Empirical identification of corporate environmental strategies

Their determinants and effects for firms in the United Kingdom and Germany

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Table of Contents

Abstract

This working paper empirically establishes types of corporate environmental strategies (CES) and analyses their determinants, as well as their link to firms' environmental management activities. The approach presented in this working paper aims to identify environmental strategies empirically, i.e. it follows an inductive approach. The research questions which this working paper aims to study are: (i) do the observable environmental attitudes of firms in Germany and the UK form consistent patterns; (ii) based on these patterns, is it possible to derive types of corporate environmental strategies; (iii) is the adoption of environmental strategies and the degree to which these are developed predominantly a result of national factors or firms' country membership or mainly influenced by firms' industry sector membership and what is the influence of firm size; and (iv) what is the link between types of corporate environmental strategies and patterns of operational environmental activities? To address these questions, a comparative study of firms in Germany and the UK was carried out, based on a questionnaire survey of a representative random sample of firms in the manufacturing sectors in Germany and the UK. The data set resulting from the survey was analysed statistically using multivariate methods to answer the above research questions. Particularly, the results reported in this paper will help establishing whether the national or the industry context are more relevant, or if a balanced influence of both exists on firms' corporate environmental strategies.

1. Introduction

Even though the focus of this paper are corporate environmental strategies, it seems appropriate to briefly put this in the wider context of sustainability and sustainable development, since the development of corporate environmental strategies is unavoidably linked to sustainability and sustainable development.[1]

According to the World Commission on Environment and Development (WCED), sustainable development is defined as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (WCED 1987, p. 43). This is maybe the most common of the almost uncountable definitions of sustainable development. It implies that "… sustainable development involves (a) making the present generation better off without making future generations worse off, and (b) focussing current development on the most disadvantaged (Pearce et al. 1993, p. 10)", in other words, sustainable development in this sense is about inter- and intra-generational equity.

However, this very general definition has to be further operationalised in order to estimate the contribution of environmental management to full sustainable development, i.e. overall sustainability. According to Pearce et al. (1993, p. 7): "Any society setting itself the goal of sustainable development should .. develop economically and socially in such a way that it minimises those activities the costs of which are borne by future generations …" and: "Deteriorating environments and loss of natural resources represent one of the main ways in which today's generation is creating uncompensated costs. Hence the conservation of natural resources and the environment is crucial to achieving sustainable development".

It is widely accepted that sustainable development has three core components which are protection of the environment, economic development (i.e. sufficient economic growth) and increasing (social, global and intergenerational) justice. This is also called the 3-pillar-concept of sustainability (see e.g. Van Dieren et al. 1995; Nutzinger & Radke 1995).

The first (environmental) pillar of sustainable development, the protection of the environment, can be quantified by a set of *three management rules* that have to be

[1] In the following 'sustainability' and 'sustainable development' are used synonymously. It is acknowledged, that sustainability and sustainable development do not have necessarily the same meaning and that, whereas sustainability refers more to a state, sustainable development refers more to a process. Both however broaden concerns with the output of industrial economies (and the simultaneous need to sustain the resource base which gives rise to this output) as well as the input to such economies (from merely natural resources to all forms of capital, be it human-made or natural) an focus on the need to embrace social goals beyond GNP (Pearce et al. 1993). Therefore, when focusing on the firm level, a distinction between sustainability and sustainable development seems to be neither fruitful, nor necessary.

followed in order to achieve sustainable development (see e.g. Pearce et al. 1993, pp. 15; Van Dieren et al. 1995).

The first of these rules requires that the *consumption rate of non-renewable resources be below the rate of technological progress*.[2] The second management rule states that *renewable resources should only be exploited at a rate that is below their rate of regeneration*. Finally the third rule requires that *ecosystems should only be used as sinks and filters for human activities to an extent that is below the critical loads and levels of pollutants and energy and material flows for these systems*. According to Pearce et al. (1993, p. 4) " .. sustainability means making sure that substitute resources are made available as non-renewable resources become physically scarce, and it means ensuring that the environmental impacts of using those resources are kept within the Earth's carrying capacity to assimilate those impacts." Therefore, at an operational level, sustainability means " … driving the ratio of resource use to gross national product (GNP) downwards, and encouraging the transition to renewable resources (Pearce et al. 1993, p. 5)" through e.g. technological change or ecological modernisation.[3]

The second (economic) pillar of sustainable development, sufficient economic development or growth, needs no further comment in so far as it represents the economic agenda since the industrial revolution. However, it is clear that in order to reach sustainability, technological progress, structural change in industry and consumer behaviour have to be given a fundamentally different direction.[4]

The third (social) pillar of sustainable development requires *three targets* to be met. Firstly, it requires a *more even national income distribution* and an *increase in national liberty rights*, especially for minorities (this can be described as the social justice aspect). Secondly, a *more equal access to resources* and at least a further approximation of material and immaterial conditions of living in developed and less- or low-developed countries is necessary in order to increase international (intra-generational) justice (Welford 1995). Thirdly, it is necessary to work towards *more equal inter-temporal resource and ecosystem function availability* (this might be referred to as the intergenerational justice aspect). The last point relates directly to the general definition given by the WCED (1987) and requires

[2] This rule (the 'constant capital rule') applies to the concept of weak sustainability. However, if strong sustainability is required, substitutability of capital is not possible, and therefore depletion and hence exploitation of non-renewable resources is not acceptable at all (see e.g. Pearce et al. 1993).

[3] On ecological modernization see also Hertin & Berkhout (2001) and Jackson (1996).

