SUCCESSFUL STRATEGIES FOR ESD

Sailing on the winds of change

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Abstract

In a series of eight experiments on ESD (education for sustainable development) between 1991 and 2010, a range of different strategies were applied, e.g. the development of a new study program dedicated to sustainable technology, the integration of SD (sustainable development) in existing programs, the development of an ESD assessment tool (AISHE) together with a system for consultancy and certification, and a tool for the introduction of SD, consisting of a textbook for students and a range of online accessories. In his dissertation, Niko Roorda described and evaluated the various experiments. He compared them with the change processes that have taken place in the same two decades within his field of study: 'HBO', the Dutch Universities of Applied Sciences. The central philosophy behind all experiments was, to make use of these change processes for the implementation of ESD, in a process that can be described as 'Sailing on the Winds of Change', as the hypothesis was that this would render a successful strategy.

Based on the evaluation of the various experiments, making use of a variety of models and theories about ESD, management and change, in the dissertation (Roorda, 2010) the conclusion is drawn that indeed 'sailing on the winds of change' is a fruitful approach, able of realizing a transformation of education towards ESD.

The present paper is a shorter version of the dissertation and its main conclusions.

Keywords

transformation, transition, strategy, change, system integration

1. The impact of sustainable development on higher education

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.

1.1. 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. (...) 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 1 offers an overview of the main topics mentioned in Agenda 21.

Table 1. 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)

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 (2004), who claims that the nature of sustainable development requires a fundamental change of epistemology, and therefore, of education. 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.

1.2. The transformation of education

In the literature about sustainable development, many authors emphasize the importance of sustainability transitions. The above citations 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.

1.2.1. Levels of change, according to Sterling

Sterling (2004) defines the concept of 'transformation', and compares it with lower-level change processes, as table 2 shows.

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.

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.

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.

1.2.2. Transformations and transitions

Sterling (2004) descibes a process of transformation as "a deep, conscious reordering of assumptions which leads to paradigm change". 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". Sterling also 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 make use of both the terms ‘transition’ and ‘transformation’, e.g. Speth (1992) and Mazmanian & Kraft (1999), such that they seem to treat them as more or less the same concept.

The use of the term ‘transformation’ or of ‘transition’ seems to be a ‘cultural’ difference between the sciences of SD and ESD. The literature about SD related to systemic change commonly uses ‘transition’; the literature about ESD usually speaks of ‘transformation’. Here, the two terms will be treated as 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 above 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.

1.3. Characteristics of ESD: a checklist

So, what is to be expected from education? Where should a transformation of higher education lead it to, in order to enable it to effectively contribute to sustainable development?

The UN Economic Commission for Europe (UNECE) developed an ESD strategy in 2005. The Committee on Environmental Policy 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 SD, making them more competent and confident and increasing their opportunities for acting for a healthy and productive life in harmony with nature and with concern for social values, gender equity and cultural diversity.” (UNECE, 2005). 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 envi-

ronmental 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 the above authors, and other sources are integrated, table 3 results.

Table 3. 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 (2004, 2005), UNECE (2005), Martens (2006), Van Dam-Mieras (2007), Dyball, Brown & Keen (2007), Barth & Burandt (2008), Dieleman and Juárez-Nájera (2008).		

1.4. Other scientific theories and models that were applied

Besides the above mentioned scientific theories and models, others were used as well to interpret and understand the rate of success of the various experiments. The main models applied are:

- Type of change (De Caluwé & Vermaak, 2006)
- Organization development (Bridges, 2000)
- Group development (Tuckman, 1965)
- Innovation diffusion (Rogers, 2003)
- Motivation (Maslow, 1954)
- Quality management (e.g. Deming, 1986; EFQM, 2009; INK, 2000; Van Kemenade, 2009)

2. A chain of ESD experiments between 1991 and 2010

The list of characteristics in table 3 was used as a checklist to investigate the rate of success of a research program consisting of a series of eight ESD experiments that were performed between 1991 and 2010. Before describing them, this section will offer an overview of possible ESD development strategies, and of the context in which the experiments took place.

