CHAPTER 6

ENVIRONMENTAL PERFORMANCE AND THE QUALITY OF CORPORATE ENVIRONMENTAL REPORTS: THE ROLE OF ENVIRONMENTAL MANAGEMENT ACCOUNTING

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Abstract. This article analyses and discusses whether there is an association between environmental performance and corporate environmental reporting in the paper and electricity industries in Germany and the United Kingdom and what the influence of environmental management accounting is on this link. After discussing environmental performance measurement and environmental reporting in general, the chapter introduces a measurement framework for both as the basis of an empirical study. Subsequently, the major empirical findings from a cross-sectional survey of corporate environmental reports and environmental statements as well as environmental performance indicators for air and water emissions in the above industries and countries are reported. These findings suggest that consistency between environmental performance and environmental reporting (operationalised empirically in terms of statistical correlation) is relatively rare, although (as is argued in the article) future credibility of companies will most likely depend on it. The findings also reveal that environmental performance tend to be linked to country location whereas quality of corporate environmental reports tend to be associated to sector membership. The chapter attempts an explanation of this, relating the findings to differences in environmental legislation in both countries. It concludes with implications for the use of environmental reports by third parties as well as a number of recommendations, especially concerning the need for more standardised indicators and reporting procedures.

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1 ENVIRONMENTAL PERFORMANCE MEASUREMENT AND CORPORATE ENVIRONMENTAL REPORTS

Environmental performance measurement (EPM) can be defined as the measurement of the interaction between business and the environment (Bennett and James, 1997). The physical environmental performance of a company or site can be defined by its performance with regard to environmental aspects such as mass, energy or pollutant flows through the manufacturing process, which constitute a direct relationship between firms and the environment (ISO, 1996). Environmental performance indicators (EPIs) are frequently used to measure performance defined in this way. EPIs can be quantitative (i.e. measured on a continuous, interval or ordinal scale) or qualitative (i.e. measured on a nominal scale). They are of special importance since they reflect an important link between management performance and environmental conditions. In theory, the firm-internal basis for EPIs and EPM is environmental accounting, which can be used in the contexts of financial or management accounting. In the first context, it addresses an external audience and is aimed at the estimation and public reporting of environmental liabilities and financial material environmental costs (Schaltegger & Burritt, 2000). In the context of management accounting, which uses a broad range of cost and performance data for internal decision making, environmental management accounting incorporates a number of tools, such as eco-controlling, eco-balancing, ecological accounting, life-cycle assessment (LCA) and indicators for sustainable development used in an firm-internal context (Schaltegger and Sturm, 1992, Young and Rikhardsson, 1996, Young and Welford, 1998). The aim of environmental management accounting (EMA) is to provide tools to integrate environmental aspects into cost allocation, capital budgeting and process or product design procedures (EPA, 1995). One specific tool of EMA is eco-balancing (synonymous: internal ecological accounting or ecological bookkeeping) which provides site and company-level information on environmental aspects and impacts (Schaltegger and Burritt, 2000). In this eco-balancing resembles very much a site-specific LCA inventory analysis. An eco balance forms the basis for aggregated environmental performance indicators. Schaltegger and Burritt clarify this by stating:

> "Sometimes, a complete inventory provides enough information to see what the main environmental problems are and where they originate. In such a case, priorities for environmental protection and pollution prevention can be defined using the inventory. However, in most cases, the inventory provides an enormous amount of unassessed, detailed data that cannot be interpreted accurately by management. If this is the case, an impact assessment of the inventory data is clearly necessary." (Schaltegger and Burritt, 2000 p. 275).

EPIs can thus be understood as one way of aggregating inventory data, in doing so providing an impact assessment (with or without utilising weighting procedures). Conceptually therefore, EPIs are an outcome of an eco balance, even though it is not essential to carry out an eco balance in order to arrive at EPIs. Given that eco-

balancing is an EMA tool the question arises how environmental performance, environmental reporting and environmental management accounting are related.

Usually, EPIs and environmental performance in general are reported in corporate environmental reports (CERs), based on an environmental reporting process. Given that many external assessments of firms are based on CERs as a whole, the question arises, how the actual environmental performance of a company or site compares to the quality of its environmental reporting process. This is of particular relevance, since work comparing environmental performance and legislation with economic performance is often based on CERs as far as concerns measurement of environmental performance (Hitchens et al., 1998, 2000, Schaltegger and Synnestvedt, 2002). This is the case even though there is no guarantee that good reporting quality and good environmental performance are correlated, if reports are merely "green glossies". The question here is what causation may derive for instance from the use of eco-balancing or other EMA tools, as revealed by reporting of the results of an eco balance in an environmental report.

