EnviroInfo 2005 (Brno)
Informatics for Environmental Protection - Networking Environmental Information

Further Developments – Software Tool Providing Tailored Sustainability Reports

Ralf Isenmann[1], Jan Brosowski, Monika Schappert[2] and
Jorge Marx Gomez[3]

Abstract

In this paper, we describe latest developments of a software tool for sustainability online reporting. This tool is implemented as a sophisticated web application in a prototype. It provides tailored sustainability reports on the fly "at one's fingertip" and has its basis on the concept of single source cross media publishing. The whole software development is a joint project carried out by the Department of Business Information Systems and Operations Research (BiOR) at the University of Kaiserslautern, Germany, and the Institute for Technical and Business Information Systems at the Otto-von-Guericke-Universität Magdeburg, Germany. Compared to the early prototype presented at the 18th EnviroInfo Conference in Geneva 2004, the current web application has been elaborated and refined along three dimensions: (i) A set of different XSL style sheets has been developed, and based on the experience made, a generic methodology for developing XSL style sheets is proposed. (ii) A software tool has been developed which supports the underlying reporting processes, e.g. update of existing report parts, text editing, graphical layout for different media, web design, formatting, database management, retrieval, cross media publication and dissemination through different channels. (iii) A recommender engine has been developed to move away from an adapted reporting system providing different but static views on reports based on stereotypes towards an adaptable reporting system providing individualised and even personalised reports enabling more features of interactivity and fulfilling users' needs and preferences in an automated manner based on dynamic user modeling. Approaching an adaptable or even adaptive reporting system is regarded as the most sophisticated approach in terms of system adaptation.

Keywords

Internet, single source cross media publishing, recommender engine, software development, sustainability online reporting, target group tailoring, workflow engine, XSL style sheets

1. Software tool for tailored sustainability online reporting

Corporate sustainability reporting has its roots in environmental or non-financial reporting respectively. It describes a development path towards a concept of balanced reporting, often communicating the three pillars of environmental, social, and economic performance and its mutual interrelations, what in business

[1] University of Bremen, Institute for Project Management and Innovation (IPMI), Wilhelm-Herbst-Strasse 12, D-28359 Bremen, Germany, email: ralf.isenmann@innovation.uni-bremen.de, web: http://www.innovation.uni-bremen.de
[2] University of Kaiserslautern, Department of Business Information Systems and Operations Research, P.O. Box 3049, 67653 Kaiserslautern, Germany, email: brosowski@bior.de; schappert@bior.de; Internet: http://www.bior.de
[3] Otto-von-Guericke-Universität Magdeburg, Faculty of Computer Science, Institute for Technical and Business Information Systems, P.O. Box 4120, 39016 Magdeburg, Germany, email: gomez@iti.cs.uni-magdeburg.de, Internet: http://www-wi.cs.uni-magdeburg.de

terms is called the triple bottom line approach, or corporate social responsibility reporting respectively. The early reporting efforts in the late 1990s have been focused primarily on print media. Due to such print media fixation, reports as the pivotal sustainability communication instruments have been prepared as "one size fits all" hard copies. Companies use such reports for disclosing sustainability issues, often including the following contents: (i) vision and strategy, (ii) profile of organisation, (iii) governance, (iv) policy, (v) management systems, (vi) stakeholder relationships, (vii) and environmental, social, economic, and integrated performance indicators (GRI 2002).

Today, as sustainability communication matured and reporters as well as report users are going to make more use of the internet, many reporting instruments are available on the WWW, or at least benefit from ICT-support: reports, brochures, leaflets, newsletters, press releases, slides, presentations, audio sequences, video clips etc. are accessible via download and/or online, prepared for being pulled or automatically disseminated via email or other current push technologies. More and more companies are moving away from an obviously outdated orthodox stage, simply providing "green glossy brochures", mainly produced on print media and usually prepared as "one size fits all" documents, towards an advanced and more sophisticated internet-based approach (Isenmann 2005; Lenz 2003; Marx Gómez and Rautenstrauch 2001): Such an online approach elevates companies to a position to provide detailed and substantial information, to automate the overall reporting workflow, to produce reporting instruments on different media and in various presentation styles and to fine tune communication vehicles to users' heterogeneous information needs, while fulfilling the requirements of various regulations, guidelines and recommendations.

