

Defining education to support sustainable operation of buildings in the Nordic Countries

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Abstract

The introduction of sustainable goals and concerns has brought many challenges to the construction sector. In particular, the combination of environmental, economic and social ambitions asks for complex solutions and require multidisciplinary competences. Likewise, construction sector related educations are facing similar challenges requiring them a crossing of barriers between traditional disciplines. Whereas most educations focus on technical and economic subjects, the social aspects of sustainability are often lagging behind. However, studies of implementation of sustainable solutions underline the importance of including all the actors concerned in the process and above all the users, but the different professionals of the sector often lack tools to do so. Engaged in the creation of a summer school gathering construction and facilities management students from three Scandinavian countries, we aim at planning and implementing such tools within our respective educational programs. Building on the stream of Project-based learning (PBL), where students acquire a deeper knowledge through active exploration of real-world challenges and problems, we intend to develop cases integrating issues related to implementations of sustainable solutions within facilities management. Such issues have been identified in a literature review and in a one-day workshop gathering more than 40 participants active in the sector. The challenge is to create a pedagogical platform which includes both theory and practice-oriented contributions and to build on their complementarity to enable the students to learn how to face and possible solve such issues. Moreover, the project offers the possibility to compare and reflect over the different educations in term of sustainability in facilities management as well as to explore the professional and cultural differences between the Nordic countries from your study that will be of interest to the reader.

Keywords: Education, Facilities management, Interdisciplinary, Nordic countries Sustainability

14. Introduction

Facilities Management (FM) can play an important role in implementing sustainable solutions and reducing energy consumption. Buildings as well as their operation and maintenance consume a large amount of energy and material; they also can have an impact on the users' health and well-being. Besides, at the local level, they can have influence on social aspects and contribute to a social coherence of sustainability (Elmualim et al. 2010). However, whereas there is a broad agreement on the need to implement sustainable measures, the concept of sustainability, upon which theory, policy, and practice are developed, is far from offering a clear definition and a shared understanding of its different dimensions and applications (Sarpin et al 2016). Both generally and contextually, the concept carries internal tensions and contradictions, in particular the social dimension creates debate and uncertainty (Buser and Koch 2014). Similarly, it can be difficult for FM professionals to comprehend the complexity of sustainability and make decisions on a daily basis integrating these concerns. In particular, the combination of environmental, economic and social ambitions asks for complex solutions and require multidisciplinary competences. Whereas standards and certifications can provide support to the professionals, they are not sufficient to define, and assess the complexity of the challenges and implement sustainable solutions (Sarpin et al 2016). Even though studies of these types of solutions emphasize the importance of including all the actors concerned in the process and above all the users, the practitioners often miss tools to implement these solutions in their actual practices. Authors (Elmualim et al. 2008, 2010; Sarpin et al. 2016) have underlined the need to develop what they call the *reflective practitioners*, professionals *who are able to navigate a work life rife with contradictions and dilemmas and who can determine the appropriate course of action at the appropriate time*, (Sarpin et al. 2016).

Furthermore, educations related to construction and facilities management are facing similar challenges forcing them to cross the barriers between the traditional disciplines. Whereas number of professional schools and universities have integrated sustainability into their education portfolio, most of them focus on technical and economic topics, neglecting the social aspects (Lozano at al. 2015, Lim et al. 2015). As the number of constructions is growing quickly, the competences needed to manage these portfolios and integrate sustainable solutions is growing accordingly. It is important therefore to find flexible solutions which can be rapidly implemented. Building on the identification of missing competences for FM practitioners, found in by both a literature review and during a one-day workshop gathering FM professionals and academics, our paper presents the development of an approach for a summer school intended for construction and facilities management students from three Scandinavian countries. The aim of this summer school is to test interactive new education tools within our respective educational programs. Building on the stream of Project-Based Learning (PBL) where students acquire a deeper knowledge through active exploration of real-world challenges and problems, we intend to develop cases integrating issues related to implementations of sustainable solutions within facilities management. The challenge is to create a pedagogical platform which includes both theoretical and practice oriented contributions and to build on their complementarity for the students to learn how to reflect and deal with such sustainability challenges. We start the paper with a brief literature review of the challenges and barriers encountered by FM professions to implement sustainability in their practices.