[4] This can be quantified in the necessary precondition that economic growth has to be de-coupled from resource consumption and environmental pollution in absolute terms, see e.g. Jackson (1996) and Pearce et al. (1993).

especially business and industry to adopt a long-term planning horizon and pro-active attitudes.

Whilst many firms are aware of the need for sustainable development and as well of some or all of the elements of the definition provided above, it is often less clear, which strategies assist firms in achieving it. In a competitive world, it is important for firms to meet customer demands, as well as societal expectations. Only when embracing *simultaneously* the economic, social and environmental challenges of sustainable development, firms will be able to retain their license to operate and their ability to attract the necessary capital and human resources to run their operations successfully. In this sense, the fourth (procedural) requirement of sustainable development is the integration of the social targets, the environmental management rules and the economic agenda.

In summary, according to the 3-pillars-concept (Van Dieren et al. 1995; Nutzinger & Radke 1995) sustainability contains ecological, social and economic aspects. Sustainable development in the 3-pillar sense would therefore require the simultaneous achievement of ecological, social and ecological goals. This is also visualized in Figure 1 below.

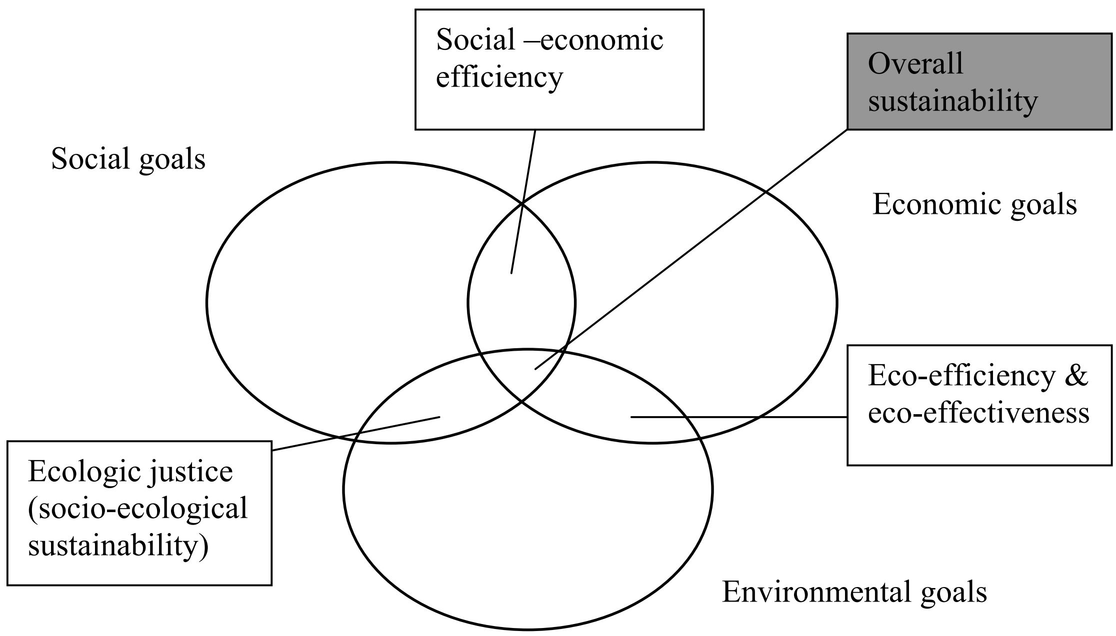

Figure 1: Sustainability based on the 3-pillar concept

Often sustainability includes today primarily ecological and social aspects (i.e. the objective is ecological justice or socio-ecological sustainability). However, the key economic goal of a company usually is the creation of business value. A necessary condition for the creation of business value is that the current value of the expected yields exceeds the current value of the expected costs (Rappaport 1999, Schaltegger & Figge 1997). As Figge (2001) points out, it is therefore a precondition fo achieving sustainability at the firm level to ensure achievement of the economic goals of the firm. According to Figge (2001), this is for three reasons. Firstly, this is because environmental or social management that reduces the economic business value is dangerous since it is only carried out by firms, as long as they are successful and can afford this ″luxury″. If firms find themselves under financial distress, the costs related to environmental management are cut down first since per definition they would not contribute to the firm’s economic goals. Therefore, environmental management which does not contribute to the economic goals of a firm would only be practiced, as long a firm is successful.

Secondly, socio–ecological sustainability at the firm level alone as a goal is an inappropriate model for other businesses. Firms who want to develop their environmental and social management often orientate themselves towards competitors and it is unlikely, that they would adopt a firm-level concept of socio–ecological sustainability which creates costs, but no benefits since acting this way, they would only deteriorate their competitive position. Conversely, if other firms simultaneously achieve their economic goals through its environmental and social management, a firm intending to promote its environmental or social management can only avoid a deterioration of its competitive position if it adopts an approach to improving its environmental or social performance which similarly assists achievement of its economic goals (Figge 2001).

Thirdly, by definition, socio-ecological sustainability alone not achieving sustainable development, since according to the 3-pillar-concept sustainability involves economic, ecological and social aspects. Therefore, sustainability is only achieved if ecological, social and economic goals are reached simultaneously. A firm, which achieves socio-ecological sustainability, but has a bad economic performance, has not achieved overall sustainability. Conversely, a firm which improves with regard to all the three dimensions of sustainability, would have achieved overall sustainability and thus Sustainable Development. What becomes however clear from Figure 1 a above is, that one necessary condition for overall sustainability is the achievement of simulatenous achievement of firms environmental and economic goals. This is why, after briefly introducing the wider scene of sustainable development which surrounds and influences the development of corporate environmental strategies, the remainder of this paper will focus on the determinants and effects of corporate environmental strategies that achieve this aim.

