



United Nations
Educational, Scientific and
Cultural Organization



AALBORG UNIVERSITY

Aalborg Centre for Problem Based Learning
in Engineering Science and Sustainability
under the auspices of UNESCO

Aalborg Centre for Problem Based Learning in Engineering Science and Sustainability *under the auspices of UNESCO*

STRATEGIC PLAN 2014-2020

Introduction

The Aalborg Centre for Problem Based Learning in Engineering Science and Sustainability (hereafter the Aalborg Centre), was established, under the auspices of UNESCO, following formal approval by the General Conference of UNESCO in November, 2013. This document presents the Strategic Plan for the Aalborg Centre for the period 2014-2020. The Strategic Plan focuses on overall, longer-term, strategic issues and policy. Shorter term, detailed tactical planning and management issues are covered in a related Workplan and Budget, 2014-2015. These two documents reflect the timeframe and approach of UNESCO's Strategic Plan, Workplan and Budget.

Global challenges underpin the vital importance of engineering and science in sustainability and sustainable development. There is a need for human and institutional capacity to address the Millennium Development Goals and post-2015 development goals - with a continuing focus on sustainable development and poverty reduction. Many countries are concerned about present and future capacity in engineering and science, and the need for capacity building to address present and future needs. This concern relates particularly to the decline of interest and enrolment of young people around the world in engineering and science education, and the consequent need to transform engineering and science education to make these fields more attractive to young people, especially young women and other under-represented groups across many areas of engineering and science.

Fortunately, young people are attracted to engineering and science when they see their role and importance for society and for sustainability, and also when education focuses on problem- and project-based learning. Aalborg University is a world leader in problem and project based learning, engineering and science education and sustainability.

The overall strategic goal of the Aalborg Centre is to facilitate the active role that universities can play in providing sustainable technological innovations by educating engineers and scientists that are able to participate in and contribute to the development of sustainable solutions to present and emerging social, economic and environmental challenges. Particular strategic goals and activities of the Aalborg Centre will combine research, education and development in three areas: 1) problem based and project based learning in engineering and science education, 2) engineering education research within engineering sciences and 3) education for sustainable development linking to the broader field of sustainability (see figure 1).

Furthermore, the strategic aim of the Centre is to connect university activities to activities in private and public organisations for sustainable technological innovation. The strategic emphases and work of the Aalborg Centre will also reflect the strategic mission and workplan priorities of UNESCO, as outlined in the UNESCO Medium Term Strategy 2014-2021 (37C/4), Work plan and Budget for 2014-2015 (37C/5). These include the Global Priorities of Africa and Gender Issues, and the second Overarching Objective of sustainable development and poverty reduction (although education and sustainable development are also key solutions to the first Overarching Objective of Peace). Sustainable development is also a key priority of Major Programme 2 in Science and strategic objectives in capacity building, engineering and science policy, innovation and technology transfer. These issues and strategic scope of the Aalborg Centre are now discussed in more detail.

Scope of the Aalborg Centre: PBL and Sustainability

Problem Based and Project Based Learning (PBL) has shown to be an effective framework for the integration of theory and practice, interdisciplinary knowledge, skills and competences. Furthermore, the PBL approach supports a system based education, emphasizing collaboration between stakeholders like universities, companies, local communities and thus supporting regional development. A PBL approach means a focus on students' learning process and the competences for learning to learn. It involves a project-organised educational model with a dialectic interaction between the subjects taught in the lecture courses and the problems dealt with in the project work. The projects are carried out in teams and the problems are often dealt with as they appear in the real world. Through the project work the students interact with industry and other relevant institutions and thereby contribute to development of society in general.

In community terms, the Education for Sustainable Development (ESD) community is an educational research community that interacts with the PBL community. PBL is a well documented pedagogy for learning complex knowledge and sustainability. Sustainability is defined as "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" ([Brundtland Commission](#) of the [United Nations](#), 1987). This involves innovations that do not use up or destroy natural and social resources and it is based on an interdisciplinary and system approach covering a series of environmental, economic and social aspects. A sustainable development implies that all aspects have been taken into consideration in both an analysis of the problems and in the innovations that will be developed.

