

Sustainability accreditation in engineering education: Comparison between Danish and French contexts

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ABSTRACT

Even though international organisations and engineering professional organisations recognise the need for engineering education institutions to prepare future engineers to contribute to a sustainable society, there are considerable differences in the push from national regulations and accreditation systems to ensure engineering education for sustainable development (EESD). This system paper presents an outcome of collaboration in the SEFI working group on Sustainability in Engineering Education set out to compare the accreditation frameworks for engineering education in two European countries, Denmark and France, with specific attention to the integration of sustainability. The study outlines the range of accreditation frameworks in terms of their call for sustainability, from sustainability as a possible (yet not explicitly formulated) approach to contextualise engineering in a societal perspective, to sustainability integration as an explicit accreditation requirement.

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1. INTRODUCTION

International organisations and engineering professional organizations recognize sustainability challenges and complex contexts that engineering students have to address. For example, the European Society for Engineering Education (SEFI), through the working group on Sustainability in Engineering Education stresses the need to implement sustainability in engineering education. The overall aim is to equip engineers with knowledge, competences and skills such as systems thinking, critical thinking, problem solving skills, communication, teamwork, interdisciplinary knowledge, flexibility, and adaptability, to address sustainability problems.

Even though, the engineering education for sustainable development (EESD) societies have achieved much in the last decades (by establishment of thematic conferences, journal publications, working groups, etc.), sustainability integration in engineering education has been slow and behind the needs. Integration of sustainability in engineering education responds to local conditions, resources and national accreditation systems where different frameworks are adopted and differ from country to country.

This system paper presents an outcome of collaboration in the SEFI working group on Sustainability in Engineering Education of examining the role of accreditation in supporting the integration of sustainability in engineering education. We have done that by comparing accreditation frameworks and standards from two European countries, France and Denmark.

The story takes point of departure in the Danish system of Accreditation of Engineering Institutions and Programmes, which illustrates a system with high attention to the quality management process and an emphasis on overall accreditation criteria. The focus then shifts to France, illustrating a case with a similar high focus on Quality management aspects but with more specific accreditation criteria for Engineering Education for sustainability.

2. ACCREDITATION OF ENGINEERING EDUCATION IN DENMARK

In Denmark, The Danish Accreditation Institution is the specific organization responsible for accrediting higher education, including institutions and programmes. The purpose of the Accreditation framework is formulated in a quality management perspective with focus on development whereas the quality assurance and control is to be seen as inputs to this process, as noted by the Danish Accreditation Institution [1:3].

“The purpose of the accreditation system and institutional accreditation is to strengthen the work carried out at education institutions to develop programmes to an increasingly high level of academic quality and relevance.”

There are two different levels of accreditation in Denmark – institutional accreditation and accreditation of specific programmes. In the following, we will focus on

presenting the different types of accreditations and the criteria for the Danish Accreditation framework. For more information about the accreditation process, please see [2] and [1].

2.1 Different levels of accreditations

Accreditation processes take place periodically and it is done at an institutional and a programme level. The accreditation guide refers to five main criteria [1][3]:

- I: Quality assurance policy and strategy; e.g. goals for overall quality assurance and development and also inclusiveness of all educational programmes
- II: Quality management and organisation; e.g. the requirement to include all relevant actors and management levels.
- III: The programmes' knowledge base, e.g. the relevance and quality of the related academic environments and staff development.
- IV: Programme level and content, e.g. compliance with the Danish qualification framework for higher education programmes and on-going evaluations on program level.
- V: Programme relevance, e.g. ensuring that the programmes reflect the needs of the labour market and include external actors involvement in development of programmes.

On the programme level there are also five criteria [3]:

- I: Demand and relevance including employability for existing educations and the relevance for the labour market (relates to Criteria V in the Institutional accreditation).
- II: Knowledge base including research base and relevance (relates to Criteria III in institutional accreditation)
- III: Learning goals e.g. whether the learning objectives for the education is aligned with the Danish qualification framework (relates to Criteria IV in the Institutional accreditation)
- IV: Planning and implementation including the structure and pedagogical quality of teaching.
- V: Internal quality assurance and development, e.g. focusing on evaluations of the actual practice (relates to Criteria II in the institutional accreditation)

If an institution has a positive institutional accreditation, they have the opportunities to establish new programmes and new local provision of programmes when they have been pre-qualified (only in relation to aspects of programme criterion I) and approved, and to make adjustment to existing programmes. If the institution on the other hand has a conditional accreditation, all new programmes and local provision of programmes must be accredited before they are established, and a plan is drawn up for improving the conditions to apply for a positive accreditation. If the institutional accreditation is refused, the institution cannot establish new programmes or local provisions of programmes, and existing programmes must be accredited in accordance with a rota plan. Thereby, a huge interest exists in obtaining institutional accreditation.

