework."

Out of the five experiments that were described in the chapters 4 till 8, one of them was not successful, and one other was modestly successful. The other three appeared to be successful. Together, this is sufficient proof that the central hypothesis is confirmed.

More conclusions
Based on the findings in the last chapters, more conclusions have been drawn or can presently be drawn. They are summarized here.

- *HBO in transformation:*

One of the main conclusions of §10.2, combining the Sterling model, the INK 5-stage model, and the AISHE model, is:
The development processes in HBO in the last twenty years, although each is no more than an accommodation or a reformation, together form a coherent and deep transformation of higher education. Until system integration of sustainable development (SISD) is realized throughout HBO, this transformation is incomplete.

- *ESD management styles:*

In §10.1, based on the model of De Caluwé & Vermaak, it was concluded that a combination of redprint, greenprint and whiteprint is an effective management style for the implementation of ESD, while blueprint and yellowprint are less so. In other words:
It is vital for ESD development processes – and probably for many other processes in higher education – to make use of a combination of stimulation, intellectual freedom, inspiration and creativity. Management styles making use of negotiations, political play, fixed targets and enforcement work counterproductive.

- *TQM completed by SISD:*

The discussion about the relations between total quality management and sustainable development gave rise to the following conclusion:
System integration of sustainable development (SISD) is a logical consequence of the progress towards total quality management in higher education.

- *ESD and accreditation:*

Applied to the accreditation system of higher education in the Netherlands, this produced the following statement, mentioned in §10.3:
An accreditation system of higher education in which the demands concerning the quality management do not explicitly incorporate essential aspects of sustainable development is out of date.

- *The adventure of ESD implementation:*

As the ESD integration process is largely a 'redprint', 'greenprint' and 'whiteprint' process, it has the characteristics of a quest or an adventure, rather than those of a project, as concluded in §10.2. This may be formulated as follows:
The implementation of sustainable development in higher education is an adventure, rather than a project. It has no fixed targets or foreseeable outcomes. Yet, every adventure should once come to completion.

Recommendations
Besides the above conclusions, the dissertation leads to some recommendations, which will be presented in this final section.

- *HBO and self-reflection:*

In §10.2, a conclusion was drawn from the plans and aspirations of HBO, as formulated in the 'Leuven Declaration' and in the 'white paper':
The Dutch HBO should apply its own principle of a self-reflective attitude to itself, and invest much more in applied research with itself as the object of study. An essential element of such self-reflective research should be the past and present integration process of sustainable development into the HBO education.

- *ESD and government:*

The role of the Dutch government towards ESD, or rather the almost complete absence of such a role, at least of the Ministry of Education, has been discussed in several places in this dissertation, and compared with the recognized importance of education for sustainable development. This leads to the following recommendation:
The Dutch national government should treat education for sustainable development as a quintessential and indispensable element in its integrated sustainability strategy. More specific, the Ministry of Education should dedicate much more priority and finances to education for sustainable development.

- *Characteristics of ESD; lessons learned:*

Some recommendations are presented concerning the new study programs dedicated to sustainable development, that are at present being developed or have recently started. These programs might be called second-generation SD study programs.
It is recommended that these programs use table 6 of this dissertation as a reference, i.e. as a checklist to investigate whether the program meets the demands of ESD. Besides, it is recommended to study the earlier, first-generation SD programs, of which M2 is an example, in order to learn from them, to reproduce the positive aspects and especially to avoid making the same mistakes again.
The same kind of recommendation goes for special projects that try to integrate sustainable development into the education of existing study programs. In earlier such projects, many lessons have been learned, as case studies in the dissertation have shown. For them, too, the checklist of table 6 may be a useful tool.

- *SISD covenant:*

The signing of a covenant on sustainable procurement by the Dutch higher education inspired the next recommendation:
A covenant between HBO, the Ministry of Education and society in the Netherlands about a wide-range system integration of sustainable development (SISD) in higher education is the natural next step after the signing of the covenant on sustainable procurement of higher education.

- *Further research:*

Several kinds of new action research are recommended. Subjects for them might be e.g.:
  - Disciplinary competences for SD
  - Participation of HBO institutions in RCE's
  - New roles for HBO in life-long learning (including sustainable development and CSR)
  - ESD as an issue for continuous learning lines, from primary till higher education (and beyond)

Such experiments could be performed by the proposed consultancy team as a part of the suggested SISD covenant, also completing and making use of the various ESD instruments of which an overview was shown in §9.5. For several of the above kinds of action research, an intensive cooperation is recommended with a range of expert institutes, companies, government organizations and ngo's. More specifically are to be mentioned: cooperation on continuous learning lines with organizations like SLO. For this and other action researches, cooperation with the RCE's is also relevant.

- *Quality management:*

Concerning the relations between ESD and the accreditation system, earlier in this chapter the remark was made that there are indications within Dutch higher education that a sufficient support may exist at this moment for the integration of sustainable development as a fixed aspect of quality management in the accreditation standards.
It is recommended to investigate whether this is indeed the case. Preferably, such an investigation should be performed in cooperation with the Dutch Ministry of Education, the NVAO, the HBO Council and the VSNU. The start of such a process should be a fundamental discussion about the 'paradox' that the Ministry of Education judges it to be allright that professional demands influence higher education and societal demands don't, while higher education is much more owned and funded by society than by the professional world.

- *Investigation into past change processes in research universities:*

Another recommendation aims at the research universities in the Netherlands, the other Dutch field of higher education besides HBO. Although the research universities were not a part of the present study, it is likely that at least a part of the above conclusions and theses apply to them as well.
It is recommended to investigate to which extent it is possible to draw a 'transformation map' for this sector, comparable with figure 55. This will require some new self-reflective research, investigating whether the change processes within the field of the research universities together form a coherent transformative process, just as in the case of HBO, and which role ESD has played or may play in it.
The same recommendation can be applied to secondary vocational education within the Netherlands, as well as to various educational levels in other countries.

- *Comparison of the HBO transformation with transition management theory*

Finally, there are some recommendations which fall outside of the field of sustainable development.
It will be interesting to investigate to which level the transformation process of HBO in the last twenty years was in agreement with the theories of transition management. In this dissertation this relation was investigated briefly, but probably a deeper study might reveal other conclusions, interesting both for the theory of transition management and for the theory of education development, including ESD.
Besides, it will be interesting to investigate to what level the various HBO institutions and their departments have progressed along the lines of the HBO Transition Map, shown in figure 55, following the usual process of diffusion of innovations, as shown in figure 59.

Appendices

Appendix 1. Initial philosophy and plans of the Cirrus Project

This appendix is an abbreviated reprint of a presentation at the ENTREE 99 Conference, Tampere, Finland 1999. It was published as Roorda (1999), and reprinted in the final report of the Cirrus Project (Dejong et al, 2003).

Integrating Sustainable Technology into Higher Engineering Education

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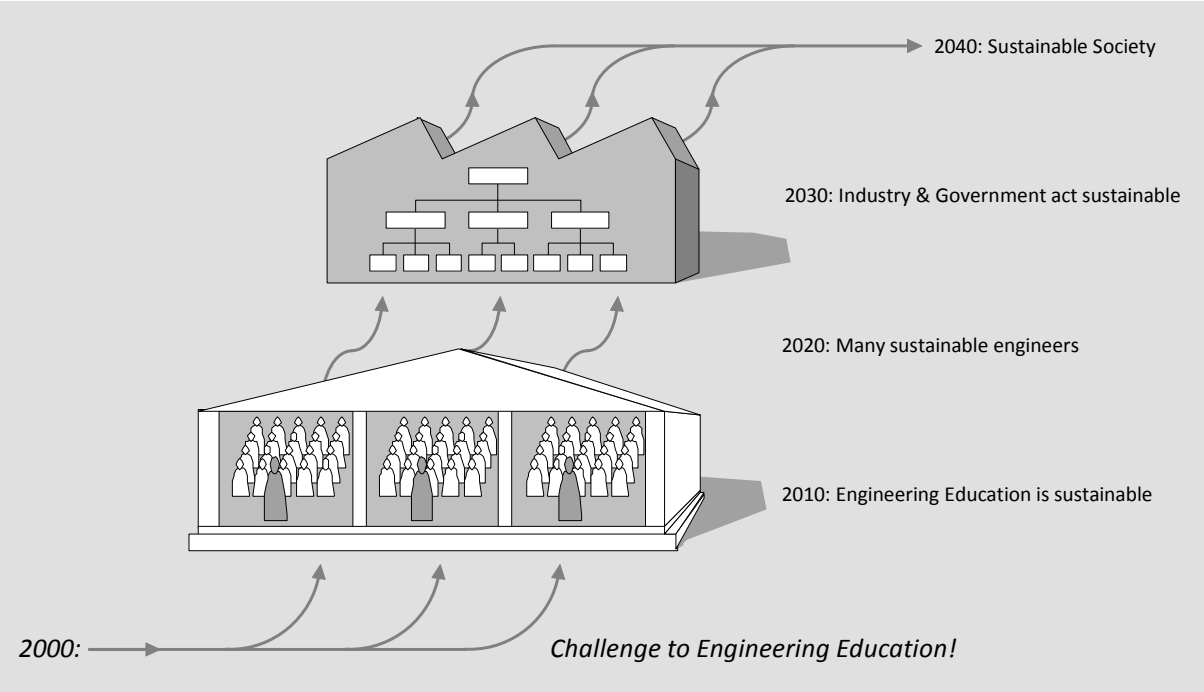
Abstract
Engineering Education will have to have completed the integration of sustainable technology in all curricula, at last in the year 2010. Since the development and realisation of such drastic alterations require a lot of time, it is necessary to start this process immediately: there is no time to be wasted.
In the Netherlands, a project called CIRRUS is started to achieve this for the Brabant University for Applied Sciences. The results are to be transferred to all engineering education in the Netherlands (and perhaps outside the country, too).
The main elements of the project are: the education in sustainability subjects of the teaching staff; the development of professional profiles for all types of engineers, aiming at the year 2010; and the development of a measuring tool for auditing (parts of) universities with respect to the degree in which sustainability is integrated.

1. Introduction: A challenge to Engineering Education
Although most of the teaching staff in Engineering Education may not be aware of it, there lies a tremendous challenge for all of them. Within one or two generations, a real sustainable society will have to be developed. This means, that it will be necessary that the way in which raw materials, energy and the environment are used will be improved by a factor of, roughly, 10 to 50 (see Jansen et al, 1997). One or two generations – say, some 40 years – may perhaps seem like a lot of time. But the time scale for Engineering Education is remarkably shorter, and this can be demonstrated quite easily.
If we agree upon the goal of reaching a real sustainable society by the year 2040, then a lot has to be done in the meantime. Looking backwards from 2040 till now, the following steps have to be taken:

- **2040: Sustainable society**
  By 2040, lifestyles of all people, in all the world, will be adapted towards sustainability. Products and processes are sustainable; in fact, every oldfashioned, non sustainable products have disappeared. The infrastructure is changed completely and functions 100% sustainable.
- **2030: Industry & governments act sustainable**
  The desired state in 2040 can only be reached if the industry and the local, national and global governmental institutions operate in a sustainable way some time earlier; let's say: in the year 2030. Production processes are improved remarkably. Materials and energy are part of closed loops. The management of all large and small companies acts by a real sustainable policy; in fact, they experience sustainability as natural, as something that stands to reason: the management has internalized sustainability.
- **2020: Many sustainable engineers**
  Managers usually aren't the youngest members of the staff of a company. They will have entered the company as young staff members some time earlier, let's say: in 2020. If we want them to have internalized sustainability, this means it is necessary that, by the year 2020, the labour market is flooded by young graduates (engineers, economists etcetera) that are educated and trained thoroughly in sustainable technologies, sustainable economy and so on: in fact, they should nearly have taken it in with their mother's milk.
- **2010: Engineering Education is sustainable**
  The labour market can only be flooded with sustainable graduates by 2020, if education itself is ready for this some time earlier, because only if education is 100% sustainable, then students can be educated in the proper way from the start of their course. This also will take about 10 years: 5 years to enable students to do their courses, and another 5 years to flood the labour market. So**:**
  Engineering education wil have to be completely sustainable by the year 2010, or else it will be too late to contribute in a proper way to the desired sustainable society in 2040.



Of course, I have been simplifying things a little bit. I have used all periods of ten years, and this is a bit too simple. Unfortunately, if you try to improve on this, things get even more serious. The time it takes for a young engineer from the start of his/her career to become a member of the management is usually more than ten years. And, from the moment that all industry operates sustainable, it takes a lot more than ten years for the infrastructure to turn sustainable.
On the other hand, the target year of 2040 is chosen rather arbitrarily. Not completely arbitrarily however, since several studies and simulations indicate that this is about the time we have before things really get nasty, if we don't change our policies drastically (see for instance Meadows et al, 1991).
Nevertheless, the conclusion is that Engineering Education will have to be ready for sustainability much, much earlier than the rest of society: we only have something in the order of ten years and no more. So, a tremendous challenge lies before us.

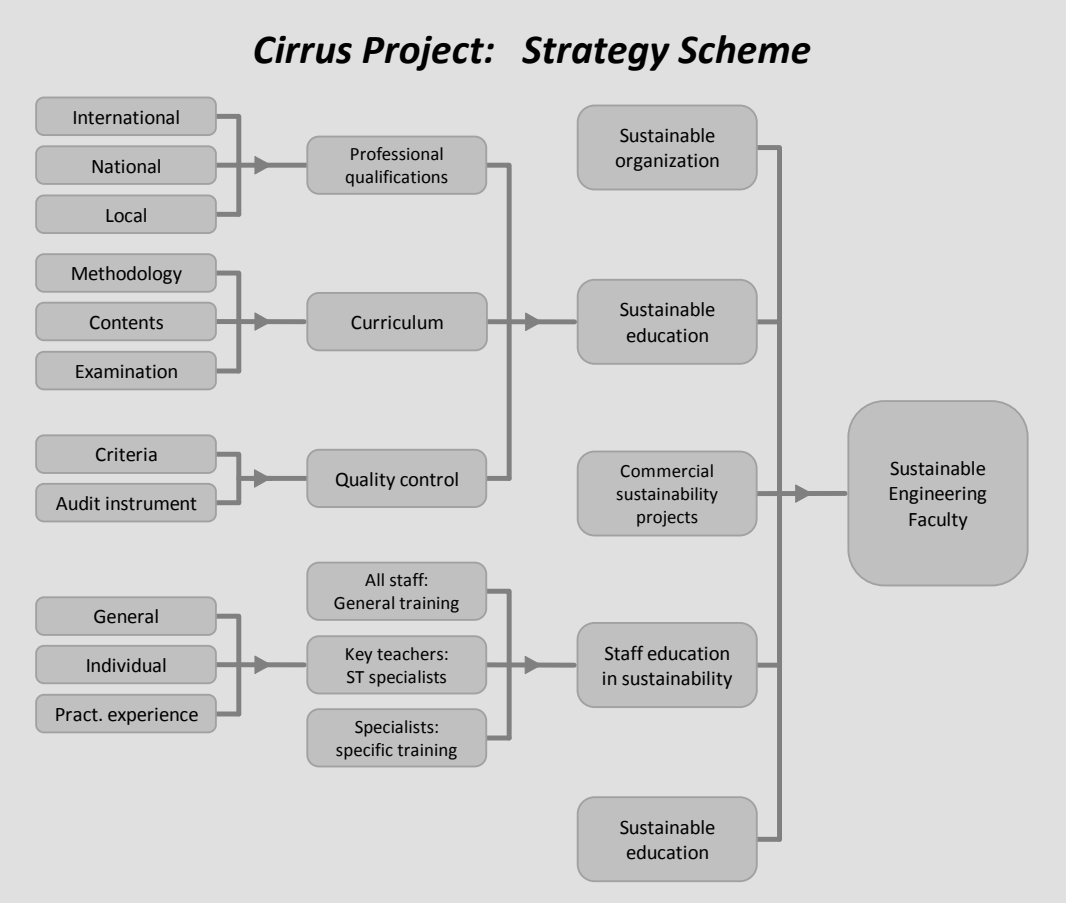
2. The Cirrus Project

Fortunately, the challenge is accepted by a lot of universities in several countries. One of these is the Brabant University for Applied Sciences, which has started a project called *Cirrus*. In a few words, the outlines of this project will be described.
In short, the goal of Project Cirrus is to integrate Sustainable Technology in all its engineering courses. The most important actions to achieve this are:

- Staff Education:
  - Educating the teaching staff with respect to sustainable development and sustainable technology
- Sustainable Education development:
  - Developing criteria for the integration of sustainable technology: professional qualifications, followed by characteristics of the curricula of many different full time university education programmes;
  - Implementing this integration in all 12 courses of the Faculty of Polytechnics (among which are, for instance: Civil -, Mechanical -, Chemical - and Constructional Engineering);
  - Developing a measuring instrument to audit the courses and determine the stage in which a course is with respect to sustainability.

Each of these subjects will be treated in this paper. Other, less important goals of the project are:

- Transformation of the Faculty to a **sustainable organization**;
- Developing **commercial sustainability projects** in which companies (mostly SME) are assisted;
- Developing tools to express the sustainable character of the Faculty in its **PR and marketing**.



Project Cirrus is to play a pioneering role in the development and integration of sustainable technology for all universities in the Netherlands. All the knowledge and experience that are developed will be transferred to the other technical universities in the Netherlands. The project will take 4 years (1999 – 2002), and has a budget of about 4 million Dutch Guilders (about 2 million Euro). It is supported by the Dutch Departments of Education and of Environment, and by about 20 large enterprises (for instance, Xerox, Shell and NedCar). A staff of 17 people (most of them teachers) is formed, which is performing the project.

3. Educating the teachers

Reasons for staff education

Educating the teaching staff with respect to sustainable technology is vital for the entire project. In fact, about half of all the time, energy and money that is spent in Project Cirrus is dedicated to the education of the staff. This is because of two reasons:

1. There is a lot of theoretical information and practical skills to be learned about sustainable technology. Of course it belongs to the natural duties of a teacher to keep his/her specialism updated; but the enlargement of the knowledge about sustainable subjects goes far beyond this normal task, and cannot be done by individual teachers without help.
2. Perhaps even more important than enlarging knowledge and skills, of teachers as well as of students, is the need to internalize sustainability. Sustainable development is primarily a matter of thinking in other patterns, of getting a new kind of intuition. If you want the teachers to be able to realize this in the minds of the students, then it is necessary first to realize the same in the minds of the teachers themselves; otherwise they will just not be convincing.

The strategy of staff education

The staff of the Faculty consists of about 250 people: a large group to educate. Of course, not everyone will have to become an expert in sustainable technology, but still there are many people that have to learn something. To achieve this, a snowball strategy is adopted.

Step 1: Project team
In the first shift, a project team is formed in which 13 teachers participate. These *key teachers,* each representing one of the Faculty programmes, receive a very thorough training programme, which takes them one to two days a week during two years. In the end, they will be experts in sustainable development and sustainable technology.
Their training programme consists of three elements:

- a **general track**, which they follow together. Many subjects are treated. For instance:
  - sustainable development as an ideal;
  - sustainable economy and policies;
  - basic environmental knowledge;
  - legal aspects;
  - specific skills, like Life Cycle Assessment (LCA) and Design for Environment (DFE).
- a **specialist track**, which is an individual programme for each. The contents depend on the programme that is represented by the teacher, in order to enable him/her optimally to introduce the subject in the staff of their programmes and function as a teacher for their colleagues.
- **practical experience**. For this, all teachers are seconded to an industrial company in which they participate in sustainability projects for some time; this can be compared with the traineeship of the students.

The education programme is coordinated by a specialist in sustainable technology, who is attached to the project for this reason. Most of the theoretical lessons are given by dozens of experts from outside the university.
A learning book is used: *Factor four – doubling wealth, halving resources use* (Von Weiszäcker, 1998).

