Environmental management activities and sustainable HRM in German manufacturing firms - incidence, determinants, and outcomes

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Environmental Management Activities and Sustainable HRM in German Manufacturing Firms – Incidence, Determinants, and Outcomes**

The relevance of environmental activities has increased both in research and practice. Yet, there is only little systematic insight into such activities of firms, particularly regarding human resource management aspects. This study improves the empirical knowledge for the manufacturing sector, by exploring the incidence of environmental activities and by analysing the determinants of their use, particularly in terms of the incidence of environmental training activities for employees. Besides this, consequences of the incidence are analysed in terms of benefits for job satisfaction and employee retention/recruitment.

Umweltmanagementaktivitäten und nachhaltiges HRM in Unternehmen des deutschen Verarbeitenden Gewerbes – Verbreitung, Bestimmungsfaktoren und Wirkungen

Umweltschutzaktivitäten von Unternehmen haben in Wissenschaft und Wirtschaftspraxis an Bedeutung gewonnen. Allerdings liegen bisher nur wenige systematische Befunde zu den Umweltschutzaktivitäten von Unternehmen vor, insbesondere im Hinblick auf personalwirtschaftlich relevante Aktivitäten. Der vorliegende Beitrag untersucht dies empirisch für das verarbeitende Gewerbe und trägt, indem er die Inzidenz bestimmter Aktivitäten und ihrer Determinanten analysiert, zu einem besseren Verständnis und einer Systematisierung der Befunde bei. Die Untersuchung fokussiert auf personalwirtschaftlich relevante Aktivitäten und insbesondere die Durchführung von umweltbezogenen Schulungen. Darüber hinaus werden die Wirkungen der Aktivitäten betrachtet und zwar insbesondere im Hinblick auf höhere Mitarbeiterzufriedenheit und bessere Gewinnung von Mitarbeitern beziehungsweise Vermeidung von Mitarbeiterfluktuation.

Key words: **environmental, management, training, sustainable, HRM**
(JEL: L60, M10, M50)

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Introduction

Environmental management activities (short: environmental activities) are considered one important way to integrate the natural environment into corporate decision making and this implies a requirement to perform financially (as is conventionally expected from firms) as well ecologically. So far, little systematic insight exists concerning the relevance of human resource management (HRM) activities such as training activities for environmental issues compared to other technical and organizational activities concerning for example the reduction of materials, water and energy usage. Also it is often not clear, what factors determine such activities, especially as concerns HRM-related ones.

This paper reviews the literature and synthesizes it by developing research questions and hypotheses on the incidence and determinants of environmentally-related HRM actions and the benefits for job satisfaction, employee recruitment and employee retention from environmental activities in the firm. It then addresses these research questions and hypotheses empirically on a larger scale using multivariate statistical methods, and especially binary and ordered probit regressions. The paper concludes with a discussion of the results focussing on the links of HRM to environmental activities and by making use of the longitudinal character of the data (in the sense that in both waves only manufacturing firms in the same set of industries are surveyed and that firm size and firm type do not differ significantly) also on the relation of changes in the activities and changes in perceived outcomes.

Links between HRM and environmental management

Four streams of literature on the link between HRM and environmental management can be identified of which two each relate to more overarching themes. These are the literatures on the fundamental relationship of sustainability concepts and on determinants for environmental activities (both relating to the linkage of structural features and the conduct of firms) and the literatures on HRM and the natural resource based view and the productivity effects of HRM (both relating to performance aspects of the HRM-environmental management link and in this sense to conduct-performance linkages). The four literature streams are discussed in the following and research questions derived from each of them.

The fundamental relationship of sustainability concepts and HRM

The first stream of literature considers the relationship of sustainability concepts and HRM. From this a dual relationship of sustainability and HR emerges. In one sense concepts such as sustainable development are seen as being informative for a "better" type of HRM and for enacting the personnel function which ultimately should also imply additional performance contributions in that it maximizes a multi-dimensional performance vector over the long term (Müller-Christ & Ehnert, 2005; Ehnert, 2006; Ferrary, 2009).

Implied in this notion is the expectation that environmental activities contribute to a more fundamental re-valorization of HRM (Thom & Zaugg 2002; Jabbour & Santos 2008a). The second notion in this dual relationship in this gives rise to an ultimately reciprocal causality in which sustainability improves HRM and as a result HRM

contributes better to the longer-term performance of the firm (in turn also enabling additional sustainability contributions), that ultimately also includes social and corporate social responsibility aspects (Müller-Camen et al., 2010).

The determinants of environmental activities

A more narrow literature that also looks at structural factors is the one on the determinants of environmental activities and their success (Henriques & Sadorsky, 1996; Fernandez et al., 2003; Linnenluecke & Griffiths, 2010). Here a basic distinction can be made at the outset between factors not related to HRM and those related to HRM. Whilst the former ones are not in the focus of this review, the latter ones focus on incentive structures at the firm level and in doing so can guide towards relevant research questions and hypotheses.

Russo and Harrison (2005) for example derive from a theoretical analysis that direct line reporting to superiors, monetary incentives for activities that improve environmental performance and coordination between the environmental function and the strategy department should reduce emissions and in doing so increase the success of environmental activities. However, when analyzing empirically these propositions, they only find support for the case of monetary incentives, suggesting that additional factors have an effect. These findings are consistent with a strong focus of other contributions on the optimal design of monetary incentive schemes (Gabel & Sinclair-Desgagné, 1993; Lothe et al., 1999).