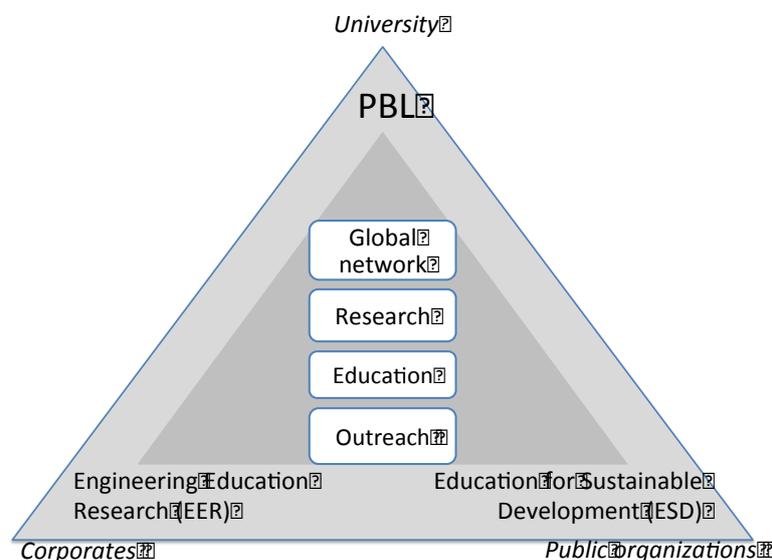


Figure 1: Scope of the Aalborg Centre

The learning of sustainability requires both deep discipline knowledge as well as the interdisciplinary interplay among disciplines that have been found relevant for the specific problem. Therefore, a PBL oriented curricula is appropriate for achievement of sustainability knowledge, skills and competences as students learn to analyse mostly real life problems and to identify impact of suggested innovations.

Engineering Education Research (EER) has been a growing global field for the last 25 years and with a research focus on both societal need of relevant engineering competences, learning and teaching within a technical field, curriculum development, assessment, institutional change and cultural diversity. The combination of the EER, ESD and PBL is new and hopefully it will lead to an increased impact on the development of engineering and science education globally.

A driving mechanism for the Aalborg Centre is that Aalborg University has an exemplary practice for both PBL and the integration of sustainability into engineering and science education. Since 1974, Aalborg University has practised PBL as the pedagogical learning methodology during the entire study. Aalborg University has also the intention that all students during their study should gain sustainability knowledge, skills and competences as a result of a series of sub-learning outcomes within the relevant disciplines that are interrelated and reflected upon. There are several studies meeting such intention. It is also a task for the Aalborg Centre to drive the integration of sustainability further and in more study programs.

Mission

The strategic mission of the Aalborg Centre will focus on the following:

- 1) to create a global society of practitioners, researchers, experts and institutions within the field of Problem Based and Project Based Learning (PBL) in Engineering Science and Sustainability from developing and developed economies;
- 2) to establish international research and doctoral training on PBL and sustainability in Engineering and Science Education;
- 3) to provide global formal education and training for academic staff and students, to disseminate and exchange knowledge and support among society members in terms of how to change engineering and science education for PBL and sustainable development at the national, regional and international levels;
- 4) outreach to institutions and schools for attracting students to engineering and science and give HE institutions and governments open access to a body of knowledge, education, training and other resources in order to facilitate PBL and Sustainability in Engineering and Science Education.

Goals and Outcomes 2014-2020

The construction of this interdisciplinary centre aims to interdisciplinary research and encompasses sustainability as an integrated part of technical research approaches by developing new knowledge and tools and by facilitating education that implements PBL and sustainability as an integrated part of the learning approaches. This will lead to education of social and environmental responsible engineers and scientists, who are able to establish sustainable innovations in terms of economic, environmental and social concerns and follow the trajectory of globalisation.

During the coming six years, it is thus expected that the Aalborg Centre will have impact globally and has documented its impact. The Aalborg Centre is expected to function as an agent for change, in collaboration with partners and with other organizations, to:

1. Raise and contribute to the discussion of the competence profiles of future engineers and scientists by combining learning of academic, entrepreneurial and community-oriented knowledge, skills and competences.
2. Leading a global network on the transformation to a more student-centred learning curriculum involving focus on technical-scientific knowledge as well as civic and process skills such as democracy, independent learning, collaborative knowledge construction and community awareness.
3. Influence the agenda for educational and institutionally change globally and regionally with a combined approach of more student centred learning/PBL and ESD.

