ARE FINNS WALKING THE TALK? EXAMINING THE NATIONAL COLLABORATION PROCESS ON ENGINEERING EDUCATION FOR SUSTAINABLE DEVELOPMENT FIVE YEARS LATER

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Abstract: In 2009, the National Collaboration Group for Finnish Engineering Education published a proposal for action on sustainable development (SD). The aim of this paper is to analyze how the three main universities providing engineering education have fulfilled their commitments. The study consists of interviews with key stakeholders supplemented with the analysis of documented material. It is argued that the studied universities are now committed to SD in their strategies. However, a lot of work remains to be done before the strategies are implemented and SD is integrated to all degree programmes. Recommendations for the next steps are presented.

1 INTRODUCTION

The main stakeholders of the Finnish engineering education collaborated during the years 2006-2009 to create a shared strategy and tools for developing education. As a part of this process, a study and proposal for action on sustainable development (SD) in engineering education was published in 2009. All seven universities providing engineering education in Finland were represented in the strategy process, so at least in principle, all of them are committed to develop engineering education to take into account SD. Now, after five years of the publication, it is the purpose of this paper to assess the current status of SD in Finnish engineering education. Furthermore, also the UN Decade of Education for Sustainable Development (2005–2014) came to end, so, what have the Finnish universities achieved during the last five years of the decade.

Meanwhile, the Finnish Government has revised its strategy on SD. It decided to replace a traditional strategy with society’s commitment to SD, The Finland we want by 2050. The commitment was accepted in December 2013. (Ministry of the Environment 2013.) The idea is to challenge all societal actors, such as companies, municipalities, NGOs, and educational institutions to make their own operational commitments. At the end of January 2015, a little more than 100 commitments had been made.

The aim of this paper is to find out what has happened in Finnish universities in regards to SD, and to reflect on the results of the national collaboration process. Have these universities walked the talk? What should be the next steps?
In this paper, we focus on three universities providing engineering education, Aalto University (Aalto), Lappeenranta University of Technology (LUT), and Tampere University of Technology (TUT)\(^1\). These three educate roughly 85% of Master’s engineers in Finland (Korhonen-Yrjänheikki 2011). To grasp the perspective of the government and working life we also interviewed people from industry and the Ministry of Education and Culture. Altogether, 15 people were interviewed. The interviews were supplemented with the analysis of documented material (University strategies, web site, and other public documents).

2 BACKGROUND

2.1 Key messages in 2009

The National Collaboration Group for Finnish Engineering Education published in 2008 a proposal for the strategy of engineering education in Finland. According to this strategy, the mission of Finnish engineering education is “to benefit people and environment through providing knowledge and skills, research and innovations for society and business life” (Allt and Korhonen-Yrjänheikki 2008, 17). The Group represented the key stakeholders on engineering education and the process was collaborative (see Korhonen-Yrjänheikki 2011, on the process). In 2009, based on an interview and literature study, the Group agreed on proposals for action on SD. These proposals were published alongside with study in a report *Engineering education for the benefit of people and environment* (Takala 2009; see also Takala and Korhonen-Yrjänheikki 2011).

The report on SD starts from the point of view that SD cannot be exactly defined, but is complex and dynamic in nature. It is a socially constructed concept having a factual and ethical side to it (Hajer and Versteeg 2005; Carew and Mitchell 2008). The factual part consists of understanding the interrelations of the human and environmental systems. Basically, the idea that societal well-being is elementarily dependent on the functioning of the Earth system (i.e. the idea of planetary boundaries by Steffen et al. 2015). The ethical side is grounded on the fact that SD gets its form and significance in a societal dialogue on what is valued and considered worth striving for; i.e. what development is considered to be (Blewitt 2008).

