Open Source ICT Tools Overcoming Barriers in EMS
Implementation and Amplifying Company Environmental Awareness

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Abstract

The investigation of authors’ team among more than hundred companies of the Czech Republic, which have implemented Environmental Management System (EMS) had identified ten main barriers, which obstruct the adoption of EMS principles and decrease environmental awareness of internal interested parties. The conceptual model of creating/overcoming barriers in EMS implementations and its continuous improvement has been developed. It is based on five basic objects and five interconnected business processes and it is suitable for ICT implementation. The appropriate set of ICT tools and the prototype of a web-based information system which supports creating/overcoming barriers in the process of EMS implementation have been developed by using mainly Java technologies (the Java Servlet Pages use Tomcat as a servlet container and Apache as a web server). Companies can easily communicate and generate tailor-made EMS documents/records/reports containing information specific to different target groups (internal or external interested parties) to increase their environmental awareness. The developed prototype is open source and it has been tested in cooperation with ten chosen Czech companies.

1. Introduction


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Table 1: Number of ISO 14001/EMAS certified companies in the Czech Republic
(Source: Czech Environmental Information Agency)

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They apply to those environmental aspects which the company can control and those over which it can be expected to have an influence. It does not state specific environmental performance criteria. Companies have to seek ways to understand, demonstrate and improve their company environmental performance, see ISO 14031:1999.

The number of companies in the Czech Republic (CR), which have implemented some form of EMS, is continuously rising since 1997, see the Tab. 1. The numbers of certified companies based on ISO 14001:1996, ISO 14001:2004 standards are much more than based on EMAS ones. The paper describes relevant investigation of barriers which obstruct EMS implementation and decrease environmental awareness in explored companies of the CR. The holistic model of creating/overcoming barriers in EMS implementation and its generalization has been developed (Balcarova 2005), (Fiala/Hlubok/Minisir 2005), (Kokrment/Hlubok 2005). The ICT tools and prototype of web information system based on the above-mentioned model and results of (Brosowski/Lenz 2004), (Isenmann 2004) is presented. It enables amplifying environmental awareness of interested parties and support an EMS implementation and overcoming identified barriers.

2. Investigation of barriers of EMS implementation

The research team of Faculty of Economics of Technical University Ostrava and Masaryk University Brno has investigated environmental awareness of employees (about thousand informants) in more than hundred companies of the Moravian-Silesian province, with implemented and certified EMS (with respect to standard ISO 14001) since 2000. It was found out that the majority of informants agreed that there is insufficient environmental awareness on site despite of previously run training on environmental awareness. Employees and some company managers claim that they generally may have awareness, but in common instances, they cannot remember they have ever had training. It means that there was not a strong direct link between what informants do on the day-to-day basis to control the environmental issues and the EMS. Informants just do what they do and they don’t have that link there. An insufficient environmental awareness comes from employee’s unwillingness to participate e.g. in recycling initiatives. Therefore, the members of research team talked to a number of informants and the frequent responses appeared as “not seeing the point to do that” and “I would do it but others don’t do, so I don’t see the point”.

It was also observed that EMS is indirectly promoted through strategic “information points” of company designated on site, mostly without appropriate ICT tools. These “information points” contain of environmental work, preventive actions and emergency plans procedures applicable to particular area. Again, the researcher investigated how frequently employees refer to the “information points”, and a random selection of employees responded in the following order: majority of people as “never” and a small fraction answered “once out of curiosity” and one “for a particular reason.”

Generally, there has been identified the consistency in terms of EMS documentation, environmental communication (ISO/DIS 14063:2004) and record control helping environmental awareness using ICT:

- Data strive to be centralized in one place;
- Procedures are concentrated in one manual (stored in document database);
- Document control is monitored through EMS with ICT tools that keep track of the environmental procedures’ distribution. Each environmental procedure informs at the bottom of the page, at which “information points” particular procedure should be distributed; EMS manual as the central high-level source of information gives directions to procedures and pro forma documents.

