92. Integrating Education for Sustainable Development into the Environmental Management System – Experiences from Chalmers University of Technology

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Abstract

If designed in a smart way and well adapted to an organisation, an environmental management system (EMS) is potentially an efficient tool for continuous improvement of education for sustainable development (ESD) at a university. Chalmers University of Technology (Chalmers) has since 2012 been certified according to ISO 14001. The core activities education, research and innovation were identified as significant environmental aspects for the organisation and are therefore in focus in the EMS and are all clearly visible in the environmental and sustainability policy, objectives, targets, and activities.

Enhancement of the quantity and quality of ESD has been an important goal at Chalmers for many years and ESD has therefore been in focus e.g. in different curriculum development projects. Over the years, some seemingly successful efforts have sometimes been lost, e.g. when too strongly tied to specific individuals that for different reasons leave their task. In order to better promote and safeguard ESD, the possibility to integrate it fully into the EMS has been explored. The EMS may provide an opportunity to review, annually, objectives and activities in order to make sure that ESD becomes integrated into the activities and will in the long run always be safeguarded by the system itself.

At Chalmers, management of different activities is also going through a shift towards process orientation. The three main processes are *to educate*, *to research*, and *to innovate*. The aim of the process orientation is to map and continuously improve the way that things are done at the university in order to make sure that it contributes to the goals of the organization in an efficient way. This has not yet been fully implemented, but provides an additional opportunity to safeguard and enhance ESD.

This paper describes an effort to review the EMS in relation to ESD at the university, with the purpose of utilising the EMS to better safeguard and enhance the quality of ESD. The opportunities that come with the on-going process orientation are also reflected upon. The paper describes the EMS and ESD at the university and the results of the analysis and it pinpoints improvement opportunities.

1 Introduction

The vision for Chalmers University of Technology (Chalmers) is “Chalmers - for a sustainable future”. This shows the firm commitment from the management in contributing to a sustainable future. There is also a requirement in the current wording of the Swedish University law that all universities must

contribute to sustainable development (SD) in all their activities. Both of these are important drivers behind the work that has been done at Chalmers and is described in this paper.

If designed in a smart way and well adapted to an organisation, an environmental management system (EMS) is potentially an efficient tool for continuous improvement of university activities. However, while an EMS at a university most often covers energy, material, chemicals and waste flows and transports related to campus activities, less often does it cover indirect environmental aspects of education, research and innovation, which can be even more important, and that also need the influence from an EMS to be continuously developed in the desired direction. In a paper published in 2012 (Disterheft *et al*., 2012) it was stated that 11 out of 47 European universities in that study had at the time (probably in 2010) linked the EMS to curriculum related activities. At Gothenburg University, for example, the EMS covers "core activities such as research and education, outreach, student participation and operations as waste management, travel and transportation, energy efficiency, staff training, hazardous chemicals, environmental risks, and procurement and purchasing" (Omrcen, Lundgren and Dalbro, 2013). Enhancement of the quantity and quality of ESD has been an important goal at Chalmers for many years and ESD has therefore been in focus e.g. in different curriculum development projects. This paper describes work that was done with the intention to explore existing and possible connections between ESD and the EMS. The project benefitted from a simultaneous Nordic collaboration (ESDAN; Education for Sustainable Development in the Nordic Countries) that aimed at the furthering of ESD through exchange of experiences around using the EMS or similar systems as a driver in ESD quality improvement (Holm *et al*., 2013).

At Chalmers, management of different activities, including education, is also going through a shift towards process orientation. The aim of the process orientation is very similar to the goal of the EMS, although it covers also many other aspects and therefore lack a specific focus on environment and sustainability. The process orientation has not yet been fully implemented, but provides an additional opportunity to safeguard and enhance ESD. The on-going process mapping provides much needed transparency to routines and responsibilities, which may positively influence work within the EMS and promote ESD if this aspect is put in focus.

In this paper, the organization of the EMS and some ESD efforts at Chalmers are described. Furthermore, the work to integrate ESD into the EMS is described as well as some outcomes of that work. Opportunities arising with process orientation are also reflected on.

2 EMS, ESD, and process orientation at Chalmers University of Technology

In this section, the organization of the EMS and some ESD efforts at Chalmers are described. Not all parts of the EMS are considered here, only the parts that relate strongly to ESD. The on-going process orientation at the university is also briefly described.

2.1 EMS

Since 2012, Chalmers has been certified according to the international environmental standard ISO 14001. Contrary to earlier efforts to introduce EMS at some other universities, the core activities of education, research and innovation were identified as significant environmental aspects for the organisation and are therefore in focus in the EMS. They are all clearly visible in the environmental and sustainability policy, objectives, targets, and activities (Kjällstrand *et al*., 2013). According to the policy, we shall offer our students a world-class education, so that they will be able to make a difference and contribute to SD.

