Using Internet Technologies and Services for Sustainability Reporting: Research Initiative, Agenda, Early Results

Ralf Isenmann[1], Hans-Knud Arndt[2], Jan Brosowski[3],
Jorge Marx Gómez[4], Monika Schappert[5]

Abstract

The paper provides an outline of a research initiative embedded in the environmental informatics community focused on the use of environmental informatics methods and the application of current internet technologies and services with the goal to improve sustainability reporting at corporate level. The outline includes the research agenda and a research map as an illustration covering the different facets of research and implementation as well as further developments that will be dealt with in the near future. The paper is organised in four major parts: First, the early history of the research initiative on internet-based sustainability reporting and major milestones are described with the help of current literature in the field. Based on the above, the research agenda and primary objectives are presented. Such a catalogue of issues seems useful for clarifying the focus of the whole enterprise and perhaps for an evaluation what has been achieved and where further work needs to be done. A research map of the co-operation network provides the whole picture the initiative is focused on. It particularly illustrates the domains in environmental informatics and corporate sustainability reporting that are of relevance to achieve the objectives set in the research agenda. Further, a current project is described. Finally, conclusions are drawn and an outlook is given on how sustainability reporting might evolve in the near future and where to support the developments through ICT.

1. Research initiative on internet-based sustainability reporting

The research initiative on internet-based sustainability reporting is supported and promoted through four institutions all located at German Universities: (i) Institute for Project Management and Innovation (IPMI)/Research Institute for Sustainability (artec), University of Bremen, (ii) Department of Business Information Systems and Operations Research (BISOR), University of Kaiserslautern, (iii) Institute for Technical and Business Information Systems, Otto-von-Guericke-Universität Magdeburg, and (iv) Department for Business Information Systems, University of Oldenburg. The institutions provide different intellectual resources from outstanding scholars with international expertise and reputation. This makes it possible to combine different knowledge and expertise needed for such an interdisciplinary and challenging enterprise, including the areas of: sustainability management, stakeholder management, corporate online reporting, project management, business information systems, database management, internet technologies and web services, mark-up languages, document engineering, software engineering as well

[1] University of Bremen, Institute for Project Management and Innovation (IPMI), and Research Institute for Sustainability (artec), Wilhelm-Herbst-Strasse 12, D-28359 Bremen, Germany, email: ralf.isenmann@innovation.uni-bremen.de, web: http://www.innovation.uni-bremen.de
[2] Otto-von-Guericke-Universität Magdeburg, Institut für Technische und Betriebliche Informationssysteme, AG Managementinformationssysteme, Universitätsplatz 2, D-39016 Magdeburg, Germany, email: hans-knud.arndt@iti.cs.uni-magdeburg.de, web: http://wwwiti.cs.uni-magdeburg.de/iti_mis
[3] University of Kaiserslautern, Department of Business Information Systems and Operations Research (BISOR), P.O. Box 3049, D-67653 Kaiserslautern, Germany, email: brosowski@bisor.de; web: http://www.bisor.de
[4] University of Oldenburg, Department for Business Information Systems, Ammerländer Heerstr. 114-118, D-26129 Oldenburg, Germany, email: marx-gomez@wi-ol.de; web: http://wi-ol.de/
[5] University of Kaiserslautern, Department of Business Information Systems and Operations Research (BISOR), P.O. Box 3049, D-67653 Kaiserslautern, Germany, email: schappert@bisor.de; web: http://www.bisor.de

as ERP (Enterprise Resource Planning) systems, EIS (Environmental Information Systems), and CMS (Content Management Systems).

Although the idea and concept of a common research initiative had a number of predecessors in the late 1990s, the institutions started co-operation and joint work around the meetings of several expert and working groups like Corporate Environmental Information Systems, Hypermedia for Environmental Protection, and Environmental Markup Language (EML) in the early 2000s. Since its launch nearly seven years ago, the initiative has started from a smart "idea", becoming a "somewhat fuzzy concept", to give rise to an ongoing research initiative. The enterprise now constitutes a solid co-operation network with a research agenda, ongoing software development projects, various tools, case studies, publications, courses at university level, resources of research, and other characteristics that make it a small but smart research project. The overall objective of this research initiative is to improve sustainability reporting with the help of modern ICT, in particular internet technologies and services; thereby, it is hoped, contributing to the evolution of triple bottom line online reporting as well as to the development of corporate performance and transparency in terms of sustainability. As the research initiative has developed a certain degree of consolidation, hence, it may be the right time to describe its research agenda and present its early results as well as its future work in a comprehensive research map. Such an effort seems particular useful as the institutions would like to share their knowledge with a broader audience. Further they may also be seeking for funding projects, not just inside the environmental informatics community, but also from outside, be they reporting companies that are interested in implementation or report users, target groups, or other stakeholders who are involved in sustainability reporting.

