FINAL CONCLUSIONS

Barcelona, 15th November 2004

Dear participants,

We are pleased to have brought together more than **230 enthusiastic participants** from 32 different countries during the 2004 EESD conference. We wish to thank every one of you for having made fertile discussions possible and for having contributed to the intense sharing of experiences from all over the world.

The fact that 25 students from 15 countries have actively participated in the event has made us aware of essential views on the future of higher education. We are truly happy to have helped them to define their project for an **international student platform** for sustainability.

Since EESD I in Delft, a **shift** from environmentally focused issues towards a wider (and more social) concept of sustainability has been detected in the papers that have been presented and the discussions that have taken place in Barcelona. We strongly believe that this is a good sign.

We are also proud to have created the **Leo Jansen Prize** for the best projects on the EESD issue. Professor Jansen is clearly deserving such a prize in his name, which has to be useful in order to recognize innovation efforts of the international academic community in the field.

We are also pleased to announce that the cities of **Lyon and Graz** are going to organize future conferences in 2006 and 2008 respectively.

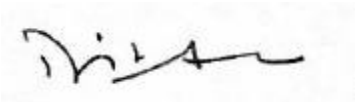
Concerning future conferences, the EESD 2004 scientific committee advises the following:

- That the possibility of focusing the next call for papers on a particularly necessary issue be studied.
- That the need to promote more spaces and time for discussions be taken note of.
- That the participation of developing countries, companies and students be encouraged.

The **Barcelona Declaration** summarizes the aim of the work that has been carried out during the conference. In addition to this declaration, the final document includes the conclusions of every session. The rector of UPC has announced the creation of the Barcelona Declaration Secretariat in the near future, as a show of commitment to the UN Decade on Education for Sustainable Development (2005-2014). You will be informed about the procedure for adhering to it.

Therefore, once this Secretariat is constituted, we will encourage you to disseminate the Declaration at your institutions and among other organizations that show interest or are already involved, in order to get as much as support as possible. It must become a tool for making the hopes we share happen.

Thank you very much.



Didac Ferrer-Balas,
on behalf of EESD 2004 Scientific, Organizing and Students Committees

Declaration of Barcelona

29th October 2004

Preamble

We live in an increasingly complex world and we are at a critical juncture at which humanity must make some serious choices about the future. Our current model of development poses significant challenges when it comes to achieving a more just society based on respect for nature and human rights, and demands a fairer economy and greater solidarity towards different cultures and future generations.

Ignoring this reality when educating and informing future citizens, and therefore future professionals, could have severe consequences. It is undeniable that the world and its cultures need a different kind of engineer, one who has a long-term, systemic approach to decision-making, one who is guided by ethics, justice, equality and solidarity, and has a holistic understanding that goes beyond his or her own field of specialisation.

Education supports a process of self-discovery and learning about the world, encourages personal development, and helps individuals find their roles in society. However, education is also a commitment to improving society by strengthening communities and stimulating social progress. This reality forces us to reconsider the purpose of our role as social actors, in particular as educators, and to construct a way of responding to these challenges.

Education, and particularly higher education, is a vital tool to be used for facing today's challenges and for building a better world. Higher education is essential if we are to achieve sustainable development and therefore social progress. It also serves to strengthen cultural identity, maintain social cohesion, reduce poverty and promote peace and understanding.

Higher education institutions must not restrict themselves to generating disciplinary knowledge and developing skills. As part of a larger cultural system, their role is also to teach, foster and develop the moral and ethical values required by society. Universities need to prepare future professionals who should be able to use their expertise not only in a scientific or technological context, but equally for broader social, political and environmental needs. This is not simply a matter of adding another layer to the technical aspects of education, but rather addressing the whole educational process in a more holistic way, by considering how the student will interact with others in his or her professional life, directly or indirectly. Engineering has responded to the needs of society and without a doubt, today's society requires a new kind of engineers.