Next to the focus on incentive structures at the firm level, another nexus of this second stream of literature is putting the individual employee in the center, where supervisory support, corporate environmental culture and strategy orientation and mechanisms related to championing behavior in the context of innovations have been suggested as determinants of employee involvement in environmental activities (Andersson & Bateman, 2000; Ramus & Steger, 2000; Ramus, 2001).

One specific environmental management activity that is stressed as an enabler in both, firm-level incentive considerations and individual-level employee behaviour is the provision of environmental training programs by the firm for its employees. Here it has been stressed, that training can raise environmental concerns and hence support pro-environmental behavior of individual employees (Fernandez et al., 2003), potentially resulting in economic benefits (Brio et al., 2007). Renwick et al. (2008) point out that many and especially larger firms in Europe and the U.S. have implemented environmental training schemes and that this supports the achievement of environmental targets as part of incentive schemes (Massoud et al., 2008; Daily et al., 2007).

The strategic view of environmental activities

The strategy literature has very early on developed a favorable perception on environmental activities (Hart, 1995; Shrivastava, 1995). Building on the resource based view (Barney, 1991), Hart (1995) developed the natural resource based view which suggests that a firm can derive competitive advantages from a certain stance towards accounting for the natural environment in their operations. He and successors particularly stress that pro-activity (e.g. reflected by a firm pursuing many and relatively more environmental activities at a time) helps the development of strategic resources that

are difficult to imitate (Aragon-Correa, 1998). Shrivastava (1995) particularly points to the role that activities relating to specific environmental technologies have in this.

On the other hand, Florida and Davison (2001) stress the additional importance of organizational environmental activities, especially in the context of EMS implementation. In an empirical study in the United States, they find that adopters of environmental management standards show better performance on a large number of indicators. They conclude from this, that a larger number of factors are therefore relevant to predict specific environmental activities. The strategy literature, similar to the literature on the sustainability-HRM link, ultimately proposes performance improvements from environmental activities. Consistent with this notion Russo and Fouts (1997) also find evidence that environmental performance improves economic performance, specifically in industries that grow strongly, corresponding to a high level of munificence.

The performance outcomes of linking HRM and environmental activities

The fourth and final stream of literature that can be identified is the one on the performance outcomes of linking HRM and environmental activities. Here, the argument is advanced that involving more strongly elements of HRM and the personnel function in implementing environmental management leads to better performance of the firm, where performance can be understood in a number of dimensions. Firstly, these are "hard" and "soft" dimensions of economic performance, secondly the performance implications of environmental management.

(1) "Hard" and "soft" performance dimensions

Traditionally, "hard" performance is measured in terms of productivity (e.g. sales per employee), but also in terms of financial performance (return on sales, return on assets). Increasingly, also precursors of longer-term competitiveness and performance such as innovation activity and success (research and development expenditure, patent counts) are involved as performance measures. This subset of the fourth literature stream is strongly related to work on the economic effects of high-performance work systems (HPWS) and specific sets of HRM practices.

For example, Ichniowski et al. (1997) show that the combined application of incentive pay, teamwork, job rotation and training leads to improved productivity in U.S. steel firms. Ichniowski and Shaw (1999) confirm this result also for Japanese firms and suggest complementarities between HRM practices as the underlying general mechanism, also based on an extended review of other studies (Ichniowski et al., 1996).

Next to evidence for positive effects of HPWS on "hard" performance dimensions, their review also suggests a number of important "soft" performance dimensions, such as employee turnover, retention and recruitment, job satisfaction and job motivation, suggesting that the overall effect of HRM practices (and their linkage with environmental management) needs to be evaluated across several performance dimensions. In the conventional HRM literature, Ahmed and Schroeder (2003) find in this respect that a set of seven HRM practices (including next to the ones mentioned above employment security, information sharing and selective hiring) improve firm performance across different "hard" and "soft" performance criteria such as manufacturing cost, product quality, new product development, motivation, satisfaction and retention. Similarly, Huslid (1995) finds evidence in a very large sample of U.S. firms that joint application of certain HRM practices reduces employee turnover, and increases employee productivity as well as the financial performance of the firm. Especially "soft" performance criteria have been suggested as underexplored in this context (Stumpf et al., 2010) and hence should be a focus of future research.

(2) Implications for "soft" performance dimensions from environmental management

In extending this literature to the link between HRM and environmental management, several studies have proposed that a high level of environmental activities and their integration with HRM and the personnel function can bring about similar benefits especially for "soft" dimensions of economic performance as the joint application of certain HRM practices (Brio et al., 2007; Egri & Hornal, 2002). As major "soft" performance dimensions were economic benefits from environmental activities could be expected, employee satisfaction, retention and recruitment have been suggested. For example, Egri and Hornal (2002) include employee turnover and employee morale as the most relevant perceived "soft" organizational benefits that related to HRM.

Beyond HRM-related organizational and economic benefits, the argument is advanced and supported in the literature, that HRM integration of environmental activities such as dedicated training programs or the use of environmental performance indicators can help to improve the overall effectiveness of such activities and hence the

environmental performance of a firm (Daily & Huang, 2001; Jabbour & Santos, 2008b; Daily et al., 2007; Renwick et al., 2008). The literature stresses that environmental performance is an aggregate construct with sub-dimensions being for example emissions, inputs and system performance (e.g. achievement of continuous improvement) and provides a link to studies on HPWS in general by suggesting that improving environmental performance is likely to be an indirect side-effect of their adoption (Martin-Tapia et al., 2008).