Corporate environmental reports (CERs) are defined as stand-alone reports issued by companies to disclose environmental information available to the public (Brophy and Starkey, 1996). Site-level and company-level environmental reports are the two main types of CERs used, mostly in the context of voluntary environmental reporting[1]. One of the most widespread voluntary reporting schemes is the EU Eco-Management and Audit Scheme, EMAS (CEC, 1993). EMAS is based on site-level reporting and thus requires only a site-level environmental statement for which dtailed guidelines exist. EMAS requires periodic publication of an environmental statement which has to include, among other things, an assessment of all significant environmental issues of relevance to the company's activities. A summary of figures on pollutant emissions, waste generation, consumption of raw materials, energy and water, noise emissions and other significant environmental aspects of relevance to the company is also required (CEC, 1993, 2001, Skillius and Wennberg, 1998). Full environmental statements under EMAS conforming to these requirements have to be prepared after an initial review (i.e. when an environmental management system according to EMAS is introduced in a firm) or upon completion of a full audit which is required every three years (CEC, 1993, Skillius and Wennberg, 1998). Simplified environmental statements have to be produced annually according to EMAS.

CERs have a variety of potential users (e.g. businesses, financial institutions, consumers, communities and government agencies); this makes different reporting requirements necessary (Bennett and James, 1998). Although CERs have been widely produced for over a decade, empirical research reveals scepticism about the value of companies' environmental reporting. A survey by Bennett and James (1997) among environmental managers finds that less than 50 per cent of the respondents agree that CERs create benefits that more than justify the resources invested in their production. Greater support was found for the statement that site reports create

benefits that justify the resources invested in their preparation, a statement with which almost 75 per cent of the respondents agreed.

One explanation for these results can be that site-level information is more suitable to inform stakeholders that are interested in localised environmental impacts of plant operations (Schaltegger and Burritt, 2000). However, shareholders and regulators are likely to be more concerned about corporate environmental performance in total and should therefore prefer company-level CERs. This last argument contradicts empirical findings to some extent as one would expect higher appreciation of CERs. It is possibly explained by the fact that environmental reports are still predominantly used within firms – i.e. by internal stakeholders (Bennett and James, 1997) and by the possibility that the level of aggregation in company-level reports is considered less reliable in terms of informing about the actual environmental performance of firms. Also, regulators still rely much on legislation and statutory reporting which is usually less discretionary than the contents of CERs.

2 RESEARCH QUESTIONS, METHODOLOGY AND SURVEY DESIGN

The evaluation of CERs is based on report quality alone and usually does not include the actual physical environmental performance of a company. However, voluntary or mandatory environmental reporting may benefit the physical environmental performance of a company as it forces companies to measure their environmental aspects (or even impacts) and to communicate these to their stakeholders (Skillius and Wennberg, 1998) which can help identifying weaknesses of firms' environmental management. On the other hand the empirical research reported above suggests disillusionment with the low number of external readers of environmental reports and the comparatively lower reliability of much of the data within these reports (IRRC, 1995). As a result, one could formulate the hypothesis that no association between the quality of CERs and the level of environmental performance will be observable.

The research question addressed in this chapter is therefore whether environmental reporting and a company's actual environmental performance are positively associated. If this were the case, then good environmental reporting and good environmental performance would be linked. On the other hand, if no association exists this would question the external use of CERs, since it would raise doubts regarding their credibility and consistency. To operationally measure environmental performance (according to ISO 14031 as defined in ISO, 1996, 1999) and the quality of environmental reporting (based on criteria mainly developed and proposed by IRRC, 1995, Schaltegger and Burritt, 2000, Skilius and Wennberg, 1998), three groups of variables have been selected (general variables, environmental performance variables and environmental reporting variables) all of which are summarised in Table 1 and for which data was gathered in an empirical survey.

The survey covered the quality of environmental reporting (as measured by the criteria set out in the right column of Table 1) and the environmental performance (middle column) among firms in the electricity and paper industries in the United Kingdom and Germany to analyse possible association between environmental performance and environmental reporting. The two sectors and countries were chosen partly because of the availability of a large number of corporate environmental reports (e.g. under ISO 14001, see Hillary, 2000) and site-level environmental statements under EMAS. Such reports or statements are usually externally validated and therefore guarantee a minimum level of data quality. More importantly however, it was considered of importance to base the research on environmentally intensive sectors as well as on countries operating under a common basic regime (that of the European Community) yet having distinct national characteristics (Gordon, 1994). Additionally both sectors produce fairly homogenous products which allowed a comparison of environmental performance. The sector classification used is based on NACE (Nomenclature generale des Activites économiques dans les Communautées Européennes) codes 21.1 (Paper) and 40.1 (Electricity).