2.1. Strategies for ESD development

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 research program 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 develop-

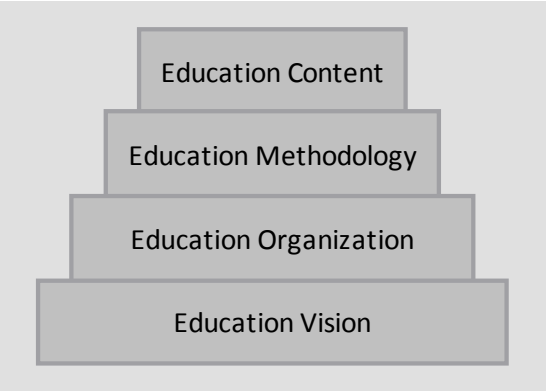

Figure 1. Four-layer model of education

ment 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, as table 4 illustrates without trying to be complete.

Table 4. 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 2010 a series of experiments were performed, each focusing on a strategy that is mentioned in table 4, indicated as 'X1' till 'X8'.

2.2. The context of the research program: HBO, a rapidly changing field of higher education in the Netherlands

The experiments all took place in one of the two sectors of higher education in the Netherlands: 'HBO' ('Hoger beroepsonderwijs'), i.e. the Universities of Applied Sciences, with nearly 400,000 students being about two thirds of the Dutch higher education.

A large number of changes took place in HBO, roughly between 1990 and 2010. These innovations in HBO formed the backbone of the research program, as each of the ESD experiments was inspired by, and made use of one or more innovations that at that time took place in HBO. A part of the change processes in HBO have been described by van Hout et al (2006). The innovation processes were:

1. *Mergers:* 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:* 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:* In the years around 1990, a large number of new study programs were developed by the enlarged HBO institutions.
4. *Toppling the organization:* 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:* As a part of the wave of new education programs, programs on environmental education were developed in quite a lot of higher education institutions. The number of students studying environmental programs increased rapidly.
6. *New educational methodologies:* 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.
7. *Restructuring HBO:* In order to increase the recognizability and transparency of the study programs, the number of different programs was reduced significantly.
8. *Dual learning routes:* 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.
9. *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 set up intensive relations with secondary schools, cooperating in developing a better fit between the two layers of education.
10. *Professorships and applied research:* 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.
11. *External quality assurance:* 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.
12. *Internal quality management:* In the nineties, the visitation system stimulated the HBO institutions to set up a structured system for quality management. The accreditation sys-

tem 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.

13. *Involvement with sustainable development:* The HBO Handvest, the sustainability charter of the HBO, was signed in 1999 by 29 HBO institutions. A part of them 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.
14. *Flexibility of education:* 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.
15. *ICT, distance learning:* 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.
16. *Internationalization:* 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.
17. *New structures:* 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 a major - minor system.
18. *Competence based learning:* 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.
19. *RCE's:* As a consequence of the UN Decade of Education for SD, a global network of Regional Centers of Expertise has been set up, supported and officially recognized by the United Nations University. The first RCE in the Netherlands was the RCE Rhine-Meuse, with operates in an international region in the Netherlands, Belgium and Germany.
20. *Covenant on sustainable procurement:* In 2008, a covenant was signed by the Dutch Minister of Environment, the chairman of the HBO Council (the association of the Universities of Applied Sciences), and the chairman of the VSNU (the association of Dutch re-

search 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.

Several of these change processes were based on recurring themes, together forming several iterative processes, as figure 2 illustrates.