Among a number of ICT-specific challenges, key players involved in sustainability reporting and pushing the field – like the Global Reporting Initative (2004) and the Sustainability Reporting Network (2004) – support such an internet-based online approach. While reporters and report users are evidently entering a digital stage of sustainability online reporting, there is an increasing need for software tools which help companies to facilitate production and communication of sustainability reporting instruments.

In order to make idea and approach of internet-based sustainability reporting actually work – academic perspective – and as a response to companies's need for such ICT-tools – practitioners' perspective –, a software development project was launched. This project is a joint endeavour of the Department of Business Information Systems and Operations Research (BiOR) at the University of Kaiserslautern, Germany, and the Institute for Technical and Business Information Systems at the Otto-von-Guericke-Universität Magdeburg, Germany, embedded in an overall process in the environmental informatic society with the goal to promote the standardisation of document structures for advanced environmental and sustainability reporting using internet technologies and services.

The software tool is developed as a web-application with a three-tier structure (fig. 1):

- The basic data layer (I) contains several sources where the XML schema, XML style sheets, user profiles and a number of other XML-documents are stored. These sources include relevant data, metadata and thesauri. The data layer is managed through a database server.
- The application layer (II) (Cocoon) includes different services and applications to generate and distribute reports in an automated manner by machine processing. This complex layer is used as a data integrator responsible for system management and performed through an application server.
- The presentation layer (III) represents an interactive user interface that is used for submitting users' information needs as well as for presenting reports. The presentation layer provides easy access via a standard web browser, e.g. Netscape Navigator or Microsoft Internet Explorer.

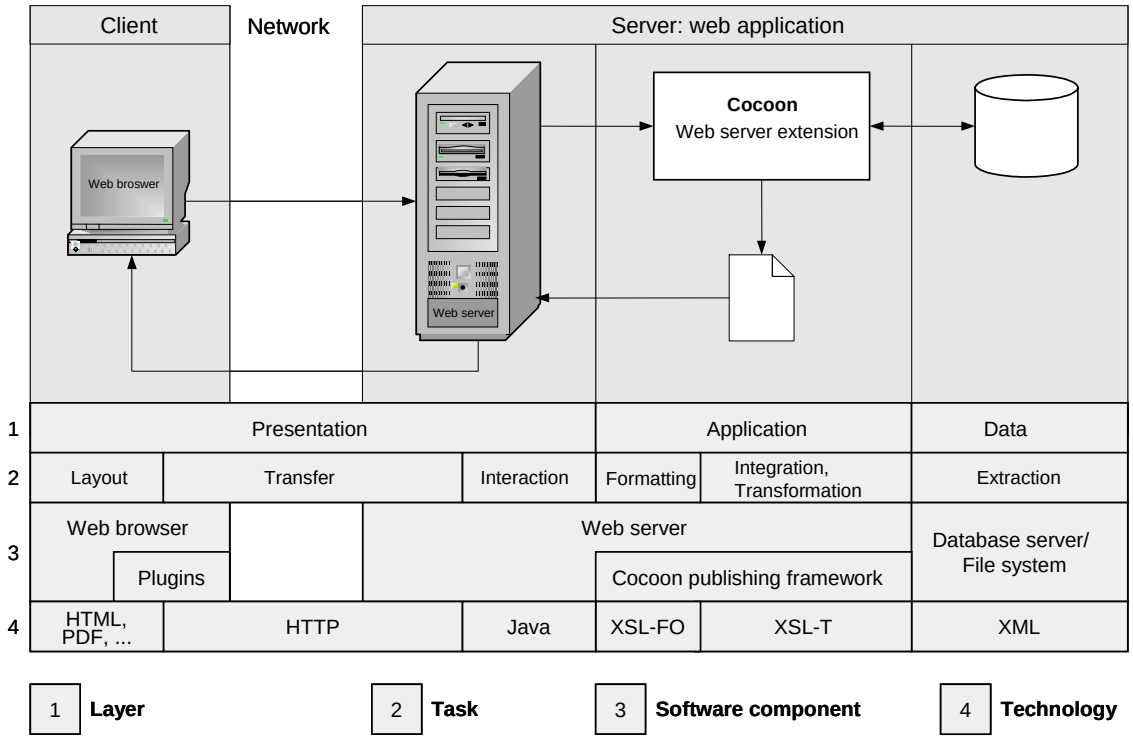

Fig. 1: ICT architecture of the software tool for tailored sustainability online reporting, implemented in a prototype and structured as a three-tier web application