In the annual audit within the EMS, the fulfilment of the specific annual goals for environment and SD at the university are checked, but also other internal and external requirements can be checked even if they are not selected and highlighted as specific focus areas for the particular annual cycle. For the purpose of this paper, the EMS is explored as a tool for annual review not only of the specific annual goals but also of underlying policies and corporate documents and the organization and activities at large.

The EMS cycle is managed by the Environmental Office, managed by Jennica Kjällstrand, one of the authors of this paper. However, the responsibility for the work lies on individuals in the university management team. An EMS is based on significant environmental aspects, identified through environmental investigations. At most departments, as well as at the central level, education was found to have the greatest impact on SD. Hence, objectives and targets for ESD have been established both for the central level at the university and locally, in the departments' operational plans.

2.2 ESD

Enhancement of the quantity and quality of ESD has been an important objective at Chalmers for many years and ESD has therefore been in focus in several curriculum development projects (e.g. Holmberg *et al*., 2011).

More or less since the mid-eighties, there has been a local requirement at Chalmers that all study programmes should contain at least 7.5 higher education credits (hec) in environment and sustainable development (E&SD). It is the responsibility of the directors of the study programmes to make sure that this is fulfilled and they order relevant courses in E&SD from the research departments. However, there is a large variation in how E&SD is interpreted by programme directors and in how much and how well it is integrated into the programmes (Lundqvist & Svanström, 2008). Over the years, some seemingly successful efforts have sometimes been lost, e.g. when too strongly tied to specific individuals that for different reasons leave their task. There is thus a need both for further quality improvements and for safeguarding ESD at the university.

Another interesting feature of ESD at Chalmers is that all new students at the bachelor level are given a lecture on SD, to show the strong commitment at the university and provide some insight into what this can mean for those that are not well prepared. Furthermore, since 2012, all PhD students are required to take a course on research ethics and SD, in which they, among other things, write an essay on potential positive and negative consequences for SD of their research work and on how the situation can be further improved.

However, these compulsory but somewhat isolated ESD activities can only have a significant impact if also our study programmes and research projects make sure to integrate SD considerations into many activities, preferably making it a starting point that sets the direction for the knowledge development. Therefore, several projects have, over the years, targeted not only curricula but also the motivation and knowledge of teachers, as well as the drivers and barriers in the surrounding organisation. From 2006-09, there was a three-year reform project on ESD with the aim to enhance ESD and to integrate ESD work into the organization (Holmberg *et al.*, 2011; 2012). It turned out that it was not possible to find appropriate sites for ESD in the organization without creating new structures. Chalmers Learning Centre was therefore created in 2009, with the aim to enhance the competences around learning, with a special concern for ESD issues. One of the authors of this paper, Magdalena Svanström, is the director of this centre. In 2012, as an effort to further support ESD enhancement, a pedagogical support function for ESD was initiated and a person was appointed this task - Ulrika Lundqvist, one of the authors of this paper.

2.3 Process orientation

At Chalmers, management of different activities is at present going through a shift towards process orientation. The three main processes are *to educate*, *to research*, and *to innovate*. The process orientation focuses on how different processes function and how they work together as a whole in order to make sure that activities contribute to the goals of the organization in an efficient way.

The process *to educate* contains a number of sub-processes, e.g. admission, teaching, and examination. In the on-going process mapping, activities, roles and routines and existing connections are described. The coordinator of this process is Malin Blomqvist, one of the authors of this paper. However, the person responsible for the process and that has the role of process "owner" is the Vice President for education.

Although the work has only just started, it is believed that the process can become an efficient tool for further safeguarding and enhancing the quality of ESD at the university. The EMS, at present, has its own routines, and although they are coherent with the process organization, the integration between these two systems has not yet been fully explored. In theory, the process *to educate* is a framework in which both ESD and the EMS could be incorporated. Beyond the earlier stated objectives, this study also serves as a driver for this integration, although it is too early to provide much detail on how they could be integrated.

2.4 Some existing connections between the ESD, the EMS and the process "to educate"

As explained above, ESD has been an important field of activities at the university for many years. The current EMS at Chalmers has now been operational for a few years and it is still developing in terms of how it is manifested in the organization for maximum impact. The EMS has created opportunities for ESD to be better integrated into the continuous quality improvement work at the university. The process orientation, however, is still only in a very early stage of development. Nevertheless, some integration opportunities have already been identified and even implemented, and the process orientation has led to modifications of the EMS work. This section describes some of these connections, relevant for ESD.