15. Theoretical frame for a summer school

15.1 FM and competences in sustainability

The potential contribution of FM to sustainable development has been clearly demonstrated by researchers and practitioners (Galamba, and Nielsen, 2016, Sarpin et al.2016). FM practitioners can play a central role in this development. As they have the opportunity to view the entire process of managing built assets they have the possibility to influence over the long-life cycle of FM by developing, implementing and maintaining sustainable solutions (Hodges 2005). However, in order to delivered results, FM practitioners need to develop the capacity to define, analyse and examine sustainability issues in a holistic manner. Despite the opportunity to drive the sustainability agenda forward, the FM profession does not yet have sufficient access to specialists' knowledge, tools and case study materials necessary to implement such solutions efficiently (Elmualim *et al.*, 2009). Sarpin et al. (2016) provided a brief literature review on the insufficiencies and barriers that sustainable development face in FM practices and identify four main types of challenges. Table I summarizes these main issues.

Table 2: *Issues and challenges in integrating sustainability with FM practices (Sarpin et al. 2016)*

<i>Challenges</i>	<i>Authors</i>	<i>Descriptions</i>
<i>Capability challenges</i>	Elmualim <i>et al.</i> (2010) Hodges (2005) Shafii <i>et al.</i> (2006) Shah (2007) Yang <i>et al.</i> (2005)	Lack of capabilities/skills Awareness of building whole-life value Lack of professional capability Unwillingness to implement sustainability Lack of competence in managing the changing attitude process of people and institutions Diversity of FM roles Undervaluation of contribution to organisational success
<i>Knowledge challenges</i>	Elmualim <i>et al.</i> (2009) Elmualim <i>et al.</i> (2010) Hodges (2005) Lai and Yik (2006) Nielsen <i>et al.</i> (2009) Shah (2007)	Lack of knowledge Limited knowledge regarding environmental themes Knowledge gap Management of sustainability knowledge Low level of knowledge regarding sustainability Discrepancy in knowledge
<i>Organisational challenges</i>	Elmualim <i>et al.</i> (2010) Hodges (2005) Nielsen <i>et al.</i> (2009) Shah (2007)	Time constraints Lack of senior management commitment Lack of incentives to create routine planning on environmental issues Too little time and few resources to implement Increasing liability
<i>Authority challenges</i>	Bosch and Pearce (2003) Nielsen <i>et al.</i> (2009) Shah (2007)	Limited data on local consumption of energy, water etc. Performance indicators Lack of guidance documentation

The list of capabilities challenges underlines the deficiency of skills and competences to identify and manage changes requested by sustainable solutions within organisations as well as a lack of awareness and engagement of the management team. The list of knowledge challenges addresses the shortage of information, knowledge and adequate methods to implement sustainability. The list of organisational challenges concentrates on the rigid and pressed situation of daily work and the lack of incitement to integrate sustainability in already existing activities. The list of authority challenges identifies the lack

of guidelines, routines and performance measures to contributing to the development of sustainable solutions.

Furthermore, Meehan and Bryde (2015) emphasize a need for integrated and collaborative strategies adapted specifically to FM practitioners' local context in order to meet the need of the stakeholders rather than developing generic solutions for sustainability.

The most effective way to achieve a transformation towards sustainability is to enhance sustainability knowledge and expertise within the industry (Shelbourn et al. 2006). The challenges presented above underline the need for FM professions to develop their understanding of sustainability, integrate the needs and characteristics of stakeholders and to strategically invest in training to support the development and realize the potential of sustainable solutions. Defining and integrating teaching and training for sustainability is one way to increase the realization of this potential.

15.2 Integrating sustainability in education

Education's providers worldwide are now creating new courses and degrees or modifying existing ones in response to the increasing interest by companies to hire sustainability trained graduates (Lozano et al. 2013). However, many of these programmes remain techno-centric, addressing either environmental and engineering topics or building on normative managerial academic teaching approach (Lozano et al. 2015).