We declare that

Today's engineers must be able to:

- Understand how their work interacts with society and the environment, locally and globally, in order to identify potential challenges, risks and impacts.
- Understand the contribution of their work in different cultural, social and political contexts and take those differences into account.
- Work in multidisciplinary teams, in order to adapt current technology to the demands imposed by sustainable lifestyles, resource efficiency, pollution prevention and waste management.
- Apply a holistic and systemic approach to solving problems and the ability to move beyond the tradition of breaking reality down into disconnected parts.
- Participate actively in the discussion and definition of economic, social and technological policies, to help redirect society towards more sustainable development.
- Apply professional knowledge according to deontological principles and universal values and ethics.
- Listen closely to the demands of citizens and other stakeholders and let them have a say in the development of new technologies and infrastructures.

Engineering education, with the support of the university community as well as the wider engineering and science community, must:

- Have an integrated approach to knowledge, attitudes, skills and values in teaching.
- Incorporate disciplines of the social sciences and humanities.
- Promote multidisciplinary teamwork.
- Stimulate creativity and critical thinking.
- Foster reflection and self-learning.
- Strengthen systemic thinking and a holistic approach.
- Train people who are motivated to participate and who are able to take responsible decisions.
- Raise awareness for the challenges posed by globalisation.

In order to achieve the above, the following aspects of the educational process must be reviewed:

- The links between all the different levels of the educational system
- The content of courses.
- Teaching strategies in the classroom.
- Teaching and learning techniques.
- Research methods.
- Training of trainers.
- Evaluation and assessment techniques.
- The participation of external bodies in developing and evaluating the curriculum.,
- Quality control systems.

These aspects cannot be reviewed in isolation. They need to be supported by an institutional commitment and all decision makers, in the form of:

- A redefinition of institutions' and universities' missions, so that they are adapted to new requirements in which sustainability is a leading concern.

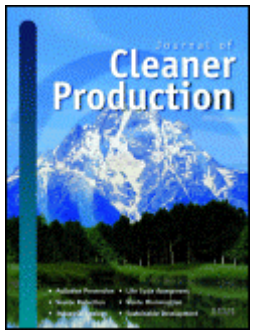
- An institutional commitment to quality.
- An institutional support for changing educational paradigms and objectives research funding.

Universities must redirect the teaching-learning process in order to become real change agents who are capable of making significant contributions by creating a new model for society. Responding to change is a fundamental part of a university's role in society. There is evidence that sustainable development has already been incorporated in engineering education in a number of institutions around the world. The United Nations Decade on Education for Sustainable Development (2005-2014) offers a great opportunity to consolidate and replicate this existing good practice across the international higher education community.

Universities now have the opportunity to re-orient the traditional functions of teaching and research, by generating alternative ideas and new knowledge. They must also be committed to responding creatively and imaginatively to social problems and in this way educate towards sustainable development.

SPECIAL EDITIONS OF JOURNALS

Journal of Cleaner Production (Ed. Don Huisingh)



Special Issue of the Journal addressing Education for Sustainable Development.

Guest Editors: F.J. Lozano, T.R. Hudspeth, K.D. Kevany

Procedure:
EESD 2004 participants are invited to send their contributions **before December 15th** to Prof. Lozano (fjlozano@itesm.mx). The papers can be improved, updated or reformulated from their EESD communication, and adapted to the journal instructions.
See guide for authors in:
http://www.elsevier.com/wps/find/journaldescription.cws_home/30440/description

International Journal of Sustainability in Higher Education (Ed. Walter Leal Filho)

Special Issue of the Journal on Engineering Education in Sustainable Development.

Procedure:
The EESD 2004 Committee will select 6 papers to be published. The authors will be contacted in order they adapt the papers to the IJHSE format **before December 15th.**

http://titania.emeraldinsight.com/vl=2895474/cl=39/nw=1/rpsv/ijshe.htm

SESSION OUTCOMES

Keys for Integrating SD in Curriculum Design

Papers at two levels:

- Those starting the sustainability path focusing mainly or solely in Environmental issues. Related strongly with former engineering courses in curricula and leaning towards environmental concept incorporation
- Those who take into account the 3 SD dimensions. Focusing in evaluation and an encompassing method to underline Sustainability as a form of critical literacy.
- Another paper using the environmental dimension to link design with needs of future users, stating that includes animals and plants.

