Environmental management systems for universities

A case study

Josef Noeke
University of Paderborn, Germany

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Abstract This paper describes the experience of the University of Paderborn in respect of the establishment of an environmental management system. It also discusses the context within which the process took place, outlining the various elements that have influenced the it, from the conception to the certification and implementation.

Environmental protection: a need for universities

Over the past ten years or so, both private and public institutions have become more aware of their responsibility as far as the environment is concerned. According to innovative management concepts, attempts to promote environmental protection must be pro-active and broad so as to involve different stakeholders. The aim of an environmental management system is to approach “looking-ahead” tasks systematically, to provide guidance to operational environmental protection targets and to see them as a management task.

This paper describes the basic elements which were necessary to develop and implement an integrated management concept in the group “process engineering” of the Faculty of Mechanical Engineering at the University of Paderborn. This management concept, developed by means of a project approach, includes the aspects of quality assurance, environmental protection and work safety. This paper describes primarily the environmentally-related topics of this management system.

The ways in which universities in Germany have been dealing with environmental issues have been influenced by contextual elements and a wide range of factors. For example:

- No other sector was subjected, with so much intensity, to the effects of environmental laws. Many aspects of recent environmental legislation in Germany have led to important “ecological spin-off effects” and have obliged universities to change aspects of their operations so as to be in line with legal requirements.

- A great proportion of university staff (teaching, research and support staff) have changed their behaviour in private (e.g. in the separation of wastes at home); they are now starting to realise that the same will have to be done at their workplace.
An increasing amount of universities include ecological targets within their guidelines for environmental protection.

Rising costs for waste disposal and waste water treatment call for prevention approaches.

Students interested in ecological matters are now including ecological aspects as part of their decision as to where they should study, thus creating a pressure among universities to be “green”.

Neighbours of public and private enterprises have become more critical; local and global environmental groups ask for more (quantitative) and detailed (qualitative) information and this demand for information is now reaching universities.

The public perception of a university which is classified as environmental-friendly is more sympathetic; an effect which leads to a positive image.

Last but not least, “high schools” now receive stronger requests for the inclusion of environmental protection in research and teaching, which in turn create a pressure on universities to cater for such information needs.

Universities have to move. The “to be pushed” or “to be pulled”, stagnation can also lead to other set-backs. In the past, accidents such as those seen in the chemical industry, have shown that the protection of the natural environment is not easy to guarantee. An effective environmental management system must be used additionally to the usual methods to ensure that the “human factor” will not be the weak point in safety-chains. Environmental management systems try to eliminate such safety deficits by a stronger inclusion of the human component. Figure 1 shows an overview of the situation in many universities.

More than 2,000 German organisations have so far implemented environmental management systems and have been certified by independent external auditors in the last few years, due to the needs that they have either realised by themselves or which were demanded by their customers. The
Operational environmental protection has a high rank in those organisations. The results of environmental management systems from industry can to a great extent also be transferred to universities.

**Aims of the project**
The aim of the project subsequently described in this paper was the development, implementation, certification and continuation of an environmental management system. The initial step was to set up a working group called “Environmental process engineering” at the University of Paderborn. Based on the experiences from step 1, an environmental management system is expected to be implemented for the next larger unit of a Faculty (see Figure 2). In a final step to be taken, the environmental management system is expected to be expanded to the whole university. The project was supported by the North Rhine-Westphalian Ministry of Education and Science, Germany.

**Methodology**
Interfaces to work safety and quality assurance are included into the implementation of an environmental management system. The reasons for that are as follows:

- strong parallels exist between work safety and environmental protection in the handling of dangerous materials;
- a global sight for the own actions is necessary. Environmental themes should not be seen as isolated;
- if the necessary audits are carried out together, the acceptance of the management system is likely to increase.

Owing to the internal variety of a university, its sophisticated structures of consultation and decision-making and its different areas of focus as far as the environment is concerned, it was seen as not appropriate to prepare the entire university for the certification in the first step. Rather, sequential action seemed...
more appropriate: first, specific tools for an environmental management system should be developed for a subsystem of a university (e.g. the group “process engineering” in this case). These tools were to be tested and improved in a second step by using them in a subsystem which is more complex (e.g. a faculty) and which has a higher ecological potential, before moving on to a higher level (see Table I).

The tools for the development and certification of environmental management systems made out in the first two steps have a model character and will be used in other universities as standardised instruments at a later stage.

Interested students are, within the context of the project, able to co-operate and prepare study theses and dissertations on project-related topics.