Adding sustainability to already existing programmes presents challenges as well. Ceulemans and De Prins (2010) identify the following barriers to incorporating sustainability in current education: the limited frame of reference of the teachers; the multidisciplinary character of research related to sustainability misunderstanding of sustainability inclusion; the workload of teachers and that sustainability is not seen as a core issue. However, the tasks of designing holistic sustainable courses should not be left to the responsibility of teachers only. Construction and MF practitioners' experiences and needs should be integrated in the programme to increase the production of knowledge and skills related to sustainability (Lim et al. 2015).

To providing a platform for exchanges between academics and industry, one solution is to integrate practitioners directly in the courses. Wilson and Pretorius (2017) underline that there is much potential in practitioners' engagement achieved through various forms of partnerships with stakeholders to enhance student engagement with sustainability issues and to co-create knowledge addressing both the academic and practitioners' interests. However, this engagement by universities with societal stakeholders in teaching and learning for transformation towards sustainability, remains a challenge and still presents opportunity for further developments (Trencher et al. 2015). This can only be done through collaborative endeavours across disciplinary and professional boundaries.

Despite these challenges, integrating sustainability into academic curricula has been recognized to be central for equipping students with the competences and to support the transformation of societies towards sustainability (Lozano, 2010).

15.3 Practice based approaches to teaching sustainability

The perspective of Project-based learning (PBL) is a comprehensive approach to classroom teaching and learning designed to engage students in investigating authentic problems (Blumenfeld et al., 1991). It aims at students acquiring a deeper knowledge through active exploration of real-world challenges and problems. Characteristics of PBL include the following: the students must take the responsibility for their own learning; the problem delivered to the students needs to be ill-structured and allows them the possibility of free enquiry; learning should be integrated from different disciplines and topics; collaboration is essential; a closing discussion and assessment of self-learning is essential at the end of the exercises (Savery, 2015). The engagement of stakeholders in the process can provide a new dimension to the incorporation of real-world exposure in teaching and learning (Mauser et al. 2013).

16. Towards an integrated summer school

The summer school will run for three full days in March 2017 and builds on complementarity: in one hand presentations from both practitioners and academics on the topics, challenges and methods of handling sustainability; on the other the work of students in groups that gather different types of education and countries, using “real cases”. 40 students from the four teaching institutions participating are expected to participate in the school as well as a group of teachers and professionals informed and active in the predetermined cases. The contact with practitioners active in the cases will take place either on site or through internet connection and online meetings. The following section presents the goals, the participants and the organisation of the spring school.

16.1 Context for developing the new course

The spring school is a project co-financed by Nordic Built and the project partners. Nordic Built is a Nordic initiative to accelerate the development of sustainable building concepts initiated by the Nordic Ministers for Trade and Industry. It aims at combining key Nordic competences and know how, providing attractive and effective arenas for collaboration and the realisation of concrete projects. It brings together companies, public administrations and researchers. The project partners include two professional schools in Denmark: KEA in Copenhagen and VIA in Horsens; two universities Chalmers University of Technology in Gothenburg Sweden and the Norwegian University of Science and Technology in Trondheim Norway. The project has been initiated and is managed by the Danish Association of Building Experts, Managers and Surveyors, Konstruktørforeningen (KF) which gathers more than 8000 professionals graduated as Bachelors in Architectural Technology and Construction Management.

16.2 Goals

The goal of the spring school is to build on the already existing educations and provide new pedagogical material to support sustainable operation of buildings in the Nordic Countries. The school does not aim at teaching specific technologies or methods, but at creating awareness about the complexity of implementing sustainable solutions and at developing skills and competences to address this complexity in specific contexts. The students are presented with “real” situations: a project in a concrete context with its stakeholders, limitations, challenges and possible contradictions. By integrating “real world” cases, we hope to enhance students’ motivation and engagement in working with sustainable

issues but also to confront them with the existing conditions and practices of professionals active in this development. The students will reflect, discuss and work in groups to develop innovative solutions to the real sustainability challenges.