SD in Chemical Engineering

At mid term Chem. Engineering must:

- Contribute to solve urgent needs like starvation of young kids in developing countries, food and water quality, develop medicines for aids, malaria, etc., New compounds control, Development and application of latest technologies. HOW?: Empowerment (of women) participation.

At Long term:

- Contribute to shift of energy resources from fossil to renewable

Competences of chemical engineers:

- Basically: Principles of Chemical Engineering completed with Attitude towards Sd, cooperation, Skills like system thinking, integrative, communicative, Knowledge: own disciplines, notion of context: cultural, social, institutional, economical, etc.
- No “extra” by integration in regular curriculum!
- Integration in curriculum with opportunity for students to deepen SD approaches in the frame of the general curriculum

Attitudes of teachers: No, Yes but constraints in time and means, Yes.

Options:

- Solve constraints: develop, fund and offer curriculum, sabbaticals, etc.

Pressure:

- Use students (usually more involved) to demand, learn from students, invite teachers to give presentations on SD in the discipline,

Facilitation:

- ¨bi¨ lateral review of curriculum with SD expert,

Contextual demand:

- competences asked for by society (industry, government).
- Learn about cycles: hydrosphere, biosphere; impact of human activities; detailed analysis (see Kleizen), Embed societal demands on problem solving.

Capacity Building for SD in North South Relations

- One need to take into account the cultural, social and political context.
- There are good examples of networking and exchange experiences.
- Concrete and practical cases can been observed.
- Capacity Building in engineering education must be increased (e.g. only 2 design schools in Africa)

Architecture and the Built Environment

- We need change the teaching-learning process in architecture
- Introduction of environmental issues taking in count the Bologna Process
- The architect student needs to know the real world. Some ideas for real practices are: Participation in some construction process at the university, facing environmental and sustainable challenges.
- The new architect has to be able to resolve sustainable challenges, know about energy management, work with real problems and interdisciplinary groups, also develop projects closely to the community.

SD Technology Transfer and Capacity Building

- As Sustainable Development (SD) includes all actors in society the social context is an appropriate context for knowledge generation for SD.

- For the same reasons learning for SD includes both learning in the formal educational system, non-formal learning and informal learning. For university education thin implies innovate approaches to learning environments and learning processes.

- Learning for SD means not only developing competences to work together in multidisciplinary teams in participatory trajectories, but also mastering sound fundamental scientific knowledge of good quality.

Specific Courses and Tools for SD Education

The educational challenges developing SD courses are:

- The complexity and multidimensionality of SD, which requires the development of new attitudes, knowledge, skills and sensitivities that are typically unfamiliar for engineering students
- The diversity of students in terms of their engineering specialisations
- The low level of appreciation of SD among many lecturers
- The need to engage stakeholders in SD education and the difficulties of doing so

The tools most useful in developing an SD course are:

- Activity-based and action-based learning using real-world problems, case-studies and projects that illustrate all the dimensions of SD and provide opportunity to practice the principles of SD, to develop students' knowledge, change students' attitudes and improve students' skills (interdisciplinarity, transdisciplinarity, internationality, 'whole system' approaches, communication, etc.)
- Tools and concepts from the field of 'future studies' that provide a means to design and manage long-term, system-level change oriented toward radically different and normative futures
- Multi-media and internet based tools that provide for self-paced learning and give opportunity for automated student evaluation and automated course evaluation by students

How can we assure an appropriate balance between SD dimensions?

- By the use of real-world problems, case studies and projects that reflect the different dimensions, have multiple stakes/stakeholders, and illustrate how perspectives on problem solving are affected by the interests of stakeholders, their time frames and their metrics for analysis

Do we need specific SD courses or is the concept better integrated into the regular curriculum?