Whilst these last insights are a side aspect for the current study, they nevertheless suggest that the link between HRM, environmental management and various forms of economic benefits for a variety of performance dimensions from both a corporate and societal point of view are complex and that there is need for more theory development that accommodates these complex linkages better.

Research questions and hypotheses

From the review of the literature on HRM and environmental management it emerges, that a dual approach including exploratory as well as confirmatory elements is appropriate, since the field is characterized by an intermediate level of theory development (Souren & Wagner, 2010). Therefore in the following, a set of research questions and hypotheses is formulated that advances our understanding in all of the above streams.

At a descriptive level, the question arises what the incidence of environmental activities (including those relating to HRM, and particularly environmental training) is? As concerns determinants the literature supports the hypotheses that firm size (hypothesis H1), existence of a quality management system (H2) and past profitability (H3) are positively, and munificence (H4) of the firm's business environment is negatively associated with a firm implementing an environmental training program.

The strategic and performance literatures, as well as the one on the fundamental link between sustainability and HRM suggest that with regard to the relationship of organizational (H5) and technical (H6) environmental activities with job satisfaction and employee recruitment/retention, a positive association can be hypothesized. Given the variety of "soft" performance dimensions, and the suggestion in extant work, that satisfaction and recruitment/retention are the most relevant ones in the context of environmental activities, the empirical testing here specifically focuses on these latter two.

Also, an implicit assumption in the literature seems to be that the role of environmental activities for job satisfaction and employee recruitment/retention benefits is stable over time and hence the question arises, whether there is empirical support for this? In the remainder of the paper, two datasets of German manufacturing firms are used to empirically address these research questions and hypotheses, ultimately to better understand antecedents and results of linking HRM with environmental management.

Data and method

The empirical analysis uses two data from surveys among German manufacturing firms from 2001 and 2006 that were aimed at exploring environmental management issues in a large number of business functions including HRM and in which firms were asked about their environmental activities and their perceived outcomes. Furthermore a number of questions elicited firm responses on various firm characteristics such as firm size and the industry the firm mainly operates in.

The first survey was carried out in 2001 on a random sample of 2000 firms drawn from the Amadeus database of Bureau van Dijk. Firms received a printed questionnaire by postal mail. Of the firms contacted 342 returned a completed questionnaire, resulting in a response rate of 17.1%. The second survey was carried out in 2006 and the sample of 581 firms was based on a sub-sample of the 2001 set of firms plus additions (due to firm exits) from different German stock indices (e.g. MDAX, SDAX, TecDAX) to balance the sample structure. Due to progress in web technology, in 2006 firms were invited by electronic mail to participate in a questionnaire accessible on the internet. Of the firms contacted, 169 responded, resulting in a response rate of 30%. Whilst a small share of respondents responded in both survey waves, the overlap was insufficient to consider the data a panel. The overlap was also insufficient to involve pseudo-panel methods such as those proposed by Baltagi (2005).

To assess the representativeness and response bias, procedures suggested by Homburg and Bucerius (2006) were adopted. Comparing the earliest and latest 10% of respondents in terms of their characteristics revealed no significant differences in the mean values of the responses of all variables were found other than late responding firms being significantly smaller. Furthermore, as can be seen from tables A1 and A2 in the appendix there is large variation across the responses in both surveys indicating that also firms less active in terms of environmental management did respond to the survey.

Whilst these results indicate that response bias is unlikely in the data, as an additional procedure to ensure that bias is, if at all, minimal, individual missing values for some variables were imputed to be included in the multivariate analysis, using the expected maximization algorithm of the Missing Value Analysis tool available in SPSS®. Imputation using the expected maximization algorithm is currently considered the best method to substitute missing values in data sets with estimated values (Schafer & Graham, 2002).

Comparing responses with data from the Bundesanstalt für Arbeit (BfA, 2000) it can be said, that larger firms with more than 500 employees are represented overproportionally in the responses, whereas firms with up to 500 employees are underrepresented in the data. Therefore, a size bias in the data needs to be acknowledged (relative to the population of manufacturing firms in Germany), which however becomes smaller from 2001 to 2006 and is also a persistent issue in empirical management in general (Armstrong & Overton, 1977).

To address the research questions and hypotheses formulated earlier, as concerns the determinants of environmental activities, the dependent variable used is if environmental training program exists in the firm (coded 0 if not and 1 if yes). The exact

survey questions for the independent variables are reproduced in table A1 of the Appendix.

Firm size is measured as the logarithm of the number of employees because the data is right-skewed (skewness in 2001: 9.48 and in 2006: 5.04). The existence of a quality management system (QMS) (as a binary dummy variable, yes equalling 1) was included since QMS and EMS have been argued to be strategic complements (Christmann, 2000; Inmaculada et al., 2008; Wagner, 2007a).

Firm type was included in the analysis in terms of a dummy variable (coded 1 if the firm is completely independent) because corporate governance structures differ across types of firms and have been suggested to be more or less supportive of environmental management (Solomon, 2004; Wagner, 2007b; Wagner, 2010).

Historic profitability is measured on a five-point scale ranging from "revenues well in excess of cost" (highest score) to "revenues so low as to cause large losses" and was included in the analysis to account for effects of slack resources that make the implementation of environmental activities easier and hence more likely (Waddock & Graves, 1997; Surroca et al., 2010).