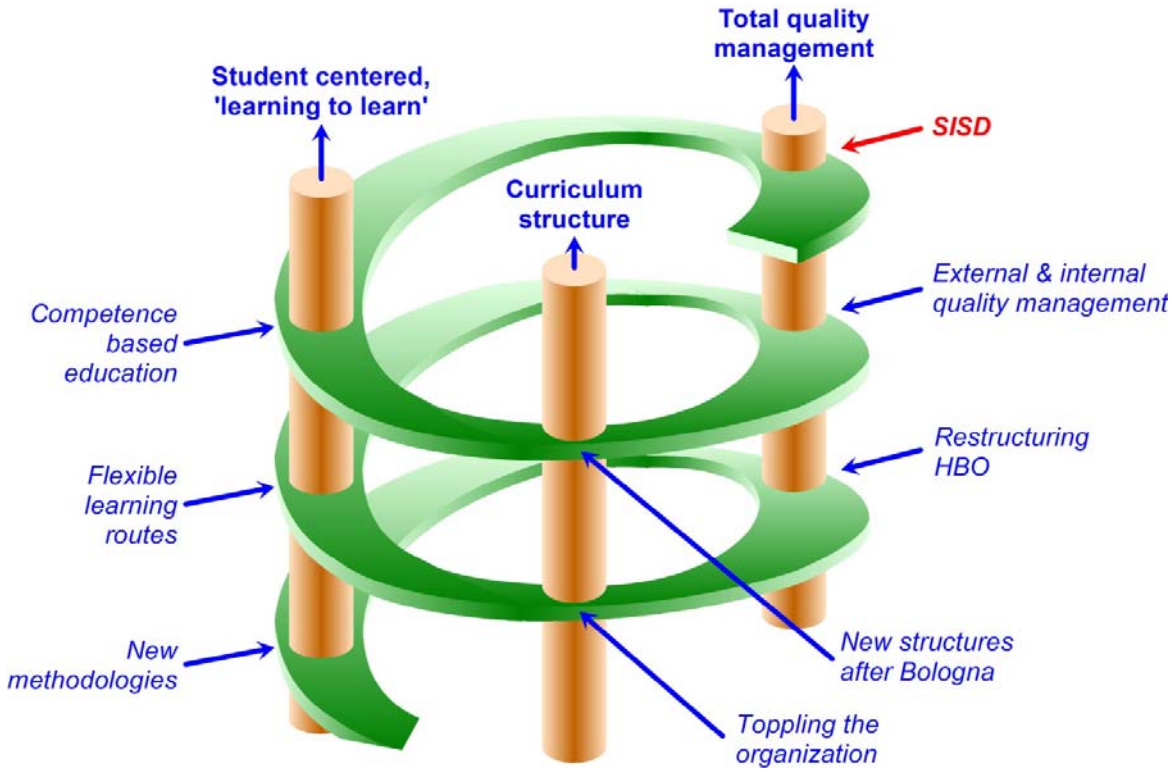

Figure 2. Several iterative processes in the development of HBO

Taken all together, the 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.

2.3. The research program: a chain of experiments

Five experiments were completed. Three more are still going on. This section describes them briefly, in the dissertation (Roorda, 2010), for each experiment a systemized description is given about its context, philosophy and process, followed by an assessment of its results, leading to a conclusion about the strengths and weaknesses of the applied ESD strategy.

Experiment #1: A new study program on sustainable technology (1991-1994)

The first experiment took place in a period in which a wave of mergers between HBO institutions was followed by 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 (Roorda, 1996).

Experiment #2: Introducing new educational methodologies (1994-1998)

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 was the application of such methodologies for the purposes of ESD (Roorda, 2005b, 2005c). For this goal, the study program that was created in experiment #1 was redesigned between 1994 and 1998, trying to realize goals like: more active attitudes of the students, and a more multidisciplinary curriculum.

Experiment #3: Integration of SD in existing study programs (1998-2002)

In the next experiment an attempt was 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, 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' (Roorda, 1999; Dejong et al, 2003) 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.

Experiment #4: Assessment, consultancy and certification of ESD (2000-2009)

In 2000 the development was started of an instrument to assess the rate of success of the integration of sustainable development into the curricula of study programs, in a quality management style. The instrument, 'AISHE', was completed and validated in 2001 (Roorda, 2001). The assessment tool makes use of the 'five stages model' for quality management, developed by the INK (2000), making use of the EFQM model for quality management (EFQM, 2009).

