Standardisation of environmental reporting

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Abstract: Environmental reporting is used by many organisations as an opportunity to improve communication with their stakeholders concerning environmental impacts and sustainability. Although several regulations and proposals for environmental reporting already exist, a standard is still lacking. The paper presents a comprehensive concept for the standardisation of environmental reporting. After an overview of the most important tendencies towards standardisation of environmental reporting, the concept comprising reporting principles, proposals for the structure of an environmental report, and valuation methods for environmental impacts is explained. Finally, the scope of reporting liability is adapted to the size, branch and country of an organisation.

Keywords: EMAS regulation; environmental management; environmental reports, input/output balance; sustainability.

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1 Problem

Since the beginning of the 1990s, many organisations have voluntarily published information about their impact on the environment. These publications have been submitted mainly in the form of environmental reports and environmental statements, especially conforming to the EMAS (Environmental Management and Audit Scheme) which has been valid in the European Union since 1993 (concerning the development of environmental reporting see [1–3]) and which was replaced by the EMAS II in 2001. In those publications, typically the recent efforts concerning pollution control and the quantities of material and energetic inputs and outputs of the organisation are given. Often the information value of the data is increased by comparative figures from former periods whereas an assessment of environmental impact is rarely undertaken.

Organisations which wish to demonstrate their success in introducing environmental management systems and in implementing pollution control measures and that want to

document both in environmental reports face a big problem because they get little support concerning methods and content. The EMAS (II) regulation only determines which fundamental elements an environmental report has to contain in order to pass through the regulated process of validation and registration, but leaves the details of design to the individual organisation. The aim of this paper is to present recommendations for a standardised procedure of environmental reporting that will serve as a guideline for the organisations concerned. We expect that such a standardisation of environmental reporting will on the one hand substantially improve the quality of environmental reports and on the other hand will have a positive impact on environmental protection.

The paper is organised as follows: Chapter 2 gives an overview of the status quo of environmental reporting and existing approaches of standardisation. Chapter 3 presents a comprehensive concept for the standardisation of environmental reporting which comprises support concerning the structure and the contents of the various parts of a good environmental report as well as concerning the assessment of environmental impact. Finally, the chances and the effects of the realisation of the system presented are discussed.

2 Position of environmental reporting

2.1 Environmental statements according to the European EMAS regulation

At the beginning of environmental reporting in the early 1990s, environmental reports were designed individually by each organisation [1], therefore the publication of environmental statements according to EMAS was a first step in the direction of standardising environmental reports. An environmental statement originally had to be supplied for every site of an organisation. According to EMAS II, which came into force in 2001, environmental statements relate to organisations which may comprise several sites. According to annex III 3.2 of the EMAS II regulation, an environmental statement has to meet the following minimum requirements [4]:

- A clear and unambiguous description of the organisation registering under the EMAS Programme and a summary of its activities, products and services and its relationship to any parent organisations as appropriate.
- The environmental policy and a brief description of the environmental management system of the organisation.
- A description of all the significant direct and indirect environmental aspects which result in significant environmental impacts of the organisation and an explanation of the nature of the impacts as related to these aspects (Annex VI).
- A description of the environmental objectives and targets in relation to the significant environmental aspects and impacts.
- A summary of the data available on the performance of the organisation against its environmental objectives and targets with respect to its significant environmental impacts. The summary may include figures on pollutant emissions, waste generation, consumption of raw materials, energy and water, noise, as well as other aspects indicated in Annex VI. The data should allow for year-by-year comparison to assess the development of the environmental performance of the organisation.

- Other factors regarding environmental performance including performance against legal provisions with respect to their significant environmental impacts.
- The name and accreditation number of the environmental verifier and the date of validation.

The reliability and completeness of the information given in the environmental report are examined by an independent environmental surveyor.

Since the first validations of environmental statements in 1995, more than 3,600 organisations in the European Union covering different sizes and different industries have prepared such an environmental statement. Table 1 gives an overview over the underlying development by some characteristic data for Germany. A reasonable number of organisations has already presented revalidations of their environmental statements which are due after three years.

Table 1 Environmental statements according to the EMAS-regulation

01/96	06/96	02/97	09/97	12/97	04/98	06/99	09/00	01/01	06/02
45	171	595	936	1.005	1.178	2.085	2552	2607	2523

As Table 2 shows, the interest in participating in environmental reporting is far lower in countries of the European Union other than the two German-speaking countries, Germany and Austria.