All identifiable companies or sites in the two sectors and countries that produced useable environmental reports or statements were included. Information on companies publishing EMAS statements was gathered from the EMAS Service Desk in Luxembourg and companies publishing non-EMAS environmental reports were identified through internet searches, especially of trade association web sites. Environmental reports were ultimately requested from 56 companies or sites in the paper sector and 35 in the electricity sector. Out of these 34 (Paper) and 27 (Electricity) were used in the analysis. These were partly reports of the same company for different years between 1994 and 1997. Although a higher total number of reports has been received from the paper sector, the quality of reports was generally better in the electricity sector. Whereas in the paper sector the majority of reports analysed were environmental statements prepared under EMAS, the majority of reports in the electricity sector were not published under the EMAS scheme. Generally, the response rate was very high, equalling on average 85 per cent over the whole sample.

Table 1. *List of variables used in the analysis*

General	*Environmental performance*	*Environmental reporting*
• Firm identifier • Year of publication of report • EMAS verification • Full or part audit • Industry sector • Country • Site- or company level report • Number of employees (firm size) • ISO 9000 certification • ISO 14001 certification • BS 7750 certification • Annual production output in Kilo tonnes or Mega Watt hours (kt or MWh)	• Annual chemical and biological oxygen demand (COD and BOD) loads • Annual nitrogen (N) load • Annual phosphate (P) load • Annual absorbable organic halogen (AOX) load • Annual water input • Annual carbon dioxide (CO_2), sulphur dioxide (SO_2) and nitrogenous oxide (NO_x) loads • Electricity generated from nuclear material as fuel input • Electricity generated from wind energy • Electricity generated from coal as fuel input or oil • Electricity generated from gas • Electricity generated from water energy	• Length of environmental report (number of pages) • Length of environmental policy (number of lines) • Discussion of sustainability in report • Use of the eco-balance method in the report • Number of water indicators used out of the following: BOD, COD, AOX, total suspended solids (TSS), nitrogen (N), phosphate (P), acidity (pH) • No. of air indicators used (CO_2, NO_x, SO_2, carbon monoxide (CO), dust) • Use of time-series (Years emissions are reported back)

3 RESULTS

3.1 Exploratory data analysis of air emissions and quality of environmental reports

Prior to the analysis, all environmental performance variables (measured as total emissions) were standardised with annual production output to arrive at efficiency measures. Based on these measures, the initial exploratory data analysis reported in the following found that the levels for most air emission efficiencies were significantly lower in Germany than in the United Kingdom. The Figures 1 to 3 each show box plots for the three air emission efficiencies analysed. The black bar in each box denotes the median value, whereas the boxes denote the inner two quartiles around the median, i.e. the inter-quartile range containing 50 per cent of the values. The whiskers denote the outer two quartiles around the median, i.e. they extend from the

box to the highest and lowest values, respectively, while excluding outlier and extreme values.

The boxplots therefore also show the distribution of the variable in question and thus also to some degree how well the variable conforms to a normal distribution. Outlier values are identified by a circle and extreme values by an asterisk, and the number of the observation the value belongs to in the data set. Significant differences between two boxplots can commonly be identified by missing (or almost missing) overlap of the whiskers of these two boxplots. This is for example the case for the SO_2 emissions per unit of output in Figure 1 below, were the emission efficiencies (i.e. emissions per unit of production output) are significantly lower for the electricity sector in Germany compared to the United Kingdom.

This significant difference was also confirmed (at the 0.05 level) through parametric t-tests as well as non-parametric Mann-Whitney tests (Hair et al., 1998). No significant differences were found between the electricity and paper sectors in Germany or in the United Kingdom. Also, no significant differences could be identified for the paper sector in Germany compared to the United Kingdom. Thus, for SO_2 emission efficiency, only country-related significant differences for one of the two sectors analysed could be identified.