2. Objectives of the research

Since there are differences in the way companies respond to environmental pressures and incentives, which vary between countries, product markets, company size and industry sectors, different types of environmental (management) strategies have been defined - up to now predominantly based on a deductive approach. Opposed to this, this paper aims to identify environmental strategies as distinctive sets of environmental attitudes, i.e. it follows an inductive approach. Using organisational attitudes (here defined as attitudes of firms towards specific characteristics of their environmental management activities) to define environmental strategies allows to empirically establish which attitudes actually comprise different strategies. This approach to go beyond deductive typologies is in line with current insights in environmental strategies (see e.g. Hass 1996; Ghobadian et al. 1998).

The literature on international comparative research in environmental management provides several hypotheses regarding the development of social phenomena in different countries that would merit empirical testing. An important research question in this respect is whether the adoption of environmental strategies and the degree to which these are developed is predominantly a result of a uniquely national context. The alternative to such a "national culture" would be that the institutional context is mainly related to industrial sectors, and indeed it has been argued that this is the case in the literature. A third potential influence factor is firm size, since it is often argued that smaller firms lack the resources and economies of scale necessary for proactive corporate environmental strategies.

The research aims of this working paper are fourfold: Firstly, the paper aims to record the observable environmental attitudes of firms in Germany and the UK and to analyse if these form consistent patterns which can be captured in underlying (lower-dimensional) factors. Secondly the paper wants to establish if it is possible to derive types of corporate environmental strategies based on firms' attitudes or the factors underlying the attitudes. Thirdly, the paper wants to analyse whether the adoption of environmental strategies and the degree to which these are developed is predominantly determined by national factors or firms' country membership or mainly influenced by firms' industry sector membership of environmental routines and what the influence of firm size on CES is. Finally, the paper wants to analyse what the link is between types of corporate environmental strategies and patterns of observable environmental activities.

For undertaking an empirical study to address these questions, a comparative study of firms in Germany and the UK is very suitable since considerable knowledge regarding the national and sectoral contexts exists which can be built upon. To address the above research questions a questionnaire survey of a representative random sample of firms in the manufacturing sector in Germany and the UK was carried out. During the survey, a detailed questionnaire was distributed to 2000 companies in each country, resulting in about 300 replies from both countries. The manufacturing sector was chosen as it represents a broad diversity of different environmental issues, including recycling, wastewater emissions, hazardous waste management, deforestation, eco-labelling of products, product take-back, and "green" product design, which has produced a diversity of organisational environmental management activities and environmental attitudes. It was decided to exclude the service sector due to its comparatively smaller environmental impact. The resulting data set was analysed statistically using specific multivariate techniques (e.g. Principal Component Analysis, Cluster Analysis) to answer the above research questions.

The objectives of the research reported in this working paper are as follows:

- To provide answers to the research questions stated below regarding the relative influence of national and sectoral factors as well as firm size on corporate environmental strategies;
- To provide a detailed statistical analysis resulting in the identification of sets of environmental activity and corporate environmental strategies;
- To establish, whether there is a link between specific sets of environmental activities and specific corporate environmental strategies.

3. Research questions and hypotheses for the research:

In this working paper, the relationship of different environmental management approaches and CES with the external factors firm size, country location and sector membership will be analysed. This will answer the following research questions:

(i) Is there a link between firm size and strategic CES orientation / environmental management approach?

(ii) Is there a link between country location and strategic orientation / environmental management approach (e.g. are firms in Germany more likely to adopt a proactive CES, than firms in the UK)?

(iii) Is there a link between sector membership and strategic orientation / environmental management approach (e.g. are firms in specific industry sectors, such as the chemicals industry with its long history of environmental awareness, significantly more likely to adopt a proactive CES)?

(iv) Is there a link between types of corporate environmental strategies and patterns of observable environmental activities?

In order to answer these research questions a number of important aspects which have not yet been addressed by previous work need to be analysed:

(a) What are the observable sets of environmental activities (operationalised by means of firms' operational and managerial environmental activities) of companies in both countries?

(b) Do these routines form consistent strategy patterns and can these be classified using existing typologies (such as e.g. the Environmental Shareholder Value (ESV) approach of Schaltegger & Figge 1998)?

(c) Is the adoption of environmental strategies and the degree to which these are developed predominantly a result of a predominantly national influence or mainly part of the sectoral context in which firms are embedded in their industry sectors?

4. Relevance of sectors and countries used in the analysis

4.1 Relevance of the manufacturing industry and choice of sectors

The transformation of Europe into an industrial economy and society since the beginning of the 19^{th} century has fundamentally changed the relationship between humankind and the environment. Whilst the industrial economy has brought massive benefits to humankind in terms of e.g. life expectancy, technological progress and quality of life in general, it has at the same time significantly altered the scale and complexity of interactions with the environment in that the material requirements of the industrial economy and society (i.e. industry) in Europe extend far beyond basic survival needs of humankind (Jackson 1996). This change in scale of complexity has resulted into a number of environmental problems. The underlying pattern which has lead industry to become a major source of environmental problems is that (different to natural ecosystems), industrial economies are largely linear systems in the sense that energy and material flows enter the system at one point and soon after exit at another point.

