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Author	Karvinen, Meeri;Malkamäki, Marianna
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Organisational Structures to Drive Sustainability Integration in Engineering Education

Karvinen M.¹ and Malkamäki M²

¹ School of Engineering / Dept. of the Built Environment, Aalto University, Finland

meeri.karvinen@aalto.fi

² School of Science / Dept. of Industrial Engineering and Management, Aalto University, Finland

Abstract

The integration of sustainability into engineering education is essential for preparing future professionals to address global challenges, such as climate change and resource depletion. This implies that the university staff engaged in teaching can bring sustainability in the courses and curricula. In this endeavour, organisational support structures that would facilitate educators' integration efforts play a substantial, yet underexplored role in technical universities.

We interviewed fourteen faculty staff members to examine the organisational actions taken and structures that the Nordic and Baltic technical universities have implemented to support the integration of sustainability in engineering curricula and courses. Further, we explored what visions the staff members have for accelerating the integration of sustainability into their university's education. The interview data was analysed using an abductive theme analysis, which allows for deductive and inductive forming of themes and subthemes.

We found a variety of actions taken to promote sustainability integration. The processes that seem particularly beneficial for university-level integration included compulsory, university-wide sustainability courses, extensive programme reviews, and incentive processes, such as internal project funding for integration initiatives. Further, faculty staff emphasises the need for having more dedicated educators to promote the integration efforts, and to achieve this, commitment and resources from the leadership would be needed.

Our findings provide a comprehensive overview of how organisational support structures can facilitate sustainability initiatives of the teaching staff. Therefore, this study can inform engineering educators and technical universities on how to further develop organisational support, thus contributing also to the wider discourse on systemic change in higher education.

1 Introduction

Engineering education has steadily been moving towards integrating sustainability in institutional policies and practices, and curricula (Tejedor *et al.*, 2019b). Previous research has identified many factors that can both hinder and enhance the integration efforts of teachers, including support from leadership, competencies of teachers, and resources, such as time and funding (Karvinen *et al.*, 2016; Rieckmann, 2019; Vare *et al.*, 2019). The high-level institutional policies that promote sustainability integration in education are similarly well known, including strategy and target-setting, or signed commitments (Karvinen *et al.*, 2017).

It is widely acknowledged that sustainability integration requires institution level commitment (Sterling, 2001; Cortese, 2003; Weiss *et al.*, 2021). Many important dimensions of sustainability education have been identified as requiring at least programme level coordination, long-term planning, and resources. For example, interdisciplinary approach, depth of the integration efforts (add-on, built-in, re-design), and breadth of the provided sustainability content (different aspects of sustainability) are all aspects that are central when embedding sustainability in curricula and that relate to support from leadership (Weiss *et al.*, 2021). In the context of engineering education, Kolmos (2016) indicated almost a decade ago how the different strategies of curriculum level integration (add-on, integrative, transformative) require increasing levels of institutional coordination and commitment to shared values. Despite this existing knowledge of the importance of institutional commitment on sustainability integration, fewer studies have investigated the support structures that would reflect this commitment. By support structures we mean the measures taken by the universities to overcome the obstacles and facilitate the integration initiatives of educators.

The specific context of this study is the Nordic-Baltic region. In the Nordic higher education institutions (HEIs), recent research indicates that there is a lack of institutional commitment to sustainability, and particularly a lack of support for teachers' competence development (Karvinen, 2024). The Nordic HEIs, in line with a global trend (Wals, 2014; Ramos *et al.* 2015), also seem to invest more to campus sustainability than to sustainability education (Karvinen *et al.*, 2017). However, the Nordic HEIs do collaborate widely through different platforms around education. Many of the collaborative efforts are facilitated by the existing, high-level networks, such as the Nordic Five Tech and the Nordtek, which also includes the Baltic countries. These networks together cover 31 HEIs that provide engineering education in Denmark, Finland, Iceland, Norway, Sweden, Estonia, Latvia, and Lithuania. The networks also aim to promote sustainability; the Nordtek, for example, has a dedicated working group for sustainability, which just published a jointly created guide to sustainability integration (Nordtek, 2025). Therefore, these networks create a fruitful gateway for deeper explorations on their organisational support structures.

This study focuses on exploring the views of experienced faculty and administrative staff in this region. We were particularly interested in how the Nordic and Baltic technical universities currently support their educators, and what should be done in the future. The following questions directed our qualitative research: 1) What organisational support structures exist in the studied universities, and 2) What visions does the faculty staff have on the future development of organisational support? We additionally investigated factors that teachers associate with a feeling of being supported, and what they found suppressing their actions, but these results are reported in detail elsewhere (Karvinen & Malkamäki, 2025). The results will hopefully be empowering for engineering educators and informative for university leadership particularly in the Nordic and Baltic region, but also in other technical higher education institutions.