This ICT architecture has been implemented and tested in a prototype (Isenmann et al. 2004). At the heart of this prototype lies Cocoon (application layer, II), a Java-based, modular structured, open source publishing framework (Apache 2003), able to process XML schemas, in particular to transform and format XML documents and thus suitable to perform single source cross media sustainability reporting. The rationale why Cocoon has been chosen, lies – among other advantages and benefits – in its powerful and sophisticated application capabilities. The modular application components could be arranged flexibly, serially grouped in so-called pipelines where different reports are then created dynamically on the basis of an XML schema. This schema for sustainability reporting is key to provide tailored reports meeting users' heterogeneous needs and exactly fulfilling a number of current reporting requirements. For database connectivity, Cocoon uses the JDBC (Java Database Connectivity), implemented as a pool of drivers for connectivity to different databases. A major benefit of using Cocoon is that arrangement, transformation, and layout procedures are all controlled through XML documents.

2. Three current developments improving the software tool

Compared to the early implemented prototype presented at the 18th EnviroInfo Conference in Geneva 2004 like mentioned above, the current application has been elaborated along three dimensions (fig. 2):

1. A set of different XSL style sheets (❶) has been developed, and based on the experience made, a generic methodology for developing XSL style sheets is proposed (2.1).
2. A recommender engine (❷) has been developed to move away from an adapted reporting system providing different but static views on reports based on stereotypes towards an adaptable reporting system providing individualised and even personalised reports enabling more features of interactivity

and fulfilling users' needs and preferences in an automated manner based on dynamic user modeling (2.2).

3. A workflow engine (❸) has been developed which supports the underlying reporting processes, e.g. update of existing report parts, text editing, graphical layout for different media, web design, formatting, database management, retrieval, cross media publication and multi channel dissemination (2.3).