On the other hand, inconsistency has been identified in various aspects of the EMS documentation and communication system of the most investigated companies:

- When keeping records, it is not always clarified who is responsible for tracking particular paper work;
When monitoring certain parts of EMS (e.g. recycling waste, machinery maintenance, incoming legislation), some information cannot be found (e.g. it is not clear when the next measurement, inspection, is due and thus the records are kept more on the reactive basis rather than proactive or preventative basis);

Essential information on utility bills is collected at a different site, which creates difficulties for other EMS team members to view environmental cost of the production. Moreover, important documents like site visit reports, management review meetings are not stored at allocated areas;

The level of details on which activities, tasks and their monitoring should be documented is not specified and a common sense approach is expected to apply;

Since there is the sense of the ownership of particular aspects of EMS prevalent between the EMS team, the location of information is not always communicated to (or received by) the others EMS team members (or more precisely it is not clearly given).

The document review of investigated companies also revealed a number of re-occurring issues identified through non-conformities. The nature of non-conformity issues was identified as: Management related issues (12%); Documentation related issues (23%); Records and monitoring issues (22%); Communication related issues (19%); Housekeeping issues (18%); and Training issues (10%).

3. Model of creating/overcoming barriers in EMS implementation

There were identified ten main barriers (Balcarova, 2005), (Fiala/Hlubick/Minař 2005), (Kokrment/Hlubick 2005) from the above analysis of non-conformity issues, which obstruct the adoption of EMS principles and decrease environmental awareness: Insufficient or not properly identified benefits; Lack of consistent data; Complexity of approach; Time pressure in companies; Lack of staff; Inadequate knowledge and skills; Struggle to understand the role of EMS for the company; Lack of explanation of concepts and more guidance needed; Positive attitudes are not translated into actions; Methods of aspects determination and evaluation.

It was proposed the model (Balcarova 2005), which illustrates creating/overcoming barriers and awareness amplifying in the process of EMS implementation. This model was generalized (Kokrment/Hlubick 2005) to the conceptual model based on the five basic objects and the five interconnected business processes, which are suitable for using appropriate ICT tools. These objects are:

1. External environment impact: i.e. external influences on company, which are critical for the implementation and continuous improvement of EMS. These include e.g. requests of external interested parties including external audits, new legislation issued by the government, cooperation with environmental agencies, etc.;

2. EMS team: i.e. a group of managers and internal auditors directly responsible for maintaining the EMS system. Their role is paramount since the EMS team has to balance the needs, requirements and pressures from all stakeholders (interested parties) and is the main communication and executive channel;

3. EMS: this represents the EMS itself, i.e. the company management system that is being audited by external auditors for compliance with ISO 14001:2004 or EMAS II;

4. Organisation: i.e. the complete company organisation including its structure as a complex social-technical system.

5. Resources and skills: i.e. a set of resources and skills of interested parties that lead to creating/overcoming barriers in EMS.
The above model establishes the five processes leading to creation/overcoming of the barriers:

A. **Transforming & value-adding** process dealing with analysis and transformation between External environment impact and the EMS team;
B. **Administration & improvement** process dealing with the maintenance of the EMS team and continuous improvement of the EMS itself;
C. **Understanding & acceptance** process describing the interaction between Organisation and the EMS itself;
D. **Communication & learning** process dealing with interactions between the EMS team and Organisation;
E. **Availability** is the essential process that enables the use of Resources & skills of internal interested parties necessary for the management of the EMS itself.

The results in explored companies showed that it is the **Administration & improving** process that consumed the majority of the EMS team time and at the same time it creates/overcomes barriers in environmental awareness. Documentation, monitoring and measurement and recording are clauses that link the company EMS together with its strength and weaknesses in environmental performance. The majority of investigated companies demonstrated in various ways their struggles to manage the "paperwork obligations". It was showed that they have a large percentage of non-conformance issues related to documentation. It is clear that using appropriate ICT tools will solve the above described problems.