Table 2 EMAS-registered organisations (state of June 2002)

Austria	351	Sweden	246
Spain	205	Denmark	170
Italy	94	UK	81
Norway	69	Finland	40
France	32	Netherlands	27
Belgium	15	Greece	10
Ireland	8	Luxembourg	1

Source: [5]

As the requirements in annex III of EMAS II only define minimal requirements whose contents are not further explained, the organisations are largely left on their own, or need the help of consultancies when preparing an environmental statement. An intensive investigation of validated environmental statements gives evidence that organisations do interpret the requirements of EMAS quite differently [1,6]. For example, the size of environmental statements ranges from two to more than 100 pages, and correspondingly the information on an organisation's activities, its environmental impact and its environmental policy vary strongly in quantity as well as quality.

2.2 Tendencies towards standardisation

In this chapter some important tendencies of standardisation of environmental reporting are summarised. The term 'environmental report' will be used as a generic term comprising environmental statements as well as other forms of reporting on environmental impacts.

2.2.1 The German DIN 33922

In Germany, the first approaches towards standardisation came up in the middle of the 1990s. They are documented in the DIN 33922 'Umweltberichte für die Öffentlichkeit' (environmental reports for the public) published in July 1997 [7]. This German industry norm was prepared in the form of a manual. It applies to organisations of every type and size which want to inform the public about their environmental activities. Objects of the norm are the following principles for the preparation of an environmental report and an enumeration of possible contents of reports:

- Truth: The contents of the report shall correspond to the facts and shall be presented in a reproducible manner.
- Materiality: The contents of the report shall contain relevant information as to the most important environmental aspects.
- Transparency: The contents of the report shall be presented and arranged in a clear manner.
- Publicity: The report shall be brief and easy to understand. Its addressee is the public which comprises in particular the workforce of the organisation, the neighbourhood, mass media, customers and suppliers, authorities and other public institutions, associations and interested persons.
- Continuity and comparability: The structure of contents of an environmental report shall normally stay unchanged in subsequent reports. Also methods of gathering data and of valuation should not be changed.

The contents of the report shall comprise the following items: 'activities of the organisation', 'environmental policy and environmental program', 'relevant data' and 'formal requirements'. These items reflect in their basic parts the requirements of the EMAS regulation. In some respects the requirements of the regulation are even specified: Concerning the data given, also the process of continuous improvement shall be presented, and a comparison of different parts of the organisation should be possible. The assessment of important environmental matters will be assured by time series analysis and ratio analyses of data.

Altogether, the DIN 33922 focuses on environmental reports conforming to the EMAS regulation. In some respects, the requirements of the regulation are put in concrete terms. Important matters such as the realisation of methods of registration and valuation, the preparation of a balance of materials and energy and the type of ratios required remain vague. The DIN 33922 can, therefore, be judged as an early and positive attempt to push ahead standardisation of environmental reporting, but it does not represent the final stroke of this development.

2.2.2 Standardisation on the ISO level

Since August 2000, the topic of standardisation of environmental reporting is treated on the International Standard Organisation (ISO) level. The origin of this initiative was a Swedish attempt to create an ISO norm for environmental communication with the stakeholders of an organisation. The intent is to create a non-certifiable norm that can be used by the organisations on a voluntary basis in order to compose the contents of their environmental reports. In the meantime, two proposals (New Work Item Proposals) for such a regulation have been presented that partly contradict each other in their basic tendency:

- The Swedish proposal [8] emphasises the necessity to harmonise and improve reporting concerning the environmental performance of an organisation. The focus of the regulation should be on methods of data generation and data preparation in order to enhance the reliability, transparency and efficiency of environmental reporting. Standardisation of environmental reporting should be improved so that the environmental performance of different organisations at different points of time can be easily compared. The preparation of the regulation should refer to the existing regulations for environmental aspects of ISO 14000 and following. Further starting points for the regulation are seen according to this proposal in the guidelines of the Global Reporting Initiative (GRI) [9] and in other relevant documents. In addition, a partial adaptation of the rules of financial accounting is thought to be reasonable. Therefore, the aim of the Swedish proposal is to take up, develop and standardise as far as possible methodological aspects of environmental reporting.
- The US Proposal [10] also emphasises the importance of environmental reporting but neglects the necessity of a standardisation of reporting methods. The USs rather put the focus of their efforts on formulating general guidelines for environmental reporting, e.g. concerning the correctness and the proper collection of the data published. Furthermore, organisations should be supported in their efforts towards environmental reporting by comprehensive bibliographic information comprising information about possible formats and media of environmental reporting, relevant initiatives, national and international standards and governmental programmes and legal regulations. The aim of this proposal is, therefore, to support organisations that want to initiate environmental reporting by general rules and principles as well as by a collection of current approaches and methods of environmental reporting and not to formulaic requirements for environmental reporting. Altogether, this proposal refers to a synopsis of the state of the art of environmental reporting.