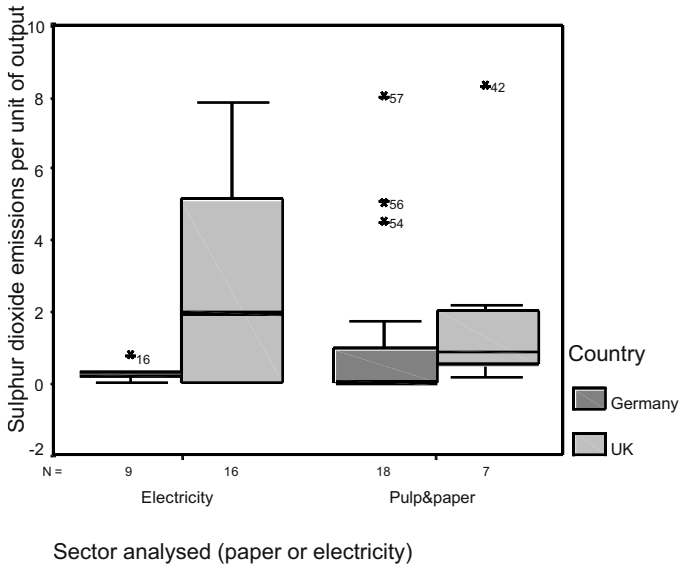

Figure 1. *Boxplots for SO_2 emissions per unit of output by sector (clustered by country)*

Next to SO_2 emissions, the mean CO_2 emissions per unit of output for the electricity sector in the United Kingdom are significantly lower (at the 0.01 level) than in the pulp and paper sector. In addition to that, the mean CO_2 emissions per unit of output were significantly different (at the 0.05 level) in the pulp and paper sector between the United Kingdom and Germany, with the latter having the lower mean.

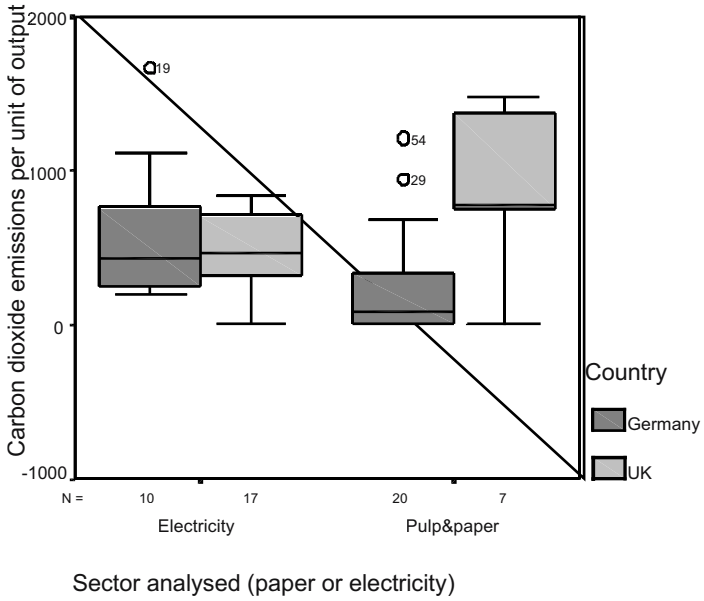

Figure 2. *Boxplots for CO_2 emissions per unit of output by sector (clustered by country)*

For NO_x emissions per unit of output (as can be seen from Figure 3) mean values were significantly lower (at the 0.05 level) for the electricity sector in Germany compared to the United Kingdom. It needs to be noted that these differences do not have any relevance beyond descriptive information as long as the different fuel mixes in both countries (probably leading to different sectoral carbon/sulphur/nitrogenous (di-)oxide emissions in the electricity sector) and different rates of self-generation of electricity in the paper sector (resulting in different emission profiles for this sector in the two countries) are not taken into account in more detail in the interpretation.

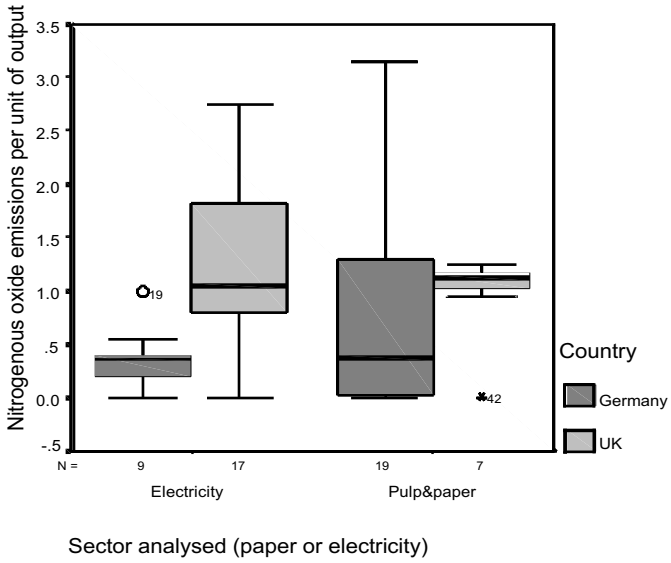

Figure 3. *Boxplots of NO_x emissions per unit of output by sector (clustered by country)*