Step 2: Specialists
Second, all members of the staff that are specialized in subjects that have something to do with sustainable technology are given a training in sustainable technology. This has a much smaller scope than that of the key teachers, as it is only aiming at their specialties. On the other hand, the group to be trained is much larger, since almost every teacher will need *some* kind of specialist training. Although external experts also have a part in this education programme, it is coordinated and partially given by the key teachers.

Step 3: All personnel
And third, each and every teacher (and the other personnel, including the management) will go through an education programme aiming at developing a general knowledge and understanding about sustainable development. This is important, because it will enable them to function in a sustainable framework.

4. Criteria for sustainable engineering education
Teaching the teachers is one important part of the project. Developing the curricula is the other one. In this part of the paper, general characteristics of the curricula will be investigated. In the next chapters, attention will be given to ways of developing specifications of individual courses.

General elements of sustainable engineering education
According to the views that are developed in Project Cirrus, there are three groups of elements that will be integrated in all the courses.

1. *Basics*

In the first year of every course, a number of subjects will be treated:
basic knowledge about environmental subjects, scarcity of materials and renewable energy.
knowledge and understanding of sustainable philosophies and policies: the Brundtland definition; Agenda 21; sustainable development versus end-of-pipe technology; national and European policies.

2. *Integrated Problem Handling (IPH)*

This is the most important group of elements. Whether a product, a process or a technology can be considered as sustainable, always depends on the way it functions together with other products, processes or technologies. A product is always a part of a larger system; so is a factory. A production process is always part of a chain of processes. The question of how to optimize all this with respect to sustainability can therefore only be answered when several, usually many, aspects are judged together in an integrated way.
There are several different aspects to IPH. All of these will have to be trained thoroughly with the students:

- ***Functional integration:*** often, when a human need is to be fulfilled, an existing product or process is taken as a starting point. This narrows the attention, because other (perhaps quite unexpected) solutions will not be considered. Instead, engineers and students should be trained to start thinking from the function (the consumer need) that is to be fulfilled.

- ***System integration:*** every product is part of a larger system. Trying to optimize a product with respect to sustainability without considering this system will lead to sub-optimalization, and will in many cases worsen instead of improve the situation.
- In many cases, a good way of studying the impact of a product on the environment is, to treat it like a black box, and map the incoming and outgoing Materials, Energy and Information (MEI). This will not do when another system is regarded: the system of the interior parts of a complicated product.
- ***Chain integration:*** important aspects of integral chain management are the technical aspect (the LCA method), and the management aspect: how can organisations that belong to a chain of production be brought together?
- ***Multidisciplinarity:*** if a designer is asked to develop a product that is to last very long, it will be made out of a lot of material, and perhaps it will use unnecessarily much energy. If a product is to put minimum strain on the environment, it will perhaps be very expensive or unattractive, and no-one will buy it. These examples show that the optimum sustainability effect will be reached when specialists of different branches work together: a multi- or interdisciplinary approach is vital. Engineers of all types, economists and others have to cooperate.
- If we want the graduates to do this, we have to teach them to do it during their studies.
- ***Future orientation:*** three stages of sustainable development can be discerned: short term (operational), middle long term (tactical) and long term (strategic). Each of these stages has its own goals and methods. It is vital that engineers are aware of this distinction, because if they don't, they will not be able to chose the right perspective of solving problems.

3. Non-technical subjects

Legal, economical, ethical, political, financial and other subjects will be treated. Also, the relation will be investigated between sustainable development and other large problems like war & peace and the development of the third world. Goal is to develop the students, not only to become good engineers but also responsible citizens.

Appendix 1: Table 1. General sustainability subjects

Facets of Sustainable Technology			**Examples**
Basics	Environment		Overview of environmental effects. End-of-pipe vs. sustainability
	Raw materials and Energy		Scarcity. Impact on environment.
	Sustainable policies		Club of Rome, Rio, Agenda 21. Compare NL - Europe - world
	Future Perspective		Method of Backcasting
IPH Integrated Problem *Handling*	Function orientation	consumer needs	Drying hands: towel / air / piece of paper / own clothes / etc.
		constraints by society	Transport: traffic queues
		natural constraints	Environment. Availability of raw materials and energy.
	System orientation	internal: organic whole	Optimize house & domestic appliances together. Role of ICT
		external: embedding	Industrial plant near city. Product in use.
		input-output model (MEI)	Coffee machine, and any energy consuming product
	Integral Chain Management	chain management	How to bring organisations in one chain together at one table?
		LCA	Diaper, highway, solar cell
	Multi-disciplinarity	diff. techn. specialisms	House + domestic appliances
		techn. + non-technical	Product development (technical / artistic / ergonomical)
		education/expertise levels	including students from other levels of education
	Future orientation	short term (operational)	Improved product design. Selection of materials.
		middle long term (tactical)	Production during transportation
		long term (strategic)	Transport of products through tunnels throughout Europe
SD-NT Sustainable Development *Non-technical*	Financial / economical		Life Cycle Cost Account. Green GNP
	Politics, organization policies		Subsidies
	Business administration		Organization culture. Management of changes
	Ethics		Responsibilities of the industry. Influencing consumer needs
	Legal aspects		Licences. Covenants
	etc. etc.		

5. Designing the professional profile through backcasting

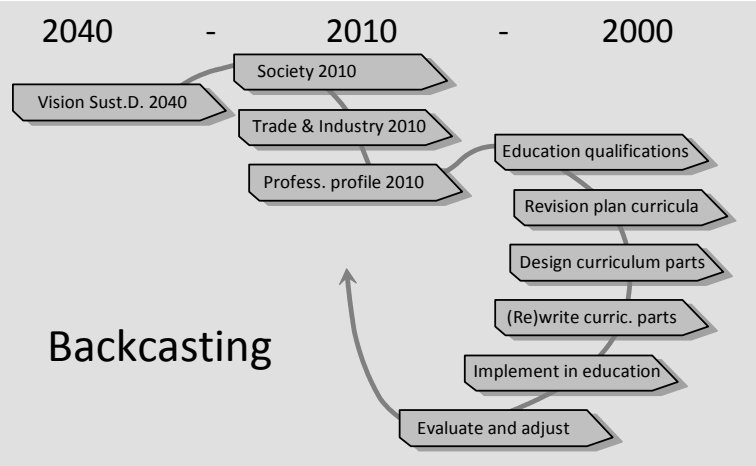
In the Netherlands, not long ago it happened once in a while that curricula of higher education courses were redesigned by the teaching staff without help from outside the university. Usually this was done by thinking about the situation in the year the teachers were living in. Perhaps this happens outside the Netherlands too; I hope it doesn't.
The first step to improve this is, to ask experts from industry, from government and from specific expert centres to cooperate and to design the curricula together with the university staff. This process should start by looking at the desired qualifications of the engineers that are to be produced by the university.
With respect to sustainable technology, this is not even good enough. It is very important to start thinking from a viewpoint somewhere in the future instead of today. There are two reasons for this.

Forecasting from 2000: trends towards the future

In the first place: a considerable time is needed to produce graduates of a new type. First, the time needed for R&D for the newly to be designed education course is at least a year, and usually it is even more. After this, the first students start in the first year of the course, and it takes four, five, six or even more years for them to complete the course. Only then, the first graduates enter the labour market. Sometime later, somewhere between a few months and a few years, feedback is possible from the companies these first graduates are employed.
Adding all this, it takes at least about six years (and probably more) before a complete developing cycle is completed. So, if you would start to develop new education in the year 2000 by looking at society and technology of 2000, one thing is absolutely certain: by the time you have finished the development, the results will be out of date.
This certainty forces the developer of education to try and forecast the state of the world and of technology in a period of about 10 years from now. This can only be done by looking at the societal, technological and educational trends that can be foreseen to happen in the coming 10 years.
In Project Cirrus, this is done: an attempt is made to develop the professional profile of the future engineer of the year 2010.

Backcasting from 2040: needs of the future

Forecasting from now is not all. If it was, then developing a sustainable society would be like wandering around with eyes closed. It is necessary to open the eyes, look ahead and try to plan the route towards the sustainable society.
This can be done by a process called *backcasting*. First, a vision is developed of the desired sustainable situation, somewhere in the future; in many studies, the year 2040 is chosen (based on conclusions of future scenarios obtained by simulations; see, for instance, Meadows, 1991).
If a fairly complete picture is formed, then a strategy consisting of a series of steps can be designed that will lead the world from now to this situation in 2040.
This process is done in the Dutch STD programme (Sustainable Technology Development; see: Jansen, 1997). The results will be used by Project Cirrus to design the sustainable engineering education.
First, the already developed picture of a sustainable society in 2040 will be used to draw conclusions of the necessary characteristics of society and of trade & industry in 2010. From this, the professional profiles of the different types of engineers of 2010 will be developed. Out of this, the qualifications of the engineering education of 2000 will be found, after which the new curricula will be designed.



This process of curriculum development, by a combination of forecasting and backcasting, is about to begin at the moment this text is written. Perhaps it will be possible to tell something of the results in the next Entree conference, in 2000 or later.

6. Evaluating sustainability in the curricula

The want of measurable criteria

If criteria are developed for sustainable engineering education, it stands to reason that these will have to be formulated in such a way that they can be measured. In other words, the criteria will only be operational if some kind of measuring instrument is defined and calibrated.
Some criteria have already been developed some years ago. They can be found in a number of Charters, Manifests and Declarations, for instance: Stockholm (1972), Talloires (1990), Tessaloniki (1997). An overview of them can be

found on the website of the IAU (International Association of Universities). The best known in the Netherlands is the Copernicus Charter (1994). Other indications of the contribution of education to sustainable development can be found in Agenda 21 (especially chapter 36).
Unfortunately, the criteria in those texts are not operational. A typical example is the following criterion:

> "Universities shall provide education, training and encouragement to their employees, so that they can pursue their work in an environmentally responsible manner." (Copernicus Charter, art. 3)

Unfortunately, if universities state that they have realised this, there is no exact method to check whether this is true. There should be a definite method of auditing; but there isn't, as far as I know.

The EFQM model
There is, however, a method which is designed to audit (parts of) universities in general (i.e. not aimed at sustainability). This is the EFQM method.
Originally, this method was developed by the European Foundation for Quality Management (EFQM). It was directed at industrial companies, not at education. In the Netherlands, a group of Universities for Applied Sciences made a 'translation' for higher education. Today, many universities in the Netherlands are using this method for internal auditing, and a number of universities outside the country have adopted it too.
In the EFQM model, a series of aspects of an organisation are discerned. Each of these aspects is formulated as an item; there are about 50 different items. If a course, a faculty or a university decides to do an EFQM audit; all items are discussed with all members of the staff. For each item, a decision is made by consensus, in which of the five stages the organisation is. The results can be used to create a 'map' of the organisation. This map can be used to decide about the organisation policy for the next years. It can also be used as an evaluation tool, by comparing the results with the results of some time ago, in order to measure the improvements that have been realised.

A measuring instrument for sustainable education
In project Cirrus, we are planning to develop a measuring instrument along the lines of the EFQM model. This instrument will make it possible to audit a course, a faculty or a university with respect to the degree of integration of sustainability.
After the original designing process of this instrument, it will be necessary to test it in real courses or faculties. For this, universities within the Netherlands will be asked to cooperate. But it stands to reason that it will be of great value if universities outside the Netherlands will be willing to cooperate as well.
Perhaps, there are representatives of universities present at the Entree conference who are willing to join.

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Appendix 2. The principles of backcasting

This appendix is a reprint of a paper published in the International Journal of Sustainability in Higher Education, Vol. 2 No. 1, 2001 (Roorda, N., 2001a). An earlier version was presented at the IFAC Conference, Aachen, Germany, 2000.

Backcasting the future

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Abstract
In this article, sustainable development will be discussed, and it will be explained why the eco efficiency will have to be raised with a factor of 20. This can be realised through three trajectories: product improvement, product innovation and system innovation.
The relation with strategic decision making will be shown, and the concept of "consequence period" will be introduced. As an example, a transportation system in a large city will be discussed.
The method of "backcasting" will be explained, and the consequences of long term sustainable development for the mission definition of companies.

1. Sustainable development

1.1. Factor 20

The control challenge of the 21st century - the theme of the session – is primarily a matter of making the right decisions. The 21st century will be a crucial era in the history of mankind: if we succeed in taking the right decisions, we will be able to create a world in which the inhabitants – *all* inhabitants - can live on a fairly high standard of living (see WCED, 1972).
In order to show how enormous the challenge is that lies ahead, let's have a look at some major developments that will come about in the new century.
In the first place: no doubt, the world population will about double, in the next 40 years. At the same time, it will be necessary to reduce the global environmental strain; it is estimated that this strain should be halved. So, the efficiency with which we make use of the environment and of our resources, the *"eco efficiency"*, will have to be improved by a factor of four. A description of this can be found in Weizsäcker (1997).
If you take another aspect in consideration, things are even more complicated. If we want to reach real sustainable development, the countries in the third world will need a rather large economical growth, in order to reach an acceptable standard of living. In the meanwhile, the developed countries will probably have an annual economical growth of a few percents. Together, this implies that the environmental impact will grow about fivefold.
The situation can be shown in a formula designed by Barry Commoner:

$$ee = \frac{N \times P}{S}$$

In this formula, the *N* stands for the world population; *P* is the average *Prosperity* per person (a measure for the global economical growth); and *S* means the global environmental *Strain*. *ee* is the *eco efficiency*.
Now, look at the period of 2000 till 2040. In this period, N will double and P will probably grow fivefold. If we want to succeed in halving the environmental strain, it means that we have to improve the eco efficiency by a factor of 20 (see: Jansen, 1997).

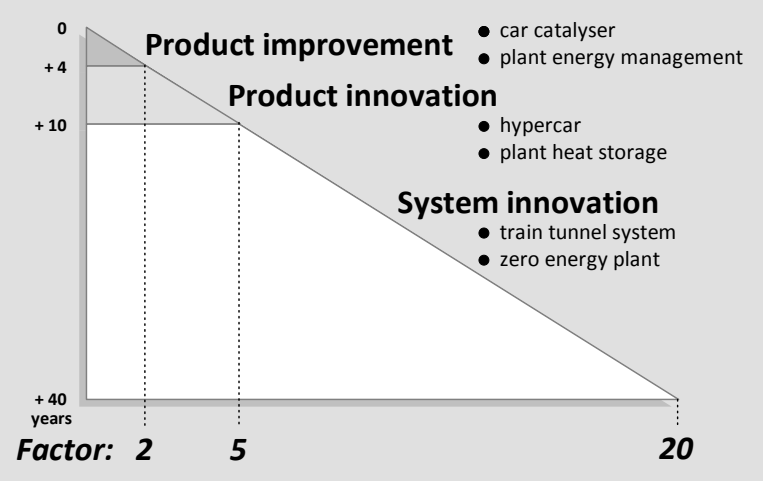
1.2. Product improvement

Certainly, this will not be an easy task. Much of it will have to be achieved by technological means.
Up till now, sustainable development through technological means usually consists of product improvements. To name only a few: the car catalyser is an example, as well as heat isolation of buildings and reduced energy usage of household equipment. In industrial processes, such improvements may be achieved by recycling waste and by an improved energy management.
In fact, these improvements can all be realised with existing technology, so nothing revolutionary will be needed. It is mainly a matter of good housekeeping and of using common sense.
Improvements like these will certainly enable us to raise the eco efficiency. It won't even take much time: the typical period in which good results can be made are 3 to 5 years. However, the effect is not enough: the efficiency will be raised by 30%, 50% or even be doubled: interesting, but in no way enough.

1.3. Product innovation

Better results can be reached by completely redesigning and replacing existing products. Examples of such product innovations are: heat storage in factories; and the so-called "hypercar", which is now being developed. Success depends on the development of the necessary new technologies. Since large investments are needed, it will take more time: something in the order of 10 years.

Innovations like these will enable us to raise the eco-efficiency with a factor of about 3 to 5. Although much better than mere improvement of existing products, this is still not good enough.



Appendix 2: Figure 1. The three trajectories towards factor 20

1.4. System innovation

If we really are to get to the factor 20, then something more drastically is needed. It is not only products and processes that have to be redesigned; in fact, the whole structure which those products and processes are part of, will have to be redesigned (see fig. 1).

For instance, the traffic system of goods nowadays depends considerably on transport by trucks. The eco-efficiency of this is very low. Much better already is the transportation by road. However, replacing trucks by railroads doesn't realise a factor of 20.

This transportation problem has been investigated in a number of projects. One of them is the Dutch STD programme ("Sustainable Technological Development": see Jansen, 1997). One of the conclusions of this investigation was, that the desired factor 20 in transportation can be reached by making a network of tunnels, in which small trains transport goods (together with other alterations of the system). This system will be completely automated.

Another example of a goal that can be reached is the development of industrial plants that don't take any energy from outside: the so-called "zero energy plants".

For developments like these a lot of new technologies are necessary. Because of this, and because of the large investments that are needed, the time scale for this changes is in the order of several decades.

2. Consequence periods

Back to the control challenge of the 21st century. In order to make sound decisions meeting the needs of the 21st century, it is essential to keep the three trajectories towards sustainable development in mind:

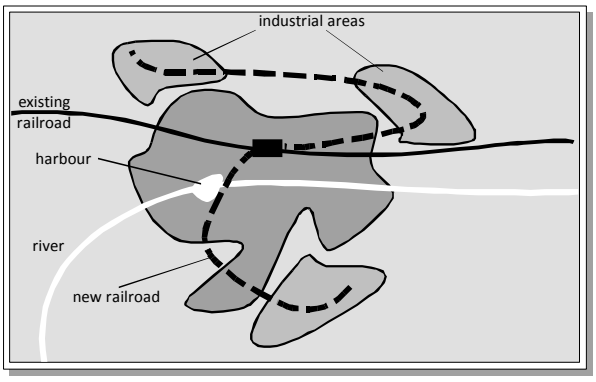
- short term: product improvement
- middle long term: product innovation
- long term: system innovation

Unfortunately, it is all too easy to forget this. As an example, the situation in a large Dutch city will be discussed.

In this city, in 1999 the local government decided it wanted to develop a Sustainable Development Policy Plan. One of the items that was investigated was the transportation of goods through the city. In this city, there are several industrial areas; there is a harbour and a train station. All of the goods traffic takes place by trucks.

Aiming at improving the environmental impact, it was decided that a railroad was to be constructed linking the industrial areas, the harbour and the station. (see fig. 2). Superficially, this seems a good decision. However, something crucially important went wrong.

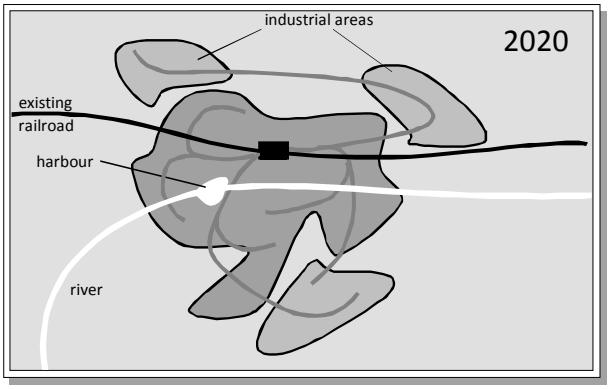
What this local government didn't take into consideration was the *consequence period* of the decision. A railroad is not to be constructed for a period of only five or ten years. A new railroad takes a lot of investments. Besides, it has many other consequences, for instance: destruction of houses; alteration of the road structure. So, the decision to construct a railroad has consequences for at least 50 years, perhaps even 100. This



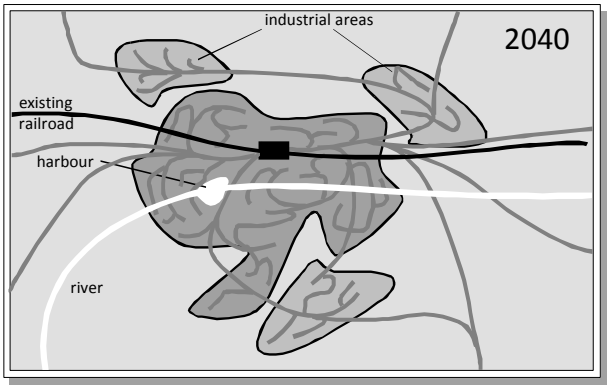
Appendix 2: Figure 2. The city map with the planned new railroad

period is at least as long as the time scale available to realise the factor 20. The construction of the railroad by no way realises this factor; so the decision simply can't be good.
During those 50 years, probably other cities will start drilling the tunnels for an underground goods traffic system. So, within 20 or 30 years the city will lag behind, having a railroad which hasn't yet been paid off; which doesn't contribute enough to sustainable development; and which cannot be removed in the next decades, because there won't be investment money for a whole new transportation system.