Another tendency towards standardisation of environmental reporting – literally it should be called sustainability reporting – stems from the Global Reporting Initiative (GRI) which was founded in 1997 [9,11,12]. The aim of GRI is to develop guidelines for sustainability reporting that can be applied regardless of the size and the geographic site of an organisation. Sustainability reports should be prepared by standardised methods and should be auditable and comparable with each other. Besides ecological aspects which are focused on by environmental reporting, sustainability reporting should integrate economic and social aspects. The GRI 2002 reporting guidelines suggest the following content of a sustainability report [11]:

1 vision and strategy

2 profile

3 governance structure and management systems

4 GRI content index

5 performance indicators

- economic performance indicators
- environmental performance indicators
- social performance indicators.

The current focus is on the presentation of environmental aspects and performance indicators, but this is to change in the near future by integrating economic and social aspects. Meanwhile, a number of organisations have declared their willingness to prepare a sustainability report that conforms to the requirements of the GRI guideline. Altogether the efforts of GRI are a positive initiative to support standardisation of environmental reporting, particularly sustainability accounting. The emphasis on the idea of sustainability shows the desire to communicate to the stakeholders not only environmental information, but also other relevant aspects.

3 Concepts for standardisation of environmental reporting

If environmental reporting in respect of sustainability accounting is – in analogy to the annual financial statement of an organisation – regarded as a part of external accounting, it seems obvious to take the respective norms of balancing and determination of earnings as a starting point for the development of standards for environmental reporting. This allows organisations not only to use well known methods with slight adaptations, but gives them a further opportunity to obtain the information and methods needed for environmental reporting from a common database already available in the organisation with little additional cost. Firstly, we will discuss German financial accounting standards as a broad guideline for preparing environmental reports. Then we will make proposals on the structure and on a uniform system of accounts for environmental reports. Finally, we will present a concept for a consistent valuation of environmental impacts that have up to now only been considered on a quantitative basis.

3.1 Financial accounting standards

As in financial accounting, environmental reporting should comply with generally accepted principles which in this field are still under development. German financial accounting standards (Grundsätze ordnungsmäßiger Bilanzierung, GoB) serve as one starting point for formulating principles appropriate to meet requirements of environmental reporting. The GoB have been formed over time as a code of conduct for prudent businessmen and are mostly codified in the German Commercial Code. We further refer to the Generally Accepted Accounting Principles (GAAP) effective in Anglo-Saxon countries and to the International Accounting Standards (IAS) [14].

In order to fulfil the information needs of environmental reporting, the reporting principles have to adhere to certain requirements. There are two minimal requirements for environmental reporting that complement and limit each other:

1 Relevant Information: Environmental accounting principles should help identify relevant information about the organisation's environmental impact. In particular the information needs of the organisation's stakeholders should be taken into account. As information interests of stakeholders are strongly divergent [13], this implies a tendency towards a nearly complete documentation of the organisation's environmental impact.

2 Practicability: The completeness of information is limited by the technical and economic practicability of environmental reporting. In contradiction to data relevant for financial accounting, it is technically not possible to identify and document all flows of material and energy caused by an organisation. Furthermore, a comprehensive documentation of environmental impacts implies considerable costs which should only be imposed on the organisation if there is a substantial interest of its stakeholders in doing so. Considering that environmental reports are published voluntarily, economic feasibility sets a limit to the supply of information.

Principles derived from these basic requirements build a system that takes into consideration the main relevant opportunities and limits of environmental reporting. If the subsequent principles are applied carefully, environmental reporting will achieve its goals concerning information and documentation.