Opposed to this, natural ecosystems are largely cyclic systems, i.e. energy and material flows are transformed in a cascading process in order to make maximum use of the exergy which energy and material flows supply ecosystems with. In addition to this, the industrial economy is an open system, i.e. it exchanges energy and materials with the system environment, whereas the global ecosystem is a closed (but not isolated system) since it only exchanges energy with its system environment (i.e. the universe). The global ecosystem in this receives high-exergy energy flows from the sun, transforms these in a cascade of material transformation into low-exergy energy flows (in this way exporting entropy into the system environment) and then dissipates low-exergy energy flows (thermal radiation) into the system environment (Jackson 1996). The system environment of the industrial economy is the global ecosystem (i.e. the industrial economy is part of the global ecosystem). The industrial economy therefore exports entropy in the form of low-exergy energy flows and dissipative material flows into the global environment. In doing so it reduces or keeps constant the entropy level within the industrial economy, but at the price of increasing the entropy of the global ecosystem (Georgescu-Roegen 1971, 1986).

Increased entropy in the global ecosystem for example implies the destruction of high-order structures, e.g. species, resulting in e.g. reduced biodiversity within the global ecosystem. The global ecosystem itself can, however, also reduce its entropy level by exporting entropy to its system environment, the universe. However, the ability to export entropy is limited for the global ecosystem by the amount of high-exergy solar radiation that flows into the system per period of time. This is reflected by the so-called solar constant which has the value of 1.35 kW per square metre at the boarder of the atmosphere (Heinrich & Hergt 1990, p. 15). Therefore, over geological periods, a dynamic steady-state equilibrium has developed in which the global ecosystem as a dissipative structure[5]

[5] The term “dissipative system” has been used for macro-level structures by Prigogine (1979) and Prigogine and Stengers (1984) and was coined by Prigogine during earlier work on chemical systems far away from the equilibrium. Georgescu-Roegen (1971) applied thermodynamics, especially entropy, to economic systems.

balances entropy in- and outflows so that the net entropy inflow is zero or negative. The industrial economy is considerably disturbing this equilibrium between the global ecosystem and its system environment, since it produces additional entropy which it transfers to the global ecosystem, in this way adding considerably to the overall entropy production of the global ecosystem (which subsequently needs to be exported). One factor that increases the problem is that since the industrial economy and society is largely linear, it is not minimising its entropy production (which would require as a precondition a largely cyclic system, such as natural ecosystems are). In summary, industry (i.e. the manufacturing sector) in Europe, but of course also elsewhere in the world is causing significant environmental problems. According to Jackson (1996, p. 20), environmental management[6] therefore needs to find a development path for industry which retains the advantages for humankind achieved through industrialisation whilst at the same time allowing for future health of the environment by reducing the environmental impacts of industry, by e.g. making industrial systems more like natural ecosystems (e.g. more cyclic). The manufacturing industry (as the focus of this working paper) is particular relevant for achieving sustainable development. Although the chosen sectors in the manufacturing industry (NACE codes 15-36) have different relative economic importance in the two countries, their common characteristic is that they all contribute to essential human needs. To improve environmental performance in these sectors through effective environmental management activities is therefore essential to ultimately achieve sustainable development in the industrial society.

Another reason for targeting predominantly the manufacturing industry in this survey is to have sufficient diversity in the scale of environmental impacts, the market structure, the environmental exposure/awareness and therefore ultimately the level and type environmental management in the sectors. For example, the pulp and paper sector is highly regulated because of its high environmental impacts, whereas textile finishing and transport equipment are less strictly regulated. Conversely, the different chemicals manufacture sub-sectors (refined petroleum products, chemical products and plastic products) and pulp and paper are more strongly affected by end consumer demands than the textiles and basic metals/fabricated metal products sectors. In terms of market structure, the pressure from downstream sectors is relatively high in wood and wood products (due to

[6] The term environmental management refers to every activity of business, which aims at the reduction of its environmental impact, i.e. which aims at improving the firm's environmental performance (Schaltegger & Burritt 2000, 113). The term social management we can define analogously to every measure which allows the attainment of a firm's social goals, i.e. which improves the social performance of a firm.

emerging forestry certification schemes), whereas it is lower in textiles (given that this is sector of the manufacturing industry is close to end consumers and therefore often sets its own eco-standards, thus creating pressure on upstream sectors).

In general, the relative strength of competitive forces differs between the sectors. Therefore, it seems likely, that the corporate environmental strategies adopted in each sector also differ.

4.2 Relevance and choice of countries

The analysis concentrates on two European countries to achieve an appropriate, yet defined, spread of regulatory, socio-economic and market-based influences with relatively distinct environmental regimes, the United Kingdom (UK) and Germany. In Germany as well as the UK, the extent of corporate environmental protection has increased significantly over the last decade. The socio-political, regulatory and economic climates of the two countries show significant differences, which means that companies in each country have developed management approaches and corporate environmental strategies that are specific to their national environment. For instance, Gordon (1994) acknowledges that, whilst awareness of broader political and social aspects in environmental policy is greater in Britain, the level of analysis and the efficiency of environmental policy making is often greater in Germany. Peattie and Ringer (1994) report strong enthusiasm for environmental management amongst British companies, and suggest that in organisational terms, they are not significantly lagging behind, but may increasingly do so due to weak environmental legislation. James, Prehn and Steger (1997) find that specific socio-political dimensions, such as stringency of regulation, the character of existing competitive strategies within firms, or the level and quality of public concern for environmental issues, have led to distinct environmental management types in both countries.