Munifience was included, measured as the trend the respondent firm faces in its main market on a 5-point scale ranging from a "considerably decreasing" (highest score) to a "considerably increasing" (lowest score) market (Dess & Beard, 1984).

As concerns the perceived outcomes of environmental activities, the two dependent variables considered are the perceived effect of environmental management on job satisfaction and recruitment/retention, respectively. The survey questions for these are also listed in table A1 of the Appendix, and data on both variables is gathered, based on Sharma (2001), on a five-point scale from "very negative" to "very positive" (highest score).

Next to the independent variables introduced above, to test the hypotheses on what types and extent of environmental activities affects job satisfaction and recruitment/retention, two indices consisting of the sum of the technical and organizational actions of a firm, respectively, are included. The underlying survey questions and individual items making up the indices are provided in table A1 of the Appendix, and the scale of the indices ranges from zero (no activity is carried out) to 17 and 20 (all possible activities are carried out), for technical and organizational activities, respectively.

The binary coded items for the indices and their validity and unidimensionality were based on earlier studies using structurally equivalent scales (Belz & Strannegard, 1997; Waddock & Graves, 1997; Kestemont & Ytterhus, 1999). Beyond this, the validity of the indices is undetermined for the samples analysed here. However, the internal-consistency reliability based on the Cronbach Alpha Coefficient (interpreted as the equivalent of the Kuder-Richardson 20 Coefficient) is 0.93 for the organizational and 0.81 for the technical environmental activities which suggests a good quality and hence usability of the two indices.

Following the exploratory data analysis on the incidence and relative relevance of environmentally-related HR actions, the hypothesized firm based characteristics associated with environmental training activities are tested with binary probit regression. Then, the hypotheses on environmental activities and firm based determinants of per-

ceived outcomes are examined involving ordered probit estimation. Models are estimated with robust standard errors and include industry dummy categories based on Chandler (1994).

Inspecting the data reported in tables A2 and A3 suggests that multi-co-linearity is not an issue for the multivariate analysis as does the condition number of 4.66. To test for significant differences in coefficients between years interactions of the explanatory variables by year are included and all estimations are done by pooling the two samples with a year variable added to the model.

Results

The questions of the incidence of environmental activities (including HRM-related ones such as training) are initially answered by means of a separate assessment of (technical and organizational) environmental activities and how their occurrence changes over time. This is discussed based on figures 1 to 4.

Based on a model testing for year effects whilst controlling for sample differences (results available on request), changes from 2001 to 2006 were not significant for 12 out of 37 activities. These activities were treatment to reduce water emissions, packaging recycling, substitution of non-renewable resources, using less packaging per product or reducing its negative environmental impact, or using waste streams of other firms, environmental, health or safety (EHS) data in annual reports, a separate EHS report or statement, informing consumers on environmental effects of products and processes, use of eco-labels or product life cycle analysis, market research/development of 'green' products, and reducing environmental effects of packaging.

As concerns significant differences, figures 1 and 2 show largely an increase in activities from 2001 to 2006. This concerns 9 out of the 11 significant technical activities. For the remaining two, namely the implementation of cleaner technologies and the treatment to reduce emissions to air the reduction is likely due to regulatory effects. This is because by law in Germany most investments required in these two areas were done before 2006 and therefore in the second survey less activities would be reported since in the time before investments with long-lasting effects were done and (partly because of this) already low pollution levels were reached.

Overall, a considerable increase in the implementation of technical environmental activities between 2001 and 2006 can be recorded for firms in the German manufacturing sector, which is however less strong than for organizational environmental activities (see figures 3 and 4). As concerns the latter, the result is even more pronounced in that only for 14 activities (out of 20), the number of firms stating that they implemented a specific activity increased significantly. The biggest increases are found for the adoption of environmental performance indicators (32 % increase), for implementation of a procedure for identification and evaluation of relevant legal requirements and for the implementation of an auditing system to check the environmental program (28 % increase each). Whilst the use of performance indicators is important also in the context of HRM, the other two indicators are more related to other business functions.

Figure 1: Technological activities in 2001 (see legend below for explanations)

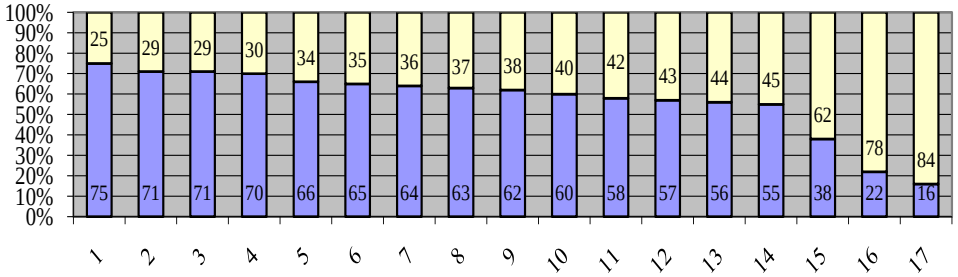
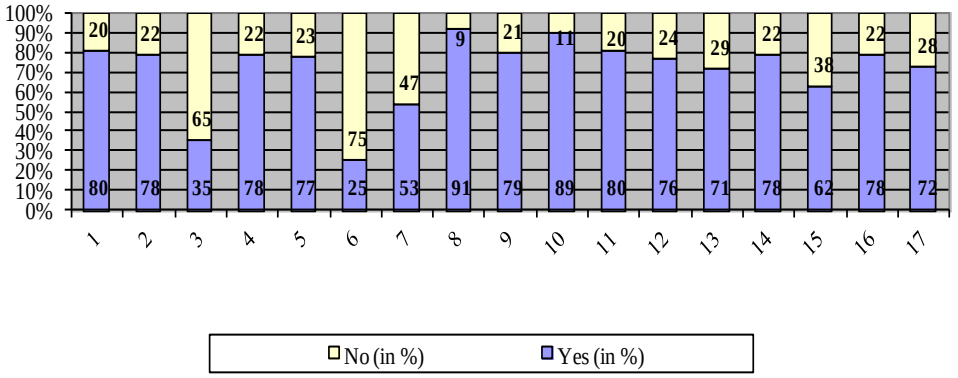