3.1.1 Principle of information value

The principle of information value implies that environmental reporting is designed and carried out to provide relevant information. The following rules increase the information value of environmental reports:

- minimal structure of environmental reports
- transparent and clear arrangement of the information (uniform classification principles, uniform methods of documentation and calculations, adequate itemisation of information)
- evidence of statements concerning measuring and valuation as well as aggregation of material and energy flows
- interpretation of selected positions.

If an environmental report does not conform with these rules, its information value is insufficient. Thus, it cannot achieve its documentation and information tasks and serves only as an instrument of public relations.

3.1.2 Time period principle

Organisations should report about their environmental impact at regular intervals. If the reporting period of environmental reporting is identical with the business year of the organisation, expenses for data collection can be substantially reduced by accessing data already provided for financial accounting. Additionally, environmental reporting should observe the key date principle.

Key dates mark the beginning and the end of each reporting period. The time period principle implies that all relevant occurrences between two subsequent key dates are documented in the environmental report of the corresponding period.

Corresponding to financial accounting which e.g. allocates the monetary value of materials as expenses in the period in which they are used in production, flows of material and energy and their environmental impacts are also assigned to the period when they are used in production, and leading to emissions. If supplementary processing has taken place, environmental impacts of the corresponding processes have to be assigned to the intermediate and finished products in stock.

The periodic assignment of environmental impacts allows comparison of environmental reports of different periods and thus an analysis of the development of the environmental performance of an organisation over time. Additionally, the construction of environmental performance indicators considering the ratio between different environmental measures or between these and financial parameters is only possible if the time period principle is applied.

3.1.3 Going concern principle

Corresponding to the going concern principle of financial accounting, environmental reporting should also assume that the organisation will continue performing its business activities as before if there is no definitively contradictory information. This would be the case e.g. if termination of a business or official closure lies ahead and if this information is already available at the point of time the environmental report is prepared.

3.1.4 Consistency principle

The consistency principle ensures that environmental reports of subsequent periods are sufficiently harmonised with each other. For this purpose, on the one hand capital assets listed in the last environmental report are taken as the basis for the next period. On the other hand, input and output quantities of current assets are set against the corresponding quantities of the last period in order to compare and interpret the organisation's environmental performance. This principle ensures that subsequent environmental reports are consistent in form and content.

In order to ensure comparability of different environmental reports of an organisation, continuity of recording principles and of valuation is necessary.

- Continuity of recording principles means that the structure of separate balance sheets and the principles of recording and of assignment of environmental impacts to certain balance sheet items are maintained over time.
- Continuity of valuation is given if a valuation method once chosen is not altered without imperative reasons.

Both aspects might cause fundamental problems in environmental reporting: If there are changes concerning one of these aspects according to new legal directions or to scientific progress, these changes will have to be commented upon due to the principle of information value. Furthermore, consequences resulting from the changes should be revealed and explained. Such changes might appear frequently especially in the current development stage of environmental reporting because classifications and relations chosen in this stage might turn out to be insufficient or inappropriate.

3.1.5 Cautionary principle

As environmental impacts may be particularly dangerous and their harmful effects may be delayed to later periods, a transfer of the cautionary principle to environmental reporting seems sensible. Just as an organisation should apply conservative valuations and an early statement of disadvantageous developments in order to avoid overstating earnings, environmental reporting has to ensure that negative environmental impacts are not understated. The following measures help to apply this principle.

- known environmental impacts have to be reported as soon as possible
- if the volume of an environmentally relevant flow of material or energy is insecure, it should be reported rather excessively
- valuation of detrimental impacts should be, in principle, too high rather than too low
- in analogy to the imparity principle of financial accounting, potentially negative environmental impacts should be reported as soon and as completely as possible whereas positive environmental impacts should be stated after having been realised.

Thus, the cautionary principle is partly in conflict with the time period principle because it requires an earlier or more scrutinised report for certain environmental impacts. This conflict has to be solved in a concrete case by a competent judgement of the whole situation. In case of doubt, the cautionary principle should be prioritised.