As was found for Figures 1 to 3, the difference between emission efficiencies was significant for sulphur dioxide (SO_2) emissions in the electricity sector, carbon dioxide (CO_2) emissions in the paper sector and nitrogenous oxide (NO_x) emissions in the electricity sector between the two countries. However, these results have to be put into the fuel mix context of the two countries: if coal was a significantly higher fuel input in the United Kingdom, higher air emissions in Britain would be the result. Consequently, differences in emission efficiencies would to lesser extent be due to differences in the relevant legislation or differences in the quality of environmental management in both countries. However, it was found (based on t-tests) that fossil fuel input (coal, gas and oil) did not have a significantly different share as fuel input for electricity generation between the two countries. Differences in self-generation in the paper sector can, however, not be ruled out completely, but this would only concern CO_2 emission efficiencies).

Given this and that no significant difference in the mean values of emission efficiencies were found (except for CO_2) between the two sectors, it was concluded that differences in emission efficiencies are determined by country rather than by sector membership. This makes legal differences a more probable explanation of the results in that stronger environmental legislation in Germany may be a determining factor for better corporate environmental performance in Germany.[2] Especially the fact that more than one air emission is significantly lower in Germany than in the United

Kingdom supports such an often argued influence of environmental legislation (Gordon, 1994, James, 1997, Peattie and Ringler, 1994). For example, Peattie and Ringler (1994) note that Germany had already in 1991 significantly lower per-capita sulphur dioxide and nitrogenous oxide emissions and also set more ambitious emission reduction targets under the EU Large Combustion Plant Directive for the 1993-2003 period. James et al. (1997) expand on this, pointing to the fact that German legislation is more often based on discharge limits than UK regulation, which more frequently employs environmental quality standards for air or water bodies. This latter approach makes good environmental performance at the firm level (and thus also for whole industries) less likely. Even though there is (mainly within the framework of EU directives) a trend of convergence with regard to environmental legislation in different EU countries, this is only very recent. One example here is the recent tightening of sulphur dioxide emission reduction targets for the two largest power station operators in the United Kingdom (James et al., 1997). This, however, only occurred in 1996 with the target set for 2005 and has therefore almost no influence on the data analysed in this chapter. A possible influence for the 1997 tightening can theoretically not be ruled out, but, given that the two operators most likely took no measures prior to finalisation of the 1996 tightening of reduction targets can almost be excluded in practice. Based on these considerations it seems likely that differences in the stringency of environmental regulation concerning air emissions are an important explanatory factor for the significant differences found in environmental performance with regard to air emission efficiencies between the two countries.

After this brief explanatory data analysis, the remainder of this article will analyse differences in reporting quality between sectors and countries and in particular the main research question on the link between environmental report quality and corporate environmental performance.

3.2 Correlation between environmental report quality and environmental performance

With regard to the quality of environmental reports analysis-of-variance (ANOVA) tests were carried out to identify significant differences between the two countries and sectors. Subsequent to reporting their results, the core research question of the chapter regarding the association between environmental report quality and corporate environmental performance is addressed. To measure the quality of environmental reports, the length of the report (in pages), the length of the environmental policy (in full page width-equivalent lines) and a 'sustainability reporting index' were used.[3] Variables for the use of quantitative environmental performance indicators were not used separately, since the 'sustainability reporting index' includes them to some extent. The length of an environmental report can be considered in a first approximation as a measure of the information content of the report and hence

the level of detail of a firm's environmental reporting. The length of the environmental policy contained in the report is to a considerable degree proportional to the level (i.e. the depth and breadth) of corporate commitment to environmental management in general and as part of this also to firms' environmental reporting activities. One would expect that actual performance in terms of emission efficiencies is associated with the firms' environmental management and reporting quality.

Initially, both sectors were analysed, and Table 2 shows results of this analysis based on the analysis-of-variance (ANOVA) method. It is found that reports from the electricity sector are significantly longer (at 0.05 the level) and provide significantly more discussion of sustainability (at the 0.01 level) than in the paper sector. However, this is partly influenced by the fact that proportionally more reports in the paper sector are site-level statements, whereas comparatively more company-level reports have been received for the electricity sector. The average length of the environmental policy was not significantly longer in the electricity sector than in the paper sector. This is, however, not surprising, given that the contents of an environmental policy are generic, rather than sector-specific (IRRC, 1996).