Between 2001 and the present, the tool was applied through consultancy to universities in and outside of the Netherlands (Roorda, 2002, 2004). Based on them, a Certificate of Sustainability in Higher Education is awarded to successful study programs or university departments. A fundamental principle, 'system integration of sustainable development' (SISD)

was defined and made operational. Case studies (Roorda & Pérez Salgado, 2007; Roorda & Martens, 2008) were used to prove that SISD is measurable, achievable, and indeed has been achieved.

Experiment #5: An SD introduction instrument (2004 – 2009)

The fifth experiment 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 textbook in the Dutch language called 'Basisboek duurzame ontwikkeling' ('Basic Book on Sustainable Development'), which was published in 2006. Besides, a range of other tools were 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 was assessed. A second Dutch edition, as well as an English edition, will be published in 2011.

Experiment #6: SD Competences (2007 – present)

The first of the three still ongoing 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 textbook that was developed for this goal.

Experiment #7: An SD curriculum scan (2007 – present)

The second ongoing 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. A draft version has been tested a number of times.

Experiment #8: Assessment of all SD roles of a university (2007 – present)

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. Some first tests of the draft version have taken place.

3. Research characteristics

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

3.1. Case study

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?"

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 accu-

rate 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.

Combinations of these types of triangulation were used to assess the results of the various experiments.

3.2. Action research, Mode-2 science, postnormal science

The research has a number of characteristics of action research, mode-2 science and post-normal science.

3.2.1. 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.

3.2.2. 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 bal-

ances (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 [5]) (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."

Table 5. 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.

3.2.3. 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. (...) 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."

With referrals to subjects like ethics and species extinction, it is no wonder that in publications about postnormal science, a direct relation with SD is emphasized, e.g. Ravetz (2006). In postnormal science, the 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 were present in the ESD research program.

3.2.4. Transdisciplinary research

The experiments of the research program all have the character of multi-, inter- and transdisciplinary research. These terms are not always used in a consistent way. For the interpretation of the results in Roorda (2010), the following definition was used (RMNO, 2000):

"*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). They 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". 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.

3.2.5. A cluster of scientific approaches

The various characteristics of the research program, described above, 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, expe-

rience 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 ESD study and its chain of eight 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."

Aspects of action research were present in all experiments. In some cases, the researcher (Roorda) 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 textbooks. In some experiments, the role was that of a consultant, trainer, teacher, coach or auditor.

The 'extended peer community' was recognizable in several experiments. E.g. when the Basic Book on SD was developed, a regular feedback was asked. One feedback group consisted of highly qualified SD researchers: 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.

4. Result assessment

All eight experiments intended to contribute to ESD in Higher Education, or – through this – to SD outside of higher education, e.g. in its professional fields or even in society in general.
In order to assess the results towards these goals in a systematic way, i.e. to evaluate and compare the rate of success of the various experiments, several criteria were designed, as shown in table 6. These criteria were used for the five completed experiments.

Table 6. Criteria and results of five experiments

Criterion \ Experiment	X1: new program	X2: methodol-ogies	X3: existing programs	X4: AISHE	X5: SD intro
Contribution to ESD towards direct stakeholders					
Implementation in vision & policy	+	++	–	++	+
Implementation in education			+		
Customer demand	– –			–	–+
Customer appreciation	+	+		++	++
Contribution to SD towards indirect stakeholders					
Indirect stakeholder appreciation	+	+	+	+	++
Contribution to SD through HE	–	–			
Transfer of expertise	–	–	++	+	+
Successful?	*No*	*Yes*	*Modest yes*	*Yes*	*Yes*

Depending on the context or the kind of experiment, the criteria were interpreted accordingly. As an example, for the 1st and 2nd experiment, both concerning an individual study program, criterion #4, 'customer demand', was interpreted as the number of students through the years. For experiment #4, AISHE, one of the indicators for this criterion was the number of AISHE assessments that were performed, whereas in experiments #5, the Basic book, the number of books sold through the years was used as 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 focused, while the indirect stakeholders are any others that may have benefited from the results of the experiment.
The set of criteria meets the validity demands formulated by Scholz et al (2006) that were mentioned above:

- *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 (see below); and finally 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 paper ends.