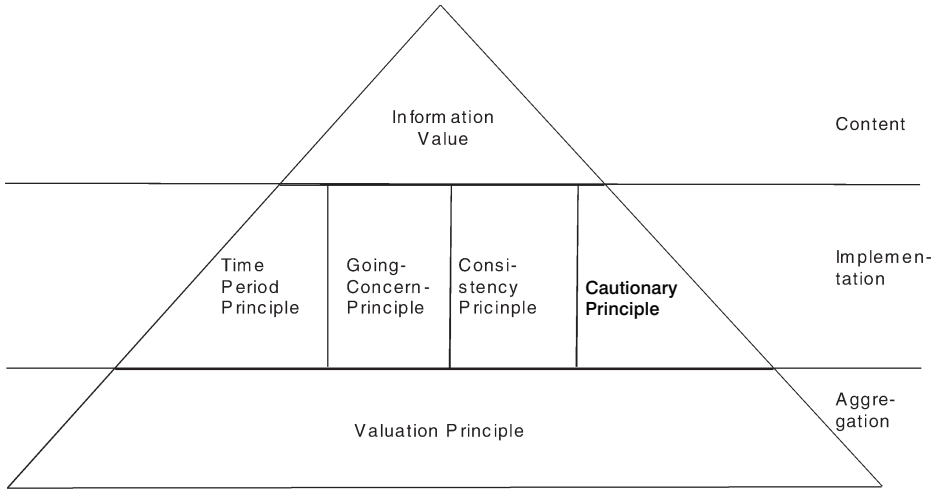
3.1.6 Valuation principle

In the past, environmental reports were mainly restricted to the documentation of the volumes of material and energy flows. An ecological valuation of these volumes would improve comparability of environmental performance with other organisations as well as with earlier reports of the same organisation. Valuation of environmental impacts will be considered in more detail in Chapter 3.4.

3.1.7 Relations between the principles of proper environmental reporting

The principle of information value is the main principle because it indicates which facts should be considered and in what manner. Under this precondition the time period principle, the going concern principle, the consistency principle and the cautionary principle give further reference concerning relevant environmental aspects. The valuation principle represents the basic principle of environmental reporting because valuation allows the transition from a quantitative presentation based on different measures to a value orientated presentation providing information about the organisation's environmental performance and allowing better comparability. Figure 1 summarises the relationship between the different principles of environmental reporting.

Figure 1 Relations between the principles of proper environmental reporting



3.2 Structure and contents of an environmental report

Standardising the formal structure of environmental reports helps locate and compare the information provided. The following considerations are based on the one hand on the structure of annual reports of listed corporations, and on the other hand on the practice of environmental reports already published [6].

3.2.1 Corporate philosophy and environmental management

Corporate philosophy is often presented in the form of a corporate overall concept which e.g. emphasises the ecological responsibility of the organisation as a guideline for all entrepreneurial actions, or in the form of a catalogue of environmental action principles. Concerning environmental management, environment-related responsibilities and competencies should be presented to comply with legal obligations and to put corporate philosophy into practice. This can be achieved e.g. by explaining the number and the hierarchical positions of authorised agents for security and environmental protection. If the organisation wants to give additional information, it may publish the organisational structure of its environmental management system and thus show how the daily processes focus on the realisation of the corporate environmental philosophy.

3.2.2 Presentation of organisation

As in the annual report of listed corporations, the mainly qualitative statements on corporate philosophy and environmental management should be followed by a self representation of the organisation including quantitative data focused on environmentally relevant subjects. In order to enable the addressees of environmental reports to estimate and valuate the potential environmental impact of the organisation, the presentation should comprise the following subjects:

- location of different sites of the organisation
- products and production processes
- number of employees, sales volume, annual profit
- environmentally relevant subjects, e.g. facilities subject to public authorities, events of default subject to registration.

3.2.3 Environmental balance sheets

Environmental balance sheets are the central part of an environmental report. They provide information about environmentally relevant inputs and outputs as completely as possible within the reporting period. As these balance sheets refer primarily to the whole organisation, organisations that are situated at several locations should prepare and present balance sheets for each site. The environmental balance sheets should report the environmental impacts of the organisation due to flows of material and energy on the input and output side as well as data covering long-term capital assets. In order to allow the reader of an environmental report to compare and evaluate the balance sheets, quantitative information should be provided for the current and previous period. The relevant flows of material and energy should be presented in a uniform system of accounts that will be explained in Chapter 3.3.

3.2.4 Notes and status report

Just like the annual report of a listed corporation, an environmental report should contain separate notes and a status report. The notes serve to explain selected balance-sheet items and valuation methods as well as subjects and processes that are not self-explanatory.

The status report should provide additional information on environmentally relevant subjects. Another important function of the status report is to give information on developments that have occurred after the balance sheet closing date and thus would not be reported otherwise.