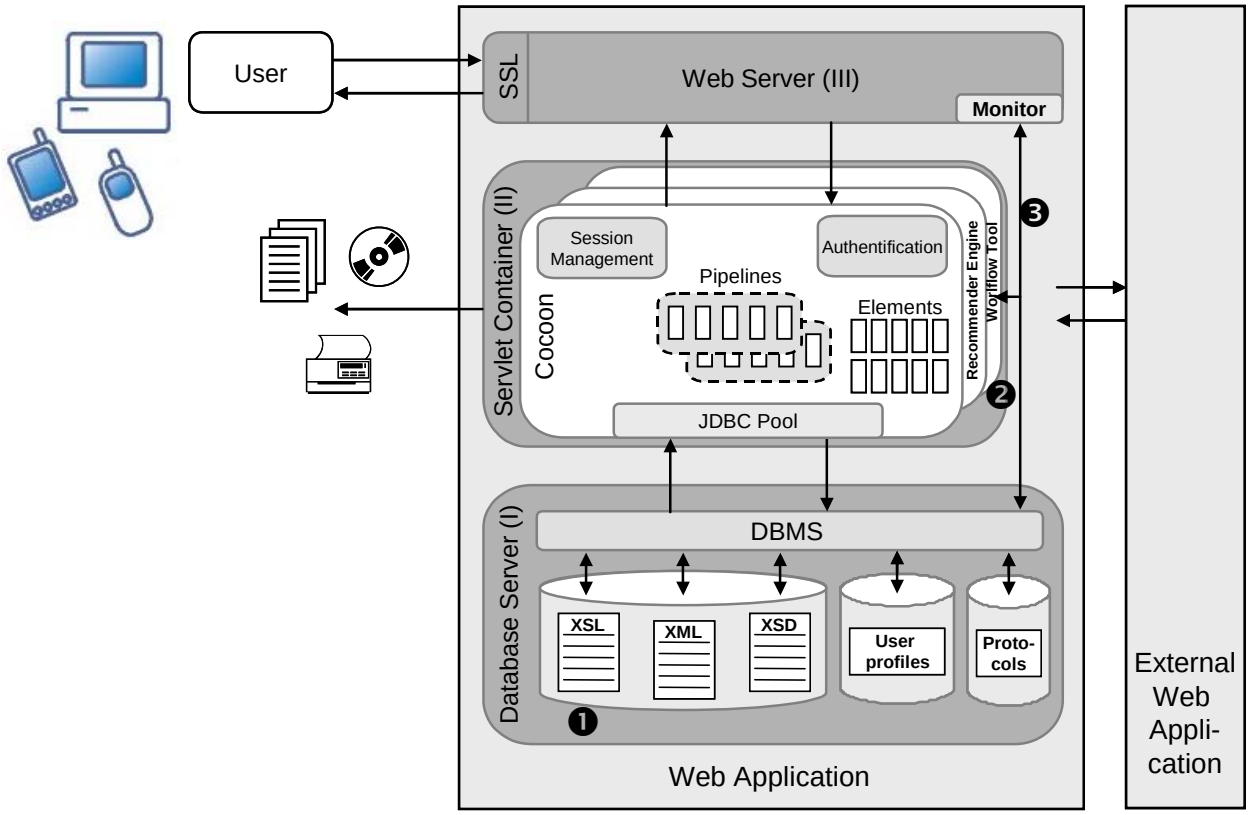

Fig. 2: Refined software tool for sustainability online reporting, illustration (improvements in bold type)

2.1 Development 1: Set of XSL style sheets

Further to the existing XML schema for sustainability reports (Brosowski et al. 2004) we developed a set of XSL style sheets (fig. 2, ❶). While the schema defines structure and legal building blocks of sustainability reports, i.e. number, order, and values of elements and attributes that could appear in these documents as well as the nature and default of data types, the style sheets are needed to extract certain contents out of an XML-based sustainability report, to transform these contents to a compound document based on the schema, and then to format the document according to certain layout requirements and user preferences.

Among the number of users' informations needs and reporting requirements that have been taken into accounct, the XML schema particularly meets the GRI (2002) "sustainability reporting guidelines", the revised European eco-management and audit scheme "EMAS II" (EC 2001) and a recently published publicly available specification (PAS) on "data exchange between ERP systems and environmental information systems" (Lang et al. 2003). Given the full GRI content, the schema covers a total of 395 semantic

components. Depending on sector supplements that may be included, then the total amount will increase up even to 415-466 semantic components.

In order to demonstrate the potential of this schema for tailored sustainability (online) reporting to its full extent, we developed a set of six different style sheets (Wassermann 2004), providing a total of nine combinations (fig. 3). For any illustrations, we used the Otto (2003) sustainability report (2003): "Bewußt-sein(s)formen. Nachhaltigkeitsbericht 2003" which we converted from a PDF file to a XML document (fig. 4, fig. 5). Three style sheets are for extracting contents according to certain needs or reporting requirements respectively, and three style sheets are for report layout on different media and further processing in (environmental) information systems.

Layout / **Content**	**Print media** (fig. 4) • Plain text • Table of contents • PDF	**Computer-based media** (fig. 4) • Hypertext structure • Multimedia features • Navigation • HTML	**Processing in (environmental) information systems** • Plain text • Marked with tags • XML
Satisfying **investors**' needs		(fig. 5)	
Fulfilling the requirements of **EMAS II**		(fig. 5)	
Meeting the **GRI guidelines**			

Fig. 3: Set of XSL style sheets to provide tailored views based on an underlying XML-based sustainability report