Technology plays a central role when trying to create welfare inside the planetary boundaries and answering to the challenges of SD. Thus, the Group agreed that all engineers should have SD competencies. These were seen to include content focused on the systemic nature of SD challenges, and especially understanding of the material and energy flows (Mulder 2006). However, the idea is not to add a lot of content to already full curriculum, but rather develop the pedagogy and learning environments. Main part of SD competencies consist of tools to cope with the uncertainty, complexity and ambiguity. Such competencies include holistic understanding, communication and collaboration skills, ability and willingness for critical and reflective thinking, creativity, innovativeness, and entrepreneurship. It is quite obvious that these competencies cannot be achieved by simply adding new content to existing courses or creating new courses. These competencies need to be integrated in all degree programmes, combined with the core technical competencies.

Furthermore, these competencies put the focus on ‘deep learning’ (or transformative or third-order learning, see Sterling 2009; Gough and Scott 2007). It is not enough to just absorb the content of what has been taught. Thus, developing the learning methods and environments is at the heart of sustainable education. The Group agreed with Wals (2006, 41) that “quality of education and a more sustainable world are two sides of the same coin”. Taken into consideration the gravity and scale of SD challenges, best possible engineers are needed to create the innovative solutions heightening the pressure on the quality of engineering education.

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\(^1\) For the sake of transparency, it is important to point out that although we are both involved with TUT (Takala is a doctoral student enrolled at TUT and Korhonen-Yrjänheikki is a member of the Board of the TUT foundation), we have tried our best not to favour TUT in analysis and stay as objective as possible. We try to be open so that the reader can make their own conclusions.
2.2 The key proposals for action

- Higher education institutions (HEIs) need to find out how the education they offer and research they conduct is contributing to SD. Furthermore, they need to adhere to the principles of continuous development and re-evaluate their activities as SD is an on-going process rather than a goal. They need to communicate externally and internally regarding the role of engineering education and research for SD.
- Strategies of the HEIs need to include SD, taking into account the environmental, social, economic, inter- and intra-generational aspects of SD. HEIs need to set example for both internal and external stakeholders.
- Engineering students need to acquire a clear understanding of their role in SD, they need to understand the possibilities but also the limitations of technology. They need to learn the necessary knowledge, skills and attitude.
- Technology alone cannot solve challenges of SD, but transdisciplinary collaboration is needed. Thus, engineering students need to attain competencies for collaboration, shared expertise, and communication. Furthermore, systems thinking is necessary.
- Despite the fact that SD should be integrated throughout the degree programmes, there is still need for specific courses covering the basics on SD, engineering ethics and the role of technology in societal development. This kind of an introductory course can also help to achieve the integration of SD if the curiosity and inspiration of students is aroused so that they challenge teachers on other courses about SD.
- HEIs need to support teaching staff to develop their competencies in SD and pedagogy.
- SD needs to be included as one of the criteria for public funding both for research and education. The Ministry of Education and Culture should monitor the progress of HEIs on SD.
- SD is dynamic, it evolves as our knowledge, skills and values evolve. Thus, it is essential that engineering education provides students with the capacity for lifelong learning. Furthermore, developing competencies through career planning need to be continuous to ensure sustainable careers.

2.3 SD in the universities in 2009

Both the external and internal stakeholders of Finnish engineering education were of the opinion that the universities lacked a common view on SD in 2009. There were many individuals who worked passionately for SD both in research and education, but SD was something that did not concern the majority. There was lack of resources, and in many cases, SD was the responsibility of one person or one department, most often environmental or energy engineering.

However, a lot was already done that related to and promoted SD, but these activities were isolated, and often not recognized as SD. Thus, they were not developed systematically. Furthermore, small separated activities did not provide system level solutions to the challenges of SD. Most focus was on the management of the environmental impacts of facilities or so called campus greening (i.e. recycling wastes, and saving electricity and water).

Most of the universities were not communicating about their contribution or commitment to SD. SD was not visible in their communication (e.g. websites). In addition, universities and their staff, did not participate in societal discussion. This applied to engineering profession in general. There were worries that this invisibility would impact the attractiveness of engineering education in the eyes of younger people (similar concerns had been raised also elsewhere in the world, see e.g. Azapagic et al. 2005, NAE 2005).