5. Results and conclusions

The results of the five completed experiments, assessed through the 7 defined success criteria, are shown in table 6. They vary between 'very successful' (++) till 'very unsuccessful' (– –). As the size of this paper does not allow to describe the reasons for these judgments, the reader is referred to the full text of the dissertation (Roorda, 2010) for an explanation. From the separate conclusions for each criterion, overall conclusions for each experiment are drawn by triangulation; the results are shown at the bottom line of table 6. Experiment #1, the new study program that started in 1991, is the only one that was not successful: although many SD researchers, education experts and the professional field were satisfied, the number of students remained low, and so the study program was ended in 2005. For this failure, several hypotheses have been formulated. Possibly, the SD-dedicated study program was simply too early, starting in 1991, and going through a period (around 2000) when environment- and sustainability-related subjects were low in popularity, after which period too many compromises had been made between finances and the curriculum goals and contents for a possible recovering. Another possible cause is the fact that the wide scope and the multidisciplinary character of the program resulted in a lack of depth, which did not appeal enough to potential students. Whichever hypothesis is the more true, certainly some important conclusions can be drawn from the early Dutch pilot project concerning similar present attempts to start a sustainability-dedicated study programs in a variety of universities.

The other four experiments that have been completed show some or even a lot of success. The experiences with the combination of new education methodologies with SD (experiment #2) appeared to deliver important lessons for later ESD projects that were assisted through the consultancy of experiment #4. The same was true for experiment #3, which resulted in the Certificate of Sustainability in Higher Education for all involved study programs at the level of 1 star, which for that time (2002) was a good achievement. The assessment tool for this Certificate, AISHE, a result of experiment #4, has now been used in seven countries, and interest in the application has been shown on nearly every continent. In the Netherlands, several hundreds of assessments have been performed. The Basic Book and its accessories, developed in experiment #5, is in use in many Dutch Universities of Applied Science. Its publishing company trusts the publication sufficiently to launch a second, revised edition in 2011, while an English publishing company is preparing an English version of the book and its accessories. Users – teachers and students – are satisfied.

All experiments were performed in such a way that they were in accordance with, and made use of, change processes that were occurring at that time. From the evaluation of the experiments it is clear that this correlation contributed strongly to the success of most of the experiments. This is regarded as sufficient proof that the philosophy of the entire research program, 'sailing on the winds of change', is a success.

As a result, an important conclusion can be drawn. Many ESD researchers have argued, as described above, that a genuine transformation (or transition) of higher education will be necessary, in order to enable it to contribute effectively to SD. The question is, whether this should be realized through *evolution* or *revolution*, i.e. by breaking down the existing higher education and rebuilding it from scratch. The research program described in this paper, performed between 1991 and the present, shows that revolution – which would raise a lot of resistance and take an immense amount of time and money - is not necessary, since a transformation of education, aiming at ESD, can be realized through an evolutionary process of sailing on the winds of change.

This becomes clearer when the 20 change processes in HBO described above are plotted in one 'transformation map' (figure 3). In this map the change processes are shown in a more or less chronological order. It appears that they followed the stages of the INK five stages model, which was also used for AISHE.