The long-term objective of the spring school is to provide pedagogical material for students and the educational institutions to develop knowledge of what sustainable Facilities Management practices are in the Nordic Countries context.

According to Lozano (2014), one key element to design and build the content of such course, is learning outcomes, which need to include the demonstrable acquisition of specific knowledge and skills and reflect the institution's objectives and graduate attributes. Once the outcomes of learning have been agreed upon, the strategies for teaching and assessing these outcomes must also be chosen. In our case, the learning outcomes have been developed to answer the challenges identified in the literature and the features identified during a workshop gathering more than 40 professional both practitioners and academics working with sustainability and facilities management.

On the completion of this summer school, the students should be able to realise the following pedagogical goals:

- Identify and evaluate suitable projects in order to deliver sustainable goals in the context of facilities management
- Identify and evaluate positions, needs and dilemmas of the diverse organizations and actors engaged or concerned by the projects
- Identify, select, implement and assess solutions including both technical, economic and social concerns according to this evaluation
- Understand and orient the complexity of sustainable interventions

16.3 Collaborating institutions

Below the participating institutions to the project are presented as well as the team of teachers involved in the spring schools.

16.3.1 Chalmers, Göteborg Sweden, and NTNU Trondheim Norway

Both Chalmers University of Technology and Norwegian University of Science and Technology (NTNU) are offering bachelor, master and PhD education in engineering. The population concerned by the spring school are Master students in both school studying Design and Construction Project Management (Organisering och Ledning i Bygg och Fastighetssektorn).

The students are trained in the skills needed to manage construction projects involving project management methods, financial accounting methods, BIM, logistics, environmental management, strategic management, facility management and sustainability. To prepare the students to demands of the construction industry, where projects are done in temporary and interdisciplinary project organizations supported by networks of colleagues, training and knowledge are provided on organizational culture, leadership, communication, group- and team work, decision making, collaborative relations, and knowledge and learning. Whereas the students at NTNU can graduate in

both construction and facilities management, this is not possible at Chalmers where they can make their master thesis within sustainability FM topics in relation to companies but not graduate in FM or sustainability.

Whereas students are informed and trained in management topics, they lack more concrete confrontations to more practical aspects of what leading sustainable project within facilities management means, such as the contact and management of the different stakeholders and in particular the users.

16.3.2 KEA Copenhagen and VIA Horsens, Denmark

Copenhagen School of Design and Technology (KEA) is an Academy of Higher Education which offers over 30 different educational programmes at Bachelor degree and Academy Professional degree levels. The school counts more than 5000 students enrolled in different trades. The students targeted by the spring school are the “bygningstekonstruktør”, enrolled in “professional” bachelor. Constructing Architects are primarily engaged in design of building and infrastructure, but they are also employed in other companies related to the construction industry, eg in state and municipal, residential and management companies, banks and credit unions, and technological institutes. Their education is technically oriented and they do not develop a holistic approach to sustainability, they may need further training and develop competences in communication, finance, planning, communication, users’ behaviors and participation, technology understanding, organization, process understanding, law, and empathic understanding.

VIA university College Horsens was established in 2008 at the results of several mergers of institutions of higher education. Similar to KEA but situated in Jylland, VIA offers professional bachelors. The target students are here as well the construction architect. VIA however is working closely with practitioners to drive their educations.

The choice of different types of educations related to facilities management is done to mirror the setting of professional practices where different educational backgrounds meet in enterprises and in projects. The participation of the different Nordic countries build on both the similarities between the participants, the Scandinavian models usually refers to flat hierarchy, well organized labour, social values (Sandberg et al. 2013) summarised in the chart of Nordic Built; and the particularities of each of the nations in term of culture, educational models and philosophy.

16.3.3 Summer school participants

The team of teachers gathered multidisciplinary competences (engineers, sociologist, active in three of the Scandinavian countries). Besides practitioners are joining to contribute with both their knowledge of the case and their concrete experiences of working with the different stakeholders. The group of practitioners includes social housing companies and facilities management companies.