- We need both; however, there is no single 'model' or 'set of rules' to follow as regards an 'optimal combination' (i.e., there are likely to be many equally good ways of combining dedicated SD courses with more integrated approaches)

How can we ensure that we motivate students for the long term?

- By changing the pedagogical objective - at the end of our courses students should know how to go about the process of problem solving - we should focus, additionally, on achieving a shift of attitudes emphasise the impact and contribution that the individual can make emphasise the feasibility of solutions (i.e., the task ahead isn't impossible, solutions can be found), by actually changing the attitudes/values/approaches of students, by developing skills, awareness and knowledge relating to the process of problem solving and the role of analysis, design and stakeholder engagement as part of the problem-solving process

In addition, our panel was asked to provide recommendations for work ahead

- For priorities for SD educators and others in Universities more emphasis on influencing colleagues and finding constructive ways to motivate them and to engage their support in SD education more efforts to improve the efficiency and effectiveness of transfer of best practice within and between Universities more emphasis on sharing tools and courses (internet based teaching/learning resource pools?) more emphasis on education relating to 'whole system' approaches to product-service systems, especially ones that look at synergies between actors in fulfilling end-demands more emphasis on linking futures studies and SD education for engineers
- For Lyon 2004: practical workshop sessions with opportunities to demonstrate and practice teaching tools engagement with the UN decade of SD education

SD in Agriculture Engineering Education

Main points

- Whole institution approach. An institutional commitment is necessary to embed sustainable development into agricultural engineering, with the involvement of the academic community, administration and external partners.
- Student participation of students. Practical field experiments are useful for Organic Waste Management, students are fundamental to catalyse research or demand new subjects and also need to be involved in an environmental management system.
- Social dimensions. The social challenges to sustainable agriculture need to be addressed in courses, (aging population, low incomes, complexity of the CAP, lack of suitable financial structures in agricultural economy)
- Local context. For example in the Mediterranean low water and nitrogen levels and a lack of labour need to be considered and in developing countries finance, education, renewable energy and water supply are key issues.
- Multidisciplinarity. Not only are experts from various disciplines needed (e.g. the Agriculture and Society module involves a chemist, vet, civil engineer, biologist, agricultural engineer), but students should also acquire the skills to interrelate these different subjects (e.g. physics, soil science, economics, cartography, machinery, chemistry) with the aid of case studies and practical projects.

Other points raised

- Affordability of farm machinery
- Is farming at the end of its technical abilities?
- The content of heavy metals in sewage sludge
- Organic farming

Issues for EESD 3

- Involve more agricultural schools

Global Aspects on Teaching and Learning Sustainability

- Many strategies developed until now like, conferences, specific courses, etc…
- We need a reflection about our work since the 90's, are we doing the correct?
- Teach values about SD in the university could be good facing the SD challenges?
- Our students are learning now how the technology affect the world or how the technology can resolve the problems create by the same technology?
- Teach to doubt!

SD in Civil Engineering

Focus points

- Change the way civil eng. courses are given
- Change vision of building, focus on holistic impact
- Be conscious of the importance of civil eng.
- SD in civil eng. and young people need better communications skills
- Civil eng. is an important factor for SD, they provide all the needed infrastructure to succeed

Estamos formando profesionales para una arquitectura sostenible?

- Coincidencia en la inexistencia de un planteamiento claro e indiscutible en el sector de lo que es una arquitectura sostenible y, como consecuencia, de estrategias para