In Germany, a considerable number of firms, and significantly more than in the UK are certified under the EU Eco-Management and Audit Scheme (EMAS). EMAS requires the publication of environmental information necessary to understand the organisation's environmental impact, which can be used for this project. More recently, findings by Wätzold et al. (2001) indicate that the up-take of EMAS in different EU countries depends on the level of regulatory relief granted to the EMAS-registered firms, as well as to whether or not regulatory relief is equivalently granted to firms certified according to ISO 14001. In Germany, for example, 2432 out of a total of 37413 firms eligible for EMAS have adopted the scheme (corresponding to 6.5 percent of the total). In the UK, only 73 out of a total of 29608 firms have adopted the scheme, corresponding to a very low 0.25 percent (Wätzold et al. 2001).[7] According to Wätzold et al. (2001) EMAS provides additional advantages in Germany (which are not available in the UK) in that public bodies provide more information and subsidies to EMAS participant and in that regulatory relief is exclusively granted to companies registered under EMAS (but not to firms which have an environmental management system certified to ISO 14001).

In Germany, the federal states are responsible for licensing, monitoring and enforcement, and all of them have introduced regulatory reliefs for EMAS-registered firms. The most comprehensive of these reliefs is the voluntary agreement between the state government of Bavaria and Bavarian industry. In this agreement, companies guaranteed for example, that 500 sites would be EMAS validated in Bavaria by October 2000 (Wätzold et al. 2001). The Bavarian state government in turn agreed to provide regulatory relief to EMAS registered firms with regard to reporting, documentation and control duties for waste, water and pollution control laws. Some of these reliefs were relatively easy to grant, since emissions monitoring is partly privatised in Germany. This means that firms are required to nominate independent institutions (e.g. the German safety standards authority, called TÜV) to measure emissions and to inspect the necessary equipment. Wätzold et al. (2001) contrast the considerable relief granted in Bavaria with a more limited relief granted to firms in North Rhine-Westphalia, were no voluntary agreement was made. Instead, the state government left it to the discretion of the competent authorities to substitute firm-internal control meachanisms for control duties. In addition to that there was the possibility for firms (if agreed to by the authorities) to provide documentation and information in the environmental statement required by EMAS as a substitute to those required by pollution control law (Wätzold et al. 2001). In terms of participation rates, Wätzold et al. (2001) find the results in Bavaria to be more successful (8.17 percent of the potential participants got registered under EMAS, compared to only 5 percent in North Rhine-Westphalia). This has to take into account however, that it was part of the voluntary agreement in Bavaria for industry to achieve a certain number of EMAS registered sites, whereas this was not required in North Rhine-Westphalia. In so far, the success measure is to some degree

[7] Wätzold et al. (2001) have also analysed up-take of ISO 14001. They found that in Germany, 1950 firms (5.21 percent) have adopted ISO, whereas in the UK 1014 firms (3.42 percent) have adopted the ISO standard. It has to be noted however, that some firms have sites that are certified under ISO as well as registered under EMAS, i.e. double-counting is likely. Wolter (1999, p. 13) has found in a survey, that approx. 10 percent of German firms are simultaneously registered under EMAS and certified under ISO (it becomes not clear whether this only concerns at least one individual site of a firm, or whole firms, or a minimum number of sites of the firm).

tautological, and should ideally be substituted by outcome measures, such as actual environmental performance of the EMAS registered firms, in comparison to those not registered (see also Wagner et al. 2001 on this issue).

Compared to Germany, at the time of the EMAS introduction, there was considerable resistance in UK industry against EMAS (due to its concurrence with BS 7750), as well as a general debate in the UK over the possibility to provide regulatory relief to firms with an externally verified EMS. Therefore, it is not surprising, that at the time of EMAS implementation, the former environmental regulator, Her Majesty Inspectorate of Pollution (HMIP, which was together with the National Rivers Authority (NRA) one of the predecessors of the UK Environment Agency) attempted to position voluntary environmental management systems as a complement to the IPC regulations (Wätzold et al. 2001).

Under the Operator and Pollution Risk Appraisal (OPRA) system, which provides an assessment of operators' performance as well as the intrinsic risks of processes regulated under the UK system of Integrated Pollution Control (IPC) , an externally verified EMS is only one of a total of 14 factors considered when establishing the inspection and monitoring visits frequencies for large industrial processes (Wätzold et al. 2001). This applies equally to EMSs validated under EMAS and EMSs certified according to ISO 14001. As a result of this approach taken by the UK Environment Agency until today, there has been little regulatory relief for EMAS validated firms. This, together with the equal treatment given to EMAS and ISO 14001 has likely been the main reason, why participation rates for EMAS are very low (0.24 percent of potential participants). In addition to that, the preference of UK firms for ISO 14001 (which is more closely linked to BS 7750) makes it likely that future regulatory relief (if granted equally to both, EMAS and ISO 14001) will mainly increase industry participation in ISO 14001, which currently stands at a 3.42 percent participation rate (Wätzold et al. 2001).

In summary, existing literature provides evidence, that there are distinct environmental regimes in the UK and Germany, as far as environmental awareness, efficiency of environmental policy-making, the stringency of and approach to environmental regulation are concerned. The last particularly concerns the different attitudes of regulators in the two countries to environmental management systems, particular with regard to granting regulatory relief to firms with an externally verified EMS. Overall, the distinct environmental regimes make it likely, that different corporate approaches to environmental management as well as corporate environmental strategies have evolved in the two countries, i.e. that the country context is a major determinant for corporate environmental strategies.