It wouldn't have been difficult for this city to make a better decision. Instead of the railroad, a tunnel with the same track could have been planned and realised by the year 2010. After that, new lines could have been realised in the next decade (see fig. 3), followed by even more tunnels – reaching individual shopping malls, hospitals, hotels etc. – and intercity connections, somewhere around 2040 (see fig. 4).



Appendix 2: Figure 3. A tunnel system in 2020



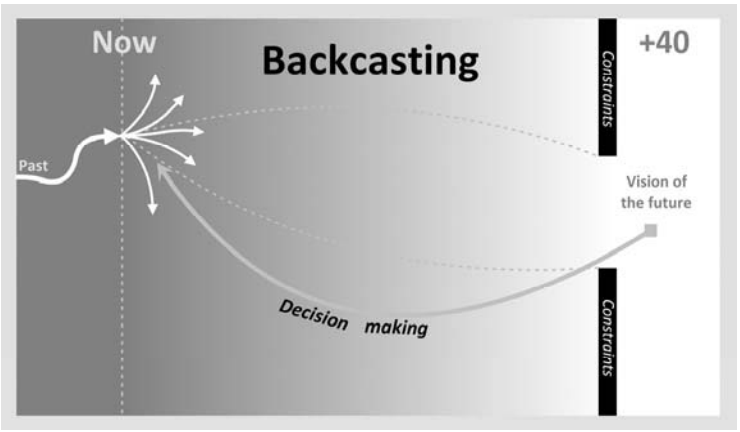
Appendix 2: Figure 4. The same tunnel system in 2040: many more lines; and intercity connections.

The error made by the local government is: on the short term the decision seems to be a good one, since an improvement of the eco-efficiency is realised. The impact of the decision, however, is much larger than the local government is aware of: they didn't ask themselves what the value of the decision would be after several decades.
So, the conclusion must be:

> ***A decision can only be a good one if it is to be expected that***
> ***People will still be happy with it at the end of its consequence period.***

3. Backcasting

This decision making principle is quite easy to understand; but it is not so easy to realise it in practice. How does one decide whether people after 40 years or more will be happy with decisions we take now?
It is impossible to be certain about that. But still, it is possible to make a sound guess. The way in which this can be done has become known as "backcasting" (see fig. 5).
In contrast with "forecasting", backcasting doesn't have the intention of trying to tell what the future will look like: backcasting is *not* prophesying.
Instead, using the information now available, a vision is developed about what the future (in, say, 40 years), would have to look like in order to consider it (now) as a desirable world (then). This vision can be worked out in detail, including technological aspects, based upon the thought of sustainable development. For instance, elements could be: chemical industry based on renewable materials (plants, not oil); an agricultural and food system that doesn't deplete the soil; no atmospheric disturbance; 100% reuse or recycling of metals; no landfill; etcetera. And a transportation system that doesn't cause traffic jam, noise, disturbance of the landscape and emissions to the atmosphere.



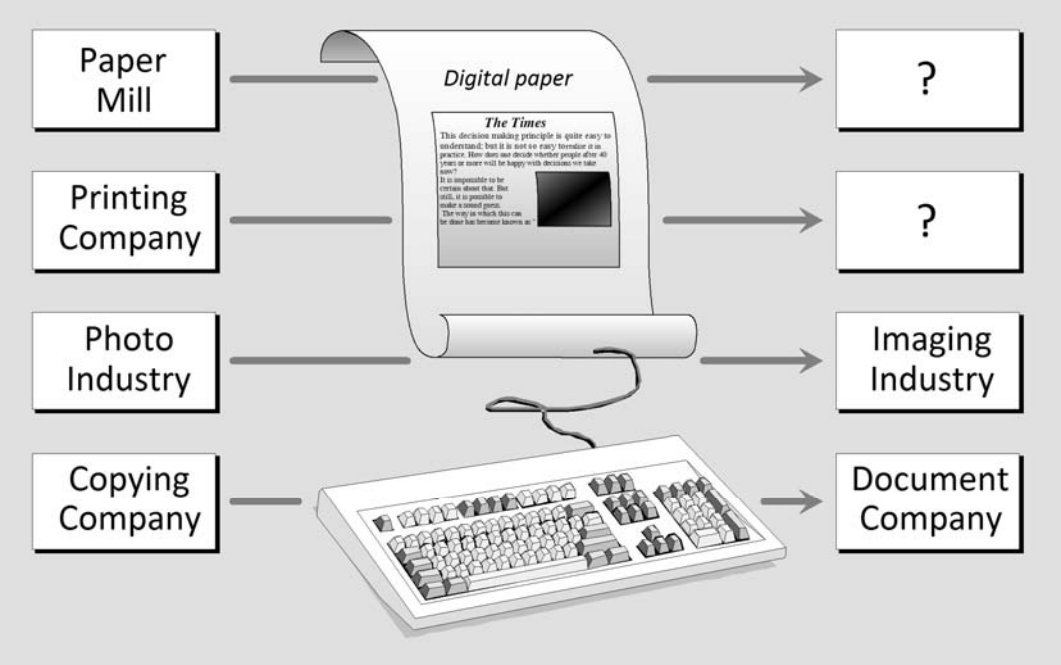
Appendix 2: Figure 5. Backcasting as a way of making decisions

This vision sets boundaries to the developments in the coming decades. It also puts a challenge to designers. For instance, if designers are to develop a “clean” transportation system: how can they do that? One of the possibilities is the tunnel system as described; this system concept is a result of the backcasting approach. Follow-up questions then are: how can that be realised; what are the investments; how to control it? Much research has already been done about those and similar questions.

Based on those investigations, strategic decisions can be made. When a choice has to be made between a number of alternatives, it will appear that some alternatives fit in a desirable sustainable development, and some will not. This gives a criterion for taking decisions.

4. Redefining the reason for being

It’s not only governments that have to think about consequence periods. The same is true for industrial companies. There are many, many things that will change drastically in the coming years. To name only one: the introduction of digital paper will have an enormous impact on industry and on society (see fig. 6). It already exists, so there can be no doubt whether it will reach the market; and it will come sooner than many people think.
Some companies know this and adjust: they change the definition they give of themselves, and choose a new company mission. A well known example is a large producer of copying machines: they don’t call themselves “copying company” anymore, but “document company”; thus preparing themselves to move from paperwork to information handling.



Appendix 2: Figure 6. Redefining a company's mission

A lot of companies aren’t that far. What about a paper mill that primarily tries to improve environmentally on paper production? A good thing, on short term. On the longer term: missing a vital clue.

References

Jansen, L. (ed.) (1997). *STD Vision 2040 - 1998; technology, key to a sustainable prosperity*. Interdepartmental Research Programme on Sustainable Technological Development (STD), Delft, Netherlands.

Roorda, N. (1999): *Integrating sustainable technology into Higher Engineering Education*. Entree 1999 Proceedings, Tampere Finland EEE Network, Brussels.

Weiszäcker, E. von (1998). Factor four - doubling wealth, halving resource use. London.

WCED (World Commission on Environment and Development) (1972). *Our Common Future.* Stockholm.

Appendix 3. Table of contents of the Cirrus Basic Module on Sustainable Technology

The Cirrus Basic Module on Sustainable Technology was published as Venselaar, Roorda and Quispel (eds.) (2000). All members of the Cirrus project team contributed to it. It was distributed to the managers of the engineering faculties and study programs of all Dutch universities, with the message that all could use it freely for their education.
Below is a reprint of the Table of Contents, which gives an impression of what the module was about.

Appendix 4. The HBO Handvest and its first Protocol

The HBO Handvest (Charter for Universities of Applied Sciences in the Netherlands)

Agreement

Signing parties,

- Universities of Applied Sciences, having education programs that are recognized as such by the Central Register for Education Programs in Higher Education (CROHO), hereafter called the universities;
- The Minister of Housing, Spatial Planning and the Environment (VROM);
- The Minister of Education, Culture and Science (OC&W);
- The Minister of Agriculture, Nature Conservation and Fishery (LNV);
- The Association of Universities of Applied Sciences, hereafter called the HBO Council,

agree to the following:

1. Goals

1. To educate students who, regardless of their discipline or professional field, acquire the competence to deal with problems in the field of sustainable development and design solutions for them.
2. To contribute effectively to the integration by the universities of the perspective of sustainable development in their education programs and research, and also in their own buildings and operations.
3. To develop and maintain a structure and equipment to support this process.

2. Contributing parties

The universities take it upon them:

1. To integrate the perspective of sustainable development in their education and research wherever this is meaningful and possible, in order to let every student meet with this on various moments in his/her study program;
2. To design the education and research in such a way that teachers and students learn to approach problems, with which aspects of sustainable development are related, from a multidisciplinary viewpoint;
3. To present sustainable development as a perspective in the contacts of the university with its professional fields and with other involved sectors of society;
4. To take steps, from the own responsibility, that lead to a containment and gradual reduction of the environmental strain by the own operations. With this, the university takes an exemplary role towards its staff and its students;
5. To carry out this Charter through a signature of the Protocol belonging to this Charter by at least one of its institutes, and to stimulate possible other institutes to do the same;
6. To participate in the Steering Group for Sustainable HBO. The tasks of the Steering Group are described in the appendix.

The HBO Council takes it upon itself:

1. To point its members at the necessity to integrate the perspective of sustainable development in the education, the research and the operations;
2. To be an advisory member of the Steering Group for Sustainable HBO;
3. To exert itself wherever possible for financing of the activities that result from this Charter.

The ministers of VROM, OC&W and LNV subscribe the goals as stated above and will support the implementation of this Charter. The ministers take it upon them:

1. To commit themselves that the integration of the perspective of sustainable development in higher education of Applied Sciences, as meant in this Charter, is mentioned in relevant policy documents as a goal.
2. To participate in the national Commission on Sustainable Higher Education, and from this to advise, by request and by own initiative, the Steering Group for Sustainable HBO.

3. Monitoring and reporting

Monitoring and reporting will take place annually through the Support Group Sustainable HBO.

1. The participating institutes will report annually, starting august 2000, to the Support Group about the subjects mentioned in the protocol, together with the necessary documents.

2. The participating institutes will render support to verification of the reports by the Support Group.
3. The Support Group will process the received data and report about them to the Steering Group for Sustainable HBO. Publication of the annual final report takes place after approval by the Steering Group. Every Board and every representative of the participating institutes receive a copy of this report.

4. Currency

This Charter will become effective at the signing date, and will remain so until august 2003. Parties express the intention to continue this Charter, possibly in an adapted version, until 2007.

5. Accession, adaptation and termination

1. During the currency of this Charter, new Universities of Applied Sciences and new institutes may join. This happens through a signed standard declaration.
2. During the currency of this Charter, other parties may join as well. The Support group will formulate a proposal about this to the Steering Group. The partners in the Charter and the newly joining party should first reach an agreement on this.
3. If, in the period until august 2003, important, unforeseen developments will occur with such a nature that this Charter by all reason has to be adapted, the parties will discuss this adaptation with each other.
4. Such a discussion will take place within two months after one of the parties expressed the wish to do so in writing to the other parties. If the discussion does not lead within three months to an agreement, every party is allowed to end its participation in this Charter immediately.

Thus agreed and signed, The Hague, 16 December 1999

Signatures of:

3 Ministers;
the vice-chair of the HBO Council;
29 Universities of Applied Sciences

Protocol 2000, the first protocol of the HBO Handvest

Introduction
The protocol gives directions to the application of the Handvest HBO within the institute. The protocol may be signed by the institute, if the Charter was signed before by the Board of the same university. The participating universities, together forming the Steering Group, decide on the contents of protocol every two years for the next period. The currency of the present protocol is until august 2001.

Agreement

A In the period until August 2000, the institute takes upon itself, unless in the improvement plan (see A.4) another date is set:
- *A.1* to formulate the integration of sustainable development in the education, research and operations as a starting point in the strategic policy of the university or the institute
  (assessment: copy of policy document, signed by institute manager);
- *A.2* to carry out the policy and the activities regarding the integration of sustainable development in the education, research and operations actively and demonstrably
  (assessment: copies of notes, school magazine, etc.);
- *A.3* to express aspects of sustainable development demonstrably in the supplementary training of teachers of the education programs of the institute
  (assessment: copies of supplementary training program, signed by institute manager);
- *A.4* to report within two months after joining the Charter to the Support Group about the present situation within the institute concerning sections A.1 till D.1, together with an improvement plan for the next two years.
  (models are available from the Support Group.)
- *A.5* to evaluate the policy and the activities concerning this Charter, based on the improvement plan and the current protocol;
  (assessment: notes of the evaluation, signed by institute manager)
- A.6 to cooperate actively to the monitoring.

B In the period until August 2000, the institute takes upon itself, unless in the improvement plan (see A.4) another date is set:
- *B.1* to express aspects of sustainable development demonstrably in the end terms of the education programs of the institute;
  (assessment: study guide of the program(s))
- *B.2* to express aspects of sustainable development demonstrably in the education programs offered by the institute;
  (assessment: study guide of the program(s))

C In the period until August 2000, the institute takes upon itself, unless in the improvement plan (see A.4) another date is set:
- *C.1* to actively follow a policy to control and reduce the environmental strain of the institute, through one or more action plans aiming at waste prevention and separation, improvement of energy efficiency and reduction of auto mobility;
  (assessment: plans, signed by proper manager)

D In the period until August 2000, the institute takes upon itself, unless in the improvement plan (see A.4) another date is set:
- *D.1* to implement the plans mentioned in C.1.
  (assessment: declaration by het proper manager).

Appendix 5. AISHE: development, validation and application

A paper was published in the journal 'Sustainability: The Journal of Record', Vol.1 – No.1, February 2008 (Roorda & Martens, 2008). Appendix 5 is an abbreviated reprint of the paper.

Assessment and Certification of Higher Education for Sustainable Development

Niko Roorda, *DHO (Dutch Foundation for Sustainable Higher Education), Avans Hogeschool*
Pim Martens, *Maastricht University, Open University of the Netherlands, Hogeschool Zuyd*

1. Fundamentals

1.1. Definitions

This paper is about assessment instruments (shortly: AI's) for Education for Sustainable Development (ESD). Although such instruments will no doubt be relevant for all levels of formal education, as well as for informal education (such as life long learning), this paper will be limited to formal higher education (HE), organised by Higher Education Institutions (HEI's). These HEI's are universities as well as 'hogescholen' (Netherlands), 'Fachhochschule' (Germany, Austria, Switzerland), 'högskola' (Sweden), CVU's (Denmark), Institutes of Technology (Ireland) and Ammattikorkeakoulu (Finland), usually described in English as universities for 'professional / vocational education' or for 'applied science'. One such AI is AISHE, developed in 2000-2001 by the Dutch ESD organisation DHO.

1.2. Reasons for an ESD assessment instrument

Several reasons exist why the existence of an AI for ESD is important, in order to realise the goals of the UN Decade of Education for Sustainable Development (DESD). This section describes the main reasons (see table 1).

Appendix 5: Table 1. Nine reasons for the assessment of ESD

1. Assessment = tool for policy development
2. Assessment = tool for evaluation of policy results
3. Assessment strengthens awareness and support for ESD among management, staff & students
4. Integration of ESD in quality management is necessary to get ESD in mainstream of HE
5. Reporting offers transparency towards stakeholders (financiers, potential students, etc.)
6. Reporting strengthens feeling of responsibility among management & staff
7. ESD certification works as an incentive
8. Benchmarking and ranking raise feeling of competition
9. Standardised assessment enables HEI's to learn from each other and cooperate

ESD policy: development, support and evaluation

The most obvious reason for an AI on ESD is that managers and policy makers want to get information about the situation in a HEI. This information can be used to formulate a policy towards ESD, in order to implement elements of SD in the education, the research etc., and in order to evaluate the policy of last years. Experiences in the Netherlands, Belgium and other countries show that the use of an AI contributes strongly to ESD development processes within HEI's. They also show that one of the most important effects of assessment is the raising of awareness and support for ESD among the management, the staff and the students.

ESD towards the mainstream of HE

In early stages of the process of implementation of SD in HEI's, usually ESD is experienced as something 'extra', 'added', not belonging to the main activities of the HEI. In later stages, SD usually grows to become an integrated part of the activities, the policy and even the mission of the HEI. This is vital in order to achieve one of the goals of the DESD, i.e. that ESD becomes part of the mainstream of education.

If ESD has to become a part of the mainstream, it is necessary that it also becomes a part of the quality management of the HEI. This requires tools, so that ESD can be a part of a Deming Cycle ('plan' – 'do' – 'check' – 'act') of quality management (see: Deming, 1986). For this, an AI cannot be missed.

Transparency, certification, benchmarking

A strong relation exists between SD and Corporate Social Responsibility (CSR). One of the main elements of CSR is transparency, i.e. organisations explain their activities to all kinds of stakeholders and give account of them, for instance through annual CSR or SD reports or through CSR or SD pages on a website.

CSR or SD accounting enables financing organisations (e.g. a ministry of education) to evaluate the activities and results of a HEI. It enables potential students to select a HEI for themselves. And it enables the general public to form an opinion about the educational and societal impact of the HEI.

This can be strengthened by a system of SD certification, as was introduced in the Netherlands by DHO in 2002. Some 50 educational programmes in the Netherlands and in Belgium have received this certificate, which will be described in more detail below. The ESD certificate appears to be a strong incentive for ESD efforts.
Finally, SD accounting based on assessment and standardised reporting may be used to compare HEI's. This opens the possibility of benchmarking and ranking HEI's regarding their ESD efforts, although no experiences with this exist in the Netherlands (and possibly elsewhere) up to date.

1.3. Characteristics of an ESD assessment instrument

The four main roles of a higher education institution
HEI's can be seen in different ways, depending on the role that is emphasised. The two core activities are no doubt *education* and *research*. Apart from that, a HEI can be seen as an organisation in itself. In this role, it performs all kinds of *operations*: it is active as an employer, a consumer of goods, a producer of waste, etc. (see: Clugston & Calder, 2000). A fourth role can be described as a 'member of *society*'. In this societal role, which in some countries (e.g. Sweden) is explicitly described in educational laws and regulations, HEI's may be active in their own local community, in political or societal discussions in their country, helpful in the development of third world communities, etc. (see for instance Megerle & Megerle, 2000).
A number of AI's exist (see: Shriberg 2002). Some of them, like the ULSF Questionnaire, put much emphasis on the operations role (Calder et al, 1999). Others, like AISHE, put the focus on the educational role. No instrument seems to exist that focuses on the assessment of the research or of the societal aspects of SD in HEI's.

Quality management
Because of the desire to integrate ESD into the mainstream of HE, it is important that an AI on ESD can easily be integrated in the general quality management (QM). This is true on two levels.
First, there is the internal quality management of a HEI. Well-known QM tools that are used in HEI's are ISO and EFQM (developed by the European Foundation for Quality Management). Specifically for the environmental management, ISO 14000 (see: Fisher 2003) and EMAS (see: EMAS 1993) are used, and several HEI's in Europe are certified on the basis of one of those methods (see: Delakowitz & Hoffman, 2000). The environmental management can be seen as one of the elements of the operations aspect of ESD. In terms of the 'Triple P': it represents a part of the 'Planet' aspect (see annex 1, below).
Second, there is a national level of QM, in the form of the accreditation system. In the Bologna agreement, the EU countries agreed to set up a quality assurance system, for instance an accreditation system, as a part of the creation of a European Higher Education Area. In the Netherlands and in Flanders (Vlaanderen, the Dutch speaking part of Belgium), the accreditation system is fully functioning, set up by the Nederlands-Vlaamse Accreditatie Organisatie (NVAO). In other countries, the development stages of the accreditation system vary.
In order to be able to integrate the assessment of ESD in the general QM, it will be necessary that an AI is designed along the lines of existing methods for QM. This is a complicated demand, because the existing methods for QM differ greatly. For instance, the fundamentals of the ISO method are very different from those of the EFQM model. Originally, ISO was primarily based on quantitative, result-oriented indicators, while EFQM focuses on qualitative, process-oriented indicators. (More recent versions of ISO also pay attention to process indicators.) Besides, it seems that the various accreditation systems in the European countries are going to differ considerably. Nevertheless, an AI for ESD has to 'fit' with the main existing QM methods or at least not contradict them.