llegar a ella
- Abundando en la cuestión, pocos pasos decisivos se han hecho y es difícil marcar, desde las instituciones representadas, objetivos claros a las profesiones implicadas
- Se detecta, como ya anunció la regidora de BCN, que actualmente los profesionales que intervienen en la arquitectura no forman parte de las propuestas para mejorar los aspectos ambientales en la arquitectura y sí forman parte del problema de implementarlas
- Se pide a la Universidad que, en ausencia de criterios técnicos y profesionales definidos respecto a la sostenibilidad, forme profesionales comprometidos personalmente con ella, capaces en el ejercicio de su profesión de apoyar con su implicación y conocimientos el desarrollo de soluciones sostenibilistas, así como de implicar al sector en la sensibilidad ambiental y en la búsqueda de nuevas propuestas
- Se cree que debe apoyarse la introducción de esa sensibilidad ambiental en toda/s la/s carrera/s, pero especialmente en las asignaturas centrales en la definición de la profesión; en el caso concreto de arquitectura, en las asignaturas de proyectos.
- Se entiende la dificultad de ambientalizar los estudios sin que el profesorado sea sensible a estos temas, y ello implica un recorrido largo puesto que su sustitución es progresiva. Apunto la necesidad de incorporar la sensibilidad y el conocimiento de los temas ambientales en las plazas a concurso para el futuro.

Students´ Perspective on SD Education

Students are important actors in the process of Sustainable Development. All the assistants were agree about founding a Platform with the main objective of join efforts an work together towards a sustainable universities.

Some vital issues for a successful student conference are the following:
- Set up a frame for information exchange
- Leave as much freedom to the participants in designing solutions, action plans
- Set concrete/reachable goals for the conference to obtain useful results
- Get feedback after the conference
- Socializing!!!
- Create an informal atmosphere
- Create environment in which participants can talk right away about issues they are most interested in/ in which participants share as much useful information as possible
- Foster creativity/exchange by putting the participants into a totally different situation (museum, bar, gym, etc.)

We don’t need to find an acronym. Take BEASTS just as a name with no particular meaning (as the name of a newborn who gets one from his parents and with time develops him/herself to a rational, emotional, responsible, intelligent, joyful, sustainably thinking person).

Technological Education and ED. Ethical Issues

Often the outcome of the work of engineers has broad implications beyond technological issues: social, economic and environmental implications. Therefore, pressures may be exercised to have an influence on the above referred outcome: designs, recommendations, evaluations, etc. This conflict is even more important when decisions have to be made under uncertainty, as it usually the case. And this brings ethical issues to the scene.
It is therefore recommended that engineering education includes the topics that are mentioned below. Education in ethical values should not be implemented as a separate item from technology instruction, on the contrary, ethical values should be incorporated in the technical subjects wherever appropriate.
Topics that should be considered when teaching ethical issues in engineering:
- Understand the strong subjective, judgement-based components that are inevitably present in engineering practice.
- Avoid limiting the scope of analysis to short term issues only, include long-term implications in the decision making process
- Avoid unnecessary fragmentation of viewpoints on the projects and engineering evaluations
- Include conflicting views when dealing with complex topics
- Pay attention to social perception and communication aspects

- Pay special attention to designing education programs and applications that target improvements for poor people
- Encourage in the university and in the format of teaching and in the relationship student/professors the following values: respect for other people, respect for the environment, solidarity, honesty, tolerance, team-work, etc
- Incorporate/transmit a global view of sustainable development within each specific industrial area

Technological Change for SD

- To provide students in engineering with sufficient scientific knowledge basic ecology courses are essential to relate sustainable development to politics and science.
- Students in ICT should be aware that the role of ICT with respect towards sustainable development is ambiguous. ICT enables more sustainable production and consumption but attaches resources seriously.
- Training is essential to implement (EU) directives. Such training opens wider possibilities towards SME's with respect to sustainable development
- Exercise in Backcasting from future visions is a powerful educative instrument even on a imaginary challenges of limited extent
- The genesis of technology is a function of social, institutional and cultural conditions which are on their turn are shaped by technology. Engineers need a firm understanding thereof on top of their skills.

Simulation Tool and Games for Teaching SD

- In future EESD it would be interesting to play games (not only presentations)

Integrating SD in the Curriculum. The Socio-economic Context Factor

How should lectures be designed and developed to make clear the complexity of our global society?