5. Definition of corporate environmental strategy (CES)

A corporate environmental strategy (CES) can be defined (based on Mintzberg's definition of corporate strategy)[8] as a pattern of environmentally related management activities in a stream of decisions. A number of CES typologies have been brought forward in the last years, and the latest and most comprehensive review was carried out by Kolk & Meuser (2002) and Wehrmeyer (1999).

What becomes apparent from the reviews of Kolk & Meuser (2002) and Wehrmeyer (1999) is that to date, the majority of approaches to define corporate environmental strategies are theoretically based (i.e. deductive). They derive the environmental management type from theoretical deliberations and conclusions. Distinguished from this can be models derived from an inductive approach, i.e. models based on empirical data. Next to the distinction between empirically based (i.e. inductive) and theoretically based (i.e. deductive) classifications of corporate environmental strategies (CESs), one can also distinguish between ordered (synonymously: linear, stages-based) and unordered classification schemes for CESs. Since both dimensions are largely independent, the CES proposed so far can be classified generally in the following matrix presented in Table 1.

Table 1: Classification of corporate environmental strategy classifications

	Inductive CES schemes	Deductive CES schemes
Ordered CES schemes	Kirchgeorg (1990)	Hunt & Auster (1990), Roome (1992)
Unordered CES schemes	Steger (1996)	Dyllick et al. (1997), Schaltegger & Figge (1998)

One problem with ordered and/or deductive CES schemes is, however, that it is often difficult to fit these with empirical observations. For example, when attempting to classify companies into the ordered and deductive CES model by Hunt & Auster (1990) using

[8] Mintzberg (1989) suggests five different definitions of strategy as a plan, ploy, pattern, position or perspective. In this plan means an intended course of action, where a specific course of action can be termed a ploy. Pattern defines a strategy as a pattern (whether intended or unintended) in a stream of decisions. This is regardless of whether the pattern is intended (in which case Mintzberg refers to it as an "intended strategy") or unintended (in which case Mintzberg terms it an "emergent strategy"). Position refers to the location of an organization in the (economic, competitive, societal) environment and is most closely to Porter's definition of strategy, whereas perspective is the view from the organization on its environment (Mintzberg 1989, Mintzberg & Quinn 1991).

empirical data from the Norwegian printing and food processing industries Hass (1996) reports difficulties. Instead an inductive approach using an empirically based model and cluster analysis methodology was able to classify firms appropriately.

Therefore, the research reported in this working paper aims to use empirical data to classify firms' CES based on empirical data without imposing too much of a pre-defined typology and then it links these to the environmental management activities that firms undertake. In doing so, it "lets the data speak for itself". After establishing the observable environmental routines (operationalised by means of operational and managerial environmental activities) of companies in both countries the research wants to link these to firms' corporate environmental strategies (CES) based on a typology found in the literature, namely Schaltegger & Figge (1998). The typology will be described in detail in the following section.

6. Methodology

6.1 Introduction of the instrument used: the European Business Environment Barometer questionnaire

The instrument used in the research reported in this working paper was the European Business Environment Barometer (EBEB) questionnaire. The questionnaire used in the survey was identical in Germany and the UK, except of course that the former survey was carried out in German. Great care was taken to ensure full comparability of the questionnaires by means of extensive pre-testing of the questionnaires in both countries with subsequent comparison of pre-test results. The questionnaire asked about specific environmental issues, such as the main environmental effects; the main management and technological actions to address these; questions to evaluate the degree of sophistication, and extent of, the corporate environmental programme. This is followed by questions about the self-assessment on the motives, drivers, benefits and obstacles of environmental management. The most important instruments in the questionnaire for the research reported here are the item batteries for environmental shareholder value (Schaltegger & Figge 1998, Figge 2001) and the battery of items for both firms' managerial environmental activities was focal for this research. These shall be explained in detail in the following.

6.2 Empirical measurement of operational and managerial environmental activities

In the EBEB questionnaire, firms were asked to state whether or not they were carrying out a number of managerial activities to diminish or prevent negative environmental impacts.

Respondents were asked to specify which managerial/organisational actions their company had or had not undertaken in the years 1998 until 2000, choosing either “Yes” or “No” as response. The items listed in the questionnaire were:

With regard to procurement:

- Taking environmental performance into account in the selection of suppliers
- Placing demands on suppliers to take environmental actions

With regard to environmental management:

- Existence of a written environmental policy
- Existence of procedures for identification and evaluation of relevant legal requirements
- Firm carried out an initial environmental review
- Existence of measurable environmental goals
- Existence of a programme to attain measurable environmental goals
- Clearly defined responsibilities
- Existence of an environmental training programme
- Existence of environmental goals that are subject to a process of continuous improvement
- Existence of environmental/HSE data in annual report
- Existence of a separate environmental/HSE report
- Existence of auditing systems to check the functioning of the environmental programme
- Adoption of environmental performance indicators by firm
- Existence of benchmarking activities on the side of the company

With regard to product/market:

- Eco-labelling
- Information to consumers on environmental effects of products and production processes
- Market research on potential of ‘green products’
- Implementation of product life cycle analysis (LCA)

6.3 Empirical measurement of corporate environmental strategies (CES)

One approach to operationally measure corporate environmental strategies (CES) is to base them on one overall concept. For the research reported here, this approach was adopted, i.e. it was decided to measure CES as one overall concept, based on the environmental shareholder value concept developed by Schaltegger & Figge (1998, 2000) and expanded by Figge (2001) as theoretical framework. The aim is then to analyse the corporate environmental strategies which can be empirically derived from this framework.