A major obstacle was considered to be the fact that there were many on-going reform processes. For example, the University Act was under modification, and the new Act became operationalized from 1 January, 2010 onwards. Degrees had ben reformed relatively recently according to the Bologna process, and the revision of degree programs was on-going. It was felt that there was no time to think about such a complex issue as SD in the middle of all the turmoil. Furthermore, in the wait of the new Act, universities were hesitant to commit to remarkable changes.
Five years is a short time to achieve remarkable changes in the university context, but taken into account the urgency of many SD challenges, it is reasonable to expect that at least some progress would have been made.

The Ministry of Education and Culture has not enforced the implementation of SD in universities, and SD is not a criterion for public funding. There are no plans to do this either, as it is perceived that SD is so ambiguous that it would be difficult to manage and measure progress objectively. After all, the goal is not to guide all universities to apply a rigid procedure on SD, but to find their own way to enhance it. Some of the interviewed university representatives saw this as a significant barrier. According to them, if SD does not show in the funding criteria, it will not be taken into account or the change will be much slower. Then again, others were content that the Ministry respects autonomy of the universities in this respect, and lets universities focus on their strengths.

The Ministry of Education and Culture has encouraged universities to give their own Commitment to SD (Finland we want by 2015). In Spring 2014, as a part of reporting, the Ministry asked universities to elaborate their plans concerning the Commitment. In February 2015, LUT and Aalto gave their Commitments. According to some of the interviewees, however, universities have been surprisingly cautious and hesitant despite the fact that they are already in many ways committed to enhancing SD.

3.1 Aalto University

Aalto University was established at the beginning of 2010 when Helsinki University of Technology, Helsinki School of Economics, and University of Art and Design merged. According to the interviewees, the new university is still strongly developing, and gradually, delivering its promises on transdisciplinarity and innovativeness. As an example, an international Master’s Degree Program in Creative Sustainability (CS) was commenced in autumn 2010, combining architecture, business, design, landscape planning, real estate and urban planning.

The president of Aalto has declared as a goal “to integrate sustainability into all our teaching and research by 2015 and become Finland’s leading sustainable university campus by 2020.” (Aalto University 2014, 3.) However, according to the interviewees, the first goal related to teaching has not been reached. This is, at least partly, due to the autonomy of the schools and degree programs. It is seen as best to give them freedom to decide the way they implement SD. Implementation has not been monitored systematically, so there is no comprehensive information on the progress.

Aalto has a Senior Advisor on sustainability and Academic Roundtable for sustainability, indicating commitment in SD. Aalto has also signed the Higher Education Sustainability Initiative (HESI) for Rio+20, and been actively involved in many international SD networks. For example, Aalto was establishing and coordinating NSCN, Nordic Sustainable Campus Network. Aalto communicates openly about their SD activities on their website (www.aalto.fi/en/about/strategy/sustainability/) and sustainability reports (see e.g. Aalto University 2014). Significant progress has been made in regards to campus sustainability.

3.2 Lappeenranta University of Technology (LUT)

The brand new strategy of LUT is built on answering four key questions facing humankind: “Are we going to burn up everything? Is humanity condemned to suffer from the water it has polluted? Will waste be the grave of our future? Will we let Europe degenerate to the world’s back yard?” According to strategy, LUT is committed to be the difference-maker who finds the alternative paths for development. (LUT 2015.)

Sounds highly impressive, but what about the practice? In 2009, LUT had degree programs and research on environmental and energy engineering, but the university as a whole, was not committed to SD. Now, the situation is quite different. In 2011, Green Campus was announced as the winner of a LUT innovation competition. According to the interviewees, this was first mostly just a publicity stunt. However, as some staff members and especially students reacted strongly, LUT had to fulfill promises given. For example, solar and wind power plants were built to the campus area, utilized also in a pilot for smart grid. There are
electric bikes and cars available for the use of students and staff. Noteworthy is that Green Campus utilizes the expertise and research of LUT’s own staff and students instead of being just a separate add-on. Students and staff have been involved in planning and building, and the actual running of the facilities is also used as a ‘living lab’ for research and education. Furthermore, many of the activities have been planned in cooperation with the city of Lappeenranta. LUT communicates openly and actively about SD activities on their website (http://www.lut.fi/web/en/green-campus).