3.3 System of accounts for environmental reports

A system of accounts for environmental reporting documents input and output flows caused during the reporting period as well as relevant stocks. These flows and stocks of an organisation can be balanced completely and properly if the following balance sheets are prepared and linked in a meaningful manner [15].

3.3.1 Balance of physical stocks

The balance of physical stocks reports stocks of capital assets the organisation is holding at the closing date of the balance sheet as well as their changes during the reporting period. The balance of physical stocks comprises accounts covering land use, buildings and facilities which have to be subdivided if necessary. The stock should be measured in mass units wherever possible. Otherwise, facilities can be measured in units, land by surface measurements and buildings by surface or floor space used. Due to the principle of completeness, all capital assets used by the organisation (also leased facilities and rented buildings) have to be reported, independent of the legal relations.

3.3.2 Balance of implicit stocks

The balance of implicit stocks serves for the adequate assignment of the environmental impacts connected with the construction or the closure of capital assets among the single periods of their operating lifetime. The use of material tied up in facilities caused by the wear and tear of facilities is registered in the form of implicit depreciations or implicit accruals. The balances of implicit stocks and physical stocks are balanced when a facility is closed down.

This can be illustrated by an example. When a new machine is acquired, the amount of material it contains is entered as an input in the balance of physical stocks, and there it remains on the same level during the whole operating lifetime. As it would not be adequate to allocate this amount of material to the period of acquisition or to the period of closure, it has to be assigned proportionately or due to utilisation to the periods of its operation. In order to report the whole amount of material that still existing, correctly, in the balance of physical stock, these depreciations are accumulated on a corresponding account in the balance of implicit stocks, similar to a value adjustment in financial accounting. When the machine is fully depreciated at the end of its operating lifetime, the values on those two accounts balance each other. If the machine is closed down earlier, the amount of material not yet depreciated has to be registered in the extraordinary input/output balance (see Chapter 3.3.4). A similar logic applies to accruals that are established e.g. for soil contaminations accumulated during the operating lifetime or for the input of material necessary for the disassembly of machines.

3.3.3 Input/output balance

Input/output balances register all operating assets that enter or leave the organisation during the reporting period according to their type and quantity. It is thus a documentation of flows whereas the balance of stocks contains amounts of materials and goods at a point of time. The aim of input/output balancing is a complete balance of quantities, so input and output quantities during the reporting period should correspond to each other. As operating assets can be divided into materials and energy, the input/output balance should also be separated into a balance of materials and a balance of energy.

Material flows are registered in adequate, quantitative measures as homogenous as possible. The input and the output side of this balance are subdivided into account classes, accounts and sub accounts for different classes of material.

The input accounts document the input flows of material. An adequate structure of the input side is the subdivision in the following account classes:

- input of material: raw material, auxiliary material, operating supplies, components, subassemblies and assemblies, merchandise, goods in process, other input material
- sources of energy: natural gas, carbon, fuel oil, power fuel
- water: drinking water, washing water, communal water, water from own wells, water from surface waters, rain water
- air: actually only compressed-air, as ambient air is still considered as a free good.

On the output side, the flow of goods leaving the organisation during the reporting period are registered in the following account classes:

- products: subdivision according to the production programme
- packaging: paper, cardboard, plastics, wood, glass, metals, composite packaging material, other packing material
- waste water: subdivision according to disposal ways or to pollutant classes
- waste materials: domestic and similar waste, hazardous waste, rubble, recycling materials
- waste air: subdivision according to pollutant classes and concentrations.

In the balance of energy, the energetic content of the sources of energy and of the other input and output materials is registered. On its input side, additional accounts for directly obtained energy are introduced, and on its output side the form in which the energy transformed leaves the organisation is documented. If registration is complete, the total amounts of energy on the input and output side have to be equal. Differences between energy input and output that cannot be explained by the technical limits of registration are an indicator for inefficiencies in business processes which should be analysed in more detail.

Input/output balances in principle can cover input flows of an organisation, of single sites of an organisation, of products or of processes. For each of these balances, a different level of aggregation of data may be appropriate.

3.3.4 Extraordinary input/output balance

The last balance needed for environmental reporting is an extraordinary input/output balance in which flows of material and energy are documented which cannot be assigned to the regular transformation processes of the organisation, but to extraordinary occurrences. Examples for such extraordinary occurrences are emissions caused by events of default during the operation of a machine, the demolition of a building or the remediation of contaminated soil that cannot be assigned to the reporting period. In order to keep the size of this balance low, accounts should only be introduced for those materials that are actually relevant.