Table 2. *One-way ANOVA of report quality for the sectors studied (Df (total) = 57)*

Sector	*Mean length of environmental report*	*Mean 'sustainability reporting index'*	*Mean length of environmental policy*
Electricity	32.96 pages	2.50 points	24.89 lines
Pulp and Paper	25.33 pages	1.80 points	23.87 lines
Both sectors	29.02 pages	2.14 points	24.36 lines
Significance of sector difference	Sig. = 0.032 F = 4.811	Sig. = 0.003 F = 9.507	Sig. = 0.796 F = 0.067

An ANOVA was also carried out for the above variables measuring the quality of the environmental reports to establish differences between two countries that were analysed. As can be seen from Table 3, between countries, only the score on the sustainability rating index differs significantly at the 0.05 level with the mean for the United Kingdom being significantly higher than the one for Germany. The quality of environmental reports was also analysed with respect to the number of employees as a proxy variable for firm size. However, no significant association could be found between the number of employees and any of the variables measuring the quality of environmental reports, so that firm size can be excluded as an explanation for the quality of reports.

Table 3. *One-way ANOVA of report quality for the countries studied (Df (total) =57)*

Country	*Mean length of environmental report*	*Mean 'sustainability reporting index'*	*Mean length of environmental policy*
United Kingdom	30.46 pages	2.50 points	24.79 lines
Germany	28.24 pages	1.91 points	24.30 lines
Both countries	29.02 pages	2.14 points	24.36 lines
Significance of sector difference	Sig. = 0.632 F = 0.395	Sig. = 0.025 F = 3.971	Sig. = 0.851 F = 0.162

Regarding the core research question as to whether environmental reporting and a firm's/site's environmental performance are correlated, no significant correlation was identified between different air and water emission efficiency variables in any of the interval-scale variables listed in the middle and right columns of Table 1. It was thus found that neither the use of more EPIs (as measured in terms of the relevant variables in the right column of Table 1) nor the production of an elaborate environmental report (in terms of the above three variables for environmental report quality) are negatively correlated with emission efficiencies/emissions per unit of output (ie associated with better environmental performance). Notably though, positive correlations (significant at the 0.01 and 0.05 levels) between the number of EPIs and emission efficiencies were found for both – air and water emissions – the latter could, however, only be analysed in the paper sector. The only exception to this pattern was a negative correlation (R = -0.396, significant at the 0.05 level) between the water input per tonne of paper produced and the number of water indicators used (BOD, COD, AOX, TSS, N, P, pH) for the paper sector data.

The only significant correlation supportive of the idea that environmental report quality and performance are positively linked was for the binary variable of whether an eco-balance was used in the report and different air and water emissions per unit of output with data for both sectors pooled (see Table 4 for a summary). Opposed to this, in the case of the average time that emissions were reported backwards in the reports (measured in years), as Table 4 shows, correlation was only significant for sulphur dioxide emissions per unit of production output. The fact that the correlation was positive means that this element of a report does relate to the environmental performance of firms, but not in the way that longer time-series correspond to better environmental performance, ie reduced emissions per unit of output. This is of particular interest, as usually time-series included in environmental reports show a falling emission trend, sometimes even for the last five to seven years.

Table 4. *Correlations for air emissions and report quality*

Report quality variable Emission variable (per unit of output)	Use of an eco-balance in the environmental report	Average time for which emissions were reported back
Air emissions factor score	Rpb = -0.355 (0.05 level)	R = 0.330 (0.05 level)
Sulphur dioxide emissions	Rpb = -0.310 (0.05 level)	R = 0.284 (0.05 level)
Nitrogenous oxide emissions	Rpb = -0.303 (0.05 level)	No significant correlation
Nitrogen emissions to water	Rpb = -0.504 (0.05 level)	No significant correlation

Next to sulphur dioxide emission efficiency, for the binary variable referring to the use of an eco-balance a negative (point-bivariate) correlation was found for other environmental performance measures, as well as for a factor score constructed from the three air emission efficiencies, indicating that the use of an eco-balance possibly reduces air and water emissions (Table 4). The exception here is the CO_2 emission efficiency which is not significantly correlated at all to the quality of environmental reports (even though in the factor score the significant positive effect of the other two air emissions analysed disguises this).