2. Background, history, and early milestones

The early history of the research initiative on internet-based sustainability reporting and the major milestones that have been reached particular (Figure 1) are described with the help of the current literature in environmental informatics:

- In Berlin 2001, an EML initiative has been launched (Arndt and Günther, 2000), and some DTDs (document type definition) for environmental reports have been presented. Moreover, case studies (Marx Gómez and Rautenstrauch, 2001), literature reviews, and benchmarking analyses (Isenmann and Lenz, 2002) made clear that environmental and sustainability reporting will become a dynamic field of research for the next decades, particularly driven by modern ICT (Isenmann and Warkotsch, 1999a,b).

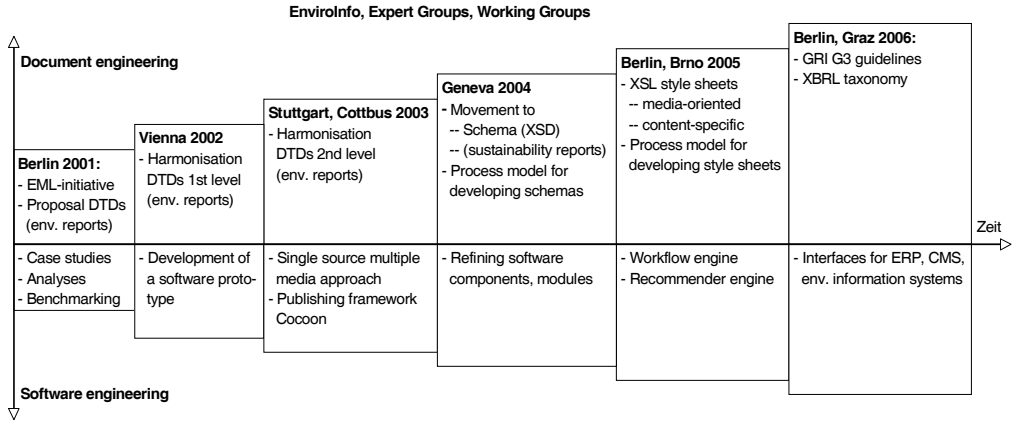

Figure 1: Milestones of the research initiative in document engineering and software engineering

- In Vienna 2002 (16th EnviroInfo Conference), it was argued to exploit the benefits using up to date ICT, in particular the internet and XML for environmental reporting. As a result, an approach on how to standardise different XML DTDs on top level was proposed (Lenz et al., 2002). Following this contribution, the aim in Stuttgart 2003 was to find out proper ways how to elaborate the basic approach in a more detailed manner. Such an effort was considered crucially important for providing efficient, automated, and target group tailored reporting. As a result, it was clear that standardisation on the second level is a difficult enterprise because of different design profiles which were used while developing the DTDs, perhaps which restrictions should be taken into account, and what procedure should be employed when selecting and arranging the relevant semantic components (Isenmann et al., 2003).
- Further to the insights of the methodical analysis, in Cottbus 2003 (17th EnviroInfo Conference) it was argued to make the underlying design profiles more transparent. As a minimum, two key criteria were identified that should be met: (i) recommendations proposed by the EML initiative (Arndt and Günther, 2000) and (ii) the need to analyse document instances both, on print media and on the WWW (Lenz 2003). Consequently, a standardised XML DTD for environmental reporting on the second level was proposed (Isenmann et al., 2003b).
- Based on a model for the design of DTDs initially proposed by Schraml (1997) and then adapted by Lenz (2003), a refined approach for schemas was developed and presented in Brno 2005 (19th EnviroInfo Conference). This approach described a generic method that takes into account the nature of a schema. In particular, the module structure of the GRI family of documents could be realised step by step. As the underlying model for DTDs was primarily focused on the selection of semantic components, some revisions and few modifications had to be made. All together, it became clear that the development of an XML Schema is much more than just a simple process of transforming a DTD. On the contrary, such a method which is based on a conceptual foundation could be a helpful instrument to ensure methodical rigour when developing a schema (Brosowski et al., 2004).
- In Berlin and in Brno 2005 latest developments of a software tool for sustainability online reporting were presented (Isenmann et al., 2005). The tool was implemented as a sophisticated web application in a prototype. It provided tailored sustainability reports on the fly "at one's fingertip" and had its basis on the concept of single source cross media publishing. Compared to the early prototype presented at the 18th EnviroInfo Conference in Geneva 2004 (Isenmann et al., 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 was proposed. (ii) A workflow engine 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 was regarded as the most sophisticated approach in terms of system adaptation (Lenz 2003).
- In Berlin and in Graz 2006 (20th EnviroInfo Conference) we proposed a reference architecture for sustainability reports based on the XBRL (eXtensible Businesses Reporting Language) which in particular meets – among others – the requirements of the Global Reporting Initiative's (GRI) sustainability reporting guidelines (Arndt et al. 2006). This third generation of GRI guidelines (G3) were at that time available as "draft-version for public comment". While developing a sustainability reporting reference architecture, we made use of on existing XBRL Financial Reporting Taxonomies Architecture (FRTA) which is widely used in financial reporting.