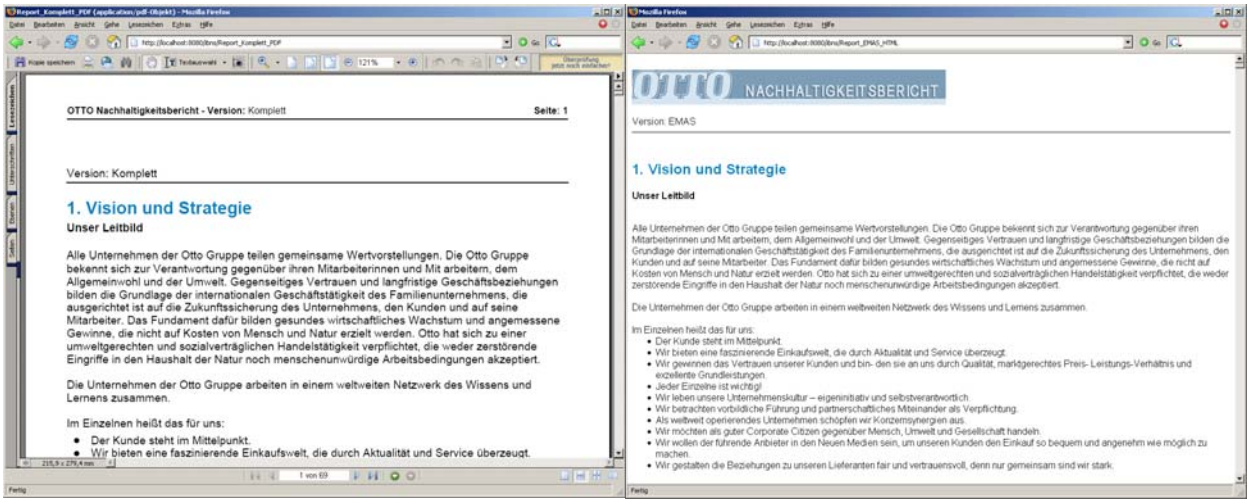

Fig. 4: Screenshots using the XSL style sheets for print media (left) and computer-based media (right) based on the Otto sustainability report (2003)

Resulting from the experience we made along this enterprise, a generic methodology of how to design XSL style sheets was developed. This methodology follows the procedure of how to design XML schemas (Brosowski et al. 2004) and uses its process-oriented model as an analogue.

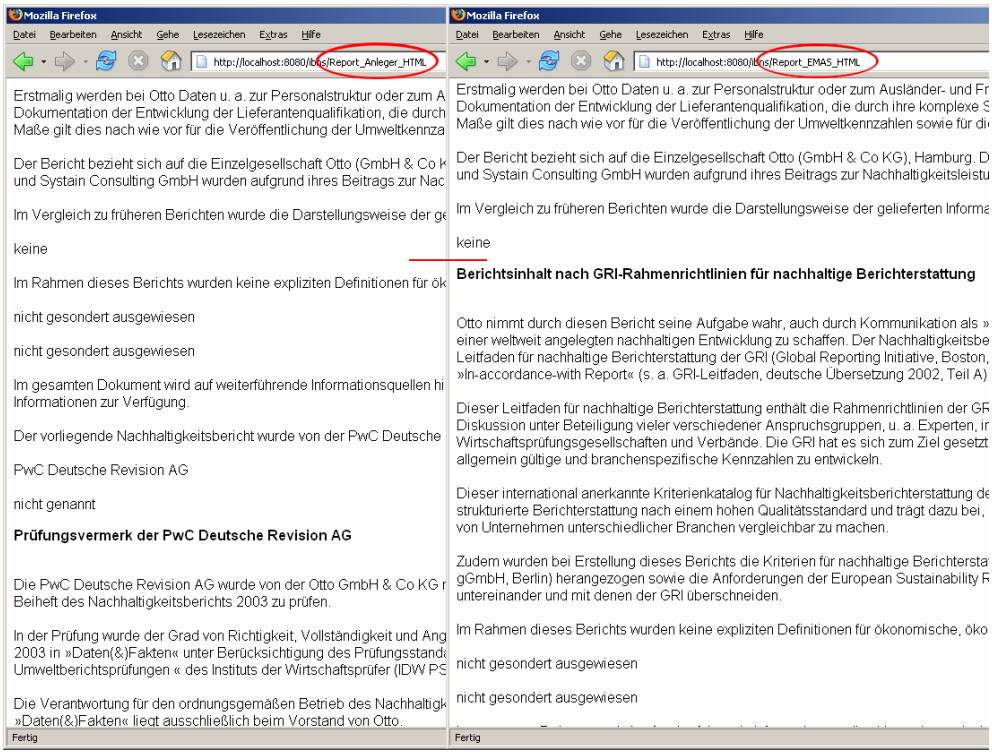

Fig. 5: Screenshots using the XSL style sheets for investors (left) and EMAS II (right) based on the Otto sustainability report (2003)