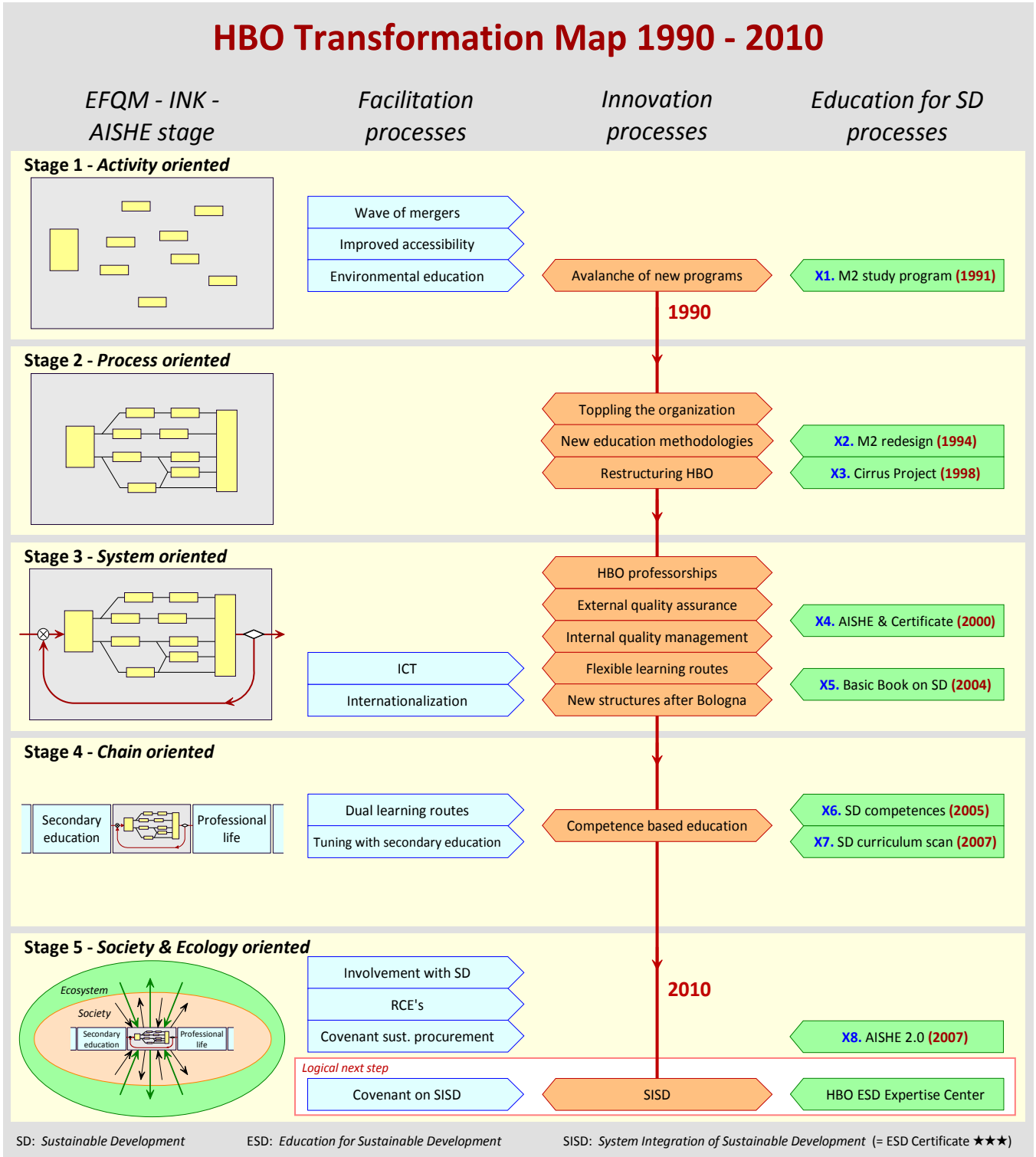

Figure 3. The Transformation Map of HBO, 1990 - 2010, including the input from the eight ESD experiments

This map makes clear that, although each HBO change process in itself took place at the level of accommodation or reformation (see table 2), together they form a real transformation. A transformation process however that has not been finished yet, because the top stage,

which was adapted from the INK fifth stage to a larger concept of ‘Society and Ecology Oriented’, has not been realized as yet. This final step, completing the transformation, may be reached through the realization of SISD, system integration of SD, throughout HBO, which might be realized within perhaps five years. In other words: the realization of SISD is certainly an intensive transformatory process, which in principle will take decades. But the case of the Dutch HBO shows that, at least in some places, 90% of it has already been realized, and the rest has come within reach.

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