2 Methodology

2.1 Data collection

We conducted fourteen semi-structured interviews to the faculty and administrative staff working in ten Nordic and Baltic technical universities (Table 1). The interviewees were mainly found through our contacts in the Nordtek and Nordic Five Tech networks, or by asking the first contacts to recommend a colleague who could be suitable for our study. We aimed at having at least one participant from each country and to gain diverse insights from course and programme development, and complementary views from the

administrational development tasks that relate to sustainability education. All the interviewees had multiple years of work experience in academia and their titles were for example, associate professor, programme director, and university lecturer.

This study aimed at gaining new insights about faculty staff members' experiences and thoughts about the support available for sustainability integration, therefore, it was considered crucial that each of the interviewees have practical experience on integrating sustainability in engineering education. Followingly, all the interviewees were asked to describe a certain sustainability related project they had been engaged in recently. They were further asked to reflect on the factors that affected the success of the project, their feelings about how their efforts had been valued in their community, and how they would develop organisational support to facilitate the integration efforts in the future. Most of the projects related to developing existing courses' sustainability content with new structure, assignments or content, but there many had also created new sustainability courses, or developed the sustainability emphasis of degree programmes for example through programme reviews.

The interviews were conducted online in English through MS Teams in August-September 2024. The average length of an interview was 50 minutes. The interviews were recorded with the consent of the participants and auto transcribed using MS Teams. The participants were given the opportunity to view and correct the transcriptions. We refrain from reporting the titles or even genders of the specific participants to secure their anonymity, as this was requested by some of them.

Guidelines of The National Committee of Research Ethics was followed throughout the research process. All participants signed a consent document before the interviews. There were no anticipated risks for participating in the research and no sensitive data was collected.

Table 1. Participant data.

Country	University	N of Interviewees
Denmark	Technical University of Denmark (DTU)	2
Estonia	Tallinn university of Technology (TalTech)	1
Finland	Aalto University	1
Iceland	University of Iceland	1
Latvia	Riga Technical University (RTU)	1
Lithuania	Vilnius Gediminas technical university (Vilnius Tech)	2
Norway	Norwegian University of Science and Technology (NTNU)	1
Sweden	KTH Royal Institute of Technology	2
Sweden	Umeå University	1
Sweden	Uppsala University	2

2.2 Data analysis

The interview data was analysed with an abductive analysis that allows for using both deductive and inductive approaches (Timmermans & Tavory, 2014). This analysis method was found particularly useful to point out what complementary findings our interviews brought to the current scientific understanding of

the research topic. We mainly followed the abductive theme analysis steps described by Thompson (2022): 1. Transcription and getting familiar with the data, 2. Coding, 3. Codebook, 4. Creating themes, 5. Theorising, 6. Comparing data groups, 7. Presentation of the data, and 8. Writing. Our analysis excluded the phase 3. Codebook., which according to Thompson, provides structure for the coding if done by a research group, and in this study, only the other author coded the data because the study builds on data that was collected for her master’s thesis (Malkamäki, 2025). The step 6. was out of focus of this study and was also excluded. After three rounds of coding (Thomas, 2022) and categorising the codes into sub-themes and themes, a map to visualise the results was created (Fig. 1).

3 Results

This section presents results concerning both of our research questions in the sub-sections below. The theme map (Fig. 1) visualises all our results as sub-themes and themes that emerged from the data.