2.2 Sustainability in the accreditations framework?

In regard to the more specific programme level content (Criterion IV-institutional accreditation; Criterion II-III – programme criteria), a reference occurs to the Danish qualification framework and the Act for Bachelor and Master Educations at Universities.

The Danish qualification framework [4] specify generic qualification levels at Bachelor and Master level, as for example interdisciplinary collaboration, however with no specific mentioning of specific cross-cutting subjects as sustainability. On the contrary, subject(s) are mentioned in indefinite articles only. Neither does the programme criterion considering learning goals specify any requirements to content besides the relevance to the Danish qualification framework.

The Act for Bachelor and Master Educations at Universities, however, specify in relation to Engineering type of education that [5]:

“The candidates within the field of engineering have the purpose to qualify the student to solve complex technical problems, design and implement complex technological products and systems in a societal context”

However, no clear indication exists on how this relation to the societal context should be framed.

Thereby, neither the Danish qualification framework nor the Act for Bachelor and Master Educations in Engineering provide any mentioning of sustainability, and as the accreditation framework does not move into more detail considering learning objectives in different knowledge domains, a positive accreditation in this framework does not assure integration of sustainability in engineering education. Rasmussen [6] has characterised this as a paradox as higher quality was introduced as the goal in the political agenda, but there is no real direction for this quality improvements, as education does not have to do anything specifically, they just have to do it in a qualified manner. Furthermore, institutions have to document in detail what they do.

The current accreditation framework, on the other hand, provides Danish universities with a high degree of freedom in terms of curricula design, as long as they can argue for relevance from an employability perspective. In relation to sustainability education, this means that sustainability learning perspectives can be framed and closely related to different disciplinary domains. Currently, due to the urgent demand to get institutional accreditation, there is, however, a risk that engineering education for sustainable development is not prioritised.

3. SD IN EE CURRICULA IN FRANCE

The “Commission des Titres d’Ingénieurs” (CTI) realizes, in a mandatory way, the accreditation of Public and Private Engineering Universities in France, and on request abroad. This agency is a member of ENQA (European Network for Quality Assurance), this means that CTI satisfies some important requirements such as adapting its accreditation criteria to the evolutions of society and demands of its stakeholders.

Social responsibility is considered an important challenge for engineers, moreover, besides CTI’s criteria concerning technical skills, there are strong criteria that concern teaching of soft skills: in French accreditations, human and social fields of teaching must represent about 25% of the programs.

Six years ago, the criteria concerning SD were not put in the mandatory ones, we had written a document called “Analysis and Prospective” which was available on our website to help institutions in their evolution towards SD. Then, they became part of the mandatory criteria that are in “Références et Orientations” (R&O) which is the reference book for French Accreditation [7].

The fact that CTI is a parity based organization composed of an academic college and a socio economic college is also a determinant factor: very often, norms concerning SD are already on application in companies, this made professional members very receptive to the problems linked to the domain of SD very soon.

3.1 The different attempts concerning SD in France

In France, the problems concerning SD have also been soon taken in account by students, as well as by organizations of deans such as Conférence des Grandes Ecoles (CGE) and by Ministries, some of them trying to act as positive lobby. CGE is still very active in this field, having recently edited a guide of skills concerning SD and its reflection group is in charge of the French evolution of the Sustainable Literacy Test.

In 2007-2008, the network of French students for SD [8] realised a survey among the students (15 000 of them gave their opinion about SD and SD education) in order to make propositions resulting from these statements and expectations. The outcome was that teaching of SD was either absent or very specialised in French education. The students expected more active pedagogies connected to the “real world”. One of their proposals was to make campuses exemplary and to define a minimal curriculum that should be taught to everybody. However, due to the autonomy of universities, it revealed very difficult for this group to make institutions evolve quickly.

A first attempt to evolve faster has been the Green Plan, perhaps because it is based on a law but also because it includes many of the aspects considered in previous attempts in Europe. According to a French law, the “Loi de Grenelle” of 2009, the Higher Education Institutions have to elaborate a Green Plan which is a plan intended for sustainable development including environmental preoccupations but also a social and economic one.