LUT’s Green Campus has also been internationally recognized, as in 2013 it was awarded by International Sustainable Campus Network (ISCN) for the best sustainable campus. Furthermore, LUT has built an environmental system (ISO 14001) that was certified in 2014. As part of this system, LUT will adopt a course classification scheme to determine how SD is addressed in courses. Scientific publications will also be scanned to find out the proportion that deals with topics concerning SD. Although the course classification scheme is, at least in the beginning, merely based on the self-assessment by the teachers, it is a good starting point to get a systematic view of what is being taught. Furthermore, the interviewees were quite confident that the students will be active about the truthfulness of the assessments.

All in all, it seems that many students are actively involved in promoting SD at LUT. They are eager to give feedback if something is considered unsustainable, and apparently the university management listens to them. Students, as well as all the members of staff, have had a chance to participate in formulating the new strategy, and it seems, they are also committed to execute it. LUT’s Commitment to SD is to improve its workplace well-being, aiming to be the best Finnish university to work in 2020.

The interviewees were proud of what LUT had achieved in such a short time span. However, they also saw that there is still room for improvement. For example, the course classification scheme is just the first step to examine how education is contributing to SD. Furthermore, SD seems to be interpreted in a somewhat limited way, mainly focusing on pollution management aspects, as is apparent in the strategy and operation of Green Campus. As one of the interviewees put it, the complex but crucial questions of planetary boundaries, resilience, and equity are not covered.

Then again, the fact that these weaknesses and needs for development are even recognized shows critical thinking and adherence to continuous improvement. Furthermore, it needs to be remembered that LUT has managed to achieve quite big changes in a very short time span. When asked what interviewees thought to be the secret for success, they highlighted the spirit that is collaborative, brave and open-minded. People are not afraid to experiment.

### 3.3 Tampere University of Technology (TUT)

TUT’s strategy for the years 2013–2016 is titled *Technology for the benefit of people and the environment*, and this phrase has also been used in recruiting new students. In addition to the title, the strategy seems to also otherwise follow the ideas of the Collaboration Group, as it states that: “All students learn to understand the importance of technology in addressing sustainability challenges and attain the skills needed for entrepreneurship. Teaching personnel is expected to possess deep subject knowledge and teaching skills. The University offers multiple pathways for lifelong learning and ensures that programmes are aligned with labour market needs.” (TUT 2012, 1). Furthermore, based on the interviews with the university management, TUT is committed to SD.

Regarding the implementation of the strategy, management invoked to the academic freedom, and the ambiguous character of SD. It had delegated the responsibility to the faculties and each degree programme to integrate SD in education. This was to be done in association with the degree reform process (the new degree programs were launched in August 2013). The university management had not monitored the execution of SD. However, based on the interviews, they promised to send a questionnaire to the planners of each degree program concerning SD and entrepreneurship to assess the execution of strategy in this respect.

On the website of TUT (www.tut.fi), research projects related to SD have been recently more and more visibly communicated. The President of TUT, Markku Kivikoski also said he includes the issues of SD and
the social responsibility of engineers when he gives speeches, for example, at the graduation ceremonies. Thus, it could be argued, that TUT’s contribution to SD is communicated to the internal and external stakeholders.

In 2012, a new professorship on sustainable design and construction was established. The degree program in architecture (Master's level) contains four courses focused on SD. The Department of Chemistry and Bioengineering coordinates a study block on sustainable production that is offered to all degree programs. Furthermore, the department offers *Introduction to SD* -course. However, there is no course on SD that would be mandatory for all students.

From the perspective of integrating SD in engineering studies and the learning environment as a whole, the strategy could have been implemented better. As an example students outside the degree programs of environmental and energy engineering and architecture need to be proactive if they want to study SD.

It is also important to note that students have not been very active in demanding development of the curriculum and learning environment from the viewpoint of SD. The cooperation of the student union and university management is relatively close, and a more active role of students might have speeded up the development.