For the use of an eco-balance, a significant and negative (point-bivariate) correlation was found for the nitrogenous oxide emission efficiency (see Table 4), which suggests that the use of an eco-balance in an environmental report is a possible indicator for above-average/better environmental performance. As this is the only quality variable that had a positive link with the environmental performance of firms this would also be a very robust indicator. One could make the theoretical argument that eco-balancing is probably the most sophisticated form of input-output analysis currently used in corporate environmental management to establish the environmental effects of firms. An eco-balance is also a very sound basis for internal eco-controllling, ie internal decision making aimed at improving environmental performance (James et al. 1997, however also more critical views have been voiced, see e.g. Schaltegger and Sturm, 1992).

This suggests that the eco-balance is useful for reporting the actual environmental performance of a firm as well as for assessing the quality of environmental performance from the environmental report. This interpretation is further supported by the fact that the only significant correlation between water emissions and quality measures for an environmental report that could be established was a negative (point-bivariate) correlation between the use of an eco-balance in the report and the nitrogen emissions to water per unit of output in the paper industry. This implies a link of eco-balance use and better environmental performance for both environmental media analysed (air and water), thus lending further support to the conclusion that the use of an eco-balance is an indicator for above-average environmental performance.

However, this cannot be generalised to other variables, as was illustrated by the case of the average time for which emissions are reported backwards.

4 CONCLUSIONS AND RECOMMENDATIONS

The main objective of the research reported in this article was to assess to what extent the level of the physical environmental performance of companies and the quality of its corporate environmental reports in two industrial sectors and two EU countries are consistent and consequently what credibility should be attributed to such reports. The basic research question was whether environmental reporting and firms' actual environmental performance are positively associated. Also, it was an aim of the chapter to clarify the role of EMA tools for the link between reporting quality and environmental performance. The results suggest that good or elaborate environmental reports on average do not necessarily guarantee higher levels of environmental performance.

In order to assess the importance of other explanatory factors and to provide a more precise description of the variation in the underlying data set, other possible influences on environmental performance were analysed (see Section 3). These included for instance the effects of industry sector and country membership on environmental performance (Section 3.1) and possible sectoral or national differences in the use of physical indicators and the quality of environmental reports (Section 3.2). It was found, that country membership is more strongly associated with the level of environmental performance than is sector membership. All three air emission efficiencies (CO_2, sulphur dioxide, nitrogenous oxide) were on average significantly higher in the United Kingdom, than in Germany in at least one sector[4], whilst differences of emission levels between sectors were not significant, except for carbon dioxide. This probably points to a comparatively higher importance of environmental legislation on environmental performance. Although a relatively small sample size, and some (unavoidable) diversity in the sample due to the use of real-life firms in different industry sectors have to be acknowledged, various additional analyses were made to ensure that this would not seriously affect validity of the basic findings.

Some significant differences in report quality were found between sectors, whereas almost no significant differences were found between the two countries as concerns the quality of environmental reports[5]. The higher quality of reports in the electricity sector (in both countries) can be explained by a higher exposure of the electricity sector to environmentalist pressure. Distinguishing between ISO-certified and EMAS-verified companies, it was found that EMAS-verified firms have slightly higher environmental performance and use slightly less environmental performance indicators. However, due to the structure of the data set, this is explained by the fact that most EMAS-verified firms are in the paper sector, which uses comparatively

lower numbers of indicators and that most of the EMAS-verified companies (ie the firms in the paper sector) are located in Germany which has stricter environmental legislation (Gordon 1994, Handler 1997, Scherer 1997).

Taken together, the results firstly suggest that there is no strong association between the quality of corporate environmental reports and the actual environmental performance of firms. It must be noted that this is only assessed in terms of correlation, which cannot necessarily be taken as proof of causation. However, the results imply that it would be rather speculative to assume that better environmental reporting causes better environmental performance, in which case it could be used as a valuable environmental management tool as well as a reliable proxy variable for external assessment of environmental performance given that reports usually address external audiences. It seems that companies do not measure what they can or want to manage from an environmental point of view, but rather measure what legislation requires.

Secondly, the findings also indicate that environmental performance is significantly linked to country (but not much to sector membership), whereas environmental report quality is more strongly linked to sector membership (but not much associated to country). This possibly explains the fact that almost no significant association between these two aspects could be found. One interpretation of this is that environmental legislation, which is mainly country-related, is a stronger driver of higher environmental performance, whereas environmental reporting is mainly rooted in voluntary environmental management schemes that tend to be more sector-related. This would also imply to some degree that legislation is more important in achieving performance than voluntary schemes, a conclusion that is in agreement with economic theory's assessment of different environmental policy tools[6] (Endres, 1994) and recent empirical research on the effect of voluntary schemes on environmental performance (Tyteca et al., 2002).