The success of “Plan Vert” needs:

- the SD strategy to be elaborated
- the institution mission to dedicate a person responsible for the animation, the setting and the evaluation of the SD process; this person must have human and financial resources

A framework has been defined after promulgation of “Loi de Grenelle”, it has been named Green Plan Reference system [9]: it is a toolbox helping to define a SD strategy, its steering and its self-evaluation. 5 dimensions are to be considered for elaboration of the “Plan Vert” of an institution: Strategy and governance, Teaching and education, Research, Environmental management, Social policy and Territorial management.

3.2 CTI requirements

In February 2014, CTI, considering that teaching social responsibility to engineers was a critical point for society and a duty for engineering institutions, decided to

include immediately SD not only in the intended learning outcomes as it was previously, but also in the description of the global policy of the institution: this was an important evolution of the accreditation criteria [10].

The strategic guidance note of the institution being evaluated should include the orientation chosen by the institution regarding SD and particularly quote the Green Plan that describes the institution's strategy, its implementation and evaluation. The strategic guidance note is an important part of the self-assessment report because the institution's administrative council votes it, and when this institution is part of a group of faculties, the university council also votes it.

CTI strongly wishes that institutions really integrate SD through curricula in the education of engineers but also apply the principles of SD in their own management, working in an exemplary way.

When an institution is accredited or reaccredited, the implementation of Green Plan has to be explained within the quality process of the institution. CTI has quoted eight dimensions of operational actions to be verified during the evaluation process:

- strategy and governance
- social management and local integration
- environmental management
- research
- curricula
- documentation
- industrial rooting
- quality management and continuous improvement

CTI stresses that a specific innovative active pedagogy has to be put in place for SD, this pedagogy of action puts the engineering student in the situation of finding and building solutions to "real world" matters. CTI also specifies that the recruitment of students must guarantee diversity according to a policy concerning chances equity.

Learning outcomes

However, regarding the curricula, the major point of the accreditation audit is the observation by the experts of the expected learning outcomes that the graduates must possess at the end of the curriculum.

Three of them are in direct relation with SD:

- The capacity to take into account the stakes of relationships at work, of ethics, of safety and health at work
- The capacity to take into account environmental challenges especially by application of principles of SD
- The capacity to take into account society's stakes and needs.

During the audit of programs, CTI's members have to check the conformity of these LO but also how they are really assessed.

3.3 Results

The first results were, however, not completely satisfactory, because very often, either the dean of the school or either the experts in charge of this audit did not really realize that criteria had changed or did not know how to act for SD.

In February 2016, CTI decided to go further. Because some new points of view concerning engineering were out of the traditional field of investigation of CTI, and because those points presented some difficulties, not only for schools but also for experts, we decided to put in place what we call “Focus” on SD. A focus is a specific point developed by the institution in 3 or 4 pages that will be delivered by the institution together with its Self-Evaluation Report [11].

The results were really satisfying and were broadcasted to all institutions.

4. CONCLUSION

In this paper, we have provided an example of the Danish Accreditation framework, which, comparable to other quality management frameworks, focuses on developing processes for quality control, assurance and integration. Crosscutting subjects of broader societal concern, like sustainability, are not even mentioned. Education for sustainability is to be defined by the institutions in an employability perspective.

If the universities take the lead in pushing for sustainable development, the degree of freedom to specify sustainability learning outcomes, which are aligned with the profession, might be an advantage. In other cases, it can just be concluded that there is only a vague and rather indirect push for education for sustainability in the Danish accreditation and legal framework for higher education. The integration of sustainable development as part of the qualification profile of Danish engineers, on the institutional as well as on programme level, is thereby left to the educational institutions to act on.

The CTI work in France shows how sustainability can be more explicitly included in the accreditation criteria. However, the lesson learned is also that the process from explicating sustainability in the accreditation criteria to actual change in the institution has to be carefully facilitated. The France case also points to potential future elaborations as to consider sustainability introduced in the management of the institutions as well as in the learning outcomes of graduates. These new recommendations have already made considerable changes at the institutions in France. A question for further research is how this change process can inspire similar change processes in Denmark, as well as in other European countries. The first step, however, is political will to push for sustainable development thought accreditation of Engineering Education.

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