Currently, 20 scientific employees are working at the specialised group “mechanical process engineering and environmental process engineering” at the University of Paderborn. Most of these employees are PhD students who work on public or industry-sponsored research projects.

Figure 3 shows additional locations and personnel resources of the specialised group.

Administration staff and academic/support work in a variety of offices and laboratories as well as in workshops and testing stations with a total area of about 1,200sqm. In addition, there are lecture and seminar halls which are provided by the university. The amount of third-party funds runs up to ca. DM2 Mio (around US$1 million) per year.

The specialised group is today working in the following areas:

(1) High viscous/data systems technology with issues such as
   - flow pattern in polyphase stirring units;
   - modelling and optimisation of mixing processes;
   - rheology, etc.

(2) Bulk material and mixing technology with issues such as
   - high performance compaction;
   - residence time and mixing quality in mixing units;
   - vibrational mixing, etc.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Subsystem</th>
<th>Application field</th>
<th>Result perspectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Group</td>
<td>Group “process engineering”</td>
<td>Certificate according to DIN EN ISO 14001</td>
</tr>
<tr>
<td>2</td>
<td>Faculty</td>
<td>Faculty, consisting of some groups</td>
<td>Use and continuation of the tools and the certificate according to DIN EN ISO 14001</td>
</tr>
<tr>
<td>3</td>
<td>University administration</td>
<td>University</td>
<td>“Coaching” of the certification capability by using the tools developed in steps 1 and 2</td>
</tr>
</tbody>
</table>

Table I. Phases of the implementation
Environmental management systems

(3) Environmental process engineering is characterised by the following projects:

- residues in returnable bottles;
- anti-foaming;
- energy supply concept in Dubna, Russia;
- waste disposal technology in Indonesia;
- environmental management for IT-producers and at universities, etc.

All research and development projects are financed by third-party funds from public and/or private institutions.

Characteristics of the group “process engineering”
The activities of the working group may be described by its kernel processes: research and teaching. Figure 4 shows the material and personnel resources which are used in the research and teaching process. The “products” of the working group are located in the centre of the environmental management system. Compared with the “processes” which have a lower ecological charging potential, more substantial outputs may be achieved by educating more students and via the results of research and development.

Steps for the implementation of an environmental management system
The implementation of an environmental management system according to EN ISO 14001 requires the following steps:

(1) As philosophical basis: Creation and approval of an environmental guideline.
(2) **Survey of the status quo situation:** Environmental review in ecological aspects.

(3) **Description of the need for action:** Course of action including single measures prioritised by urgency, to equalise the calls for action identified in step 2.

(4) **Documentation of structures and processes:** Written description of the management system, including the structure, and of the procedures in core processes and in supporting processes.

(5) **Evaluation of the chosen system by internal auditors:** Results of internal audits are submitted to the management for evaluation.

(6) **Evaluation of the system by an external expert:** Do philosophy as well as strategic and operative actions correspond with the international valid norm DIN EN ISO 14001?

(7) **Internal and external use and presentation of the certificate.**

These steps are depicted in Figure 5.

**1st step: Environmental policy as ecological guideline.** Statements of the environmental policy are of a more philosophical nature. They show the direction of the environmental focus of an organisation. Environmental statements may be transferred to measurable targets in the subsequent steps of implementation outlined in Table II.

For the implementation of environmental management systems, an environmental policy should describe the general wishes of the management of an enterprise and the direction in which it should develop under an ecological perspective.
During a workshop at the specialised group “process engineering”, brainstorming was initiated to gather elements for the ecological guidelines of the specialised group. Already available environmental methods from other universities were used as basis for discussion. Later on, the Head of the institution reviewed this proposal which was to be additionally discussed with all employees (see Figure 6).

The final document was subsequently approved and came into force. The environmental policy was made public via a presentation at a meeting attended by various institutes, via a publication on the Intranet as well as on the blackboard. It was seen that a suitable guideline serves as an important factor for the success of an environmental management system, provided that it expresses the consciousness, conviction and – equally important – responsibility of the highest level of administration.

2nd step: Ecological analysis.

Based on the environmental policy, the aim of the ecological stock analysis was to check whether the ecological guiding principles were already implemented in the group. This internal analysis of all...
environmental-related circumstances is not strictly demanded by EN ISO 14001 but it seemed to be necessary in practice, due to the need for a base for the formulation of the operational environmental protection targets and for the development of an environmental management concept that could be achieved in this way (see Figure 7).