Regarding environmental management in general, Schaltegger and Figge (2000) argue that the amount of corporate environmental protection in itself neither spurs nor reduces shareholder value (or similarly other measures of economic performance). Contrary to the often held view that the amount of environmental protection (and thus the level of environmental performance which is related to it) is (negatively or positively) related to the economic performance of firms, it is argued that such a relationship strongly depends on factors internal to the firm (Schaltegger & Synnestvedt 2002). Particularly, corporate environmental strategies, environmental management approaches used and activities adopted by the firm, as well as the tools utilized are seen as major factors which moderate the relationship between environmental and economic performance at the firm level.

Schaltegger and Figge (1998) link environmental performance and shareholder value (which is, strictly speaking, not based on profit, but on free cash flows) by means of theoretically derived value drivers for shareholder value. These value drivers derived from the original shareholder value concept are (Schaltegger & Figge 1998, 18):

- the level of fixed capital and working capital investments (which jointly determine the expected capital investment),
- the systematic risk, the return of risk-free investments, and the return of the market portfolio (which determine costs of capital and thus the discount rate), and finally,
- sales growth, operating profit margin, income tax rate and value growth duration (which in combination with the fixed and working capital investments determine the expected cash flow).

Together, the expected capital investment, the discount rate, and the expected cash flow determine the long-term (discounted) expected risk-adjusted return, and thus the shareholder value. Schaltegger and Figge (1998) then go on assessing the influence of different types of environmental strategies on the described value drivers. For example, if large sums have to be invested by a firm in end-of-pipe pollution abatement, this likely reduces free cash flow and thus economic performance, although environmental performance might have improved considerably. Also, growing internalisation of external environmental costs by means of e.g. taxes will bring the objective of cost reduction increasingly in line with the ecological goal of reducing environmental burdens and thus are interesting for both, a strategy of cost leadership as well as one of quality leadership, appropriate environmental management will become increasingly important. Figge (2001) expands on Schaltegger and Figge (1998; 1999; 2000) in a way that allows to incorporate option value considerations and proposes a question battery which was used as the basis for the items used in the questionnaire of the survey. The items (based on Figge 2001), in their appearance in the survey are reported in Table 2. For each item (which was in each case a full statement), respondents were asked to evaluate the extent to which they agree or disagree with the statement. Responses had to be given on a 5-point Likert scale ranging from "Fully disagree" via "Disagree", "Neutral" and "Agree" to "Fully agree". Respondents were asked to focus on environmental management alone and to disregard the influence of other activities of their firm on the statements when evaluating these.

Table 2: Questions used in the EBEB survey for environmental shareholder value concept

- Through eco-products or eco-marketing we can achieve above-average market prices for our current products
- Eco-products or eco-marketing help us to charge above-average market prices for possible future products
- Environmental management helps us to have lower costs for our processes
- Eco-products or eco-marketing help us to sell more of our current products
- Environmental management in our company leads to lower capital investments for our current processes
- Environmental management in our company helps us to utilize better existing equipment
- Environmental management in our company helps us to utilize better existing equipment
- Environmental management in our company helps us to create a competitive advantage that is difficult to imitate
- Environmental management helps our company to better predict its costs
- Through environmental management the proportion of variable costs in our company is higher
- Through its environmental management our company can defer investments to a later point in time
- Environmental management helps our company to extend the operational life of our production equipment
- Environmental management helps our company to better predict its future investments
- Environmental management helps our company to extend the operational life of our products

In the empirical analysis to follow, corporate environmental strategy orientation will be measured according to the above items operationalising the ESV concept (Figge 2001).

6.4 Statistical analysis

The statistical analysis was carried out with the SPSS® programme package. First the data files for UK and German with all firms that are in manufacturing sector (approx. 300 altogether) were merged into one analysis file. Following this, factor analyses were carried out for the items used in the survey to assess the ESV orientation of a company. Also, factor analyses were carried out for the operational and managerial environmental activities of firms. The resulting factors/components were labeled, and it was compared to which degree these factors/components (which are essentially empirically derived factors for corporate environmental strategies) were consistent with the propositions made by the ESV concept (Schaltegger & Figge 2000; Figge 2001). Finally, cluster analyses were carried out on assign firms to specific types of CES based on the factors established in the factor analyses.

7. Description of the data sets

7.1 Germany

The sample for the German survey was based on random sampling. The sampling frame was the manufacturing sector in Germany. The German firm population equals the total number of firms in the German manufacturing sector. Their sectoral breakdown, based on the industry NACE code classification is provided in Table 3, which was provided by the German Federal Bureau for Employment (Bundesanstalt für Arbeit).

Table 3: Number of companies in different firm size categories and industries in Germany

Industry NACE code	*50-99 employees*	*100-499 employees*	*500 and more employees*
15	1267	1206	100
16	3	12	7
17	328	316	20
18	181	154	13
19	68	70	5
20	320	216	25
21	231	329	43
22	785	626	78
23	20	28	18
24	459	578	171
25	781	730	110
26	583	494	58
27	384	509	134
28	1630	1229	115
29	1610	1740	316
30	62	58	23
31	439	526	139
32	188	239	89
33	534	561	96
34	199	287	158
35	90	115	62
36	476	463	42
Total	10638	10486	1822

Source: Bundesanstalt für Arbeit (German Federal Bureau for Employment), No. of manufacturing firms as of 31 December 1999, data provided to University of Lüneburg on 8 November 2000

The questionnaires of the German survey were addressed to the environmental manager of the company and were in most cases answered by them. In some cases, quality managers completed the questionnaire. Especially in small firms, often the managing director him- or herself completed the questionnaire. After having sent questionnaires to about 2000 companies, 166 usable questionnaires in total were returned, corresponding to an effective response rate of 8,3%. This response rate is in consistent with the average of the other countries (e.g. Hungary with responses of 187 firms), in which the 2000/2001 survey round of the European Business Environment Barometer has been already completed (see Harkai & Pataki 2001; Pacheco & Wehrmeyer 2001). The final sample of respondents resulting from the German survey is described in Table 4 in terms of the industry and firm size distribution.