Figure 2: Technological activities in 2006 (see legend below for explanations)



Legend to figures 1/2: (light colour: no in %; dark colour: yes in %; *: significant difference)

1: Packaging recycling	9: 'Green' design of a new product*
2: Treatment to reduce solid waste*	10: Treatment to reduce noise*
3: Treatment to reduce emissions to air*	11: Using less material per unit of product*
4: Using less packaging per unit of product	12: Material recycling within your company*
5: Substitution of hazardous inputs*	13: Reducing negative environmental effects of packaging
6: Implementation of cleaner technology*	14: Product recycling*
7: Treatment to reduce emissions to surface water	15: Reduced energy use in transport*
8: Reduced water use in production*	16: Substitution of non-renewable resources
	17: Use of waste streams of other companies

Nevertheless, the group of runner-ups, comprising of a program to attain environmental goals (27 % increase), existence of measurable environmental goals (26 % increase), written environmental policy (22 % increase) and environmental training program (19 % increase) are all considerably more related to HRM with the last activity (as a core HRM one) having the seventh largest increase. Finally, whilst environmental training was in 2001 the seventh most frequently stated activity, in 2006 it was the tenth most frequently stated one, suggesting that its relative importance has declined.

However, this does not mean necessarily that the personnel function lost relevance, because as stated earlier, several activities cannot be linked solely to one function alone.

Figure 3: Organizational activities in 2001 (see legend below for explanations)

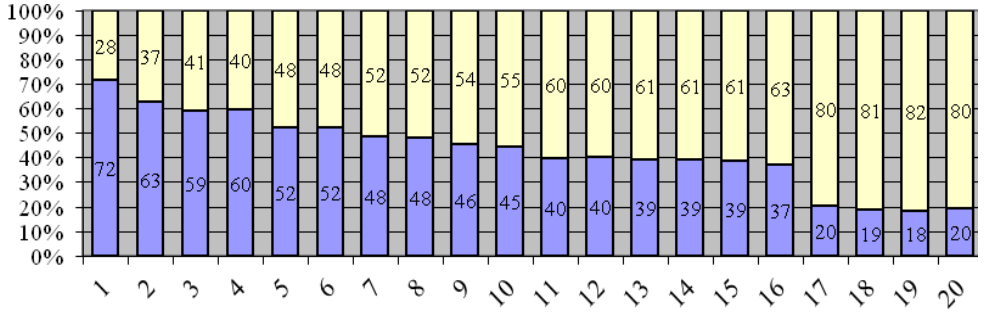
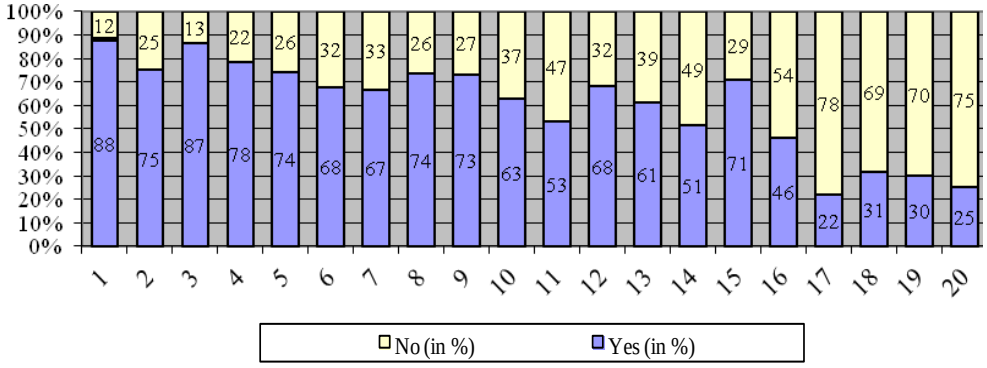


Figure 4: Organizational activities in 2006 (see legend below for explanations)



Legend to figures 3/4: (light colour: no in %; dark colour: yes in %; *: significant difference)

1: Clearly defined responsibilities*
2: Initial environmental review*
3: Procedure for identification and evaluation of relevant legal requirements*
4: Environmental goals are part of a continuous improvement process*
5: Written environmental policy*
6: Taking environmental performance into account in selection of suppliers*
7: Environmental training program*
8: Measurable environmental goals*
9: Program to attain measurable environmental goals*
10: Placing demands on suppliers to take environmental actions*
11: Environmental/health/safety data in annual report
12: Auditing system to check the environmental program*
13: Evaluation of the environmental efficiency of the environmental management system*
14: Separate environmental/health/safety report or environmental statement
15: Adoption of environmental performance indicators*
16: Informing consumers on environmental effects of products and production processes
17: Usage of eco-labeling
18: Benchmarking (environmental performance comparison with other firms)*
19: Implementation of product life cycle analysis
20: Market research on potential of 'green products'

Whilst the exploratory data analysis reveals some interesting dynamics, it is necessary to test what determines specific activities such as the implementation of environmental training programs. To shed more light on this hypothesis testing in a first step focuses on environmental training activities in 2001 and 2006 as this is the survey item is most closely related to HRM and for which also the literature review suggests particular relevance. The independent variables used to predict this dependent variable are those described and hypothesized about earlier. Table 1 summarises the results of the analysis (coefficients of explanatory variables estimated per year are available on request).