2.2 Development 2: Recommender engine

Next to the set of style sheets (2.1), a recommender engine (fig. 2, ❷) has been developed. With the help of a recommender engine (Hermann 2005), the software tools moves away from an adaptable reporting system (fig. 6, II) providing different but static views on reports based on stereotypes towards an adaptable reporting system truly providing tailored reports meeting the needs of individual users (fig. 6, IV).

Such an adaptable reporting system using the support of the recommender engine provides more interactivity. For example, the recommender engine (i) suggests bookmarks, (ii) offers navigation features and (iii) recommends further sources which are likely relevant in the eyes of certain users in an automated manner, based on dynamic user modeling. According to an underlying conceptual classification for sophisticated tailored reporting in terms of user modelling and system adaptation (Lenz 2003), this development represents a progression moving away from (II) in figure 6 towards (IV).

The recommendations made by the engine are based on a number of sophisticated algorithms that have been implemented. The algorithms are using methods of collaborative filtering. Hence, the recommendation engine helps to anticipate which content a certain user may likely require. Among other features, the recommendation engine offers highlighted links to documents that may meet these individual needs and preferences. Further to the links, the engine adapts the reports' layout to the users' individual needs, based on the use of current web mining techniques. For example, the recommender engine matches the already stored profiles of the current user with the profiles of other users or it calculates rather similar clickpaths. The results of these calculations are then ranked, sorted and finally injected in data stream of the Cocoon pipeline which is currently processed.

Degree of user modelling	adapted	adaptable	adaptive
personalised	-	VI	VII
individualised	-	IV	V
stereotyped	I	II	III

Degree of system adaptation

Fig. 6: Classification for sophisticated tailored reporting in terms of user modelling and system adaptation

2.3 Development 3: Workflow engine

In addition to style sheets (2.1) and recommender engine (2.2), a workflow engine (❸) is the third development that improves the early implementation. Closely linked with the other two, there are institutional aspects to consider, e.g. the allocation of staff and other resources in an efficient manner: How can reporting procedures and other related measures in decision-making be carried out efficiently? How can the reporting processes benefit from ICT?

The processes that underlie sustainability reporting are multi-faceted. For example, from a process-oriented perspective, the reporting workflow consists of at least four core processes, preparation, administration, distribution and presentation. Further, the work to be managed along the workflow varies: definition of document structure, update of existing report parts, text editing, graphical layout for different media, web design, formatting, database management, retrieval, cross media publication, dissemination through different channels, stakeholder communication, etc. These tasks require different resources and specific expertise. They often reach beyond responsibilities and competences of one single functional unit. Therefore a number of people are involved, e.g. editorial team, environmental department, special task forces, accountants, lawyers, public relations specialists, auditors and external consultants.

Within the teamwork of such complexity, careful co-ordination of activities, procedures and responsibilities becomes crucial while collaborative work should be made possible without hindering the work of others. Thus, a workflow engine has been developed (Jordan 2005). Such a workflow engine (i) reduces time-consuming procedures such as text editing and publishing, (ii) improves the quality of procedures and processes, (iii) reduces overall publishing costs, and (iv) provides reports and other communication tools with value added features. In terms of reporting costs, it is expected that an advanced reporting approach based on the internet and using XML can save companies significant resources, up to 60% of the costs compared with orthodox reporting methods (DiPiazza and Eccles 2002).

While sophisticated software tools and reporting wizards are under development (e.g. Hřebícek et al. 2004), some pioneers are already employing portals, or are going to combine reporting tools with environmental information systems like “umberto”, ERP systems such as “mySAP”, or CMS like “RedDot” respectively to support the whole reporting workflow and to improve underlying core processes, from material and process flows to eco input-output-inventory. Such information systems allows reports’ content to be updated with quantitative data, stored, retrieved, edited, controlled and then output cross media in an automated cost saving manner.