3.4 Valuation of environmental impacts

In order to be able to compare environmental impacts, it is necessary to introduce a valuation method. Valuation means the transformation of measures in different dimensions into a homogenous measure to compare heterogeneous categories of different substances.

Possible objects of valuation are all material and energetic substances documented in the stocks and input/output balances of the organisation. Several methods of ecological valuation have been discussed in the literature. They can be classified as follows [16,17]:

- Qualitative valuation methods: product line analysis, technology assessment, ABC/XYZ method.
- Quantitative valuation methods: energy-orientated methods, material-orientated methods, threshold value-orientated methods, material intensity per service unit (mips) and toxicity equivalents.
- Monetary valuation methods: market price, willingness to pay, extended economic calculations and allocation of external effects.

As none of these approaches seems sufficient for environmental reporting purposes, we will describe a pragmatic valuation method that is based on scientific laws and that supplies well founded statements about the environmental impacts caused by an organisation [1,16].

For the valuation of environmental impacts the following steps have to be passed:

1 Firstly, substances and mixtures to be valuated are selected. This will be especially substances occurring in high quantities and substances that are, even in small quantities, harmful to the environment. Later, also substances with a lower potential to be harmful to the environment may be considered.

2 Secondly, information about the relevant qualities and the reactions of the selected substances in the environment are gathered by using all sources of information available.

3 Thirdly, criteria for the valuation of the different substances and mixtures are defined and set in relation to each other. Again, different sources of information, especially scientific literature, should be used for this purpose. Ultimately, the selection of criteria and their ranking underlie subjective estimations which should reflect the real problems and their social relevance as accurately as possible. As an example for such a catalogue of criteria the ecological valuation concept suggested by the Cetrum voor Milieukunde of the University of Leiden (Netherlands) may be considered (so-called CLM concept) [18]. In this concept, the attributes of the different criteria are measured by means of so-called reference functions. Some selected criteria and their corresponding reference functions are presented in Table 3. In order to calculate the damage points attributed to a substance or mixture, the goals given in Table 3 are weighted according to their relevance.

4 In the fourth and last step, the attributes of each criterion are multiplied by the corresponding weight factor, and all weighted attribute values are summed up. This gives the damage points per unit of the substance under investigation. The amount of damage points per unit reflects the environmental damage connected with the substance. This coefficient can be further used e.g. for a subsequent monetary valuation of environmental impacts.

Table 3 Selected reference functions of the CLM concept

Classification	*Reference function*	*Remark*
Depletion of abiotic resources	$\frac{\text{consumption of resources (kg)}}{\text{recoverable reserves (kg)}}$	Considering only resources that will probably be found for less than 100 years
Depletion of biotic resources	$\frac{\text{reproduction rate consumption}}{(\text{actual inventory of resources})^2}$	
Enhanced greenhouse effect	GWP of a substance consumption of the substance reference substance: CO_2	GWP stands for global warming potential
Depletion of the ozone layer	ODP of a substance consumption of the substance reference substance: CFC_4	ODP stands for ozone depletion potential
Human toxicity	HCA emissions to air + HCW emissions into water + HCS emissions into soil	HCA, HCW and HCS stand for Human Toxilogical Classification Factor for Air, Water and Soil
Ecotoxicity	Aquatic ecosystems: ECA emissions into water Terrestrial ecosystems: ECT emissions into soil	ECA and ECT stand for Ecotoxical Classification Factor for Aquatic and Terrestrial Ecosystems
Photochemical smog	POCP of a substance emission to air reference substance: ethylene	POCP stands for Photochemical Ozone Creation Potential
Acidification	AP of a substance emission to air reference substance: SO_2	AP stands for Acidification Potential
Nutrification	NP of a substance emission to air reference substance: PO_4^{3-}	NP stands for Nutrification Potential

Source: [18]

3.5 Scope of reporting liability

The effort necessary to prepare an environmental report will differ for organisations depending on their size, branch or country. Whereas organisations in industrial countries normally already have the detailed information basis needed for environmental reporting, organisations in developing countries often do not possess a sophisticated system of financial accounting and control. Therefore, the scope and content of environmental reports should be adjusted to the country, the size and the environmental relevance of an organisation.