2. AISHE

2.1. Fundamental choices

Emphasis on education
The AISHE method, developed in 2000-2001 by the Dutch ESD network organisation DHO, focuses mainly on the education. This decision was made by DHO because, in their opinion, the educational role of HEI's is the strongest way in which a HEI can contribute to SD, due to a snowball effect that the education can have on society.

Organisational level
Because of the emphasis on education, in its design AISHE aims at the level of separate education programmes within HEI's. During the testing phase (in the fall of 2001) one experiment was made to apply AISHE to a complete, large HEI (the University of Gothenburg, Sweden, with some 40,000 students). In accordance with expectations, this did not turn out to be successful. Within this one university, many differences existed: in the educational methodologies, the education development policies, the stages that the integration of ESD was in, etc. So, it appeared that the educational aspect of ESD can best be assessed on a level on which a sufficient amount of homogeneity exists: a separate educational programme, or a group of programmes (like a faculty or a department) under certain conditions.
AISHE pays some (but not much) attention to the research, the operations and the societal role of a HEI.

Process orientation

In 2000, when the development of AISHE started, some HEI's in the Netherlands were in a pioneering stage towards ESD. Most of the other HEI's were hardly interested in ESD at that time. For this reason, it was not a good idea to construct an AI focusing on the achieved results of ESD policies. Instead, it was a better idea to focus on the process of ESD integration, in order to strengthen and encourage this process. Therefore, the qualitative, process-oriented EFQM approach to QM and assessment was better suited than the quantitative, result-oriented ISO approach (see: EFQM, 1991 and Nuland et al, 2000). So, the EFQM model was adopted as a fundament. Another source was a QM model developed by INK, which made use of a five-point ordinal scale based on the EFQM philosophy (see: INK, 2000). This INK management model had already been transposed to a general tool for QM in HE (see: HBO Expert Group, 1999 and Van Schaik et al, 1998), which offered a good starting point for the development of AISHE. More details about these and other fundamental choices can be found in Roorda (2002a) and Roorda (2004).

Appendix 5: Table 2. The 20 criteria of AISHE 1.0

Certificate levels:	**1**	**2**	**3**	**4**
1.1. Vision on ESD	1	2	3	4
1.2. ESD policy	1	2	3	4
1.3. Communication on ESD	1	2	3	4
1.4. Environmental management	1	2	3	4
2.1. External network for SD		1	2	3
2.2. SD expert group		1	2	3
2.3. ESD in staff development plan	1	2	3	4
2.4. SD in research, external services			1	2
3.1. SD in profile of the graduate	1	2	3	4
3.2. Educational methodology	1	2	3	4
3.3. Role of the teacher		1	2	3
3.4. SD in student examination	1	2	3	4
4.1. SD in curriculum	1	2	3	4
4.2. Integrated Problem Handling	1	2	3	4
4.3. SD in traineeships, graduation	1	2	3	4
4.4. SD speciality			1	2
5.1. Appreciation by staff		1	2	3
5.2. Appreciation by students		1	2	3
5.3. Apprec. by professional field		1	2	3
5.4. Appreciation by society		1	2	3
Number of Certificate demands	11	18	20	20

2.2. The development project

At the start of the development process of AISHE in 2000, a stakeholder analysis was made. Several kinds of groups and organisations were considered as stakeholders, for instance: HEI's and their managers and staff, students and their organisations, national HE organisations, local and national governments. Also: the professional field, including companies, labour organisations, employer organisations, non profit organisations. Society in general, represented by NGO's like environmental action groups and human rights groups.

For all relevant stakeholders, representative organisations were selected, and within those organisations representative experts were invited to become a member of a 'stakeholder forum'. This forum, consisting of about 25 people, commented on each development step of AISHE.

First, a list of criteria was designed. After several adjustments, finally this list consisted of 20 criteria (see table 2). Next, the five-point ordinal scale (see table 3) was explicited for each of the 20 criteria, thus resulting in an array of 5 × 20 descriptions. To this was added a set of procedures for the performance of an assessment, after which the tool was ready for practical tests which took place in the second half of 2001.

Appendix 5: Table 3. General description of the 5-point ordinal scale of AISHE 1.0

***Stage* 1: Activity oriented**	***Stage* 2: Process oriented**	***Stage* 3: System oriented**	***Stage* 4: Chain oriented**	***Stage* 5: Society oriented**
- Educational goals are subject oriented. - The processes are based on actions of individual members of the staff. Decisions are usually made ad hoc.	- Educational goals are related to the educational process as a whole. - Decisions are made by groups of professionals.	- The goals are student oriented instead of teacher oriented. - There is an organisation policy related to (middle)long-term goals. - Goals are formulated explicitly, are measured and evaluated. There is feedback from the results.	- The educational process is seen as part of a chain. - There is a network of contacts with secondary education and with the companies in which the graduates will find their jobs. - The curriculum is based on formulated qualifications of professionals.	- There is a long-term strategy. The policy is aiming at constant improvement. - Contacts are maintained, not only with direct customers but also with other stakeholders. - The organisation fulfils a prominent role in society.

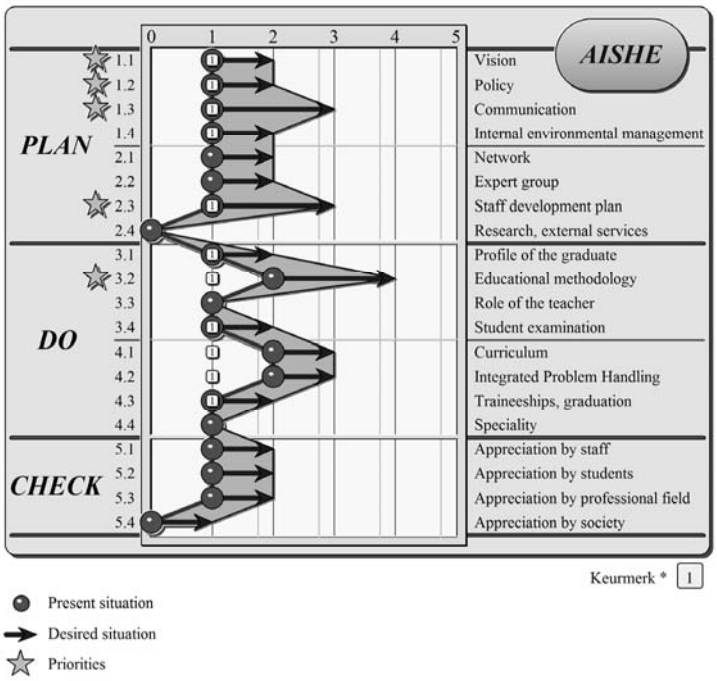
More details about the structure of AISHE can be found in the AISHE book itself (Roorda, 2001) which can be downloaded (in English or Dutch) from www.dho.nl/aishe. From this site, also the computer application AISHE Reporter can be downloaded. Figure 1 shows a result diagram of an assessment.

2.3. Testing and validation

The AISHE method has been tested in several ways in order to validate the tool. The evaluation made use of:

- Feedback by the stakeholder forum;

- Questionnaires for several groups, like the management, the teaching and the non-teaching staff and the students, on several moments, e.g. before the assessment, halfway during the assessment, immediately after and two months after the assessment;
- Test and retest within one organisation with several disjoint groups of participants.



Appendix 5: Figure 1. Results of an AISHE 1.0 assessment. The demands of the first Certificate are also shown. *(Figure made with AISHE Reporter)*

Stakeholder forum

At the start of the development of AISHE it was impossible to investigate the *conceptual validity* (criterion validity) and the *representativity* (content validity) of the method, based on exactly defined concepts, because no general consensus existed about the definition of sustainable development or about the meaning of it for higher education.

In order to create a way of testing both aspects of validity, after each developmental step of AISHE, the design was presented to the forum. These steps were:

7. Fundamentals of the tool
8. Design of the list of criteria
9. Design of the 5 stages for each criterion
10. Further details: format and layout, appendices, procedures etc.
11. Practical tests

After each step, the discussions with the forum lead to adjustments and corrections.

Practical tests

In a series of practical tests in universities and “hogescholen” (universities for professional education) in the Netherlands and in Sweden, AISHE was tested in 2001. These tests showed the applicability of AISHE, in those cases where either a separate study programme was assessed, or a department consisting of several study programmes sharing a clear unity in their vision and their educational methodology.

Investigation among participants

Before and after the assessments, the participants of the practical tests were interviewed, using standardized questionnaires. In this way, aspects of validity, reliability and applicability of AISHE were investigated. Besides, separate questionnaires were answered by the management of the assessed organisations. Annex 2 (see below) shows some examples of the questions asked. The questions aimed at investigating:

Validity: concept validity, representativity

Reliability: internal consistency

Applicability: unambiguousness, practicability, investments, efficacy, acceptability.

The results of the investigation indicated that AISHE sufficed in most respects. A number of smaller problems that occurred gave rise to suitable adjustments.

Equivalence

Another aspect of reliability, *equivalence*, was investigated when, in one university, two assessments were performed on two consecutive days within one and the same study programme. The two groups of participants were fully separate, and both had an equivalent constitution. The second group did not know the results of the first group. The results of both assessments with respect to the *present* situation were nearly identical. The results of the *desired* situation differed somewhat more, but did not show remarkable differences. Interestingly, the *policy ambition* of both groups is almost identical.

The conclusion was drawn that the equivalence of AISHE was proved sufficiently.

Concurrent validity

The concurrent validity of AISHE has not been investigated. For such an investigation, other assessment methods would be necessary, aiming at measuring the same things as AISHE, in order to decide whether they render the same

results as AISHE does. Such methods did not exist at the time of the development of AISHE, and this is still the case. So, such an investigation is impossible.

After AISHE's validity was proved in this way, the tool was published and made available on the website www.dho.nl/aishe. From that moment, HEI's are free to download all necessary documents and tools and to use AISHE all by themselves, or to invite DHO to send an assessor and organise an assessment.

2.4. Implementation

In order to streamline and standardise the application of AISHE, a number of items have been added.

- The assessment procedure was published.
- A checklist was made to investigate whether a combination of educational programmes may be assessed together.
- A computer application, 'AISHE Reporter', was made for the automatic production of the report of the assessment. The application (functioning in English and in Dutch) can be downloaded from www.dho.nl/aishe.
- A 3-day training course for assessors was designed and is organised annually.
- For the participants in this course, a follow-up practical training and examination programme was set up, leading to the possibility of acquiring the 'AISHE assessor certificate'.

The assessment procedure

The assessment takes 5 to 6 hours for a group of about 15 people (see table 4), chaired by the assessor. After the AISHE book has been distributed and the model has been explained to the participants, they are asked to read a part of the AISHE book that contains the descriptions of the five stages for all criteria. While doing this, individually, they compare this to their own organisation (e.g. an education programme or a faculty of their university), and select the stage that – in their personal opinion - resembles the situation in their organisation most.

At the end, they write their conclusions down on a form and hand it to the assessment leader, who combines the conclusions of all on one composite form.

Next, a *consensus meeting* takes place in which all of the participants are present. At the beginning, the copied composite form is distributed. As before, every participant has the AISHE book, in which they wrote their own scores and annotations.

The criteria are discussed one by one. All participants have an equal weight in the discussions, in the proceeding of the conversation and in the decision making. On a basis of intrinsic reasoning, a common conclusion is looked for about the right scores for the organisation.

If possible, decisions are made based on consensus. If, however, for some criterion no consensus can be reached, the assessor will conclude that, of all proposed scores, the *lowest* is the one that is decided upon: this is, because a (higher) score has only definitively been realised if all participants agree with it. In *no* case at all, decisions are made by voting.

Appendix 5: Table 4. Some elements of the AISHE assessment procedure

- Group of about 15 participants: a representative delegation of management, teaching and non-teaching staff, students
- Assessment is only possible if participants have at least elementary knowledge of sustainable development; if not, option of an introductory workshop by DHO
- Time use: about 5 – 6 hours: ca. 30 minutes introduction by assessor, about 45 minutes individual scoring; 4 - 5 hours consensus meeting
- ESD certificate can only be awarded if the assessment was chaired by a certified AISHE assessor
- The use of the computer application AISHE Reporter is obligatory, in order to ensure a well-structured report
- Follow-up: ESD policy determination by management within one week after assessment, if desired with consultancy by DHO

Desired situation, priorities, policy proposals

During the discussion of the criteria, naturally a number of possible improvement points will rise. This will enable the group to formulate – for each criterion – a *desired* situation. This desired situation is defined, not only in the form of a stage to be reached, but also in the form of a series of concrete targets and associated activities that will lead to the desired stage. In order to guarantee that the necessary concreteness is really achieved, at the beginning of the consensus meeting an exact date is chosen on which this desired situation is to be realised. Usually, a date is selected about one or two years after the assessment.

After policy intentions are thus defined for all 20 criteria, a large list of goals and activities is formed for the coming period. Usually this list is long, and so in the end a small number of priorities are appointed.

Results

At the end, the assessment results consist of:

- *A report containing a description of the present situation, in the form of a stage number and a verbal description for each criterion;*
- *A ditto description of the desired situation, giving ample opportunity to the management to formulate an SD policy plan;*
- *A date on which this desired situation has to be reached;*
- *A list of first priorities, that are considered to be crucial in order to be permitted to conclude that the policy will have been successful;*
- In practically all cases: an growing awareness, enthusiasm and support for SD within the group of participants;
- Indications for the management about which staff members may be given responsibility for certain aspects of the SD policy plan that is to be designed.

Overall indicators
In the AISHE audit report, a small group of global indicators is calculated:

- *In the years from 2001 till (roughly) 2005, the median of the 20 scores was, in most cases, stage 1. In many of the assessments, the participants define a desired situation with a median of 2. In the last few years, more and more assessments result in a median of stage 2 and a desired situation with a median of stage 3. This shows that real progress is being made.*
- *The Plan Do balance is defined as the difference between the added scores of the "Do" part (criteria 3.1 till 4.4) and those of the "Plan" part (criteria 1.1 till 2.4). If this indicator is far below 0, this indicates that the university is making a lot of plans and visions, but is not very successful in implementing this in the education. If, one the other hand, the indicator is very high above zero, much has been achieved with respect to the education, but there is not much support from the management, and so there is a risk that the achievements may vanish in the near future: they are not anchored in the university policy.*
- *The Policy ambition is calculated by adding all scores of the desired situation, and subtracting the sum of the scores of the present situation. Policy ambitions appear to vary between about 5 and about 20, with an average of about 12. An interesting phenomenon is that usually the ambition is higher when the present situation is higher: it seems that the forerunners tend to be wanting to preserve their front position.*
- *The Distance to a Certificate is defined as the sum of the differences between the demands of this certificate and the scores of the (present or desired) situation, only if those scores are lower than the demands. If some scores are equal to or higher than the demands, those scores don't influence the Distance to the Certificate. If the Distance to Certificate equals zero, in principle (i.e. apart from a final check) this Certificate has been achieved.*

Quality cycle
In the first year of the use of AISHE (2002) it happened a number of times that, several months after an assessment was performed, the HEI had not made effective use of the assessment results. As a consequence, the enthusiasm and support that the assessment had raised had disappeared, and most or all of the participants, including the management, had forgotten most of the subjects that were discussed. So, the effects of the assessment were small or nil. From this it became clear that it is vital to use the assessment results soon after the assessment, in order to design a concrete ESD policy plan (either as a separate plan or as a part of a general policy). Therefore, in all cases where a HEI and DHO together prepare an assessment, DHO emphasises that a meeting of the management takes place at most one week after the assessment. Support by DHO is offered, and if accepted, a consultant of DHO takes part in the decision process.
Ideally, this leads to a policy plan for the next one or more years, and this plan results in actions that are taken. In this way, the start is made of a quality cycle (Plan – Do – Check – Act). The 'Plan' phase is formed by the assessment and the formulation of the policy plan. The 'Do' phase consists of the activities that follow. The cycle can be closed by repeating the AISHE assessment in order to evaluate the results ("Check'), and by taking next actions for further improvements ("Act'). In this way, AISHE contributes to a continuous improvement with respect to ESD.

Present situation
So far (halfway 2007), AISHE assessments have been done in the Netherlands, Belgium and Sweden. Assessments in Finland and other European countries are in preparation. A large ESD project in Brazil is starting up in which AISHE will be used in a range of HEI's, assisted by DHO.

2.5. Certification and accreditation
A certification system based on AISHE was designed by DHO. Educational programmes in HEI's can acquire the ESD Certificate on several levels, which together form a 'star system'. The demands of the four different star levels can be seen in table 2 (see also figure 1). In order to acquire the Certificate, educational programmes have to do an AISHE assessment chaired by a certified AISHE auditor selected by DHO. The resulting report is checked by the DHO Certificate Commission. If necessary, an extra visitation to the HEI by this Commission is made. If the Commission confirms the results of the AISHE assessment, the Certificate is awarded.

Between 2002 and 2007, about 60 educational programmes in about 12 HEI's in the Netherlands and Belgium received the Certificate, mostly on the first level; some 10 of them received the second level Certificate.

At the end of 2006, an agreement was made with the Dutch & Flemish national organisation for the accreditation of higher education, NVAO. This resulted in a formal recognition of AISHE by the NVAO, and to the introduction of a 'special recognition' of SD, to be assessed with AISHE, as a formal part of the accreditation of HE in the Netherlands. Starting in 2007, educational programmes will be awarded this special recognition if they have at least the second level DHO Certificate of Sustainability in Higher Education, since the assessment results prove that this is the present level of excellence. DHO and the NVAO have agreed that together they will check this minimum level annually, and if necessary, they will raise the threshold level.
At the beginning of 2007, the first three educational programmes actually received this special recognition, as a part of their accreditation.
The DHO Certificate is valid for three years. This is exactly half of the validity period of the accreditation of higher education in the Netherlands, which is six years. This makes it possible to complete two complete quality cycles of ESD during one accreditation cycle.

3. Practical experiences

In this chapter, first some general conclusions from assessments will be described. Next, two cases will be discussed in more detail.

3.1. General conclusions

At the beginning of 2007, more than 100 assessments have been done. A part of them were done by the universities themselves, using the equipment from the DHO website but without the assistance of DHO itself. Those assessments are not valid for the Certificate. Most of the assessments however are chaired by a certified assessor.
From the assessments done so far, some interesting conclusions can be drawn.