The results also imply that the use of a higher number of indicators or the production of detailed environmental reports are unlikely to be related significantly to better environmental performance of companies across entire industries. Only the reported use of an eco-balance seems to be positively correlated with better environmental performance. The observed negative correlation between emission efficiencies and the reported use of an eco-balance as an EMA tool for data gathering and aggregation points to the possibility that EMA is potentially very relevant for the ultimate levels of environmental performance that firms achieve. It seems that a detailed data collection process (which is much supported by the use of an eco-balance) and the resulting database assist much in the identification of optimisation potentials for improving environmental performance. This would explain why use of an eco-balance or similar EMA tools enables focus on reporting and improving the most important performance aspects.

In conclusion, the results of the research reported in this chapter point to the considerable need for standardisation of environmental performance measurement and the use of quantitative environmental performance indicators in order to make possible comparisons of environmental performance within and across sectors in future. The research raises certain doubts regarding the credibility of environmental reports, due to the lack of consistency with the firms' environmental performance. This reinforces the need to further support true and fair stakeholder information, e.g. through precise guidelines (see e.g. Grafe-Buckens, 1998, GRI, 2002, IRRC, 1995), in order to avoid confusion. In the case of eco-investment funds, country location of a company, or whether or not firms use the eco-balance method to record their environmental effects (or use similar EMA tools) might be a more reliable predictor for environmental performance than the larger number of criteria based on the quality of environmental reports/statements or on environmental management systems. This proposition should be analysed further in future studies.

Overall, this article finds that consistency in environmental performance, use of EPIs and environmental reporting is rare, but takes the view that future credibility of companies most likely depends on it to a large degree. This suggests the need to revise current standards for environmental management, leading to more standardised indicators and data collection procedures (Ditz and Ranganathan, 1997, Tyteca, 1996). Such a review should aim for example at a life-cycle approach to environmental performance measurement, inclusion and expansion of existing EMA tools and should include the broader sustainability agenda, thereby ultimately aiming at sustainability indicators (Schaltegger and Burritt, 2000, Tyteca, 1996, Wehrmeyer and Tyteca, 1998) and sustainability reporting (GRI, 2002) including for example distribution issues on the firm level as well as issues of employee participation (Cable, 1984). Recent developments in this respect give hope that industry and governments increasingly rise to the challenges of consistency and credibility (GRI, 2002).

Finally, with regard to environmental management accounting, the results indicate that EMA tools may have an important influence on linking the quality of environmental reporting to the environmental performance of firms. The fact that reporting the use of eco-balancing in an environmental report in the research reported in this chapter was significantly related to firms' environmental performance could mean that EMA tools in general have an important role in linking environmental reporting and environmental performance.

NOTES

1 Site-level environmental reports are often termed environmental statements (for example under the EU Eco-Management and Audit Scheme (EMAS) regulations), whereas company-level reports are usually referred to as environmental reports.

2 See Handler (1997) and Scherer (1997) for basic descriptions of the respective regulatory regimes with regard to environmental legislation in general and air emissions regulation in particular.
3 The 'sustainability reporting index' consists of the components eco-balance use, use of CO_2 and NO_x indicators and qualitative discussion of sustainability, which results in a value from 4 to 0, depending on if or if the components were not used in the environmental report. Using the arithmetic mean to calculate this scale was considered acceptable as a first approximation of the quality of sustainability reporting, since no detailed framework exists yet, which could provide appropriate weights for calculating a more refined index. CO2 and NOx are significant global pollutants (contributing e.g. to global warming) and eco-balances are important management tools to holistically reduce a company's environmental impact. Finally, the use of a qualitative indicator of sustainability discussion addresses the fact that many sustainability aspects cannot be quantified easily.
4 Due to insufficient data availability for the electricity sector, a comparison was not possible for water emissions here.
5 The variables measuring report quality were the length of the report, the length of the environmental policy, the sustainability index calculated for the report, whether or not an eco-balance was used, the total number of water-related environmental performance indicators and of air-related environmental performance indicators used in the report and the number of years for which emissions were reported backwards.
6 These are, broadly speaking, legislation, different economic instruments and voluntary schemes (Endres, 1994).

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