4 HAS FINNISH ENGINEERING EDUCATION COMMUNITY WALKED THE TALK?

Five years after the publication of the report and proposals for action by the National Collaboration Group, it can be said that progress has been made, but a lot of work remains to be done. The three universities and other engineering education actors have included SD in their strategies and goals. Thus, it seems that there is commitment at the management level and SD is legitimized. These have been identified as crucial success factors or driving forces for enhancing SD in engineering education (Holmberg et al. 2008, Lidgren et al. 2006, Sharp 2002).

The reform processes (for example, the renewal of University Act and Bologna Process) have kept universities busy. Many interviewees said that there had not been time to implement any further changes. Also Peet et al. (2004) observed that the various external reforms diminish sympathies towards further reforms. Then again, the impetus of such changes can also be used to include SD. When current systems are under scrutiny, it is possible to also reflect on the role of SD in education (Holmberg et al. 2008). It can be argued that LUT managed to utilize this impetus, and their change from 2009 to 2015 has been remarkable. In general, however, these reform processes could have been utilized better.

A key problem is that despite the strategies and goals, education for SD is still not integrated in all engineering education. There are many courses and modules that cover SD and the role of engineers in society, but these are separate from the core and optional. It is only the students who are already interested in SD who take these courses. The majority is still unconcerned about SD.

One explanation is that management of universities in the context of long-tradition of academic freedom is not as straight-forward as in private companies. Teachers and researchers are relatively free to focus on aspects that they are interested in (Peet et al. 2004). Furthermore, systematic management of teaching is possible in cross-cutting themes like SD, but there is a lot of work in improving this. The course classification scheme applied at LUT as part of their environmental management system is an example of one tool (see also Holm et al. 2014).

Another explanation is related to the ambiguity and complexity of SD. It is not simple to integrate SD. Then again, entrepreneurship as a competence is in many ways similar to SD; it is ambiguous, consisting of factual part, knowledge and skills, but also attitudes and values. Still, many universities have made progress in integrating entrepreneurship across all degree programs. For example, in Aalto it was perceived that in past couple of years entrepreneurship had become cross-cutting theme in studies and this already shows in practice. TUT has also been focused on integrating entrepreneurship. Thus, it cannot be said that it would be impossible to integrate a complex cross-cutting theme in a university. Instead, resources and true commitment are required.
It seems that more progress has been made incorporating SD into research than to education. This is perhaps due to emphasis in research funding, and possibly research is also more agile to react to societal pressures and needs. As education in universities is to be based on research, the emphasis of SD in research will hopefully also gradually reflect in education.

One of the most positive signals concerning sustainable education is that more attention is paid to the quality of education. Pedagogical competence is a more important recruitment criterion for university staff, and training is also available. Furthermore, a lot of effort is put to increase the appreciation for teaching at universities. According to the interviewees, more versatile teaching and learning methods are in use in all universities.

5 THE NEXT STEPS

It seems that one of the main issues in enhancing education for SD is finding the balance between rigid control and fostering academic freedom and innovativeness. Management and leadership of universities and educational policies in general, are essential. Incentives to take SD into account need to be incorporated in the public funding but also in the internal funding allocations inside the universities. As SD is part of the national strategy and also the strategy of universities, the responsible thing to do is to assess how well SD is already included in education, commit to develop it consistently, and to monitor progress on systematic and regular basis. Strategic goals should show also in the work of individual teachers and researchers.

The activity of students can have a significant impact, especially in cultures where students are considered as core members of the university community, and whose views are taken into account. Thus, the activity of students should be encouraged and they need to be listened to. Furthermore, it seems that building a functioning community that is committed to collaborative learning, is central. After all, SD is a learning process (see Blewitt 2008). Thus, human resources management and well-being of staff and students should be highlighted in universities.

One key question is how to get everyone involved and engaged in education for SD. There are obvious lacks in communication both internal and external. Staff and students are not aware of the strategic commitments, management is not aware of what is already done, and communicating this to the surrounding society could also be improved. Open and continuous dialogue is needed.

There is still much work to be done. However, it is empowering to see the example of LUT. A lot can be achieved in just five years with innovative leadership, collaboration and courage. Hopefully this serves as an inspiring example to engineering education community in Finland, and also elsewhere.

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References