3. Conclusions

The refined software tool is regarded as a forward looking approach and cutting edge web application in the rapidly developing field of advanced environmental and sustainability reporting. Such a comprehensive and promising development offers a number of insights and a variety of added value creating features compared with early reporting stages. It enables "single source cross media publishing" for tailored sustainability reports and thus helps to make the concept of internet-based reporting actually work.

Bibliography

Apache (2003): Apache Cocoon. In: <http://cocoon.apache.org>, access 2003-06-24.

Brosowski, J.; Isenmann, R.; Beisel, M.; Marx Gómez, J. (2004): XML schema for sustainbility reports meeting the needs of the GRI guidelines. In: Minier, P.; Susini, A. (Eds.): Sh@ring. Proceedings EnviroInfo 2004. Geneve: Editions du Tricorne, 184-193.

European Communities (EC) (2001): Regulation (EC) No. 761/2001 of the European Parliament and of the Council of 19 March 2001 allowing voluntary participation by organisations in a Community eco-management and audit scheme (EMAS II). Official Journal of the European Communities. L 114.

DiPiazza, S.A.; Eccles, R.G. (2002): Building corporate trust. The future of corporate reporting.

Global Reporting Initiative (GRI) (2002): Sustainability reporting guidelines. Boston: GRI.

Global Reporting Initiative (GRI) (2004): GRI software development. GRI enters digital age. In: <http://www.globalreporting.org/software>, access 2004-05-18.

Hermann, C. (2005): Automatisierte Anpassung internet-basierter Nahhaltigkeitsberichte. Konzept und Implementierung. Diplomarbeit. Technische Universität Clausthal.

Hřebícek, J.; Kokrment, L.; Ráček, J. (2004): Workflow support of corporate environmental communication and reporting. In: Minier, P.; Susini, A. (Eds.): Sh@ring. Proceedings EnviroInfo 2004. Geneve: Editions du Tricorne, 194-207.

Isenmann, R. (2005): Corporate sustainability reporting – a case for the internet. In: Hilty, L.M.; Seifert, E.K.; Treibert, R. (Eds.): Information Systems for Sustainable Development. Hershey: Idea Group, 164-212.

Isenmann, R.; Beisel, M., Brosowski, J.; Marx Gómez, J. (2004): Software tool for single source multiple media sustainability reporting. In: Minier, P.; Susini, A. (Eds.): Sh@ring. Proceedings EnviroInfo 2004. Geneve: Editions du Tricorne, 152-162.

Jordan, T. (2005): Konzeption und prototypische Implementierung eines Softwaretools für die workflowgestützte Erstellung und Verwaltung XML-basierter Nachhaltigkeitsberichte. Diplomarbeit. Otto-von-Guericke-Universität Magdeburg.

Lang, C.; Rey, U.; Wohlgemuth, V.; Genz, S.; Pawlytsch, S. (2003): Data exchange between ERP-systems and environmental information systems. Publicly available specification (PAS) 1025. Berlin: Beuth.

Lenz, C. (2003): Empfängerorientierte Unternehmenskommunikation – Einsatz der Internet-Technologie am Beispiel der Umweltberichterstattung. Köln: Eul.

Marx Gómez, J.; Rautenstrauch, C. (Eds.) (2001): Von der Ökobilanzierung bis zur automatisierten Umweltberichterstattung mit Stoffstrommanagementsystemen – eine Fallstudie. Aachen: Shaker.

Otto (2003): Bewußtsein(s)formen. Nachhaltigkeitsbericht 2003. Hamburg: Otto.

The Sustainability Reporting Network (SRI) (2004): One report. In: <http://www.one-report.com/about_onereport.html>, access 2004-04-26.

United Nations Environment Programme Industry and Environment (UNEP), SustainAbility (1994): Company environmental reporting. Technical Report 24. Paris: UNEP.

Wassermann, R. (2004): Konzeption und Implementierung eines zielgruppenorientierten Systems zur internetbasierten Nachhaltigkeitsberichterstattung. Diplomarbeit. Technische Universität Kaiserslautern.