When the process orientation started, it became clear that some new responsibilities within the emerging process organisation could adopt also some of the responsibilities in the EMS. It had also become clear at the time that the annual work within the EMS had not yet become fully integrated into regular planning and goal setting at the university and therefore existed as a parallel activity. Although the work within different areas was not conflicting, it had not been fully integrated and potential synergies could not be explored. To solve both of these issues, the process "owners" for *to educate*, *to research* and *to innovate* became responsible for the implementation of objectives and targets in their respective areas, both within the overall planning and within the EMS. Furthermore, the process coordinators, one for each process, also became the persons that coordinated the work within the EMS, within their respective areas, objectives and targets included. Thus, at present, the Vice President for education is the process "owner" for *to educate*, and also the person responsible for education within the EMS, and therefore over-all responsible for all ESD work at the university. The coordinator of the process *to educate* coordinates also the work on education in the EMS, and thus coordinates the overall ESD work at the university. The other processes are managed in a corresponding manner.

Additionally, appointed by the Vice President for SD, *sustainability coaches* were recently introduced for the areas education, research, innovation, internal environment and strategic communication. They are experts on sustainability within their respective fields and are expected to support the organisation

in integrating sustainability in different ways. For education, the person that is the pedagogical support person within ESD at the university, mentioned earlier, was deliberately given also this role.

3 Method

This paper describes an effort to review the EMS in relation to ESD at the university, with the purpose of better utilising the EMS to safeguard and enhance the quality of ESD. The EMS may provide an opportunity to review, annually, objectives and activities in order to make sure that ESD becomes integrated into the activities and in the long run is always safeguarded by the system itself. The opportunities that come with the on-going process orientation are also reflected upon.

The project had an interventionist agenda and was performed using action research. It was performed by people deeply involved in the three areas (ESD, EMS and the process *to educate*) and with the purpose of achieving change in a positive direction, with the quality of and conditions for ESD at the university as the target area.

An important assumption was the idea that ESD can be continuously safeguarded and developed if well integrated into the EMS at the university. As Sammalisto (2007) puts it: "It is possible to work with ESD without an EMS, but there seems to be evident advantages in connecting such activities to the EMS and to include the structure for objectives, targets, action plan, audits as follow-up and reporting to make it more visible". However, this of course ultimately depends also on the type of ESD activities that are performed and the effectiveness by which they provide a desirable set of learning outcomes to the students. This paper will not discuss the appropriateness and effectiveness of the specific ESD activities but rather look into how well activities are and can be further connected to the EMS in order for the EMS to be an effective driver for change. Further opportunities that arise with the on-going process orientation will only be briefly discussed.

The method that was applied can be divided into the following steps:

1. Identify recurring ESD activities and relevant visions and goals;
2. Sort the ESD activities into the structure of a Shewart or Deming cycle (Deming, 1986), i.e. *plan*, *do*, *check*, *act*;
3. Identify which of the ESD activities
    a. that are already or are planned to be connected to the EMS and how;
    b. that should be connected to the EMS in the future and how;
4. Reflect on ESD enhancement opportunities that arise with the on-going process orientation

Steps 1-2 are described in the Results section, while steps 3-4 are dealt with in the Discussion section. Figure 1 describes the focus of the work in this paper - the ESD activities at the university and the different elements of a Shewart or Deming or cycle (applied in an EMS).

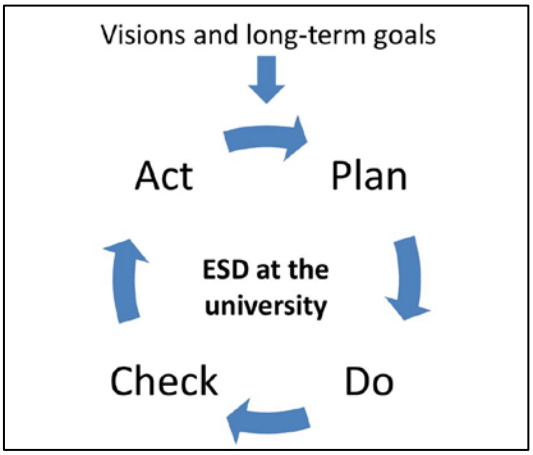

Figure 1: A Shewart or Deming cycle as applied in the analysis in this paper.

Table 2: Some annual ESD activities at Chalmers that can be sorted into the different parts of a Shewart/Deming cycle.