The Centre will organise and monitor activities based on these strategic goals and outcomes by developing a roadmap and associated milestones in line with evidence- and results-based management.

Activities

To meet the mission and the expected results there will be four overall strategic activities of the Aalborg Centre: 1) Global Network, 2) Research and PhD training, 3) Education, and 4) Outreach Activities. These four main strategic activities will be carried out within each of the subject areas (PBL, EER and ESD) as well as across and with integration of the subject areas.

1) Global Network

The Aalborg Centre will establish a global network of institutions already having or wanting to develop expertise in PBL and sustainability in Engineering and Science Education. This will be achieved by organising:

- conferences, research symposia, and seminars nationally, regionally and globally
- workshops and summer schools at both Aalborg University and around the world
- virtual communities to develop PBL for engineering, science and sustainability
- provide exchange of students and staff between related institutions
- develop relations between private enterprises and public organisations in order to connect educational programs with work based learning
- online tutorials, video and virtual seminars on PBL and sustainability

The Aalborg Centre wish to co-organise events with existing professional national and international organisations.

2) Research and PhD programme

Research and PhD training will be a core element in the function of the Aalborg Centre as organisational change agent. By research training, the Aalborg Centre aims to educate change agents that contribute to change in their local context. The Aalborg Centre will focus on the establishment of:

- international research projects
- collaborative and joint PhD programmes with partner universities,
- online Doctoral training for PBL in Engineering Science and Sustainability, including online PhD courses
- research training on sustainability by using PBL.
- the next generation of PBL models by integrating sustainability, intercultural collaboration, and ICT.
- initiatives to publish special journal issues, books on PBL and sustainability in Engineering and Science.

3) Education and training

Educational activities will also be a core element in training change agents. Activities offered will be research based, however the participants' learning outcome will be focus on educational change. Activities will be offered in the following areas:

- interdisciplinary educations within sustainability for master students
- online master programs within PBL and sustainability combined with development of new formal degree based or certificate based programmes in the area such as Master Programme in Problem Based Learning in Engineering and Science (MPBL).
- new methods for continuing education of professional engineers.
- training for outreach activities for Engineering and Science Education, e.g. educational activities for staff in high schools.
- assist different institutions in developing PBL models that are adequate to institutional and cultural needs.
- develop adequate strategies for integration of sustainability in existing engineering and science programmes.
- provide possibility for training and consultancy for institutions and individual staff members wanting to implement innovative pedagogy such as PBL.

4) Outreach and regional development

Open access resources will be one of the leading principles for the Aalborg Centre. There will be developed diverse strategies for outreach activities regional as well as internationally. There will be initiated activities in the following areas:

- initiating PBL and sustainability in primary and secondary school and high school regionally
- outreach activities for improving science and engineering in primary and secondary school regionally
- establishment of closer collaboration with institutions and companies in the Aalborg University region exemplary to overall regional development
- international capacity building in PBL and sustainability adjusted to cultural, institutional and economic conditions. Workshops will be held with a regional focus, focussing on development within a particular region, such as Latin America, Asia, Africa and Eastern Europe, and touching on the spectrum of topics mentioned above.

Partnerships

The core of the Aalborg Centre will be the combined focus of PBL, EER and ESD. The Centre will be an internal actor for Aalborg University and by that form the basis for development of educational strategies for educating green engineers and scientists by integrating sustainability into engineering and science education, develop institutional and regional strategies involving a close collaboration with corporates.