Table 1: Factors determining environmental training program implementation

Variables	Raw estimate	Marginal effect
Stable technology sector	0. 089 (0.177)	0.034
High technology sector	0.004 (0.224)	0.001
Firm size (logarithm of employees)	0.230 (0.052)***	0.089
Quality management system	-0.206 (0.292)	-0.078
Profitability	-0.034 (0.139)	-0.013
Munificence	-0.162 (0.131)	-0.062
Firm type (fully independent vs. subsidiary)	-0.019 (0.226)	-0.007
Observation of year 2001	-1.830 (0.857)***	-0.594
Number of employees x year 2001	0.082 (0.083)	0.032
Quality management system x year 2001	1.037 (0.369)***	0.380
Profitability x year 2001	-0.109 (0.169)	-0.042
Munificence x year 2001	0.182 (0.156)	-0.070
Firm completely independent x year 2001	-0.169 (0.291)	-0.065
R^2	0.167	
Log-likelihood	-221.389	
Wald	81.16***	

Notes: Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01; heteroskedasticity-robust standard errors, observations: 383 (2001: 215, 2006: 168)

The results for environmental training show, that only firm size is significantly associated with the propensity of a firm to pursue such a program. The significant interaction term of QMS certification with the year dummy shows, that only in 2001, having a certified QMS no longer associates significantly positive with the propensity of having implemented an environmental training program, but not anymore in 2006. Finally, the negative and significant year dummy indicating an observation from the 2001 sample reveals that the existence of an environmental program is significantly less likely in 2001 than it is in 2006 (which is consistent with the descriptive findings reported in figures 3 and 4).

At the final stage of the analysis, the hypotheses about economic benefits that have been proposed are tested for German firms (where large-scale studies on this issue have not been carried out so far), and the issue of whether these benefits from environmental management are empirically stable over time is addressed. Given that not

all performance categories identified in the literature review were evaluated in the two survey waves constituting the data sources, the multivariate analysis of incidence and effects of environmental activities on HRM-related variables in the following focuses on job satisfaction and employee recruitment and retention. The analysis also separates technical from organizational environmental activities (based on the classification used in figures 1 to 4) and incorporates the explanatory variables described in the method section above as well as indices for technical and organizational activities (the coefficients reported in table 2 are raw estimates – as before, coefficients of the explanatory variables estimated separately for the years 2001 and 2006 are available on request).

Table 2: Factors determining employee satisfaction and recruitment/retention

Variables	Satisfaction	Recruitment
Stable technology sector	-0.007 (0.167)	-0.235 (0.164)
High technology sector	0.267 (0.215)	0.191 (0.225)
Technical environmental activities	0.017 (0.042)	-0.025 (0.032)
Organizational environmental activities	0.140 (0.023)***	0.165 (0.028)***
Firm size (logarithm of employees)	-0.024 (0.054)	-0.118 (0.046)**
Quality management system	-0.280 (0.273)	0.080 (0.305)
Profitability	0.064 (0.127)	-0.239 (0.116)*
Munificence	0.170 (0.117)	0. 114 (0.101)
Firm type (fully independent vs. subsidiary)	-0.095 (0.222)	0.025 (0.225)
Observation of year 2001	1.419 (0.940)	-0.119 (0.933)
Technical activities x year 2001	0.099 (0.050)**	0.162 (0.044)***
Organizational activities x year 2001	-0.077 (0.029)***	-0.108 (0.033)***
Number of employees x year 2001	-0.037 (0.087)	0.052 (0.070)
Quality management system x year 2001	-0.453 (0.356)	-0.476 (0.370)
Profitability x year 2001	-0.024 (0.155)	0.327 (0.137)**
Munificence x year 2001	-0.121 (0.143)	-0.045 (0.130)
Firm completely independent x year 2001	0.051 (0.288)	-0.062 (0.297)
R^2	0.151	0.183
Log-likelihood	-293.417	-257.965
Wald	79.27***	84.14***

Notes: Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01; heteroskedasticity-robust standard errors; observations: 383 (2001: 215, 2006: 168)

Turning to benefits from environmental management, table 2 shows very similar results and patterns for employee recruitment/retention as for job satisfaction. As hypothesized, both environmental activities have a significant positive association with satisfaction and recruitment/retention. However whereas in 2001 both, technical as well as organizational environmental activities are significant associated, in 2006 only organizational activities are significantly associated with the two dependent variables, but more strongly than in 2001 as is indicated by the significant negative interaction term of organizational activities with the year dummy indicating 2001. To ensure that

not one specification of industry dummies is driving the results, a variant specification distinguishing industries at the two-digit NACE code level was additionally used in the estimations. The results (available on request) remain qualitatively unchanged.