- AISHE is used in various kinds of disciplines. Among them are:
    - Science and technology departments and programmes, e.g. physics, chemistry, architecture, civil engineering, mechanical engineering, ICT;
    - Economical and law departments and programmes, e.g. economics, financial studies, management studies, law studies, real estate studies;
    - Environmental science and technology;
    - Social studies;
    - Agriculture and biology;
    - Health departments and programmes, e.g. medicine, nursing, obstetrics;
    - Educational studies, e.g. primary teacher education, technical professional teacher education.
- *Communication about SD (criterion 1.3) is nearly always a main point for improvement (i.e. it is given high priority). Usually, many criteria are less than optimal because of a lack of effective communication between the management and the staff, among staff members themselves, with other people or parties involved (like the professional field) and especially, between the university and the students.*
- *Also, in almost all assessments, improvements in the vision and the policy about SD (criteria 1.1 and 1.2) have a high priority. The vision and the policy often lack an explicit mentioning of SD. In some cases, explicit reference is made to related subjects, like ethics, responsibility, societal role, etc. When SD is mentioned implicitly or explicitly, in most cases the texts are regarded by the assessment group as a dead letter. So, an improvement that is often regarded as vital is the explicit formulation of SD in the mission statement and in the policy plans in such a way that there are real implications for the HEI activities and the education.*
- *Usually, there is a wide variety in the individual opinions. It is not uncommon that the opinions about a criterion vary from stage 1 up to stage 4. It appears that there are two main causes for this. One cause is a lack of effective communication. The other cause usually is a difference of opinion about the concept of SD and the meaning of it in relation to the own education. Nevertheless, nearly always it appears to be possible to find a consensus on all criteria.*
- *Also rather typical: In a number of criteria, the manager thinks more optimistic than the other participants. This, too, is usually caused by a lack of communication: often, the manager knows much more about management processes that are going on, but less about the effectiveness of them, than the staff and (especially) the students.*
- *Not in all cases, consensus is reached on a stage where originally the majority of participants thought it should be. There are interesting examples in which it even occurred that a stage was concluded that was lower than everyone expected. This was usually caused by a critical examination of the existing opinions by the assessor selected by DHO.*
- More and more universities use the requirements of the various Certificate levels as guiding lines for their ESD policy. Usually this is done by comparing the desired situation, formulated during an assessment, with the Certificate demands. If the desired situation is close but not equal to the set of demands of a certain level, the goals are

adapted in order to receive the Certificate at the end of the policy period. In other cases, the long term strategy is formulated, using for instance the demands of the level 3 Certificate, even if the university department involved has just acquired level 1 or not even that.

- This shows that the Certificate is an effective means to strengthen the process of integration of SD in HE. This is confirmed in interviews with managers and teachers, in which the Certificate appears to be experienced as an incentive.

3.2. The case of an economics study programme: Communication

In a large Dutch university for professional education, the staff of an economics study programme was working on the implementation of ESD, and DHO was asked to perform an AISHE assessment. It appeared that the economics programme scored not very well, compared to other universities. The median of the scores was 1. The programme failed to meet the demands of the first Certificate. The high priorities that were selected at the end of the assessment were the criteria 1.1, 1.2 and 1.3: *vision*, *policy* and *communication*, as well as on criterion 4.1: *curriculum*.

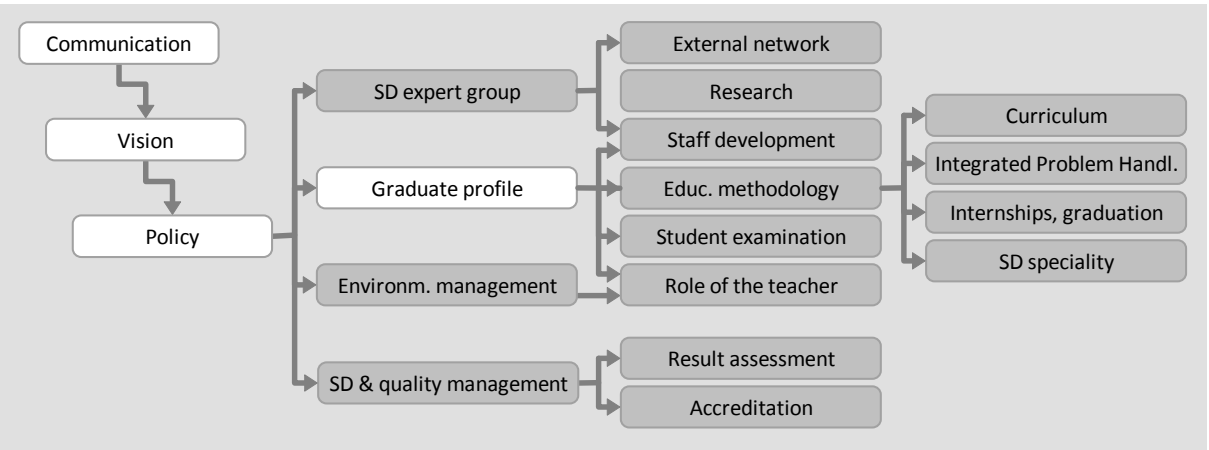
During the next half year, the department team worked on the implementation of the goals of the 'desired situation'. The vision and the policy towards SD were strengthened by participating in a university-wide process of redesigning the mission statement. The redesign of the curriculum resulted in a basic module on SD for the propaedeutic year, a large student project on SD in the second year, and adaptations of the educational methodology. However, the team was not satisfied. SD had not yet been integrated into the curriculum in a systematic way: the sustainable elements were not logically connected as a thread throughout the curriculum. The new university mission statement contained some SD related elements, like ethics and professional responsibility, but SD itself was not mentioned explicitly, and the text was rather abstract, so it was difficult to draw conclusions from it with respect to a policy or to concrete activities. A major problem, according to the manager, was the definition of the professional profile of the future graduates (criterion 3.1): he and his team experienced a gap between the university vision, as formulated in the Mission Statement, and the professional profile of the Economics programme. If it would be possible to make the vision more explicit, i.e. to operationalise it, then it could be used to formulate the professional profile, and next to redesign the curriculum in such a way that SD could be integrated systematically.

On the subject of communication, some achievements were made, but rather ad hoc, not in a systematic way. In the university magazine attention had been given to SD once. It had been on the agenda of some meetings. The department team was in doubt about possible next steps. As the manager expressed it: 'We have communicated about SD in every way we could think of – so what can we do next?'

Together with DHO consultants the situation was analysed. It was concluded that a systematic communication with the university board and the other university departments could lead to the desired more explicit formulation of the university vision on SD, based on the new Mission Statement. Next, a systematic communication with the teaching staff, the students and the professional field could lead to ideas about the integration of SD in the curricula. So, instead of the ad hoc communication of the former half year, a communication plan was needed as a first step.

A simple communication plan was designed, based on two dimensions. One dimension described reasons for communication, like "give information", "Receive information", "Generate new ideas together", "Create support", etc. The other dimension was based on a stakeholder analysis, for instance: teaching staff, students, management, PR department, professional field, public media, government, etc.

This communication plan was used as a first step for a total SD policy, which is shown in figure 3. The Economics team worked along these lines for some years. After a second AISHE assessment in 2005, the department was awarded a level 1 Certificate of Sustainability in Higher Education.



Appendix 5: Figure 3. A systematic approach to the development of sustainability in the education and the organisation, starting with a communication plan. The four white boxes represent the four highest priorities, selected during the audit.

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Annex: Examples of questionnaire items

Assertions have been proposed to the participants of the practical tests during the final development phase of AISHE. The participants could react with "agree fully", "agree partially", "disagree partially" or "disagree fully". Besides, for each answer they had the opportunity to add comments.
Some examples of the assertions are:

Before the AISHE assessment (but after the introduction):

- The goals of the AISHE assessment are clear to me.
- The procedure to be followed is clear to me.
- I have a clear image of what is expected of me during the assessment process.
- I have a clear expectation of the usefulness for me and/or our organisation of the AISHE process and the results.

After the individual scoring, but before the consensus meeting:

- The time that I spent on the individual scoring was acceptable.
- The AISHE criteria and their descriptions were clear to me.
- For each criterion, it was no problem for me to recognise the stage our organisation is in.
- The relevance of AISHE for our education and our organisation is clear.

After the assessment:

- The AISHE assessment process went well.
- The constitution of the participant group is representative for the investigated organisation.
- The descriptions of the criteria and of the corresponding five stage descriptions are clear.
- Each criterion of AISHE is relevant with respect to sustainability in higher education.
- The criteria differ enough from each other.
- The criteria complement each other and they don't contradict each other.

- To the various aspects of sustainable higher education, the criteria attribute the right relative weights.
- Together, i.e. seen in its entirety, the criteria of AISHE form a complete and correct description of sustainable development with respect to higher education.
- The results present a correct image of the actual situation with respect to sustainability in our education.
- The results present a correct image of the actual situation with respect to sustainability in our organisation.
- For each criterion, it was no problem to recognise the stage our organisation is in.
- This assessment changed my view on the present situation and the future possibilities with respect to sustainability in our organisation and our education.
- I expect that the results will contribute to the development and the realisation of a policy with respect to sustainability.

After the assessment, specifically for the management:

- Knowledge and insight about sustainable higher education within the organisation have increased, due to the assessment.
- Enthusiasm and support for working on sustainable higher education within this organisation have increased, due to the assessment.
- I expect that the assessment will lead to concrete policy developments of the organisation.
- Weighing costs and effects, the AISHE assessment was worth the investment.

Appendix 6. Users' questionnaire about the application of AISHE

A questionnaire was sent by e-mail to representatives of three Universities of Applied Sciences in the Netherlands in September 2009. All answers were received by e-mail within two weeks.
The universities and interviewees were:

Inholland HTRO:
Hogeschool Inholland is a large University of Applied Sciences, mainly in the western part of the Netherlands. HTRO (Hogere Toeristische en Recreatieve Opleiding) is the study program of Tourism and Recreation, a part of the School of Economics in Rotterdam.
The interviewee is Arjen van Tol, one of the twelve teachers of the study program, who chairs a group of three teachers that have an official task of stimulating and implementing ESD in the study program.
At the time of the interview, the study program possesses the Certificate of Sustainability in Higher Education at the level of 1 star. However, based on a recent AISHE assessment, the request for the 2-star Certificate will be sent to the Certification Commission within weeks.

Marnix Academie:
The Marnix Academie is a small University of Applied Sciences in the city of Utrecht. It has only one study program: teacher education for primary education ('Pabo').
The interviewee is Gerben de Vries. He is the coordinator of the Taskforce for Sustainable Development at the Marnix Academie.

Fontys TNW:
Fontys Hogescholen is a large University of Applied Sciences, mainly in the southern part of the Netherlands. TNW is the School of Applied Sciences ('Toegepaste Natuurwetenschappen') in Eindhoven. TNW educates students in disciplines of biology, chemistry and technology.
The interviewee is Marthie Meester. She is the manager of TNW.
At the time of the interview, the university possesses the Certificate of Sustainability in Higher Education at the level of 3 stars.

Questions and answers:

The assessment

1. Was the use of AISHE helpful in the attempts to integrate sustainable development into the education of your department(s)?

Inholland HTRO:
Yes, it was helpful in many ways. It gave us direction to create an own vision and some tools to implement this vision in our organization and curriculum.
The method is very clear about the different areas which should be taken in account when you try to implement sustainability in your organization.

Marnix Academie:
It helped to get clear development standards for working on ESD as part of the total academy, starting with the theoretical part (vision, policy, expertise) and slowly working its way into practice (curriculum, assignments, evaluations etc.)

Fontys TNW:
AISHE is very helpful. It forces us to look at the different aspects of the audit how they fit with our vision, policy and education goals and to identify the 'gaps' in our curriculum. As a consequence we formulate goals for the next year in how to fill the 'gaps'.

2. Is it possible to make an estimate of a possible difference between the present situation and the situation as it would have been without the use of AISHE?

Inholland HTRO:
Without AISHE it would have been a lot harder to convince the management the importance of sustainability in our curriculum and in the way we behave. I think it would have taken a much longer time before we would reach our present situation in which sustainability is integrated in every part of our curriculum and in which we stimulate our students and give them the tools to come up with their own vision on the role sustainability should play in our society.

Marnix Academie:
Without AISHE we would not have explicit statements in relevant documents as year reports, vision documents etc. Without AISHE we would not have a structural stepwise 'building' of ESD in the total program, from first till fourth year. Without AISHE we would not have an external board of advisors, who cooperate in lectures from time to time. Without AISHE we would not have ESD as a 'weaving project' in our institute. Without AISHE we would have had less pressure on the implementation of ESD and less reorganization in the direction of SD.

Fontys TNW:
Without the use of AISHE we wouldn't have got the task from our Board to develop the minor People, Planet, Profit. Because of our 'stars' we were known as a department interested in sustainable development within Fontys.

3. Is the use of AISHE in any way integrated in the general quality management of your department(s)?

Inholland HTRO:
We have a audit every year and from this audit we get a list of actions to improve our situation.

Marnix Academie:
More or less; we are working our way through official accreditation first, then we can focus on other things again. We are working on making AISHE a mainstream activity, part of the regular evaluation process.

Fontys TNW:
Yes, it is integrated. Our questionnaires for the stakeholders (students, colleagues, companies, etc.) contain some questions about the presence and recognition of sustainable development in our curriculum.

4. Is the use of AISHE in any way integrated in a policy on sustainable development that is broader than just your department(s)? E.g., is AISHE also applied in other parts of your university, and is there some kind of a planned coherence between the several assessments?

Inholland HTRO:
Unfortunately not now but we try to change this within the near future as we think it should be.

Marnix Academie:
As we are a mono-sectoral university, this question on an institutional level is not relevant.
AISHE helped us to develop activities outside the institute, being part of bigger taskforces on ESD.

Fontys TNW:
A number of institutes of Fontys has made use of AISHE. The corporate policy is that all departments have to perform a zero-scan. However not many institutes have actually done one.

5. Do you expect that AISHE may be applied again to your department(s) in the future?

Inholland HTRO:
Yes, we're sure. We had an official audit in June 2007, did our own audit in 2008, another official audit in June 2009 and next year we will do our own, unofficial audit again in June. In 2011 we will have another official audit.

Marnix Academie:
We are – slowly - working on AISHE 3 stars, so it is a continuing story.

Fontys TNW:
Our department has three stars as the first department in the Netherlands. If in three years time we are still the only one with three stars we will go for it again. We don't have the ambition to try to get four stars. Our impression is in that case you have a curriculum Sustainable Development instead of sustainability integrated in the courses of the curriculum.

6. If you have applied AISHE several times, can you say something more about the repeated use? E.g. is this a planned closed quality cycle ('Deming cycle'), and what are the consequences of this?

Inholland HTRO:
We use AISHE every year to maintain and improve the way sustainability is integrated in our program and department.

Marnix Academie:
We worked from 0 to AISHE 1 star, then to AISHE 2 stars, now to AISHE 3 stars. So we use it as an instrument that does not provide in a development as a closed circle, but in a spiral wise improvement.

Fontys TNW:
See also my answer at question 5. AISHE has worked as an accelerator to think about all the aspects of sustainability and to develop the curriculum accordingly. However, it also asks a lot of time and energy from the staff of the department.

The Certificate
If your department(s) has a Certificate of Sustainability in Higher Education:

7. At what level is the Certificate at present?

Inholland HTRO:
We reached level one and will apply for level two within weeks.

Marnix Academie:
AISHE 2 stars.

Fontys TNW:
Three Stars.

8. Was/is this Certificate of any relevance for you, your colleagues / staff, your department(s

Inholland HTRO:
It helped us to convince the management to invest in sustainability and is a motivation for all our personnel, teachers and students to go for the next level. We use the Certificate for promotional goals towards potential students and delivering schools.

Marnix Academie:
As an incentive or an award for the staff, because it gave us the special remark at the accreditation of NVAO.
As a goal, before the Certificate was awarded, because as SD coordinator I could use the criteria as a set of concrete goals; and the award of the certificate as the 'sausage in front of the dog's nose….'
Not so much as a stimulus to get to the next level Certificate: from the beginning on we headed for AISHE 3 stars. It only helped to formulate 'in-between' goals.
For PR. The special NVAO remark helped; and the articles in several magazines helped too.
As coordinator of the taskforce for sustainable development at the Marnix Academie, I could use AISHE1, 2, 3 as very concrete goals, with in-between steps, clear development routes. This system suited my personal way of dealing with development trajectories and implementation.

Fontys TNW:
Of course, the certificate is of relevance to our stakeholders. We don't think we get more students because of the certificate with three stars.

9. Are there any plans or expectations to renew the Certificate (as its validity period is three years) on the same level, or acquire a Certificate on a higher level?

Inholland HTRO:
Within weeks!

Marnix Academie:
We are heading for AISHE 3 stars, so we will ask for that in due time.

Fontys TNW:
See the answer at question 5.

The NVAO Certificate
If your department(s) has a Special Recognition of sustainable development by the NVAO:

10. Does this special recognition have any relevance for you, your colleague / staff, your department(s)? (For possible answers, see question 8.

Inholland HTRO:
We don't.

Marnix Academie:
See question 8.

Fontys TNW:
See the answer at question 8. The bad thing of AISHE is the three-year-cycle, while the NVAO-cycle takes six years. My preference is a six-year-cycle for AISHE as well.

Appendix 7. Some parts of the 'Basisboek Duurzame Ontwikkeling'

This appendix contains:
Part 1: The Table of Contents;
Part 2: A sample: The first pages of chapter 2;
Part 3: The educational goals of chapter 2, as printed in the Teachers' Guide.

Appendix 7, part 1: Table of Contents

Appendix 7, part 2: A sample: The first pages of chapter 2

Case 2.1: Feed for livestock
Everybody eats. Some eat only vegetarian food, but most people eat meat. This is the case in the Netherlands, where especially meat is eaten from cows, pigs and chicken. These animals are, together with the people who eat them, a part of the food chain.
This chain starts with the vegetable feed consumed by the animals. In the past this feed was grown just in the Netherland, often in a mixed farm by the same farmer who also owned the cattle. But this is not entirely true anymore. Nowadays nearly half of the Dutch fodder is imported by ships from other countries.
This foreign fodder consists e.g. of corn, tapioca, soy and copra (coconut flour), together forming an import of about 12 million tons annually. It is imported from more than 60 countries, among which the USA, Brazil, Argentina and Thailand are the most important.

A disadvantage of this is that it implies one-way traffic from these countries to the Netherlands. Look at it: valuable nutrients in the soil of the supplying countries are used for the cultivation of livestock feed, which is shipped to the Netherlands. There these materials are consumed by the livestock, and next by humans. In the end, a large majority of the nutrients will arrive through the manure on the farming land. In the Netherlands! And not in the original countries.

This procedure is harmful for both ends of the chain. In the Netherlands the nutrients gather, and thanks to this overfertilization more and more nitrates arrive in the ground water and the surface water. The consequences: a green 'soup' of algae in lakes and rivers, acidification of natural areas, decrease of biodiversity (variety of species), especially among butterflies and mushrooms, which don't do well in an acid environment. And regularly the drinking water in the east of the Netherlands contains too much nitrates and has to be treated or diluted.
In the feed supplying countries, the consequences are graver. There the opposite occurs: a loss of valuable nutrients. The soil fertility decreases, and erosion is caused, which harms the soil beyond repair. In places where the cultivation needs irrigation, this demands valuable sweet water. And it takes a lot of surface area, for which tropical rainforests are cut down, especially in Thailand and Brazil. The cultivation of livestock feed occupies fertile areas that might have been used for the development of agriculture for the own population, a problem

Many of the problems that make sustainable development necessary are consequences of fundamental flaws in the way in which humanity has structured its world. In this chapter you will investigate a series of such 'weaving faults in the system'. One of them is the fact that valuable resources, like the fertile soil of case 2.1, is used but not replenished: this is about the absence of a closed cycle. Another weaving fault is the continuous exhaustion of nature. Other weaving faults have to do with the economical structure, with the growth of the World population, the distribution of prosperity and more.
These weaving faults are the main cause of the large problems in the world. Fortunately, against the weaving faults we have a huge amount of 'power sources' that can be applied to work on correcting the weaving faults. You will read about the power sources in the next chapter. First now, in the present chapter, the faults.

2.1. One-way traffic (no closed cycles)
The Dutch feed for livestock comes partly from abroad, which is a tough problem.
In the past this problem did not occur. The livestock simply ate plants from the own soil, which growed thanks the manure of the same livestock: there was a closed cycle. This is the essence of the problem: the present system (partly) consists of one-way traffic. *The cycle is not closed*.