Visions and long-term goals	
External and central level	***Programme level***
Learning outcomes for ESD in the Swedish degree ordinances Local course requirements for ESD: 7.5 hec in E&SD and 7.5 hec in science, technology and society (STS); and corresponding guidelines (not binding) for course content and learning outcomes Decision on compulsory introductory lecture on SD for all new BSc students Decision on compulsory course on SD for all PhD students	Programme descriptions: including learning outcomes for ESD and notes on which courses that fulfill the local course requirements on E&SD Course syllabi

Plan		
Central level	***Programme level***	***Department level***
Formulation of annual prioritized goals in the university's operational plan* Formulation of annual goals for E&SD in the EMS	Annual decision on how BSc (2 years) and MSc (3 years) programmes can be combined for the MSc in engineering (5 years) degrees Annual agreements between programmes and the departments that give courses	Formulation of annual goals in the departments' operational plans* Annual work to revise course descriptions and course content: e.g. learning outcomes, teaching and learning activities and assessment of learning for ESD

Do	
Teaching	***Other activities***
Introductory lecture on SD (1 hour) for all new students Courses at the BSc level that fulfill the local course requirements for ESD Integrated parts on E&SD in various courses Master's programmes with special focus on E&SD Elective courses on SD at Master's level PhD course on research ethics and SD	Research into ESD in engineering education Seminars on ESD arranged by e.g. Chalmers Learning Centre

Check
Course evaluation of E&SD courses
Programme evaluation*
Master's programmes evaluation, including programmes with special focuses on ESD
Alumni questionnaire, which includes a question on ESD
Follow-up of the annual operational plans for central and departmental level*, including the environmental and sustainability plans
Input from study programme advisory boards, which include external stakeholders*

Act	
Central level	***Programme and course level***
Decisions on support to teachers and programme directors Decisions on activities for competence building* Decision on theme for annual conference on teaching and learning*	Decisions on programme development Decisions on course development Decisions on correcting actions regarding nonconformities discovered during the internal and external audits of the EMS

*ESD optional but appears occasionally

4 Results

In Table 2, some of the information gathered and sorted in steps 1-2, can be found. The purpose was not only to identify where ESD is already strongly manifested but also to reveal interesting points of intervention for further enhancement of ESD quality. Therefore, for some of the activities listed, marked by an asterisk (*) in the table, ESD is at present only included occasionally. The current analysis, however, does not claim to include all interesting points of intervention.

In addition to the listed activities, there are occasionally special efforts or projects that can include ESD. Some examples are: major programme or course development efforts, external evaluations of programmes performed by the Swedish Agency for Higher Education, or internal evaluations of E&SD courses performed by pedagogical support persons for ESD at Chalmers.

5 Discussion and conclusions

As can be seen in Table 2, although this is not a complete view of relevant ESD activities at the university, there are still many different activities that already take place. An EMS has as its main objectives to continuously improve the activities in the organization. Annually, development needs are checked and acted upon and new plans contain new or reformed descriptions of the work, which are then implemented and checked again. The sorting into the four parts of the cycle and its drivers (visions and goals) provides a basis for mapping the connection between the different parts and understanding how the EMS can function better in safeguarding and enhancing ESD.

For some of the activities listed in Table 2, ESD is only occasionally included, but could be included to a larger extent, depending on routine descriptions and the awareness and competences of individuals in the organisation. There are also some additional recurring activities that at present do not include ESD but that could include ESD in the future, e.g. courses in pedagogy for teachers.

For an EMS to be functional as a driver for ESD work, education has to be identified as a significant environmental aspect. Since this was actually done at Chalmers, the EMS has already provided some benefits to the ESD work. As ESD has been part of the focus of the EMS from the beginning, it has been included in the continuous development work. Each year, there have been specific annual objectives, targets and activities that relate to ESD in the environmental and sustainability plan. Using the EMS for ESD has provided a learning process for the organization and the people involved, and over time, routines and skills have improved so that goals are now formulated in a more meaningful way, i.e. realistic in terms of what can actually be achieved, and measurable, and responsibilities are now more clearly described and appropriate resources given.

Internal and external audits are already, and can to an even larger extent be used to improve ESD, if it is part of what you check for. However, for this to function optimally, more detailed routines need to be developed. A network of Chalmers' employees, holding different competences, carries out internal environmental audits. A future development could be to include ESD specialists in this network, and to a greater extent review how ESD progresses in our programmes as well as how the educational organization includes corporate and other requirements.

It can be concluded that many elements for safeguarding and enhancing ESD already exist in the EMS and to maintain progress over time and facilitate environmental audits, the following should be established:

- Documented procedures for important activities, such as the introductory lecture on SD

- Functional descriptions of Chalmers Learning Centre and other important parts of the organization
- Role descriptions for the manager of the Learning Centre, and other important parts of the organization as well as other important functions, such as pedagogical support persons
- Descriptions of the programme directors', vice department heads' and teachers' responsibilities to integrate SD into the education

The on-going process orientation may provide additional benefits since the process will keep track of routines, work descriptions and responsibilities and describe how things fit together. With purposeful work, we hope that the two systems (the EMS and the process *to educate*), when fully integrated, will find synergies and further improve ESD at the university and effectively safeguard this area.

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