Conclusions and discussion

This paper sheds light on the environmental activities of firms, particularly as they relate to HRM aspects by analysing two surveys of firms in the German manufacturing sector at two different points in time (2001 and 2006). It specifically focuses on exploring the incidence of a number of technical and organizational environmental activities, their evolution over time and the determinants and outcomes of their implementation especially with regard to HRM aspects.

In doing so it addresses a set of related research questions and hypotheses derived from extant literature and assists in the development of more systematic insights into such activities and their link to HRM. Most importantly, as concerns the 17 technical and 20 organizational environmental activities analysed it is found that for 25 of them (that is, over two thirds) the incidence has increased significantly between 2001 and 2006. However, as concerns the very strongly HR-related activity of providing environmental training programs, even though the percentage of firms having adopted it increased, the relative ranking amongst all activities has decreased from seventh to tenth most frequent activity (that is, whilst in absolute terms the share of firms which adopted it in 2006 (67%) is higher than in 2001 (48%), providing environmental training programs has declined in relative relevance). Thus it seems that the relevance of HRM for environmental management has not increased since 2001. This could also be interpreted as an indication, that HRM still has to engage more fundamentally with notions of sustainability, as has been done quite extensively for other business functions, most notably marketing and accounting (Kestemont & Ytterhus, 1999; Lamberton, 2005).

As concerns the determinants for the incidence of environmental training activities, the most stable determinant over time is firm size and H1 is therefore fully confirmed. The fact that H2 on QMS implementation is only confirmed for 2001 could indicate that the complementarities suggested in the literature have become less relevant over time. This also suggests an important alley for future research namely to analyse in more detail whether this is in fact the case and what the main reasons are for this development. For example it could be that whilst early on environmental activities where often implemented by quality managers because of the similarity of the relevant international standards underlying both domains (ISO 14001 and ISO 9001 for example), increasingly environmental management has emancipated itself within the firm and is today less guided by quality management philosophies and more so by increasingly accepted notions of corporate sustainability? Such a fundamental shift could also explain that the slack resources hypothesis (H3) as well as a positive effect of a munificent business environment (H4) could not be confirmed.

Besides analysing incidences and determinants of (especially HRM-related) environmental activities, this paper also addressed the consequences of such incidences. Therefore in the final step of the empirical analysis, perceived outcomes of environmental activities on HRM-related benefit dimensions were evaluated, focusing specifi-

cally on job satisfaction and recruitment/retention of employees. The results here suggest that findings of earlier research for other countries are replicated in Germany, namely that environmental activities positively associate with HRM-related benefits in terms of job satisfaction and recruitment or retention, in turn confirming H5 and H6 (but the latter only for 2001). Making use of the longitudinal character of the data, the results however also suggest that the temporal stability of this association varies. Whilst organizational environmental activities are in both periods significantly positively associated, technical activities become insignificant for 2006. One possible interpretation of this is that saturation occurs with regard to the latter, so that firms cannot any longer differentiate on this dimension.

Looking at the average percentage of activities implemented, this argument receives support: whilst in 2001, across all 20 organizational activities on average 43 % of the responding firms confirmed implementation, in 2006 this figure rose to 60 %. Opposed to this, for technical environmental activities, the respective averages for 2001 and 2006 are 57 % and 71 %. Therefore, whilst average adoption increased slightly more strongly for organizational than for technical activities, the decreasing adaptation rate for latter and the relatively higher overall adoption level could make saturation possible. Future research should however try to corroborate this interpretation based on both, large-scale quantitative as well as more qualitative case evidence.

Whilst this analysis reveals that the link of HRM with environmental activities remains relevant, it has also some limitations that should be improved upon in the future. The most important of these are the use of mainly self-reported data and the availability of only some of the various performance dimensions identified in the literature. Future research should therefore focus on additional dimensions such as innovation performance, financial performance and productivity and should involve data from independent sources such as patents or data from balance sheets and profit-and-loss statements to calculate return measures or employee productivity figures based on sales data.

Another extension of this research could be the exploration of linked employer-employee data, especially with respect to perceived employee participation (Nerdinger 2008). Since this seems to be an important aspect of HRM-related benefits from environmental activities, future research could clarify to what degree participation matters relative to other factors discussed such as transformational leadership of environmental managers (Ramus & Steger, 2000; Ramus, 2001; Felfe et al., 2004) and to what degree appropriate conditions exist as concerns environmental management for improving the various performance dimensions identified in the literature?

Finally, the literature on strategic HRM proposes a fit between HRM practices and strategic orientation, for example in terms of cost or quality leadership (Jackson & Schuler, 1987). This can be related to different environmental strategy orientations (Orsato, 2006) and consequently a field for future research would be contingent configurations of the link between HRM and environmental management activities depending on strategy orientation.