At first, the system limits of this partial field of the entire university had to be named in the specialised group “process engineering”. With it, the interfaces were defined, including areas such as fresh water and energy use and the disposal of special wastes, which is subject to monitoring.

Checklists were the bases for the actual analysis. They were based on the “...points of view to be treated at least”, like those which are given in the EU-Eco-Audit-Regulation.

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**Figure 6.** Formulating ecological guidelines

**Figure 7.** Carrying out an ECO check
The results, i.e. the outputs, of the analysis were:

- a collection of the environmental effects of all tasks;
- a directory of all regulations and approval records;
- the consumption of energy (electricity, gas, etc.);
- data of the consumption of fresh water, of the disposal of waste water and of the amount of waste;
- the consideration of ecological aspects for the selection of new processes;
- the environmental friendly acting of buyers and suppliers;
- the avoidance and limitation of environmentally harmful accidents;
- the environmental-related information and education of the employees; and
- the external information about ecological questions.

Finally, the actual conditions were compared with the target state required by the legislation concerning chemical substances, wastes, emissions and water control. Deficits seen were transferred to the plan of action.

The documentation of the analysis results with a camera, as seen in Figure 8, is shown to be effective.

Figure 8. Good example for the correct ECO-behaviour motivation
In addition, it is not only negative behaviour patterns which should be addressed. The description positive and “correct” behaviour concerning environmental protection may contribute to encouraging the desired environmental behaviour and should be supported.

3rd step: Environmental protection targets and measures. Based on the deficits collected during the actual analysis, acting fields were defined, which can be worked out in the future. This future-oriented environmental programme is the heart of an environmental management system. For example, controlling and executing equipment shall not be installed but a future-oriented help that supports the operational environmental protection is welcome. Table III shows some environmental protection targets and measures.

The environmental programme was implemented with the aim of supporting environmental protection measures by the employees. If such measures proceed only by command, the change of behaviour will not last for a long time. Short-term changes of behaviour result in limited ecologically-sound results.

4th step: Environmental management system and environmental protection documentation. If effective environmental protection is to be carried out, operational environmental protection must not be seen simply as the responsibility of a few persons interested in environmental protection. It also must be up-valued as a recognisable management task.

The personnel and organisational tasks for operational environmental protection are listed in an environmental protection manual. This is necessary to define the strategies and responsibilities and flowing how the environmental

<table>
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<th>Action</th>
<th>Measure</th>
<th>Responsibility</th>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Missing shower for eyes</td>
<td>Contact to university administration</td>
<td>Mr Stickling</td>
<td>✓</td>
</tr>
<tr>
<td>2.</td>
<td>Missing risk assessment for the workplaces</td>
<td>Fill in the formula sheets</td>
<td>Mr Beckmann</td>
<td>✓</td>
</tr>
<tr>
<td>3.</td>
<td>Decreasing interest of students in process engineering</td>
<td>Monthly e-mails to all engineering students</td>
<td>Mr Wagener</td>
<td>Permanent</td>
</tr>
<tr>
<td>4.</td>
<td>Improvement of teaching, interesting presentation</td>
<td>Workshop: using a beamer in lecture</td>
<td>Dr Noeke</td>
<td>SS 2000</td>
</tr>
<tr>
<td>5.</td>
<td>“Greening the curriculum”</td>
<td>Course “special knowledge for representatives in waste management” for engineers</td>
<td>Dr Noeke</td>
<td>SS 2000</td>
</tr>
<tr>
<td>6.</td>
<td>Check of old equipment: asbestos</td>
<td>Examination of all old instruments</td>
<td>Mr Beckmann</td>
<td>WS 99/00</td>
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</table>

Table III. Action-plan of the specialised group “process engineering”
protection targets can be reached principally. This includes a description of the environmentally related tasks which are necessary (e.g. process descriptions and instructions).

In the system, the function of an environmental protection representative is described. In other chapters of the operational environmental protection manual, all regulations, approval conditions and environmentally relevant enclosures are collected, or the environmental protection controls are described. Finally, the instruments and tools which are used for the internal and external environmental protection communication are documented (see Figure 9).

Owing to frequent use of forms like applications for leave or business trips, the employees are virtually “forced” to work with the management documentation daily. The potential obstacle of using the manual to solve complex circumstances will decrease. The advantage of a computer-based documentation is that there is the opportunity to make central and fast adaptations so that a continuous actuality of the tool is guaranteed.

Further advantages of a data-processing-based documentation are:

- quick and daily access;
- no paper needed (another ecological aspect);
- simple orientation due to structured contents;
- central modification office which guarantees a continuous updating of the contents.