In total, the sequence of presentations at the EnviroInfo Conferences and the number of (journal) articles and book chapters that have been published illustrate the continuous development which the research initiative has obviously made (Marx Gómez and Isenmann, 2004).

3. Research agenda

Based on the above, the research agenda and a set of objectives are presented. From an environmental informatics perspective, the ICT-heavy area of research is focused on two major branches (see Figure 1): (i) document engineering and (ii) software engineering. Document engineering represents the branch of developing standardized document structures for advanced environmental and sustainability reporting, especially while exploiting the full benefits of internet technologies and services. Software engineering is the branch of designing software tools and implementing ICT applications for reporting issues. Both branches are intertwined and related to each other: On the one hand, sophisticated software tools and ICT applications for sustainability reporting rely on standardized document structures. For example, XML-based document structures like DTDs or schemas are often key for advanced reporting systems, particularly for current ICT applications like (web) content management systems. On the other hand, improvements in sophisticated software tools and progression in ICT applications call for standardized document structures, preferably using current markup languages like XML.

The overall objective of the research initiative is to bridge the gap between the business-driven field of sustainability reporting and its different facets on the one hand and the ICT-heavy area of (environmental) informatics, software engineering, document engineering, online information systems and information management on the other hand. Although research in both domains is still quite separated, improvements in ICT, however, enable an array of unique capabilities to be employed for progressing in the field. Particularly the internet and its associated technologies, services, and markup languages like XML (Glushko and McGrath, 2005; W3C 2004), XBRL (XBRL 2006; DiPiazza and Eccles, 2002) and EML (Arndt and Günther, 2000) provide powerful tools, finally to the benefit of all groups involved in or affected by sustainability reporting (GRI 2004), be they managers, accountants, employees, members of the financial community, customers, suppliers, local authorities, non-governmental institutions, pressure groups, or organisations focused on benchmarking, rating and ranking.

4. Research map

A research map of the co-operation network provides the whole picture of the initiative (Figure 2). It particularly illustrates the domains in environmental informatics and sustainability reporting that are of relevance to achieve the objectives set in the research agenda.

One major current research effort is to develop a “Sustainable Reporting Taxonomies Architecture” (SRTA). This architecture is based on the Financial Reporting Taxonomies Architecture 1.0 (FRTA), intended to enhance consistency among the XBRL taxonomies used for sustainability reporting. An important design goal for sustainability reporting taxonomies is to maximise the usability of the taxonomy to the non-technical (from a computer science perspective) users and experts of the reporting domain, while not compromising the ability of the taxonomy to describe reporting requirements and possibilities in an accurate and XBRL-compliant manner (FRTA 2005).