Such a differentiation can refer to the transition period as well as to the degree of specification of the system of accounts and to the scope of environmental impacts due to valuation. Further political discussion will have to agree upon which components and rules of environmental reporting are necessary for a certain organisation.

Important criteria for the scope of reporting liability are the environmental relevance of the industrial sector in which the organisation is active or certain indicators related to environment. For an organisation in an industrial sector with low environmental relevance, some components of an environmental report might be left out. In the following, several environmental criteria for the scope of reporting liability are presented:

- Amount of waste: Critical annual amounts of domestic and similar waste or of hazardous waste have to be defined. If an organisation exceeds these amounts, it should be obliged to prepare an environmental report or to report in more detail. This kind of limit already exists in German waste legislation for some waste substances. Exceeding the limits leads to the obligation to prepare a waste management conception and to appoint an authorised waste agent.
- Waste water: The scope of reporting liability can be determined according to the amount of waste water produced by the organisation and its degree of pollution. A reference point for a classification might be the degrees of pollution as defined in the German Waste Water Charges Act (Abwasserabgabengesetz) that lead to a different extent of waste water duties, or the obligation to install an authorised agent for water pollution control as it is demanded in the German Federal Water Act (Wasserhaushaltsgesetz).
- Emissions into the air: As in the area of waste water, limits for emissions into the air have to be defined. If they are exceeded, the scope of reporting liability of the organisation should be expanded.
- Potential of events of fault: If the organisation runs one or more facilities that may cause leakages and considerable harm to the environment, at least for this part of the organisation higher requirements concerning environmental reporting should be demanded. Corresponding regulations can already be found in the German Hazardous Incident Ordinance (Störfall-Verordnung).
- Input of material: An organisation that needs more material resources for its activities has a higher environmental impact, thus it should be obliged to give a more detailed environmental report.
- Input of energy: Corresponding to the input of material also a higher input of energy justifies a higher scope of reporting liability, at least, if the organisation does not primarily use regenerative sources of energy.
- Product related indicators: A final criterion to determine the scope of reporting liability of an organisation might be the negative environmental impact caused during the use period of its products. These impacts should be measured in an adequate unity.

This catalogue of criteria might be built up successively over time. It may later be extended and refined, e.g. in the long run, multiple criteria might be used for each category. Thus, the scope of reporting liability of a certain organisation can be adjusted to its potential to harm the environment.

4 Further development

The proposals towards a standardisation of environmental reporting presented here are based on the up-to-date level of knowledge concerning the registration and valuation of environmental impacts of business activities. The methods proposed have been developed from methods applied in financial accounting which are already known in the organisations, so they should be easy to transfer to environmental subjects. Not only the methods applied, but also the contents of an environmental report are important to increase its information value. Besides the methodological discussion, the actual efforts of standardisation of environmental reporting should also concentrate on the definition of the expected contents. Only if both aspects are treated adequately, can environmental reporting obtain the validity and transparency that it needs in order to be widely accepted.

All in all, a standardisation of environmental reporting is desirable. In particular, an ISO norm covering demands from the methodological point of view as well as concerning the contents of environmental reporting would push forward this field of interest. As the discussion of the problems of valuation of environmental reporting has shown, the development in this field is still far from completion. A future ISO norm should, therefore, be open to progress. This could happen as a methodological discussion e.g. on principles of proper environmental accounting that are steadily being developed due to practical experience and scientific findings.

Environmental reporting is a great chance, particularly for organisations that enforce environmental protection and can prove this by a corresponding reduction in their environmental impact. Such a position of an environmentally active organisation can initiate changes in the attitude of stakeholders and thus lead e.g. to a higher demand of environmentally conscious customers or to lower premiums for insurances concerning environmental and product liability. Furthermore, it might be possible to relax certain costly rules of environmental legislation if an organisation can demonstrate advantages in other fields that at least compensate for the additional environmental impact caused by the relaxation. Before such an effect of environmental reporting can come about, not only political resistance has to be overcome, but also resistance within organisations and their associations. These actors often underestimate the chances of environmental reporting and overestimate its risks.

Altogether, the relevance of environmental reporting will – especially with the background of an increasing intensity of the discussion on sustainability – become more important in the future. The tendency towards standardisation can accelerate this process and raise the acceptance of environmental reporting in the long run.

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