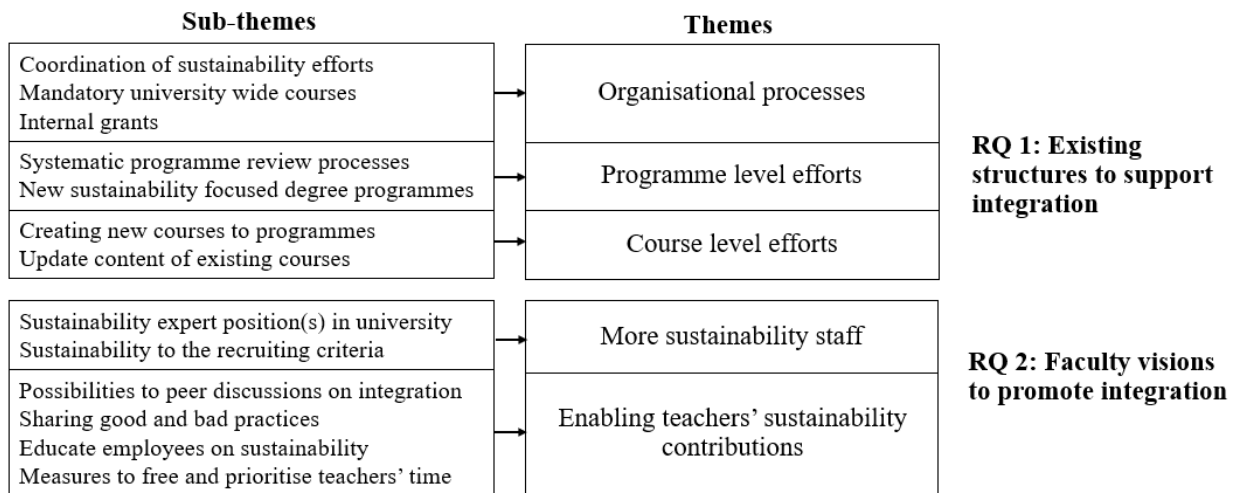


Figure 1: Theme map illustrating the sub-themes and themes relating to the two research questions (RQs).

3.1 Existing processes and practices that support sustainability integration

During their sustainability projects, the interviewees had encountered multiple organisational practices that they identified as being a measure to support sustainability integration. These identified measures, however, varied substantially between different universities. We were still able to identify three main themes from the interview data: Organisational processes, Programme level efforts, and Course level efforts (Fig. 1). The combining factor for Organisational processes and Programme level efforts was the coordination needed from university, faculty, or departmental levels. Therefore, they required support or were even initiated by the leadership. The course level efforts were more dependent on the efforts of individual teachers.

Organisational processes consisted of three sub-themes. 1) Coordination of the organisations’ sustainability efforts was emphasised with mentions about expert teams. These teams were said to for example drive and facilitate organisation level initiatives or focused on providing pedagogical support for teachers to embed sustainability. Concerning the latter, a few interviewees told that their university provided pedagogical training for teachers on sustainability, such as a course, seminar, or workshops. This, however, varied a lot between the universities. One university had a sustainability centre taking care of both

overall coordination and pedagogical support of sustainability education. 2) A structure that three of the interviewees mentioned was a mandatory, university wide course relating to sustainability themes. One participant explained that the aim of the mandatory course was to ensure that all engineering students from bachelor to doctoral levels acquire foundational knowledge and skills in sustainability, regardless of their specific engineering discipline or interest towards sustainability. 3) Internal grants that teachers could apply to develop their teaching around sustainability worked as a driver for bottom-up initiatives. Interestingly, the interviewees revealed that the funding they had received was only a secondary motivator, whereas the time that they were able to allocate to integration efforts was the primary incentive resulting from the grant.

Programme level efforts comprised of two sub-themes, Systematic programme review processes, and New programmes focused on sustainability. In three of the studied universities, feedback from university wide programme reviews had resulted in more careful reviews on the sustainability contents of engineering programmes from bachelor to doctoral levels. The process required surveying or interviewing teachers, as not all the sustainability content of courses was explicitly written in official course documents. In one of these universities, the sustainability review had focused specifically on how the programme supports the development of sustainability competencies and had resulted in a conclusion that a wide “sustainability competence” needed to be integrated into all programmes. New sustainability focused programmes had been started in two of the universities, from which the other one was initiated as a result of the internal grant system mentioned above.

Course level efforts included two sub-themes: New courses and Developing existing courses. New courses to engineering programmes were initiated both top-down by departments and bottom-up by individual professors. In both cases, a gap in sustainability related course offering was observed and a decision made to create a new course. Integrating sustainability aspects in existing courses was mainly described to be a teacher-led process, where the responsible teacher wanted to include some lacking aspects, such as circular economy. Visitors were mentioned as one way to fill in observed sustainability gaps in existing courses.

3.2 Faculty visions for furthering sustainability integration in engineering education

This sub-section presents how the interviewees would develop their university’s support for sustainability integration based on their experiences and evaluation of current measures described in the previous sub-section. The interviewees strongly emphasised a need to engage more interested educators in the integration work, and a need to better support the educators. The two themes that emerged were More sustainability staff, and Enabling teachers’ sustainability contributions (Fig. 1).