The FRTA is characterized through a number of so-called taxonomy schemas and linkbases. A taxonomy schema is an XML schema, usually a standardized schema (XSD), and contains XBRL concepts. A concept is a definition of kind of fact that can be reported about the activities or nature of a business entity. Taxonomies contain XBRL concepts represented by XML schema element definitions (FRTA 2005). Principles for defining sustainability report content (concepts) and ensuring the quality of reported information are standardized by the Global Reporting Initiative (GRI) with their Sustainability Reporting Guidelines. Version 3 (GRI 2006) also includes standard disclosures made up of performance indicators and other disclosure items, as well as guidance on specific technical topics in reporting.

The GRI guidelines identify information that is relevant and material to most organizations and of interest to most stakeholders for reporting the three types of Standard Disclosures (GRI 2006):

- Strategy and Profile: GRI disclosure items that set the overall context for understanding organizational performance such as its strategy, profile, and governance.
- Management Approach: GRI disclosure items that cover how an organization addresses a given set of topics in order to provide context for understanding performance in a specific area.
- Performance Indicators: GRI indicators that elicit comparable information on the economic, environmental, and social performance of the organization.

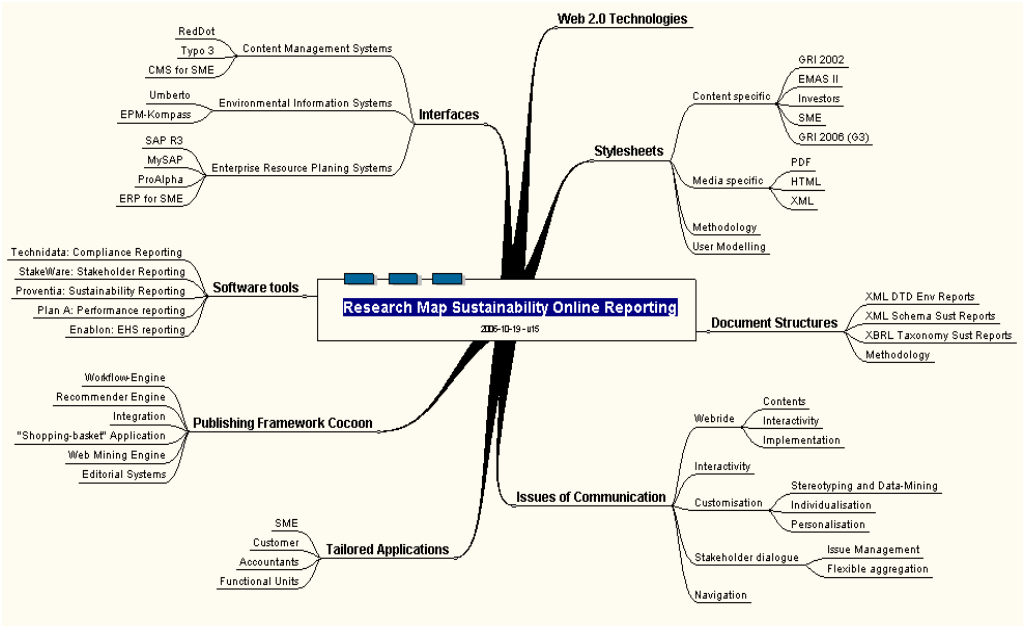

Figure 2: Issues of sustainability online reporting research, illustrated in a research map

According to the GRI guidelines, the SRTA extracts concepts out of these three GRI standard disclosures. Each extracted concept is an XML schema element in the XML Schema "sustainability.xsd". The XML Schema "sustainability.xsd" is the core of the SRTA and represents the pivotal document of the sustainability reporting taxonomy. Any concept of the GRI disclosure items is represented as XML elements in this document as well as any linkbase references. Figure 3 provides an impression of the sustainability discoverable taxonomy set (Sustainability DTS), highlighting the various relations between linkbases and taxonomy schema (XSD).