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Appendix

Table A1: Overview of survey questions and items used

DV: Specify the effects of your firm's activities on the following factors, based on a five-point scale, 'very negative'–'negative'–'no effect'–'positive'–'very positive' for the items: Worker satisfaction, Recruitment/staff retention (part of a list of 16 factors including market share, profit, cost savings, productivity, sales, image, …).
IV: Please specify which technological actions your company has undertaken in the last three years, for the items: Reduced water use in production, Using less material per unit of product, Material recycling within your company, Use of waste streams of other companies, Substitution of non-renewable materials, Substitution of hazardous inputs, Treatment to reduce emissions to air, Treatment to reduce emissions to surface water, Treatment to reduce noise, Treatment to reduce solid waste, Implementation of cleaner technology, 'Green' design of a new product, Product recycling, Packaging recycling, Reducing negative environmental effects of packaging, Using less packaging per unit of product, Reduced energy use in transport (order as in original survey question)
IV/DV(Environmental training). Please specify which managerial actions your company has undertaken in the last three years, for the items: taking environmental performance into account in selection of suppliers, placing demands on suppliers to take environmental actions, written environmental policy, procedure for identification and evaluation of relevant legal requirements, initial environmental review, measurable environmental goals, program to attain measurable environmental goals, clearly defined responsibilities, environmental training pro-gram, environmental goals are part of a continuous improvement process, environmental/health/safety (EHS) data in annual report, separate EHS report/statement, auditing system to check the environmental program, evaluating efficiency of EMS adoption of environmental performance indicators, benchmarking, eco-labeling, in-forming consumers on environmental effects of products and production processes, market research on potential of 'green products', implementation of product life cycle analysis (order as in original survey question)
4) Did your company acquire a quality standard (ISO 9000 series or similar, please choose 'no' or 'yes')
5) Please specify (or estimate) the total number of people who are presently employed by your company?
6) Is your company in any way (e.g. as a subsidiary) part of a larger company or is it completely independent?
7) In assessing the overall business performance of your firm would you say the gross revenue over the past 3 years has been: 'so low as to produce large losses', 'insufficient to cover costs', 'enough to break even', 'sufficient for a small profit', 'well in excess of costs'?
8) Over the last three years, would you say the market you sell your main product to has: 'decreased significantly', 'declined', 'stayed the same', 'increased', 'increased significantly'?

Table A2: Descriptive statistics and correlations for 2001

Variable	Min.	Max.	Mean	Std. Dev.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	VIF range
Technical activities (1)	1	16	7.688	3.447												1.40-1.40
Organizational activities (2)	1	19	8.595	5.479	0.497***											1.72-1.72
Number of employees (3)	1.699	4.842	2.516	0.637	0.337***	0.431***										1.07-1.29
QMS, no (0) or yes (4)	0	1	0.763	-	0.137**	0.291***	0.191***									1.23-1.26
Profitability (5)	1	5	3.763	0.840	0.144**	0.080	-0.116*	-0.066								1.04-1.06
Munifience (6)	1	5	3.051	1.055	0.206***	0.112	0.185***	0.183***	0.188***							1.14-1.16
Firm type, subsidiary vs. independent (7)	0	1	0.553	-	-0.147**	-0.327***	-0.116*	-0.215***	0.058	0.088						1.11-1.18
Stable technology sector (8)	0	1	0.363	-	0.091	0.119**	0.016	0.227***	-0.005	0.111**	-0.184***					1.27-1.28
High technology sector (9)	0	1	0.129	-	0.011	-0.022	0.036	0.115**	0.052	0.056	0.061	0.290***				1.16-1.19
Employee satisfaction (10)	2	5	3.662	0.576	0.406***	0.383***	0.202***	0.144**	-0.019	0.131**	-0.120**	0.047	0.041			-
Recruitment/retention (11)	1	5	3.396	0.563	0.383***	0.320***	0.175***	0.074	-0.030	0.090	-0.094	0.005	0.037	0.601***		-
Environmental training activities, no(0) or yes (12)	0	1	0.478	-	0.347***	0.692***	0.387***	0.292***	-0.079	0.153***	-0.148***	0.098	0.029	0.328***	0.287***	-

Notes: Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; reported are the lowest/highest values of the variance inflation factors (VIF) across all regressions; observations: 215

Table A3: Descriptive statistics and correlations for 2006

Variable	Min.	Max.	Mean	Std. Dev.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	VIF range
Technical activities (1)	0	16	6.548	3.733												3.28-3.56
Organizational activities (2)	0	20	11.464	5.299	-0.473***											1.43-1.45
Number of employees (3)	0.24	12	6.119	2.559	-0.579***	0.491***										1.23-2.54
QMS, no (0) or yes (4)	0	1	0.833	-	-0.333***	0.069	0.136*									1.10-1.26
Profitability (5)	1	5	1.958	0.833	0.102	-0.130*	-0.374*	-0.109								1.20-1.23
Munifience (6)	1	5	3.333	0.995	0.160**	-0.049	0.071	0.166**	-0.193							1.25-1.52
Firm type, subsidiary vs. independent (7)	0	1	0.531	-	-0.481	0.205***	-0.004	0.134*	-0.004	-0.173**						1.10-1.72
Stable technology sector (8)	0	1	0.669	-	-0.219***	0.094	-0.197**	0.194**	-0.101	-0.354**	0.173**					1.98-2.41
High technology sector (9)	0	1	0.124	-	0.046	-0.163**	-0.307***	0.023	0.164**	-0.056	-0.070	-0.535***				1.75-1.97
Employee satisfaction (10)	1	5	3.604	0.619	-0.205***	0.489***	0.193**	0.126	-0.034	-0.083	-0.115	0.077	0.010			-
Recruitment/retention (11)	2	5	3.302	0.532	-0.198**	0.518***	0.123	0.044	-0.127*	0.020	-0.134*	0.090	-0.026	0.510***		-
Environmental training activities (12)	0	1	0.669	-	-0.330***	0.606***	0.386***	0.002	-0.132*	-0.084	-0.051	0.042	-0.178**	0.342***	0.280***	-

Notes: Significance levels: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; reported are the lowest/highest values of the variance inflation factors (VIF) across all regressions; observations: 168