The solution seems simple: send a part of the manure, the surplus, back to the countries where the feed comes from, and you will close the cycle. Experiments for this approach have been done. The manure was manufactured to dry grains that were exported by ship. But is appeared not to be economically feasible: too expensive.
So you may wonder: why do people go on in this way, as it seems logical that this cannot go on indefinitely?
But it is not so easy to stop this one-way traffic. One cause is that there are many stakeholders. Imagine that the Dutch farmers together would decide to stop using foreign feed. That would be highly problematic, because the change to 100% feed from Dutch soil would raise the costs considerably, and the Agricultural sector has a hard time even without this. Many farming companies would simply go broke. Even stronger: it is impossible. Because, with the present number of cows, pigs and chicken, the Netherlands simply have not enough square kilometers of surface area by far to cultivate all needed feed. And this is not going to become easier in the future: think of the third case in chapter 1, about lack of space.

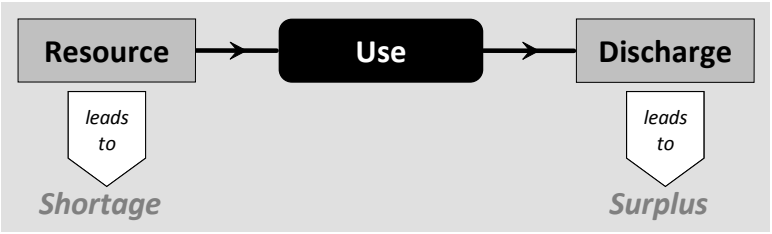
Who then might change the system which is based on one-way traffic? The importers perhaps? The feed import is their business, at least partially. The foreign farmers cultivating the feed? For many farmers in developing countries it is the only way to make enough money for a living.
The Dutch government perhaps? On its own, it cannot do much, because it is not just about the Netherlands, as quite a lot of other western countries also import a considerable amount of feed. If the Netherlands alone would try to break the system, the effect would be that its farmers and dairy industry would go bankrupt thanks to foreign competition. In the meantime, the system would just go on. Of course you could try to change the system together with more countries. But suppose that enough countries would cooperate. What would their governments have to do: prohibit the import? Or impose high import tariffs? In that case, thousands of farmers in the Netherlands *and* in developing countries would go broke.
And then there is the consumer. The ordinary man or woman in the Netherlands (and in other countries), who buy meat, or dairy products. What can you do?
On your own, not much of course. You can become a vegetarian. But most vegetarians may not eat meat, but they do use dairy products such as milk, eggs and cheese. So you would have to become a **vegan**, and refuse everything with an animal origin. This would only have a considerable effect if many people would do so, which is not very likely.

Questions

- (If you are not a vegan:) Do you think you should feel guilty because, every time you eat meat or drink milk, you contribute a little bit to the destruction of the tropical rainforest in Asia or South America?
- Who is responsible for keeping the one-way traffic alive: the multinational companies that import the feed? The farmers who use it? The people who eat meat of cheese? You? All in all, who is to blame?

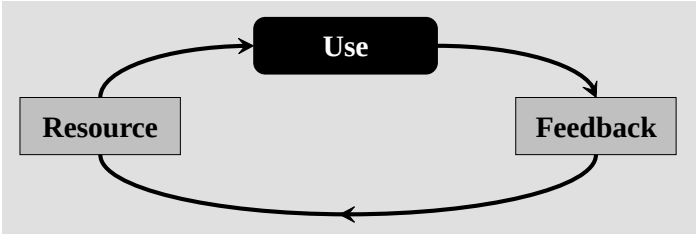
One-way traffic: a weaving fault in the system

It is really difficult to change the system of the import of livestock feed. The reason is that it is deeply rooted in a much larger system, consisting of the food supply in the Netherlands and in other countries, plus the agriculture in large parts of the world. This system contains a fundamental flaw. You might call it a weaving fault, an error in the tissue out of which the system is constructed.



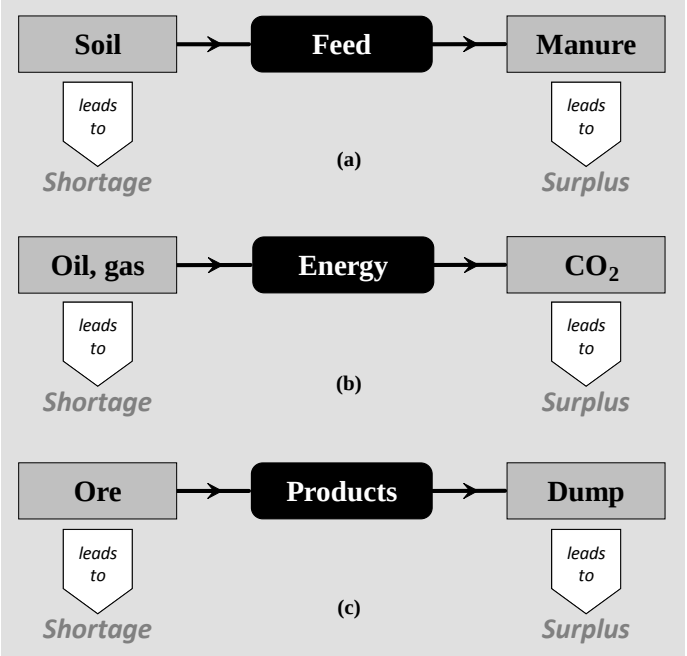
Appendix 7: Figure 1. One-way traffic, or: a cycle that is not closed.

You can illustrate the feed fault in an easy way, as in figure 1. There you see the term **resource**. Everything you can get out of nature, including the soil or the air, is a resource. So, ores are resources, and oil and gas. Clean water is a resource, as are plants, nutrients from the soil, wind (as a source of energy), solar radiation. In a wider sense even the landscape is a resource (a source of beauty and quiet), and silence.
Figure 1 shows the weaving fault: if there is one-way traffic from a resource to a discharge point, it is logical that eventually in one place a shortage will occur and in another place a surplus.
In principle the weaving fault can be easily repaired by closing the cycle, as in figure 2: after use, you return the resources to their origin. *In principle* this is easy, but in real life usually it is not, because the system often is very complicated and has a lot of stakeholders.
This weaving fault, one-way traffic, occurs in many more cases. E.g. the greenhouse effect is caused by it. Look at figure 3, where in (a) the livestock feed is shown, and in (b) the one-way traffic which leads to the greenhouse effect. In this case, the resource is oil and gas (and more, e.g. pit coal and brown coal). Fossil fuels, that have been in the soil for hundreds of millions of years, and are now taken from it at high speed and burnt. The 'discharge' in this case is the emission of greenhouse gases in the atmosphere, carbon dioxide (CO_2) being the most important.
The one-way traffic of the greenhouse emissions as a weaving fault is also anchored strongly in the system, because about the entire world economy is based on oil and gas. The solution of this weaving fault cannot be found by closing the cycle of fossil fuels. In part it may be possible to pump the CO_2 back into the ground but the majority escapes into the atmosphere. That is why in this case the solution (at least partially) will have to be found in alternative energy sources, that can be a part of a closed cycle: energy from wind, water, sun.



Appendix 7: Figure 2. A closed cycle

And then there is the extraction of ores, such as iron, aluminum and other metals ('c' in figure 3). Here too is a resource that can be exhausted, since every kilogram you take out of the ground will not be replenished. The environmental contribution for recycling, discussed in the first chapter in case 3, is an attempt to contribute to closing this cycle by reusing components or recycling materials.
For each non-closed cycle, the question is always which problem is more serious: the shortage on the resource side, or the surplus on the discharge side. In the case of the livestock feed the worst problem is probably on the resource side, as the damage, especially in the developing countries, is huge. In the case of the fossil fuels it is rather the discharge side which is most severe, as the emission of greenhouse gases really cannot go on for decades, while probably sufficient oil and gas will be available for a longer period against acceptable extraction costs.



Appendix 7: Figure 3. Three examples of one-way traffic

Each of the examples of one-way traffic is a way to transfer the negative consequences of our economic well-being to others. In the case of the livestock feed, in the Netherlands we have the problem that we possess not enough surface area to grow the necessary feed. Instead of solving this problem on our own, we transfer it to people in other countries. In the case of the CO_2 we emit in the atmosphere, we transfer the damage of our energy consumption to nature and to future generations. The same is true for the waste dump.
In chapter 4 you will read more about this transfer mechanism.

One-way traffic: oil came from the soil, CO_2 vanishes into the air

Weaving faults and transitions
One-way traffic is not the only weaving fault in the system of the human civilization, although it is one of the more serious ones. There are more, and in this chapter you will study several others.
If, in the course of this chapter, you read about a series of these faults, it might be that you get pessimistic or even afraid. Perhaps you will get the impression that there are so many errors deeply rooted in our world system, that it will be virtually impossible to improve all of that, i.e. to really develop the world sustainably. If this is so, it is good to know that the next chapter will be about a long series of 'power sources', tools for improvement. So only at the end of that chapter you will be able to acquire a realistic image of both the system weaknesses as its inherent strengths, enabling you to make a balanced judgment. You will see that there are all kinds of reasons not to throw in the towel, but instead to put your back into it.
Putting our backs into it will be necessary, though. It's the deeply rooted weaving faults that cause the need for sustainable development. If they were all simple errors that could be solved easily and preferably independently, nobody would ever be talking about sustainable development. But exactly because it is about such fundamental and far-reaching subjects, sustainable development is a process that progresses very slowly, step by step. It will take decades at least. The necessary changes will turn over the system profoundly. In other words, you will see the world changing drastically. More than you can probably imagine.

There is a word for such a drastic change: transition. The changeover to sustainable agriculture can only happen through such a transition, as the agriculture- and food system contains real weaving faults. The same is true for the global energy system, which at present is mostly based on fossil fuels: another weaving fault, ergo only to be solved through a transition.

Questions

- An example of a transition in the past years is the introduction of modern electronics such as computers, mobile phones and internet. Can you imagine what your life would have been like without this transition?
- Transitions follow each other with an increasing speed, and besides develop faster and faster. Try to imagine what your life will look like in 25 years.

Appendix 7, part 3: Educational goals of chapter 2

These goals, based on the KISA model, are a part of the Teachers' Manual of the 'Basisboek Duurzame Ontwikkeling'. In chapter 2 the following goals are aimed at, using the text and the exercises:

Knowledge

At the end of the chapter the reader knows:

- One-way traffic and closed cycle
- Positive and negative feedback
- The concepts resource, transition, debt trap
- GDP, GDP per capita, PPP (purchasing power parity) dollar and green GDP
- Overuse and exhaustion, biocapacity, fair share, ecological footprint
- Dematerialization

Insight

At the end of the chapter the reader understands:

- The meaning of weaving faults in systems, and the consequences of them for sustainable development
- The effects of the one-way traffic for the purpose of cattle breeding in the Netherlands
- The effects of one-way traffic in general
- The causes and consequences of positive and negative feedback
- An overall image of the nature and dimensions of the growth of the world population
- The main aspects of inequity
- The causes and consequences of the debt trap of the poor countries
- The cultural domination by the rich countries
- Some causes and consequences of overuse and exhaustion
- The imbalance in the three P's
- Some different visions on the relation between the 3 P's
- The relation between the pursuance of efficiency and a number of consequences for society and the environment
- The long-term consequences of continuous economic growth
- The reasons for, and the consequences of barriers and subsidies in international trade
- The low efficiency of animal proteins

Skills

At the end of the chapter the reader is able to:

- Recognize and produce examples of one-way traffic, and propose ideas to close cycles
- Give examples of positive and negative feedback
- Compare the own personal financial situation with that of people living in poor countries
- Determine the own individual ecological footprint
- Determine an individual opinion about a fair distribution of prosperity

Attitude

At the end of the chapter the reader is:

- Aware that the presently dominant human systems are not the only possible ones
- Convinced of the serious consequences of the existing weaving faults in the systems
- Motivated to discover which systemic changes are thinkable
- Curious to find out which power sources can be used to change the systems

Appendix 8. Table of Contents of the book 'Werken aan Duurzame Ontwikkeling'

Appendix 9. Competences Cards for Sustainable Development, based on the RESFIA+D model

The RESFIA+D model is explained in §9.2. Based on this model, a set of Competence Cards for Sustainable Development is developed.The first parts of this set, the 'R' and the 'E' competence cards, are shown in this appendix.

Competence R: Responsibility

R1. Make a stakeholder analysis			
Apply	**Integrate**	**Improve**	**Innovate**
• You name all possible stakeholders of a certain professional activity within your own discipline. • For each of these stakeholders you describe their stakes.	• You name all possible stakeholders and their interests of a certain professional activity beyond the boundaries of your own discipline. • You divide the stakeholders and interests according to the categories 'people', 'planet' and 'profit' or 'prosperity'.	• You involve the conclusions of the stakeholder analysis in the design, performance and accounting of the activity. • You do this in cooperation with the stakeholders or their representatives. • You contribute thus to a balanced weighing of interests according to the categories 'people', 'planet' and 'profit' or 'prosperity'.	• You describe possible consequences for the stakeholders, including the possible future stakeholders, on the long term. • You describe them from several possible future scenario's.
R2. Take personal responsibility			
Apply	**Integrate**	**Improve**	**Innovate**
• You feel and show responsibility for your professional activities and the consequences of them.	• You feel and show shared responsibility for the professional activities performed by the teams[1] you belong to, and for the consequences of them. • Doing this, you put the activities, as far as possible and relevant, in a societal, economic, scientific, natural or other broader context. • Wherever several of your professional responsibilities conflict with each other, you make a careful weighing and act accordingly.	• Based on this responsibility you work regularly on improvement of the professional activities and their goals, aiming at a positive contribution to aspects of sustainable development.	• You realize your professional responsibility pro-actively, by relating it to present and possible future developments and trends.
R3. Render personal account to society			
Apply	**Integrate**	**Improve**	**Innovate**
• You describe your professional activity, their goals and results, and the consequences for stakeholders openly and honestly on behalf of your direct colleagues, peers and executives.[2]	• You do this also on behalf of a variety of other stakeholders[3], in a for each of them comprehensible and attractive way.	• You ask and get feedback from those to whom you render account to in this way, and you use this to continuously improve your activities.	• You yourself organize the total of target groups to which, and the methods with which you render account.
R4. Critically evaluate own actions			
Apply	**Integrate**	**Improve**	**Innovate**
• You evaluate your own actions in your professional work systematically.[4]	• In this evaluation you also involve feedback of others, and consider this carefully.	• You do this evaluation regularly, and you use the results to continuously improve your functioning.	• You use the results of the evaluation for you personal future planning.[5]

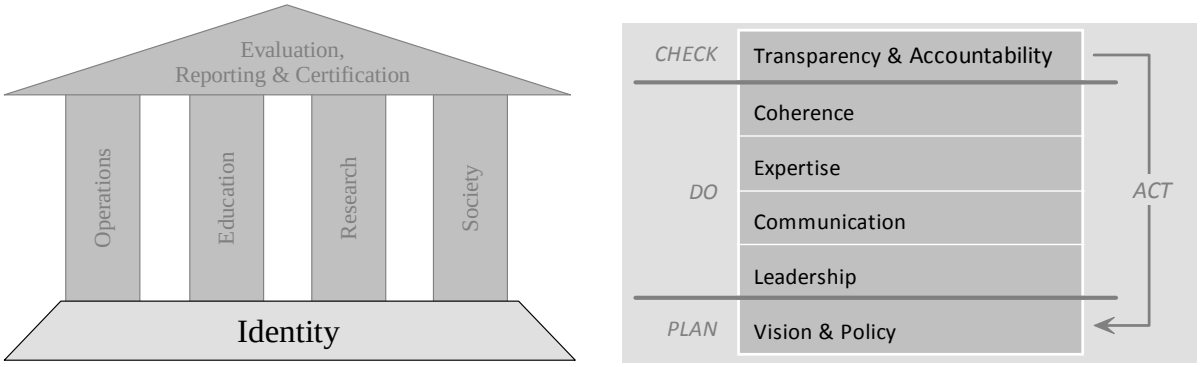
Competence E: Emotional intelligence

[1] E.g. a student group, a department, a company, a commission.
[2] This may be in the shape of formal reports, presentations, publications, books etc., and besides (but not exclusively) in a more informal way through e.g. conversations, stories, columns, websites, participation in online forums, TV programs.
[3] Such as: interest groups, civilians, members of your family, neighbors, journalists, government employees, schools.
[4] This may include concepts like: consequences, respect, objectivity, ethics, involvement, independence, freedom from prejudice, ability to cooperate, etc.
[5] Think e.g. of career planning, ambitions, lifelong learning, personality development, balance between work and private stakes.

E1. Recognize and respect own values and those of other people and cultures			
Apply	**Integrate**	**Improve**	**Innovate**
• You formulate the values from which you think and act as a professional.[1]	• You formulate the values from which others[2] think and act who are involved or have an interest in your professional actions. • You describe the differences and similarities between your values and those of others. • You communicate respectfully with these others about the differences in values.	• You cooperate with these others, during which you utilize both the similarities and the differences of the values as an enrichment and reinforcement of the quality of your activities.	• You enrich and reinforce the quality of your professional activities by actively expanding the cooperation to people or cultures with other values.
E2. Recognize and respect own action perspectives and those of other people and cultures			
Apply	**Integrate**	**Improve**	**Innovate**
• You formulate the action perspectives from which you act as a professional.[3]	• You formulate the action perspectives from which others act as professionals who are involved or have an interest in your prof. actions. • You describe the differences and similarities between your action perspectives and those of these others.[4] • You communicate respectfully and effectively about the differences in action perspectives.	• You cooperate with these others, during which you utilize both the similarities and the differences of the action perspectives as opportunities to reach the desired goals in various ways.	• You enlarge the chances of success of your professional activities by actively widening the cooperation to people or cultures with different action perspectives.
E3. Listen to opinions and emotions of others			
Apply	**Integrate**	**Improve**	**Innovate**
• You take the time to dedicate attention to the opinions and emotions of those with who you are in contact as a professional. • You are conscious of your own opinions and emotions concerning your professional activities and the contacts related to them, and distinguish between these and those of others.	• You 'listen actively' to others.[5] • You distinguish between emotions, opinions and rational thoughts, both of yourself and of others.	• Together with these others you use the communication about emotions and opinions to increase the quality of the cooperation and the activities.	• You see to it that relevant opinions and emotions of all stakeholders are expressed sufficiently in your professional activities.
E4. Distinguish between facts, presumptions and opinions			
Apply	**Integrate**	**Improve**	**Innovate**
• You determine about assertions[6] whether they are about facts, hypotheses or opinions.	• You communicate about such a conclusion in such a way that others, including the person who made the assertion, come to a consensus about its nature.	• You decide on which moment during your professional activity a fact is desired or a hypothesis or an opinion. You plan your activities accordingly.	• If necessary, you design acceptable and realistic ways to turn a hypothesis into a fact, or to change the nature of an assertion in any other way.[7]

[1] Relevant concepts are e.g.: cultural values, ethical standards, beliefs, philosophy of life, traditions. See: Roorda (2007), chapter 3.
[2] Such as: other people, whether or not in the same culture or country as you; families, societal groups, countries, etc.
[3] Action perspective: the image one has about the own options and those of others to reach certain goals or effects through actions. See: Roorda (2007), chapter 4.
[4] Some examples of differences in action perspectives: level of belief in own capabilities; globalizing versus antiglobalism; progression thinking versus 'back to the past'; revolution or evolution; emphasis on the collective versus to the individual.
[5] *Active listening* is not just hearing what the other says, but also trying to understand what the other says. Besides, listening skills enable you to let the other know that you listen, to let the other tell his story, and, whenever necessary, to let him clarify.
(Source: http://www.rug.nl/noordster/mondelingevaardigheden/voorstudenten/luisteren, 2008)
[6] Both assertions of yourself and of others.
[7] E.g. by: further investigation, further discussion, involving third persons, change an attempt to reach objectivity into an attempt to reach intersubjectivity, reformulating a question, research into the meaning of the words that are used.

Appendix 10. The first part of AISHE 2.0: the Identity Module



Introduction
The Identity Module describes a number of fundamental characteristics of the organization. Together they describe the essence, or the nature of the organization.
Relevant questions for this module are:

- Who are we?
- Why do we do the things we do?
- How can we make a real difference concerning sustainable development?
- Would it be correct to describe us as a 'sustainable organization'?

