

Preface

The first decade of the twenty-first century showed an exponential growth in interest around sustainability in general and its environmental pillar in particular. Academia, industry, and policy-makers alike continue to put more emphasis on ways to monitor and reduce environmental impacts within organizations and across industries or supply chains.

Within academia, this niche subject has established itself in a plethora of dedicated journals such as the *Journal of Cleaner Production*, the *Journal of Industrial Ecology*, and *Environmental Modeling and Software*, in addition to conferences such as the International Conference on Informatics for Environmental Protection (EnviroInfo), the International Symposium on Information Technologies in Environmental Engineering (ITEE) and the Expert Conference on Environmental Management Information Systems. In addition to domain-specific publications, the subject also found its way to the top ranked general-purpose ones, e.g., MIS Quarterly (Melville 2010; Elliot 2011; Watson et al. 2010). This emphasizes that the topic of environmental sustainability is of great interest in the scientific community.

The surge in academic studies and publications is for the major part a result of an unprecedented industrial interest in environmental sustainability. This interest is evident in the various initiatives around that topic that aim to simplify the calculation, reporting, and reduction of environmental impacts. For example, 744 companies reported their 2011 sustainability performance following the Global Reporting Initiative (GRI) guidelines. The GRI defines specific organizational-level indicators for financial, social, and environmental categories and these became a de-facto guideline for sustainability reporting. Companies see real business value in this otherwise effort-intensive exercise as investors, shareholders, and customers are asking for it more often. For example, FTSE provides indices based on companies' sustainability actions and reports such as the FTSE4Good Index Series which is used by investors in their decision-making. Another prominent example of sustainability investment is the SAM group whose Corporate Sustainability Assessment (CSA) methodology for benchmarking corporate sustainability performance is the basis for the prestigious Dow Jones Sustainability Indexes (DJSI). An additional initiative also worth noting is the Carbon Disclosure Project (CDP), a

not-for-profit organization that primarily collects and shares organization-level Carbon dioxide (CO₂) emission data from the biggest 500 companies world-wide. According to the CDP, the 2011 questionnaire was sent on behalf of 551 investors with US\$71 trillion of assets, and over 400 corporations responded. CO₂ and greenhouse gas emissions in general have been the subject of particular emphasis due to global warming, and this is reflected in reporting initiatives such as the CDP but also standardization efforts. The latter are necessary to have a common way to account for and calculate emissions of business activities. A prominent example is the Greenhouse Gas Protocol that was originally focused on organization-level emissions but recently new standards appeared to cover the supply chain and product levels. The need to broaden the scope of environmental considerations beyond the own organization into the supply chain and product life cycle is evident in further examples. First, the CDP added a supply chain reporting initiative in addition to the above-mentioned organization-level reporting. The new initiative aims to make the upstream and downstream CO₂ emissions of companies more transparent. In addition to such third-party initiatives, the recent years have seen mandates by focal players in the supply chain, e.g., Walmart and Unilever, who request their top suppliers to provide specific environmental information and trigger them to continuously improve. These mandates usually either focus on the supplier-level information, e.g., total energy, waste, or emissions of a supplier, or go beyond that to a product perspective. For the latter, life cycle assessments are typically used and results often reported in the form of an Environmental Product Declaration (EPD) or a carbon label if only CO₂/greenhouse gas emissions are considered. Inter-organizational initiatives such as the International EPD System and The Sustainability Consortium have been active to promote common ways to calculate and disseminate these product indicators.

In addition to academia and industry, policy-makers are continuously driving to protect the environment, both globally and in their own jurisdiction. For example, the European Union has a target for 2020 to reduce greenhouse gas emissions and primary energy use by 20 % (compared to 1990 levels) and have 20 % of the energy consumed coming from renewables. They also issued many directives and regulations that companies in certain industries have to comply with. Examples are the Integrated Product Policy (IPP), the EU Emission Trading Scheme (ETS), the end-of-life vehicles directive (2000/53/EC), the WEEE (Waste of Electronic and Electrical Equipment) directive, and many more. Especially the legislation for product compliance becomes more stringent, obliging companies to report chemicals used to special governmental agencies and prohibiting the use of so-called substances of very high concern (SVHC). The situation in other parts of the world is similar. Companies can expect that in the near future, stricter regulations are to be enacted worldwide (Nawrocka 2008). A typical example is the restriction of hazardous substances in the manufacture of electronic and electrical equipment (RoHS) within the EU. Similar, but in some aspects diverging legislation is already planned or enacted in Canada, many states of the US and China. Compliance worldwide will be more complex and legislation will include a wider variety of materials and substances.