4. **ICT tools for overcoming barriers in EMS implementation**

We have been developing a set of ICT tools that should help to overcome above identified barriers in EMS implementation and enable to communicate easily with both internal and external interested parties, (Hřebíček/Kokrment/Rádeček,2004), (Fiala/Hřebíček/Minstr 2005), (Kokrment/Hřebíček 2005). Interested
parties can use them to generate documents/records/reports tailored to their needs, they could choose what information they would like to have in their reports and they could choose in which form they would like to have their report (e.g. in PDF, HTML format). Company employees could use these ICT tools to prepare some generic reports for different target groups. This prototype system has been developed using mainly Java technologies. Internet based application is developed in JSP (Java Server Pages) using Tomcat as a servlet server and Apache as a web server. Two chosen company have used this in communication processes in EMS as an output and input format mainly in XML (when possible) since 2002, but it was used also its native format with necessary conversions, because large volume of input data is stored in existing company information systems. Processing general EMS records/data into documents/reports is customized for various interested parties in various forms (XHTML, PDF, text, etc.). Each document/report contains data from three main categories: basic part, which includes all the records/data, which are subject of communication/reporting (but not all these data are contained in the final customized document/report); information about interested parties (target group) and foreword for specific target group. These data are transformed to the structure demanded by a specific target group. Next step is the application of the design for the target group. Finally, the data are sent to serialization process, which produces a final document in XHTML, PDF format.

There were many high-quality open source ICT tools for generating, validating XML documents, when we began our research in 2002. We choose Cocoon (http://cocoon.apache.org/), which is an open source web development framework for publishing documents. It is written in Java language. Cocoon generates XML data according to the requests from web browser, further it generates some SAX (Simple API for XML) event. The data are then passed to further component, which can perform some transformations with them (usually using XSLT). These transformed data are then passed to serialization, where the final document is generated (in PDF, HTML, XHTML, text format...). Processing documents/records/reports into their final version is customized for various target groups in various forms (XHTML, PDF, text, etc.)(Wokoun 2004), (Kokrment/Hřibčík 2005).

Documents/reports (e.g. in the PDF form) are usually generated on-line and they aren’t stored statically in the system. Therefore we always need to have the appropriate description of design and structure for the reports. Because these descriptions can be changed during the time, it may be useful to store generated reports in an archive. Design of the documents/reports is defined separately for each group and standardized. Usually one group has one pre-defined standard design, but it is not a problem to let user choose from many available standardized designs (Hřibčík/Píšťak/Benko 2003), (Kokrment/Hřibčík 2005). The detailed analysis has preceded standardization process, where we cooperated with the Czech EMAS Agency (http://www.cenia.cz/emas) and more than twenty companies with implemented EMS. This brings another tool for standardization to the document/report reader. Standardized designs are defined in XML style sheets, so when we want to change a pre-defined standardized design for some target group we can simply substitute old style sheet with a new one. The developed prototype of web information system has been tested in ten companies since 2004. We suppose that standardized set of pre-defined style sheets should be sufficient, but it was necessary to change design and structure of documents/reports for various target groups several times. The final version of prototype web information system will pass through acceptance tests in May 2006 and the open source of prototype web information system will be available to small and medium enterprises.

5. Conclusions

A valuable part of the Communication & learning process is the feedback that is received from target groups in the EMS. It confirms/informs their environmental awareness. The EMS team can be sure that the Communication & learning process has reached the target group only by identifying their reactions, e.g. if they have received the intended information, and they have understood the EMS itself. When the
Communication & learning process has succeeded in all of these aspects, there is still a need for the company to obtain feedback from the different interested parties and then to respond, showing that the company understands their views, is interested in them, and will consider them. In the event a Communication & learning process on, for example prevention has failed in any of these aspects, a quick reaction may be necessary. A failure in the Communication & learning process can be remedied by providing clearer information through more direct access and discussion. A negative reaction to the information by some of the target groups is more serious - it may foreshadow opposition to the environmental program. The reaction should be investigated to provide a full understanding of the concerns; at best, the issue can be resolved by the improved communication.

Companies issuing environmental reports or other documents for public information can include forms for feedback within the reports. The feedback can assist the company in continuous improving of the environmental awareness of its employees and managers. Companies will be able use the developed prototype of web information system with cooperation of Faculty of Economics as the open source ICT tool amplifying environmental awareness. They can receive this to evaluate the effectiveness of their communication activities and to refine and improve environmental awareness of interested parties.

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Bibliography