- To approach complexity, lectures should be designed to deal with concrete objects and their relationships with the rest of nature and society, to illustrate the way in which an analysis of the problem itself is affected by ecological and environmental services, as well as by other societal activities.

How should the multidisciplinary approach in educational programs be dealt with?

- Professors participation
- Different study areas interacting strongly
- Basic knowledge in ecology and SD
- Activities like seminars, workshop, etc..
- Research about regional problems
- Developing a disciplinary expertise

How can the aspects of stakeholder participation be dealt with educational programs?

- Information and social sensitivity
- Strong association with governments, companies, social groups and communities.
- Trough research and outreach programs.

Towards Sustainable Universities for SD Education

Main points

Institutional commitment – what are the key success factors and barriers?

- Key success factors include financial resources, commitment from the senior management, adopting a sustainability policy, using the students to "fuel" initiatives, twinning studies with other institutions and celebrating successes.
- Key barriers are the participation of students and staff, the externalities of the University's activities and changing the culture of an institution.

Student experience - how is it affected?

- Opportunity to take up new courses (optional and mandatory)
- Putting environmental conscience into practice (laboratory work, field work, involvement in Environmental Management Systems).
- International partnerships and student ambassador schemes.
- Feedback of sustainability initiatives is generally positive.

Sustainability literacy – how can it be achieved across the university?

- Integration of sustainable development into all subjects.

- Evaluation needs to be addressed as sustainability literacy means something different for different subjects.
- Introduce an environmental management system and involve students. Use this as the means, not the goal! This is also an effective way of teaching.

Integrating SD in the Curriculum. Strategies and Approaches

In this oral session the time just burned out, so it was no time for a real debate, but we can say that the clue to bring about the integration of SD in the curriculum is to involve all the teachers, and from the oral presentations we can say that it seems that the best way to do it is, furthermore having an up-down policy which promotes this integration, working teacher to teacher and guide each teacher to recognise the role he/she can play in SD.

Ethics and values in engineering education.
Is there a point in teaching values and ethics to engineering students? The students have already developed their values and ethic before the university time? Is there any chance? Is the university the right place? Which strategies can be used to teach ethics and values in our curriculum? Shall the curriculum be redesign?

Despite one of the speakers doesn't agree, there was a debate in favour of teaching values and ethics in engineering.

Specific course on SD.
Is a course on SD necessary? What it has to be taught in a specific course on SD? Compulsory or elective courses on SD?

A specific course on SD is needed in order to guaranty a sustainability basic knowledge, although not everybody thinks it has to be compulsory.

SD for non SD lecturers.
How to involve lecturers in SD vision on their fields of knowledge? How to teach these lecturers? Top-down or bottom-up political strategies?

The approach to non SD teachers has to be both with top-down and bottom-up policies.

Regional differences leading to a site specific approach?

The following conclusions came out of the panel discussion:

- There are indeed regional differences. Tools should be used as an open learning stucture. There are two important aspects in those differences: the audience and the data.
- The development of databases is quite 'eurocentric'; databases should take into account regional differences.
- Tools, databases, etc. can not be used in other circumstances just 'one by one'. There is no one ecodesign for one product.
- This is an important conclusion in a so-called 'globalizing' world.

Master Programs in Industrial Ecology and SD

Both Programmes initiate this term.

- Program at Delft Univ. of Tech. elaborated that they would address a political view, as well as generating an overarching view including, besides business also NGOs, communities & government.
- Also the actual examples on Industrial Ecology projects that could be carried out were among small and medium enterprises in the Netherlands, that according to them could give an examples of connectedness. They do not have still possible projects with larger

industrial enterprises.

- Program at Royal Institute of Tech., they were critical of actual practices provided by Env. Manag. Systems (EMS), which the Master's programme would complement, giving a more encompassing approach.

- Co-operation among European universities for this programme is basic.

- Among the audience comments towards considering the whole network connectedness needed in Industrial Ecology was put forward. Considering relevant to emphasise this issue for the sake of a sound Master's programme.