Ideally, the vision of the organization about itself plays an active role in all kinds of activities of the organization. This is not the main subject of the Identity Module, as it is assessed in each of the other modules, from Operations till Society.

Directions for the application
This module can be applied on several levels:

- a department, faculty or school (i.e. an organizational unit);
- a campus or building (i.e. a physical unit);
- a study program (i.e. a basic education unit) or a group of related study programs;
- a research program or institute;
- the entire university.

Wherever the term 'organization' is used, it should be interpreted accordingly. For advantages, disadvantages and directions regarding the various application levels, see chapter 4. An example: in several texts, the term 'vision' is used. If it is not the entire university that is assessed, but e.g. a study program, this term refers to the vision of the study program, i.e. of the management, the staff and possibly the students of the program. Probably this vision will not be independent of the vision of a larger organizational unit (a faculty or even the entire university). During the assessment it will be investigated whether this vision is 'alive' within the study program, i.e. the management & team of the program have its own ideas, opinions and specifications, based on the vision of the larger unit.

The criteria
Text that is marked refers to an explanation below.

I-1. Vision and Policy				
The organization has a vision on sustainable development and on corporate social responsibility in general, on aspects within the own fields of expertise and on the consequences of this for the organization policy. The vision is expressed in the policy. This policy translates the vision in concrete plans for action. Goals are formulated, and activities are designed aiming to realize these goals.				
***Stage* 1:** **Activity oriented**	***Stage* 2:** **Process oriented**	***Stage* 3:** **System oriented**	***Stage* 4:** **Chain oriented**	***Stage* 5:** **Society oriented**
- The management has a vision on sustainable development and CSR related to the activities of the organization. - The policy with respect to sustainable development is developed mainly top-down by the management. - This vision and policy are formulated implicitly.	- Main elements in the vision are the basic values and ethics of the organization. - The staff is actively involved in the continuous development and improvement of the vision and policy on sustainable development. - The vision and the policy on sustainable development have been formulated in documents. - The management offers facilities to work out the vision and the policy as concrete actions, mainly focusing on short term developments.	- The organization visions itself as a key player for sustainable development, at least on the level of adaptations and improvements. - The students are actively involved in the continuous development and improvement of the vision and policy on sustainable development. The organization can be characterized as a learning organization. - The vision has been expressed in the mission statement, and it has been worked out into a policy containing assessable goals, which are evaluated and adjusted regularly. - The sustainability policy is mainly focusing on middle long term developments.	- The organization is recognized by its direct stakeholders as a key player for sustainable development, acting in an intensive cooperation with these direct stakeholders on the level of long term developments and sustainable innovations. - This cooperation is the basis for the continuous improvement of the vision and policy on sustainable development, both of the organization and its direct stakeholders.	- Within society at large, the organization is recognized as a leading key player for sustainable development, acting pro-actively on the level of systemic change. - Society is actively involved in the continuous development and improvement of the vision and policy on sustainable development - The vision is integrated with the vision on long term development of society and the role in it of the organization.

Sustainable development: A generally accepted definition of the concept of sustainable development is the one of the Brundtland Commission (1987). According to their report, entitled "Our common future - the world commission on environment and development", sustainable development means:

> *… meeting the needs of the present generation without compromising the* **ability** *of future generations to meet their own needs.*

In the Higher Education 21-project, which was performed in the United Kingdom, sustainable development was described as:

> *Sustainable development is a process which enables all people to realize their potential and to improve their quality of life in ways that protect and enhance the Earth's life support systems.*

Goals*:* Wrongly, goals are often formulated as a series of activities. A goal is a description of the situation that will have to be realized at the end of a policy period. Goals are operationalized by formulating activities which are to lead to the goals that have been appointed.

CSR: Corporate Social Responsibility.

Mainly top-down: Although the ordinal scales of AISHE are cumulative, which means that the demands of lower stages are applicable to the higher stages as well, a restricting demand like this is of course not again a demand at higher stages. The same is true e.g. for the term 'implicitly'.

Implicitly: i.e. is not formulated explicitly in documents.

The staff: i.e. (at least) a representative part of the teaching staff.

Actively involved: this means more than just commenting on a draft version of the graduate profile. Instead, it implies a direct involvement from the very beginning of the (re)development process.

Documents: can relate to internal documents, e.g. meeting notes, but may also mean that a generally accepted declaration has been signed, for instance the World Declaration on Higher Education for the Twenty-first Century, the Copernicus Charter, or the Talloires Declaration.
The Copernicus Charter says about this in the preamble:

> *Universities are increasingly called upon to play a leading role in developing a multidisciplinary and ethically oriented form of education in order to devise solutions for the problems linked to sustainable development. They must therefore commit themselves to an ongoing process of informing, educating and mobilizing all the relevant parts of society concerning the consequences of ecological degradation, including its impact on global development and the conditions needed to ensure a sustainable and just world.*

Facilities: Think of: time, budget (e.g. for course- and travelling costs), timetable consequences, supervision, authorities, communication tools, etc.

Short term*:* about 1 to 2 years, mainly operationally oriented.

Adaptations and improvements: as opposed to **systemic change** (q.v.), i.e. less intensive changes.

The students: i.e. (at least) a representative part of the students.

Learning organization: an organization that encourages the learning of its members and continuously and consciously develops itself.

Mission statement: This may either be a part of the overall mission statement of the university or of a department, or a separate official text that is directly linked to the mission statement. An example:

> *Mission Statement of Aichi University of Education (abbreviated):*
> *"The university declares that its universal mission is to contribute to world peace, human welfare, and the advancement of arts, culture and sciences.Aichi University of Education ensures academic freedom with confidence that research in sciences, arts and humanities created out of free will contributes to world peace and the sustainable development and improvement of society.*
> *Aichi University of Education strives to be fully responsible and accountable to society through public information and public relations, and by constantly responding to the voices of communities, nations and global society.*
> *Every member of Aichi University of Education respects the fundamental human rights and the equality of the sexes, and is committed to the proscription of any form of human rights abuse such as discrimination and oppression."*
> *Source: http://www.aichi-edu.ac.jp/eng/mission_e.html, 2008*

If the AISHE assessment is performed to an entire university, its mission statement (or a comparable document) may be used for this criterion. If the assessment is related to a part of a university (e.g. a school, faculty, study program), the same is true if this part possesses its own particular mission statement (or a comparable document). If it does not, then the mission statement of the entire university is relevant; besides, the interpretation, eventual addenda, and the application of this mission statement within the assessed part is even more relevant.

Assessable goals: goals that have been formulated in such a way that it is possible to investigate in an objective or intersubjective way whether they have been reached or not. The "assessment" does not necessarily mean the determination of quantitative values on a ratio scale: e.g. performing an AISHE assessment, using ordinal scales, is an assessment too.

Middle long term: 3 to 5 years, with a tactical emphasis. **Long term**: 5 to 10 years or even more, on a strategic level.

Direct stakeholders: those persons or institutions that are explicitly mentioned as stakeholders of the activities and results of the organization. For the education this is the professional field. For the research and for the societal interactions it is either the persons or institutions that ordered or asked for the activities, that cooperate in implementing them, or a focus group that may benefit from the activities, e.g. a category of patients for whom a medical research takes place.

Systemic change: large-scale innovations in which fundamental structures are redesigned. This may involve physical structures as well as organizational or social structures.

Society: i.e. a representative delegation from societal organizations, *not* belonging to the direct stakeholders, which are otherwise stakeholders of the assessed organization in any (positive or negative) way. Examples are: the local community, ngo's, governmental organizations, primary, secondary or informal education, museums, festivals, consumer organizations, trade unions, interest groups, etc.

I-2. Leadership

The management is not only formally responsible for the integration of sustainable development in the organization vision and activities. It also takes leadership for it, i.e.: it shows personal involvement. It inspires the staff, the students and possibly the other stakeholders. It listens actively to them, knows and uses their ideas and opinions, and asks feedback about its functioning. Thus, it uses its authority in a genuinely participatory way.

***Stage* 1: Activity oriented**	***Stage* 2: Process oriented**	***Stage* 3: System oriented**	***Stage* 4: Chain oriented**	***Stage* 5: Society oriented**
- Occasionally, the management pays attention to and appreciates activities concerning sustainable development by staff members.	- The management promotes the relevance of sustainable development for the organization actively and regularly. - The management listens actively to the opinions of staff members and students about sustainable development. - The management supports initiatives from staff members or students.	- The management systematically stimulates, motivates and supports the processes of integration of sustainable development and the staff members who perform those projects. - The management systematically encourages an active participation and shared responsibility of the staff and the students in the development and improvement of the organization vision, strategy, policy, activities and result assessments. - This encouragement is based explicitly on the vision of the organization concerning sustainable development, and on a (middle-)long term strategy. - Corporate governance is a cornerstone of the organization strategy and policy.	- Based on a visible personal commitment, the management, the staff and the students together support and expand relations with the direct stakeholders and with centers of expertise, with the explicit aim of strengthening the process of integration of sustainable development into the organization. - These efforts take place on the basis of a long-term vision of the organization.	- The management, the staff and the students together stimulate and realize a pro-active and excellent role of the organization within society and the educational and professional field. - In this way, the entire organization shows leadership towards society concerning sustainable development.

Management: Every person or group with a formal managing, coaching or tutoring role. This includes e.g. teachers who give lessons and guidance to students, staff members who lead self-responsible teams or staff members who coach students in their internships.

Active listening: not just hearing what the other says, but also trying to understand what the other says. Besides, listening skills enable you to let the other know that you listen, to let the other tell his story, and, whenever necessary, to let him clarify. (Source: RUG, 2008)

Supports: i.e. not only mentally, but also with real facilities, e.g.: budget, time, work schedules, information, training programs, authorizations, supervision.

Encourages: i.e. instead of waiting for initiatives of staff or students, the management stimulates their involvement in a variety of ways.

I-3. Communication

Communication about sustainable development in relation to the organization takes place, both within the organization and with the outside world. The communication is used to strengthen the organization vision about sustainable development, to develop new initiatives, and to inform and get feedback from all sorts of stakeholders, e.g. staff, students, the professional field and other direct stakeholders, and society in general.

***Stage* 1: Activity oriented**	***Stage* 2: Process oriented**	***Stage* 3: System oriented**	***Stage* 4: Chain oriented**	***Stage* 5: Society oriented**
- Efforts of individual members of the staff or of parts of the organization to enlarge the attention for sustainability take place. - Staff members are informed about sustainability initiatives of the management on an ad hoc basis, often at their own request.	- Sustainable development is a regularly appearing subject in meetings and in internal and external publications and presentations.	- The communication about sustainable development is based on a structured communication plan. - The staff and the management are well-informed about each other's opinions and aspirations concerning sustainable development.	- The direct stakeholders are actively involved in the communication about sustainable development. - This communication is in both directions, not only aimed at the interests of the organization itself but also of the direct stakeholders. - Publications by staff members and/or students with a clear relation to sustainability appear regularly in scientific journals or public media.	- A wide variety of societal actors is involved in the communication about sustainability - This communication is in both directions, not only aimed at the interests of the organization itself but also of society in general. - Publications by staff members and/or students, are leading.

Subject in meetings: not just because, as a habit, the subject of sustainable development is put on every agenda, but rather because there really is something to discuss.

Publications: These may be scientific publications in journals. But also: books, proceedings of meetings, annual reports, university magazines, brochures, PR posters, press releases, web pages, etc.

Structured communication plan: In this plan, at least an overview is given of:

- Reasons to communicate (e.g. inform, being informed, generate information, raise awareness or involvement, stimulate, reward, etc.);
- Persons or groups with whom the communication takes place (e.g. teaching staff, staff in general, students, professional field, clients, patients, other direct stakeholders, press media, procurers, society in general, etc.)
- Means of communication (e.g. letters, e-mail, sms, meetings, debates, brainstorms, newsletters, informal conversation, symposia, etc.)
- A time schedule.

I-4. Expertise

The expertise available to the organization about sustainable development is kept up-to-date and is sufficient to enable to work actively on the integration and improvement of sustainable development in the vision and the activities of the organization.
Partly, this expertise is available within the organization staff. Besides, an external network is functioning in order to utilize the expertise available in the outside world.

***Stage* 1: Activity oriented**	***Stage* 2: Process oriented**	***Stage* 3: System oriented**	***Stage* 4: Chain oriented**	***Stage* 5: Society oriented**
- Staff development in sustainability depends on individual initiatives. - Individual staff members have contacts with the direct stakeholders and with centers of expertise, in order to enlarge their knowledge and experience about sustainability.	- There is a staff development plan in sustainability. This plan is mainly short term related. - For the execution of the plan, facilities are made available by the management. - On a regular basis, the organization benefits from the expertise about sustainability that is present with the direct stakeholders.	- There is a systematic staff development plan related to sustainable development, aimed at a middle long term. - The expertise of the direct stakeholders is used systematically for the realization of this plan. - For this goal, the external network is maintained and expanded systematically.	- The regular contacts with the external network not only contribute to the expertise within the organization, but also to the expertise of the network partners.	- The organization is or has an (inter)nationally recognized center of expertise concerning sustainable development. - Characteristics of this center are terms like: excellent, innovative, pro-active, long-term future-oriented. - Society and the process of sustainable development benefit clearly from this expertise.

Staff development plan: This is either a separate plan dedicated to sustainable development, or a part of a more general staff development plan.

Benefits from: either directly, e.g. through appearances of visiting teachers, or indirectly, through enlargement of the knowledge of the teaching staff.

Systematic staff development plan: The plan is systematic, thanks to:

- A systematic and regularly repeated investigation into the needs of the organization of expertise concerning sustainable development;
- A systematic and regularly repeated investigation into the present expertise on sustainable development of individual staff members and their ambitions to enlarge this expertise;
- An optimal combination of both kinds of information, aimed at a middle long- or long-term perspective, including e.g. refresher courses, continuing education, job descriptions for vacancies.

Contribute to: I.e. information is passed between all members of the network; and besides, the accumulated expertise is used in an interdisciplinary way to generate new knowledge and experience.

I-5. Coherence

A university can contribute to sustainable development in a variety of roles: through its education, its research, its own operations and its direct contribution to society. These various roles may strengthen each other if there is cooperation between them. For instance, the campus may be used as a tool for the education, the research or societal interactions. Students may contribute to sustainability research or to community development. Coherence between the roles enables the institution to act according to its own standards ('practice what it preaches').

***Stage* 1: Activity oriented**	***Stage* 2: Process oriented**	***Stage* 3: System oriented**	***Stage* 4: Chain oriented**	***Stage* 5: Society oriented**
- Occasionally, mostly ad hoc, actions of designing or implementing sustainable development in several roles of the organization are clearly in mutual interaction.	- Many examples can be given where several of the four roles strengthen each other with respect to subjects or actions that are explicitly related to aspects of sustainable development.	- Policies and actions related to sustainable development in the four roles are related to each other in a systematic way. - This creates a strong synergy, which inspires and is evidently beneficial to the people and institutes working on all four roles. - This synergic structure is explicitly based on the vision of the organization about sustainable development.	- The organization functions as a holistic entity of which all departments, institutes and study programs are organic parts that interact continuously. - The synergic relations of policies and actions are not only existent between the four roles of the organization, but it also involves a range of direct stakeholders.	- The organization has a strong 'open doors' policy, and through the societal synergy this creates, it forms an organic whole with many actors in society. - Thanks to this, the organization contributes to sustainable systemic changes of society, including itself.

Several roles: This refers to the four roles that a university can have: education, research, operations and society (see §2.5). The division into these four roles is the basis for the modular structure of AISHE 2.0.
Within the four role modules, only subjects are assessed that are related to that separate role. The present criterion asks for the relations between the four roles.

Explicitly related: i.e. not just related to sustainability aspects with hindsight during the assessment, but with an explicit and planned reference to sustainability.
(An example of a 'relation with hindsight' is a remark that 'our human resource management is well-designed and people-friendly; I think I can call this sustainable!' Opinions like these don't score.)

I-6. Transparency and accountability				
The institution reports to its stakeholders about its activities and results concerning sustainable development in a transparent way, and thus it renders account to those stakeholders, including society as a whole.				
***Stage* 1: Activity oriented**	***Stage* 2: Process oriented**	***Stage* 3: System oriented**	***Stage* 4: Chain oriented**	***Stage* 5: Society oriented**
- Occasionally, the management provides information about individual goals, processes and results related to sustainable development. - This happens mainly only if asked. - The information is mainly provided to a limited group of staff members within the organization.	- Periodically, the management provides structured information about goals, processes and results concerning sustainable development and CSR. - The information is mainly provided to all staff members and students.	- The sustainability & CSR reporting is systematically integrated in the annual public reporting. - The reporting is based on a complete stakeholder analysis. - An (inter)nationally accepted reporting standard is used that explicitly aims at transparency and public accountability.	- The organization gathers systematic feedback on the sustainability & CSR reporting from the direct stakeholders. - In this way, the organization holds itself accountable for all of its goals, actions and impacts. - This feedback is used systematically to improve the goals, processes and results.	- The external accountability is a cornerstone of the CSR and sustainability vision of the organization. - In order to implement this, the organization gathers systematic feedback on the sustainability & CSR reporting from a wide variety of representatives of society. - This feedback is used systematically to improve the goals, processes and results.

Stakeholder analysis: Based on an analysis of the consequence reach and the consequence period of the organizational goals, processes and effects.
This implies that the stakeholder analysis not only includes the present but also future generations.
The stakes can either be positive or negative.

Consequence reach: The total size of the people, the organizations, nature and the environment that experience the consequences of a decision, a behavior or a lifestyle.

Consequence period: The time it takes before the consequences of a decision, a behavior or a lifestyle have disappeared.

Reporting standard: A standard that is based on principles of sustainability and CSR. An example is the Global Reporting Initiative (GRI) standard (GRI, 2002).

Nederlandse samenvatting

Duurzame ontwikkeling is niet meer weg te denken uit de samenleving. Het is een voornaam proces geworden, dat vorm geeft aan de toekomst van de mens en van onze planeet. Onderwijs zal in dit proces een belangrijk aandeel dienen te hebben, aangezien het bijdraagt aan deze toekomst zoals geen enkele andere sector in de samenleving. De centrale vraag van 'Onderwijs voor Duurzame Ontwikkeling' ('Education for Sustainable Development', ESD) is: "Welke strategieën zijn geschikt om ervoor te zorgen dat het onderwijs effectief bijdraagt aan duurzame ontwikkeling?" Het huidige promotieonderzoek is een poging om vruchtbare strategieën voor ESD te ontdekken.
In de loop van het proefschrift wordt een hypothese getest die stelt dat een succesvolle strategie er een is van 'zeilen op de wind van verandering', d.w.z. het volgen en gebruiken van veranderingsprocessen die al optreden in het hoger onderwijs, mits zulke veranderingsprocessen inderdaad plaatsvinden en in een geschikte richting bewegen.

In de laatste decennia is ESD een nieuw veld van wetenschappelijk onderzoek geworden, dat beschreven wordt in **hoofdstuk 1**. Het maakt gebruik van recent ontwikkelde of verbeterde wetenschappelijke methoden en paradigma's, zoals casestudy onderzoek, actieonderzoek, mode-2 wetenschap, postnormale wetenschap en transdisciplinair onderzoek. Samen vormen deze het fundament voor het promotieonderzoek dat wordt gepresenteerd in dit proefschrift. Een belangrijk principe van casestudies is 'triangulatie', dat de onderzoeker in staat stelt om empirische informatie vanuit verschillende soorten bronnen te combineren. Dit principe zal intensief worden toegepast.
Het onderzoek was inderdaad actieonderzoek, uitgevoerd als een keten van casestudies die plaatsvonden tussen 1991 en 2009. Elk volgde de bovengenoemde strategie van 'zeilen op de wind van verandering'. Sommige waren succesvoller dan andere. Teneinde de successen en de tegenvallers te begrijpen, worden diverse theoretische modellen toegepast die veranderingsprocessen beschrijven. De voor dit onderzoek voornaamste modellen zijn: een model van Sterling voor het niveau van verandering; een model van De Caluwé & Vermaak voor het type veranderingsproces; en een model van Bridges dat de natuurlijke ontwikkeling van organisaties beschrijft.