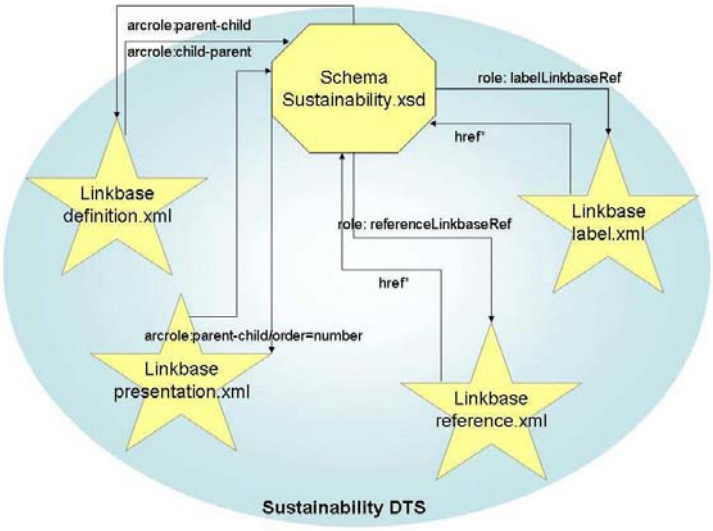

Figure 3: Sustainability Reporting Discoverable Taxonomy Set

The XML schema element names of the sustainability.xsd document represent the tree-like structure of the GRI disclosure items by the point linkage. For example, the GRI disclosure item "prioritization of key sustainability topics as risks and opportunities" is part of the subsection "1.2 description of key impacts, risks, and opportunities", this subsection is again part of the GRI standard disclosure section "1. strategy and analysis", and this section is again part of a sustainability report (Figure 4). The way of naming the XML schema elements has been derived from the FRTA, accounting reference data and the equality of XML element names and ID (FRTA 2005).

```
<element
name="sustainReport.strategyAnd                    Analy-
sis.keyRisksAndOpportunities.
prioritizingKeyRiskAndOpportunities"
type="xbrli:stringItemType"
subsitutionGroup="xbrli:item"
id="sustainReport.strategyAnd                      Analy-
sis.keyRisksAndOpportunities.
prioritizingKeyRiskAndOpportunities"/>
```

Figure 4: Example of a schema element definition in the "sustainability.xsd"

The SRTA contains the following linkbase references: (i) Label-Linkbase: The XML document "linksbase.xml" links all XML schema elements of the sustainability.xsd document to their literal meaning. (ii) Reference-Linkbase: In the German XBRL taxonomy these references refer to paragraphs of the German Commercial Code (HGB). Since there are no paragraphs in the GRI guidelines the GRI disclosure items number is used. (iii) Definition-Linkbase: Based on a list of elements the required tree struc-

ture is created. (iv) Presentation-Linkbase: Arrangement and regularity between children-nodes in a level with the same parent-node is created.

5. Conclusions and outlook

Internet-based sustainability reporting keeps companies in a position to provide sustainability reports and other communication vehicles on a variety of media, based on a single data source that serves as a shared publishing basis. DiPiazza and Eccles (2002, 127) state that "corporate information, in all its growing quantity and complexity can be – and in reality must be – communicated more effectively with the use of new technology. Reported information needs to break away from the constraints of paper-based formats." For some companies, internet-based sustainability reporting might seem a nice extra in comparison to orthodox practice and the traditional disclosure focused on print media. The unique capabilities and benefits of internet-based online reporting, however, elevate it beyond the status of a mere buzzword. Internet technologies and services, employed with XML and incorporated into a (web) content management system or a reporting software tool can do more than offer new channels for report distribution or presentation. The WWW is a service for distributing and presenting reports, including hypermedia features, online information and global access around the clock. Moreover, information management can be improved in various ways: data relevant for performance in terms of sustainability is captured from different data sources, combined despite different data formats, analysed for decision making, professionally mastered and hypermedia-featured, customised according to specific information needs and certain guidelines, distributed and presented, e.g. via email, cross media, fax, or ordinary mail. The content and design of reports will need to be transformed: online availability, downloads, additional environmental documents, interactivity, feedback opportunities, contact details, automatic order forms, sustainability electronic forums, hyperlinks, graphically designed websites, navigation, search engines, web rides, regular updates, and site promotion are some of the form and content capabilities that are already implemented to a certain extent.

All in all, the internet could be regarded as a "reporting facilitator". Sensing that traditional sustainability reporting might have its limits, more companies are considering improving their reporting practice and making more use of reports in general. On improving reporting, an announcement on the Volkswagen website (2003) makes the point: "'Glossy brochures' which are not real are worthless. What is required here is to harness modern, flexible and cost-effective information technologies and channels – means that are also within the reach of small and medium-sized enterprises, and not just the global players. The Internet provides numerous possibilities along these lines." With this in mind, one major challenge seems to be using the internet properly. Sustainability online reporting assists companies in moving away from traditional reporting practice towards more advanced sustainability communication.

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