In light of the highlighted relevance of sustainability in everyday business, the book at hand addresses a need which is critical for any environmental program:—measuring performance. All the above-mentioned examples of reporting initiatives, compliance regulations, etc., assume that a certain environmental indicator is quantifiable. Companies always need to measure the performance with respect to a certain indicator and set quantifiable improvement targets. Therefore, the subject of this book is Environmental Performance Indicators (EPIs), be them on organizational-, product-, or supply-chain-level. Namely, we propose an IT solution to address existing challenges in measuring, sharing, and leveraging EPIs in intra- and inter-organizational processes. The book is comprised of five parts each focusing on a different aspect as outlined below.

Part I provides a detailed introduction into the main subjects of the book answering three major questions each in a chapter. The first question, “what are EPIs”, is answered first to clarify the “currency” of environmental activities and programs. We then address the second question, namely “how are EPIs managed with current IT solutions?”. Finally, we tackle the third question which is “why is there a need for a new solution”. This last chapter outlines the current open challenges and what do we propose—the OEPI solution—to address them.

Part II goes from the general to the specific by describing four use cases in which EPIs are used, with current limitations, and the proposed solution is expected to help. Each of these is analyzed in a chapter: design for environment, sustainable sourcing and procurement, environmental reporting, and network deployment and circuit provisioning. This part takes a purely business-driven perspective to outline the current processes and challenges when it comes to EPI incorporation, in addition to the user needs and requirements.

Part III represents the nucleus of the book where the three core aspects of the solution are described. First is the OEPI ontology, which is a formalized description language that is used to represent any EPI in a common format. This is important to ensure that our solution (and others in the future) can connect to and leverage existing EPIs which are currently rarely possible. The second solution aspect is the OEPI platform, the backend software layer which provides access to EPIs and related data on organizational-, product-, or process-level. Companies can use the platform to provision their EPIs and share them with others. Finally, the OEPI portal is the frontend application that exposes the platform data and provides the business users with the value-adding functionalities outlined in part II. Examples include inter-organizational EPI comparison, benchmarking, reporting, and target management.

Part IV leverages the core solution components to address two major challenges, each in a chapter. The first challenge is incorporating EPIs and related data from external sources. This is a must because companies currently use many different environmental databases and applications to calculate certain indicators, and they would want to continue leveraging these in OEPI. We illustrate, using concrete external databases and applications, how the developed ontology serves as a common format to which the data is transformed before it is used in OEPI. In addition to tackling this rather technical problem, also business challenges are

addressed. Namely, how can companies motivate their suppliers or other stakeholders to contribute data and share their EPIs with them via OEPI? For that we analyze and propose a conceptual solution to this problem.

Part V closes the loop by revisiting the business user after the solution has been outlined. It provides an assessment of value and benefits associated with our approach, analyzes technological or market risks, and outlines practical guidelines for the providers of similar commercial solutions. We finally conclude with a summary and outlook to further areas of investigation.

The work embodied in this book is a result of a two-and-half years of collaboration within OEPI, a research project including nine academic and industrial organizations. To produce the project results, we had the opportunity to collaborate with many people and stakeholders without whom this book wouldn't have seen the light. First, we thank the European Commission and its representative, the project officer Feodora von Franz, who partially funded the research and provided support and feedback for the activities throughout the project lifetime. The rest of the funding and the execution of the work were the responsibility of the nine participating organizations whose commitment couldn't be overstated: SAP AG, the University of Oldenburg, Ericsson, the University of St. Gallen, Siemens AG, Atos, KONE, VTT, and the Otto-von-Guericke-University Magdeburg. Special thanks go to the test users from each of the industrial organizations involved, who took the time to try out the developed systems and provided input that helped to improve them. The evaluation included four testers from Ericsson, and five testers each at KONE, Siemens, VTT, and SAP in various roles such as environmental management, product management, project management, engineering, sales, supply chain management, and procurement. We also thank the four project reviewers, Roland Hischier, Tina Dettmer, Balázs Sára, and Pedro Faria, who provided valuable feedback and suggestions for improvement in each of the review meetings we had. The OEPI project expanded its reach beyond the core consortium by involving external stakeholders who were key to the project success. These engagements led to a fruitful engagement that enriched the results, so many thanks to Mark Goedkoop and Michael Moore from Pré consultants, Joakim Thornéus, Sven-Olof Ryding, and Kristian Jelse from the International EPD System, Tyler Christie and James Smith from AMEE, Andreas Ciroth representing openLCA and head of EnviroInfo expert committee Dr. Werner Pillmann. We also thank Prof. Jan vom Brocke, who wrote the foreword to this book.

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