Figure 9.
Contents of management documentation
Since standard forms like leave and duty applications are elements of management documentation as well, a high belated chance of contact with the documentation exists.

**5th step: Internal audits and management reviews.** The steps taken until now created political statements and listed aims and measures. The structural and procedural specifications, however, need to be checked. Are the aims of the environmental management system and the operational reality really equal? It is necessary to check whether the environmental policy may continue by operable aims and measures and if the structures described are usable to influence the environmental targets positively (see Figure 10).

Some internal audits are combined with the whole audit which is required by the norm. The results of the environmental audit are sampled to a management review which will be checked and evaluated by the management (Head of the Institute/Group).

After the first audit cycle in the first year of using the management system, a strict orientation of the planned audits by quarterly periods has not turned out to be goal-oriented. At the moment, new audit topics and periods are reflected.

**6th step: Certification by an external consultant.** The effectiveness of an environmental management system is checked by an external and independent consultant. The most important areas to be checked are shown in Figure 11.

The certification of the environmental management system of the group “process engineering” according to DIN EN ISO 14001 was successfully performed in November 1998 by an external expert of TÜV Nord, the official agency for standards. At the beginning of the year 2000, the first external repeat audit by the same external expert was performed. Thereby, the functionality of the system elements and the continuous improvement process in qualitative and ecological aspects were valued after a one-year application period.

After certifying the specialised group “process engineering”, an environmental management system for an entire department has been developed, implemented and certified. At present a working group is concentrating on the ecological key processes of a university which are usually

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**Figure 10.** Internal audits in the group “process engineering”

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**Planned Audits**

I. Quarto Laboratories, Equipment
II. Workshop
III. System Audit
IV. Bureaus

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**Audit teams**

Representatives for:
- environmental protection
- quality improvement
- work safety

**Internal Auditors**

Students
Westphalian Environmental Centre

**External Auditors**

Each talk about deficits between the head of institute and members of staff is an internal audit
located in the university administration. Many decisions on supplies (e.g. of energy, fresh water and other resources) are sited at the university’s administration. Decisions on alternatives to waste water reprocessing and waste disposal are often also made there. An essential step forward towards a substantial future-oriented university will be taken, if decisions according to a systematic environmental management system are planned, executed and controlled.

An environmental management concept must “live”
The thesis that management systems provide their positive effects only by implementing, documenting and certifying is wrong. In some organisations, the quality of their products could not improve in the same way as their (formal) efforts although their documentation was excellent.

A management system does not provide full benefits only because it has been certified. In addition, an external vote about a management system does not guarantee that its structural and procedural demands have been included in the daily work of all employees. What is the reason for this? A certificate does not guarantee that the self-chosen structures and processes “live” in the organisation. This “living” seems to be the key to success. If quality should be increased and the use of the natural environment should be decreased at the same time, all employees must be included intensively (and sustainably!) into these processes. Employees will only accept long-term changes of behaviour if they can see the use of environmental friendly behaviour beyond their own workplace.

The internal and the external costs will be too high if a certificate is only received due to public relations reasons only. Other PR-instruments may lead to better results at lower costs.

Looking back, the employees of the different groups of the university can contribute to the different steps of development and continuation of an integrated management system.
Benefits of a certified environmental management system

The figures shown above may question whether an “environmental certificate” is useful for a university. Figure 12 shows the benefits of an environmental management system. The most important elements of use of the group Process Engineering:

- A complete environmental management system, documented in an environmental protection manual, offers absolute transparency. Responsibilities and competencies are regulated clearly and completely.
- The risk of penalties and punishments can be reduced for the leadership by the transparency, the documentation and the routine check of specifications.
- The good relationship with the authorities will be stabilised by excluding irregularities caused by lack of information.
- This effect of a positive image continues in relationships with neighbours and environmental associations.
- Costs can be reduced because the output is produced more rational.
- Motivated employees say: “I like working in a environment-friendly university!”

Interested students get an overview of implementing management systems which is requested in all enterprises in the sectors of environmental protection, quality assurance, work safety, etc. today.

Up to now, the environmental management system of the specialised group Process Engineering has been certified according to DIN EN ISO 14001 and the quality management system according to DIN EN ISO 9001. In future, the
usefulness of a certification of the work safety contents according to SCC-Standard or to BS 8800 will be tested. Finally, gathered results and experiences thus far shall be transferred to other areas of the university.

Bibliography