More sustainability staff comprised of two sub-themes, Sustainability expert position(s) in university, and Sustainability to the recruiting criteria. These were both brought up in the context of needing more committed faculty staff who could drive sustainability integration. The expert positions were also said to reflect leadership’s commitment to sustainability. One of the teachers described that the sustainability expert of the organisation was perceived as a clear indication of leadership’s interest towards sustainability integration and their willingness to guide the organisation towards a direction emphasised in the strategy. Recruiting sustainability oriented new academic staff was partly seen as a similar measure that shows leadership’s commitment to sustainability education. More importantly, recruiting was mentioned as a way to ensure that the new educators are motivated to promote sustainability. One teacher explained that you need a few dedicated persons to drive sustainability integration, not every teacher. The same teacher was critical towards incentivising non-interested academics through internal grant systems. The teacher had suspicions that the system could attract people to use sustainability instrumentally just to receive funding,

even if they wouldn't intend to focus on sustainability integration. The point this teacher wanted to underline was that sustainability integration required people genuinely interested in doing it.

Enabling teachers' sustainability contributions included four interconnected sub-themes underlining teachers' need to jointly develop sustainability contents of engineering education: Possibilities for peer discussions on sustainability, Sharing good and bad practices, Educating teachers on sustainability, and Measures to free and prioritise teachers' time.

The interviewees particularly emphasised the need to jointly gather around sustainability integration. The observations the interviewees had made were that there are varying understandings of what is meant by sustainability integration, what would be sufficient integration, and how sustainability is defined. Therefore, the interviewees saw that there should be organised platforms or other structures enabling peer discussions on these important topics. Similarly, the sharing of good and bad practices was seen central to promoting practical integration work. One participant said that sharing practical examples of how sustainability can be integrated could motivate also those teachers who have earlier been unmotivated to develop their courses. Those teachers who had experiences of programme level screening of sustainability contents and introducing mandatory sustainability courses into programmes or university saw these measures as something that should be encouraged more in universities. They saw that teachers with experience of such measures should be able to share them with inexperienced colleagues.

Some interviewees advocated for more teacher training on sustainability, explaining that it is difficult to integrate something you are not at all familiar with. However, a key downside of the trainings, mentioned by one teacher, is that they are usually voluntary. This, the teacher argued, results in always gathering the same interested people together who are already familiar with the topic instead of engaging those who maybe should take part. The interviewees identified time as a key obstacle for course development and therefore saw that more efficiency would be needed in allocating teachers' time. The solutions suggested included for example encouraging teachers to use artificial intelligent in basic level courses, such as mathematics, to allocate more time for courses that require more advanced pedagogical approaches. Another suggestion was the use of ready-made digital material for sustainability related contents.

4 Discussion and conclusions

This study explored how the Nordic and Baltic technical universities support their staff in integrating sustainability in education. We specifically investigated what the teachers and administrators working with education identify as existing, beneficial organisational support structures and how they would further develop these practices. Our findings are in line with earlier observations (Weiss *et al.*, 2021) by strongly emphasising the meaning of organisational coordination measures as enablers of practical sustainability integration initiatives. The novel insights emerging from our explorations are more related to the studied region: our interviews indicate that many good organisational practices already exist in the Nordic-Baltic technical universities, such as expert groups or pedagogical support for sustainability integration. In addition, the findings highlight systematic programme reviews focusing on sustainability and internal grants for sustainability projects as the most prominent support structures. Like our interviewees described, many of the bottom-up initiatives they had seen or taken themselves were possible due to received resources, whether that was in the form of time, or funding. Followingly, there seems to be a clear need for having more motivated academic and administrative staff in the universities of this region who can drive and coordinate these processes.

Other influential support structures that our results indicate relate to these knowledgeable and motivated staff members. As highlighted by our participants and previous research (Schönach *et al.*, 2023), sustainability integration requires joint efforts and possibilities to share experiences with peers. Our participants specifically emphasised the need to jointly make sense of sustainability and its integration to own teaching; they indicated a lack of shared understanding of how to define sustainability, and what does it mean in practice to embed it into education. Most of all, the teachers want to see more interested and engaged colleagues contributing to a more sustainable engineering education, which according to our participants, can also be one result from sharing existing, tangible integration cases. Therefore, this study strongly suggests technical universities to invest in facilitating joint discussions and sharing and help teachers find like-minded colleagues. In addition, this study seconds earlier suggestions (Vare *et al.*, 2019; Schönach *et al.*, 2023) to increase sustainability competencies of teachers and other staff, be it through recruiting criteria of new professors, educating the staff on sustainability, or other suitable means.

To conclude, technical universities in the Nordic and Baltic countries seem to have a good direction with integrating sustainability in their teaching. The support structures vary between institutions, but based on our study, we are now more aware of the existing practices in this region, which opens up better possibilities for further collaboration and learning from each other. The feature that all our studied institutions share is the limited leeway of individual teachers to further institutional sustainability education through bottom-up initiatives. This emphasises the need for higher-level coordination and a systematic approach for the integration work. Therefore, committed leadership who understands and answers the support needs of their staff members is the key to accelerate sustainability integration in engineering education.

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