Collaboration with Engineering and Sustainability

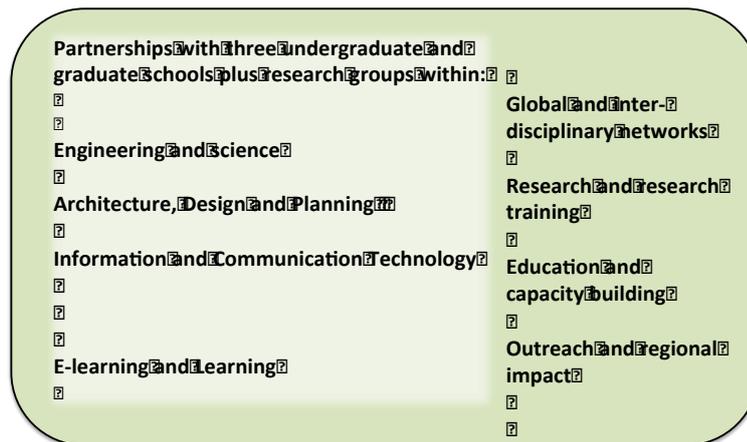


Figure 2: Partnership and collaboration with discipline areas

Internally at the university, the three core subject area (PBL, EER, ESD) will be the starting point for extended internal partnerships. The partnerships will reach out to the technical and scientific research and education subject areas and create a platform for more specific interdisciplinary projects.

The original and innovative aspect of the Aalborg Centre brings together a range of research groups and forms an international community of practice striving for excellence for research, education and training.

Funding

The Centre will be funded partly by Aalborg University and partly by relevant external funding sources. A funding and sponsorship scheme will be developed in collaboration with external and internal partners. Several of the activities will be based on participants' fees or external funds through project's cooperation. Obtaining external funds will be considered a priority in order to ensure a strong platform for cooperation and development of key projects within PBL and sustainability in engineering and science education.

Organisation

Aalborg University has the responsibility for running the Aalborg Centre. The centre is part of the Department for Planning and Development, where there is research on Problem Based Learning, Engineering Education, Sustainability and Social Responsibility in Engineering.

The organisation will reflect the basic philosophy of global networking capacity building. There is an **Advisory Board** with representatives from UNESCO and Member States with the responsibilities as outlined in the UNESCO standard agreement for Category 2 Centres with the necessary adjustments in relation to Danish law. There is also an internal AAU **Management Committee** consisting of the leaders of the different task forces and AAU representatives across the engineering and science departments and schools.

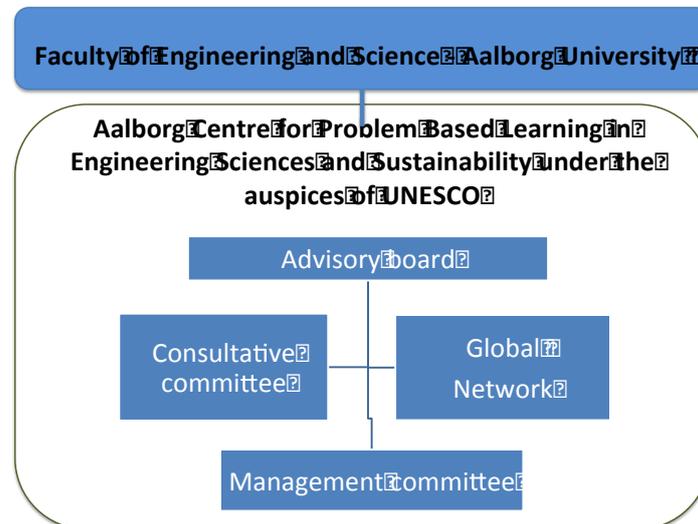


Figure 3: Organisation structure

The Aalborg Centre has established a **Consultative Committee** involving around 40 wide-ranging specialists in PBL, sustainability, engineering and science education from academia, industry and professional organisations around the world. The Consultative Committee will:

- provide strategic advice and policy input to the work and activities of the Aalborg Centre at regional and international level, based on the strategic plans and reports, and
- provide ideas for new activities, partners, areas, and modes of collaboration.

The Consultative Committee will function as a virtual group, through email and Skype, and will be chaired by Tony Marjoram, Guest Professor at Aalborg, former Head of Engineering at UNESCO and editor of the UNESCO Engineering Report.

Finally, through a Global Network institutions and individuals involved in PBL, EER and/or ESD can participate in a variety of activities. Initiatives will be taken to develop a business model for collaboration with core partners.