16.4 Teaching concepts

Building on the PBL philosophy of teaching, the summer school focuses mostly on students’ project work introduced by a few academic lectures and case presentations from professionals working with

sustainability. Merging both the learning from academic research and professional expertise, the goals of the presentations is to draw the attention of these engineer students away from focusing only on the design of technical solutions towards more social aspects such as the roles and the competences of stakeholders and the needs and behaviours of the users.

The cases build on written descriptions of the companies' profiles: size, portfolio, competences, location and the characteristics of the specific project: buildings physics and conditions, actual issues, profile and types of users, budget. These written documents are completed by technical drawings, pictures and video interviews of some of the stakeholders involved in the project (janitors, inhabitants, technic providers). The cases are presented in plenum and the students are introduced to different challenges, they then are distributed in small workshops where two groups of four students work separately on the same case. Each case is attributed a supervisor who provides support to the students' process. Contact with the professionals working with the case are organised so that the students are able to seek information or test the feasibility of their ideas. During the three days of the spring school, the groups work mostly independently. However daily meetings with other students allow a reflection not only on the designed solution but also the methods the groups have chosen and the process they follow as well as their eventual interrogations and doubts in carrying the project.

Most of the cases includes technological improvements for the building. However, the focus is on designing solutions adapted to the specific users and easy to maintain. The results of the groups are presented to the others students, teachers and the practitioners related to the case.

Whereas describing the context, process and goals of the spring school, seems to be rather straightforward defining the outcomes and judging of their qualities appears to be more difficult! The assessment of the students is of course important but the deepness of the learning may be arduous to judge on a very short term basis. Besides the practitioners and teachers have also to agree on the criteria of assessment.

17. Preliminary results

The summer school has taken place in the middle of March in Trondheim. The analysis of the different evaluation strategies (individual and groups assessment, qualitative and quantitative methods including observation and feedback from all the participants: students, teachers, and practitioners) is still ongoing. However, the preliminary results show a real enthusiasm from the all the participants. 90% of the students claim to have increase their understanding of sustainability and would recommend the summer school to their comrades. They have shown an engagement and diligence which have delighted their teachers. The practitioners have asked the students for a copy of their proposals.

18. Discussion and conclusions

The concept of the summer school answers the call of Meehan and Bryde (2015) for FM management education to integrate and collaborate with FM professionals to define education targets including the contextualised needs and knowhow of the practitioners. Regarding, the challenges identified by Sarpin et al. (2016), the project work and the exchanges between various groups and students should help to develop competences in identifying and managing the changes induced by sustainability within organisation and ways to tackle them. The summer school does not advertise for a certain method or

technology, but rather aims at providing the students with a frame of reference helping them to find and organise the necessary information for each particular project. The organisational challenges described by Elmualim et al. (2010) or Hodges (2005) are not directly addressed by the spring school. The PM professionals though are expected to flag the working conditions and remind the students of the reality of the work environment. The authority challenges (Sarpin 2016) is not a central topic, even if they contribute to the development of sustainable practices.

Following the principles of PBL and building on active learning approaches, we hope that the students move away from dependence on teachers as providers of knowledge towards a personal responsibility approach as described by MacVaugh and Norton (2012). The spring school is designed to introduce students to the complexity of sustainability and help them to orient their choices and decisions as future practitioners. In doing so we come closer to Lozano et al. (2015) definition of FM professionals as change agents engaged and contributing to the transition to sustainability. These change agents should be competent to deal with the both the complexities of sustainability understood from a technical point of view and bridging with the 'soft' issues in organizational and stakeholders' management (Lozano et al. 2015). Our summer school seems to have been a success, and most of the goals seem to have been reached. However, there are two questions left: 1. Is this summer school going to have any influence on the professional life of the students who have participated? 2. How can we translate the summer school dynamic context and the different actors enthusiasm in a likely more static version which can serve as teaching material and be reused in different settings.

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