Hoofdstuk 2 beschrijft het concept duurzame ontwikkeling, en definieert het op een wijze die volstaat voor het onderhavige onderzoek. Het effect van onderwijs op duurzame ontwikkeling wordt besproken, zowel op een mondiaal niveau, waaronder het Decennium van Onderwijs voor Duurzame Ontwikkeling van de Verenigde Naties, als in Nederland, inclusief de Nederlandse nationale strategie voor duurzame ontwikkeling. Het omgekeerde, dat wil zeggen het effect van duurzame ontwikkeling op het onderwijs, wordt met enige diepgang bestudeerd, aangezien dit effect essentieel is voor het promotieonderzoek. Verschillende literatuurbronnen worden geraadpleegd, waaronder Agenda 21 en een reeks van publicaties van ESD-onderzoekers, hetgeen leidt tot een overzicht van kenmerken die karakteristiek zijn voor onderwijs dat effectief bijdraagt aan duurzame ontwikkeling. Dit overzicht wordt door het gehele proefschrift gebruikt als een checklist om een belangrijk aspect van de diverse experimenten te beoordelen.

Hoofdstuk 3 is gewijd aan de selectie van het onderzoeksgebied. Dat is de sector van het Nederlandse HBO, het Hoger Beroepsonderwijs, dat zo'n tweederde van het gehele Nederlandse hoger onderwijs vormt. In de laatste twee decennia, dezelfde periode waarin de keten van experimenten van het promotieonderzoek plaatsvond, onderging deze sector een serie ingrijpende veranderingsprocessen. Deze processen worden kort beschreven in hoofdstuk 3, waarna ze in latere hoofdstukken gedetailleerder worden onderzocht.
Vervolgens beschrijft hoofdstuk 3 de uitgevoerde experimenten. Vijf daarvan zijn voltooid, elk in gemiddeld zo'n vier jaar. Drie andere experimenten begonnen slechts enkele jaren geleden en zijn nog niet afgerond.
Het hoofdstuk eindigt met de beschrijving van de wijze waarop de resultaten van elk van de experimenten systematisch wordt beoordeeld. Een reeks succescriteria wordt beschreven die gebruikt is voor alle experimenten, en er wordt aangetoond dat deze criteria samen voldoen aan de validiteitseisen waaraan het toegepaste type onderzoek dient te voldoen.

De volgende vijf hoofdstukken zijn elk gewijd aan een van de voltooide experimenten. Ze hebben alle dezelfde structuur. In het eerste ervan, **hoofdstuk 4**, wordt eerst de context beschreven waarin het experiment plaatsvond, d.w.z. de veranderingsprocessen in het HBO die in die periode optraden, zoals een golf van fusies tussen HBO-instellingen en een lawine van nieuwe opleidingen. In deze context werd een passende ESD-strategie gevolgd tussen 1991 en 1994, namelijk de ontwikkeling van een geheel nieuwe opleiding gericht op duurzame technologie in een hogeschool in het zuiden van Nederland. De filosofie, de ontwikkeling en het resulterende curriculum worden beschreven in het tweede gedeelte van hoofdstuk 4, gevolgd door een beoordeling van de resultaten, waarna tenslotte een conclusie wordt getrokken over de sterkten en zwakten van de toegepaste ESD-strategie.

Het tweede experiment vond plaats in een context waarin een reeks van nieuwe onderwijsmethodieken werden ingevoerd in het HBO, zoals probleemgestuurd onderwijs en projectonderwijs. De tweede strategie, onderwerp van **hoofdstuk 5**, richtte zich op de toepassing van zulke methodieken ten behoeve van ESD. Voor dit doel werd de opleiding die in hoofdstuk 4 werd beschreven herontworpen in de jaren 1994 tot 1998, waarbij doelen werden nagestreefd zoals een meer actieve houding van de studenten en een meer multidisciplinair curriculum. Na een beschrij-

ving van de context en van de hernieuwde ontwikkeling van de opleiding worden weer de resultaten beoordeeld, en conclusies worden getrokken omtrent de effectiviteit van de gevolgde strategie.

Hoofdstuk 6 beschrijft een experiment waarin een poging werd gedaan om duurzame ontwikkeling te integreren in de 13 opleidingen van een Faculteit Techniek, waarvan de meeste tot dan toe weinig of geen aandacht besteedden aan duurzaamheidgerelateerde aspecten. Dit was een logische ESD-strategie in die periode, 1998 tot 2002, omdat in die tijd getracht werd om het HBO te herstructureren en het aantal opleidingen te verkleinen teneinde de inzichtelijkheid en de kwaliteit te verhogen. Het Cirrus Project werd ondersteund door een flink aantal bedrijven, nationale en locale overheidsinstellingen, ngo's, en door de HBO-raad, de vereniging van hogescholen. Net als in de vorige hoofdstukken worden de successen en mislukkingen van het experiment beoordeeld met gebruikmaking van de managementtheorieën beschreven in hoofdstuk 1.

In **hoofdstuk 7** wordt de ontwikkeling beschreven van een instrument voor de beoordeling van de mate van succes van de integratie van duurzame ontwikkeling in het curriculum van opleidingen, in de stijl van kwaliteitsmanagement. Het instrument, 'AISHE', werd ontwikkeld in 2000 – 2001. Tussen 2002 and nu werd het toegepast met behulp van consultancy, aangeboden aan de Nederlandse universiteiten en hogescholen door DHO, de Stichting Duurzaam Hoger Onderwijs. Gebaseerd op AISHE audits wordt het Keurmerk Duurzaam Hoger Onderwijs toegekend aan succesvolle opleidingen of afdelingen. De aanpak en de methoden van deze consultancy worden beschreven en geëvalueerd. Een fundamenteel principe, 'systeemintegratie van duurzame ontwikkeling' ('system integration of sustainable development', SISD) wordt gedefinieerd en operationeel gemaakt, waarna casestudies worden gebruikt om aan te tonen dat SISD haalbaar is en ook daadwerkelijk is gerealiseerd.

Het experiment van **hoofdstuk 8** vond plaats in een context waarin het HBO deel was van het internationaliseringsproces van het hoger onderwijs, onder meer in de vorm van het Bologna proces, en waarin flexibele leerroutes en ICT steeds belangrijker werden. Uit onderzoek bleek een toenemende behoefte aan onderwijsmaterialen over duurzame ontwikkeling, en daarom werd een strategie gevolgd waarin een instrument werd ontwikkeld voor de introductie van duurzame ontwikkeling voor zowel docenten als studenten. De kern van het instrument is een studieboek getiteld 'Basisboek Duurzame Ontwikkeling', dat werd gepubliceerd in 2006. Daarbij zijn diverse andere hulpmiddelen ontwikkeld, alle beschikbaar via een website. Het DO introductie-instrument is tussen 2006 en heden toegepast in hogescholen, en de mate waarin dit tegemoetkomt aan de behoeften van docenten en studenten wordt beoordeeld.

Hoofdstuk 9 beschrijft de drie experimenten die momenteel nog uitvoering zijn. De structuur van dit hoofdstuk wijkt af van de vorige, aangezien er nog geen resultaatbeoordeling mogelijk is, en er dus ook geen conclusies kunnen worden getrokken.
Opnieuw wordt eerst de context beschreven, d.w.z. een in deze periode relevant veranderingsproces. In dit geval betreft dit de introductie van competentiegericht onderwijs.
Het eerste van de drie nog lopende experimenten betreft het ontwerp van een instrument voor de ontwikkeling of bijstelling van het competentieprofiel van een opleiding vanuit duurzaamheidsperspectief. De 'DO Competentiekaarten' zijn gebaseerd op een model voor duurzaamheidscompetenties genaamd 'VESTIA+D', dat wordt uiteengezet in een boek dat voor dat doel is geschreven.
Het tweede huidige experiment richt zich op de curriculuminhoud. De 'DO Curriculumscan' is te gebruiken door onderwijsontwikkelaars om hun curriculum te vergelijken met een lijst van thema's en onderwerpen, waardoor zij in staat zijn om sterkten, zwakten en 'witte plekken' met betrekking tot duurzame ontwikkeling te ontdekken.
Het laatste nog lopende experiment betreft het herontwerp van het AISHE auditinstrument, deze keer door een internationale groep. Het doel is om het onderzoeksterrein van AISHE, dat in de eerste versie gericht is op de onderwijsrol van universiteiten en hogescholen, uit te breiden tot de andere rollen: onderzoek, bedrijfsvoering en maatschappelijke activiteiten.

In het afsluitende **hoofdstuk 10** komen alle lijnen samen. De eerste paragraaf heeft een analytisch karakter, waarin de verschillende experimenten onderling worden vergeleken, gevolgd door een poging om een aantal algemene conclusies te trekken over de vraag waarom bepaalde strategieën succesvol waren en andere minder.
De tweede paragraaf brengt een volledige synthese van alle resultaten, gebaseerd op een 'grote triangulatie'. Hier wordt de conclusie getrokken dat elk van de ontwikkelingsprocessen in het HBO in de afgelopen twintig jaar, afzonderlijk gezien, niet meer waren dan een proces van aanpassing of a hervorming; maar dat zij niettemin samen een samenhangende en diepgaande transformatie vormen van het hoger onderwijs. Echter, totdat systeemintegratie van duurzame ontwikkeling (SISD) is gerealiseerd in het gehele HBO, is deze transformatie incompleet.
Gebaseerd op de conclusies over de mate waarin de diverse toegepaste strategieën van het promotieonderzoek succesvol waren, wordt de slotvraag beantwoord met de conclusie dat bewezen is dat het fundamentele principe achter alle experimenten, 'zeilen op de wind van verandering', succesvol is.

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M2 study program, 1991 – 1998
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Cirrus Project, 1998 – 2002
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DHO & AISHE, 2000 – 2008
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List of abbreviations

ABM	Academy of Building and Management (of Avans Hogeschool)
ACO	Adviescommissie Onderwijsaanbod (Advisory Commission on Education Availability)
AISHE	Auditing (or: Assessment) Instrument of Sustainability in Higher Education
ALS	Academy of Life Sciences (of Avans Hogeschool)
ATGM	Academy of Technology for Health and Environment (of Avans Hogeschool)
ATM	Academy of Technology and Management (of Avans Hogeschool)
BAA	Bachelor of Applied Arts
BaMa	Bachelor-Master
BASc	Bachelor of Applied Sciences
BDI	Library and Documentation Program (of the HB)
BS	British Standard
CAE	Computer aided education
CBE	Competence based education
CDHO	Commissie Duurzaam Hoger Onderwijs (Commission on Sustainable Higher Education)
CLTM	Commissie Lange Termijn Milieubeleid (Dutch Commission on Long-Term Environmental Policy)
CRE	Conférence des Recteurs Européens (Association of European Universities)
CROHO	Centraal Register van Opleidingen in het Hoger Onderwijs (Central Register of Higher Education Study Programs)
CSR	Corporate Social Responsibility
DESD	United Nations Decade of Education for Sustainable Development
DFD	Design for Disassembly
Dfl	Guilders (Dutch currency before the euro)
DHO	Stichting Duurzaam Hoger Onderwijs (Dutch Foundation for Sustainable Higher Education)
DTO	Duurzame Technologische Ontwikkeling *(= STD)*
EAC	Earlier / elsewhere acquired competences *(= EVC)*
ECTS	European Credit Transfer (and Accumulation) System
EFQM	European Foundation for Quality Management
EHEA	European Higher Education Area
EMAS	Eco-Management & Audit Scheme
EMS	Environmental management system
EOLSS	Encyclopedia of Life Support Systems
ESD	Education for sustainable development
EUA	European University Association
EVC	Eerder / elders verworven competenties *(= EAC)*
EVS	European Virtual Seminar
EZ	Ministerie van Economische Zaken (Ministry of Economic Affairs)
FTN	Faculteit Techniek en Natuur (Faculty of Technology and Nature of the HB)
GHESP	Global Higher Education for Sustainability Partnership
GRI	Global Reporting Initiative
HAVO	Hoger Algemeen Vormend Onderwijs (general secondary education in the Netherlands)
HB	Hogeschool Brabant
HBO	Hoger Beroepsonderwijs (Dutch higher education sector of the Universities of Applied Sciences)
HE	Higher education
HE21	Higher Education 21 programme
HEI	Higher Education Institution
HMB	Hogeschool Midden-Brabant
HOAK	Hoger Onderwijs: Autonomie en Kwaliteit (Higher Education: Autonomy and Quality)
HTRO	Hogere Toeristische en Recreatieve Opleiding (Study Program of Tourism and Recreation Management of the Hogeschool Inholland)
HU2	Högre Utbildning för Hållbar Utveckling (Swedish Network of Higher Education for Sustainable Development)
HWB	Hogeschool West-Brabant
IAU	International Association of Universities
ICT	Information & communication technology
IJSHE	International Journal of Sustainability in Higher Education
INK	Instituut Nederlandse Kwaliteit (Dutch Institute for Quality)
IPH	Integrated Problem Handling
JIT	Just in time
KADO	Kabinetsbrede Aanpak Duurzame Ontwikkeling (Cabinet-wide sustainable development strategy)
KISA	Knowledge, insight, skills, attitude *(= KIVA)*
KIVA	Kennis, inzicht, vaardigheden, attitude *(= KISA)*
KIvI	Koninklijk Instituut voor Ingenieurs (Dutch Royal Institute for Engineers)
KOV	Kennis Overdracht en Verankering *(= KTI)*
KTI	Knowledge Transfer and Implementation *(= KOV)*
LCA	Lifecycle Analysis (or: Assessment)
LHUMP	Landelijk Hogeschool- en Universitair Milieu Platform (National Higher Education Environmental Platform)
LNV	Ministerie van Landbouw, Natuurbeheer en Visserij (Ministry of Agriculture, Nature Protection and Fisheries)
LvDO	Leren voor Duurzame Ontwikkeling (Learning for Sustainable Development)

M2	Milieugerichte Materiaaltechnologie (Environmentally Oriented Materials Technology, study program of the HMB)
MER	Management, Economie en Recht (School of Management, Economics and Law of Fontys Hogescholen and of other universities)
MJA	Meerjarenafspraak energie (long-term agreement on energy)
NCDO	Narionale Commissie voor Internationale Samenwerking en Duurzame Ontwikkeling (National Committee for International Cooperation and Sustainable Development)
NDBB	Netwerk Duurzaam Brabants Beroepsonderwijs (Network of Profession Oriented Education in North Brabant)
NGO	Non-governmental organization
NMP	Nationaal Milieubeleidsplan (Dutch National Environmental Policy Plan)
NVAO	Nederlands-Vlaamse Accreditatie Organisatie (Dutch and Flemish Higher Education Accreditation Organisation)
O&W	Ministerie van Onderwijs en Wetenschap (Ministry of Education and Science)
OCW	Ministerie van Onderwijs, Cultuur en Wetenschap (Ministry of Education, Culture and Science)
OECD	Organization for Economic Cooperation and Development
Pabo	Pedagogische academie basisonderwijs (Pedagogical academy for primary education)
PBL	Problem Based Learning *(= PGO)*
PE	Project education
PGO	Probleemgestuurd onderwijs *(= PBL)*
PTH	Pedagogisch-Technische Hogeschool (School for Teacher Education for Secondary Technology Education of Fontys Hogescholen)
RCE	Regional Center of Expertise
RESFIA+D	Model for SD Competences: Responsibility, Emotional Intelligence, System orientation, Future orientation, personal Involvement, Action skills + Disciplinary competences *(= VESTIA+D)*
RMNO	Raad voor Ruimtelijk, Milieu- en Natuuronderzoek (Dutch Advisory Council for Research on Spatial planning, Nature and the Environment)
SD	Sustainable development
SER	Sociaal-Economische Raad (Social-Economic Council)
SISD	System integration of sustainable development
SKO	Stichting Kennisontwikkeling (Foundation for Knowledge Development)
STC	Schaalvergroting, Taakverdeling en Concentratie (Up-scaling, Task-Allocation and Concentration)
STD	Dutch National Inter-Ministerial Program for Sustainable Technology Development *(= DTO)*
STIR	Stimuleringsfonds Internationale Universitaire Samenwerkingsrelaties (Stimulation Fund for International University Cooperation Relations)
TDO	Technologie voor Duurzame Ontwikkeling (Center of Technology for Sustainable Development of Eindhoven Polytechnic University)
TNW	Toegepaste Natuurwetenschappen (School of Applied Sciences of Fontys Hogescholen)
TQM	Total quality management
UNCED	United Nations Conference on Environment and Development (Rio de Janeiro, 1992)
UNECE	United Nations Economic Commission for Europe
UNU	United Nations University
V&W	Ministerie van Verkeer en Waterstaat (Ministry of Transport, Public Works and Water Management)
VBI	Visiterende en Beoordelende Instantie (Visiting and Assessing Institution)
VCSE	Virtual Campus for a Sustainable Europe
VEC(A)	Virtual Environmental Consultancy (Agency)
VESTIA + D	Verantwoordelijkheid, Emotionele intelligentie, Systeemgerichtheid, Toekomstgerichtheid, persoonlijke Inzet, Actievaardigheid + Disciplinaire competenties *(= RESFIA + D)*
VROM	Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieu (Ministry of Housing, Spatial Planning and the Environment)
VSNU	Vereniging van Samenwerkende Nederlandse Universiteiten (Association of Universities in the Netherlands)
VWO	Voorbereidend Wetenschappelijk Onderwijs (Preparatory Scientific Education)
WCED	World Commission on Environment and Development
WHBO	Wet op het Hoger Beroepsonderwijs (Law on Higher Professional Education)
WHW	Wet op het Hoger en Wetenschappelijk Onderwijs (Higher Education and Research Act)
WSSD	World Summit on Sustainable Development (Johannesburg, 2002)

Alphabetical register

About the author

Niko Roorda was born on April 12, 1955 in Apeldoorn, Netherlands. In 1972 he received his secondary education (HBS) diploma in Hilversum. He studied astronomy at Leiden University, and after receiving his candidate diploma (comparable nowadays to BSc) he went to Utrecht University, where he studied theoretical physics and the philosophy of science. He received his doctoral diploma (MSc) in 1981. In the meantime he had worked several times as a replacement teacher in schools for secondary education, and after his MSc diploma he started his career as a teacher of physics and mathematics, first in Schiedam and later in Leiden.

In 1990 he moved to Tilburg and started working in the Hogeschool Midden-Brabant, a University of Applied Sciences, as a teacher of physics, mathematics, statistics and ICT. His first activities concerning sustainable development began in 1991, when he started developing, together with others, a new study program focusing on sustainable technology. This was the first of a series of experiments on the integration of sustainable development into university education which form the topic of the present PhD thesis.

From 1994 he was the manager of this study program, until 1998, when he started the preparations for the Cirrus Project, which intended to integrate sustainable development within the curricula of the 13 study programs of the Faculty of Technology of the Hogeschool Brabant in Breda and Tilburg, in which the former Hogeschool Midden-Brabant was one of the merging partners. This project was finished in 2002, and it was awarded with the National Award for Innovation and Sustainable Development, the 'Egg of Columbus'. Niko still works for the university he started in 1990, which is now called Avans Hogeschool after a second merger. In the meantime Niko also started working for the Dutch Foundation for Sustainability in Higher Education (DHO). For this NGO he designed AISHE, the 'assessment instrument for sustainability in higher education'. With this and other tools he worked as a consultant for DHO, visiting and coaching many universities in the Netherlands and several in other countries.

In 2006 his first book was published, the 'Basisboek Duurzame Ontwikkeling' (Basic Book on Sustainable Development), a study book for first-year students. This was followed in 2007 by the sequel 'Werken aan Duurzame Ontwikkeling' (Working on Sustainable Development), aiming at higher-level students, and contributing to competence-based education. In 2008 his next book was published, this time aiming not at students but at a larger general public, entitled 'Ons huis, Planeet Aarde' (Our house, Planet Earth).