Table 4: Breakdown by industry sector and firm size (number of employees) in Germany

	Categorised number of employees				*Total*
Sector of industry	10-99	100-249	250-499	>500	
Food and tobacco	5	8	3	5	21
Textile	2	5	3	4	14
Pulp and paper	2	2	-	-	4
Publishing and printing	4	3	4	2	13
Energy, oil products and nuclear fuel	-	-	-	1	1
Chemicals and fibres	3	2	-	4	9
Rubber and plastic	3	2	1	2	8
Non-ferrous mineral products	2	5	1	2	10
Metals	4	8	6	2	20
Machines and equipment	5	11	3	4	23
Electrical and optical equipment	5	5	4	6	20
Transport products	2	2	2	7	13
Other manufacturing	2	4	3	1	10
All sectors	39	57	30	40	166

As can be seen, sector coverage is relatively high in food and tobacco products, metal products, machines equipment and transport products, whereas it is low in energy, cokes and oil fuels, as well as pulp and paper products. Except for three (timber industry, leather processing and recycling), all target branches are represented in the returned questionnaires. The biggest part of the questionnaires returned involved the production of machines and equipment (n=23), the food and tobacco industry (n=21), the manufacture of metal products and electrical and optical equipment (each n=20). Following these, the best covered industries are the textile industries (n=14) and publishing and printing and transport products (n=13).

With regard to the number of employees, in Germany, firms with 500 and more employees are clearly over-represented in the response sample (24,10% of the total number of responding firms are in this size category, as opposed to 7,94% for the German manufacturing sector as a whole) compared to companies with 100-499 employees (52,41% of all responding firms, of which 34,34% are in the category of 100-249 employees and 18,07% in the category of 250-499 employees) and companies with less than 100 employees (23,49% of all firms). This compares to 46,36% of firms below 100 employees, and 45,70% of firms with between 100 and 499 employees for the German manufacturing sector as a whole. These findings for firm size distribution are, however, consistent with the firm size bias towards larger firms found in previous surveys on environmental management (Baumast & Dyllick 1998; Baumast 2000). To some degree, due to their response behaviour, the group of small firms is a sub-universe almost “unobservable”.

7.2 United Kingdom

In April and May 2001 the EBEB questionnaire was sent to approx. 1000 British firms which are representative (in terms of industry sector membership) for large and medium-sized firms in the UK manufacturing sector. 135 usable questionnaires were returned (corresponding to a response rate of approximately 16.25 percent). With regard to the size of the firms it was found that the answer rate of bigger firms are above the average. It is possible and even likely that here a *non-response bias* occurs, in which case the companies which are active with regard to the environmental protection sent a questionnaire back sooner and more likely than those which are inactive. This is nevertheless a common problem of surveys in environmental management which is difficult to avoid. It is however not considered a problem in the current survey since the analysis has revealed considerable variability in firm behaviour which indicates that any bias is likely not very strong (Pacheco & Wehrmeyer 2001).

The UK firm population from which the representative sample was drawn is based on the number of firms for which the job function “Environmental/Recycling Manager” exists.

From a data base, 5996 manufacturing firms were identified who had this job function category available. Their sectoral breakdown, based on the broad 1992 SIC industry classification is provided in Table 5 below.

Table 5: Number of companies in different industries in the UK

Industry NACE code	*50-99*	*100-249*	*250-499*	*500-999*	*1000+*	*Total*
15	441	0	0	118	0	559
16	0	0	0	0	0	0
17	283	283	103	33	9	711
18	217	122	37	23	20	419
19	64	50	16	0	0	130
20	144	76	16	0	0	236
21	176	204	63	17	9	469
22	502	297	112	61	21	993
23	14	13	10	6	3	46
24	262	224	121	68	47	722
25	394	370	127	34	19	944
26	206	158	61	23	22	470
27	164	170	73	23	11	441
28	782	409	97	26	10	1324
29	601	483	177	76	30	1367
30	30	40	0	0	18	88
31	255	248	84	41	23	651
32	107	121	0	0	24	252
33	245	165	66	27	10	513
34	163	169	89	52	24	497
35	98	87	34	31	35	285
36	341	0	0	0	5	346
Other manufacturing	125	750	402	113	128	1518
Total manufacturing	5614	4439	1688	772	468	12986

Source: Eurostat, No. of manufacturing firms as of 1997, data provided to University of Lüneburg on 14 March 2002 (Eurostat New Cronos database, Industry, Trade and Services, Structural Business Statistics (Industry, Construction, Trade and Services) Annual enterprise statistics broken down by size classes.

In the survey, 135 usable questionnaires were returned in the British manufacturing sector, for which the distribution according to industry sectors and firm size is shown in Table 6.

Table 6: Breakdown by industry sector and by firm size (number of employees) in the UK

Sector of industry	Categorised number of employees				Total
	10-99	100-249	250-499	>500	
Food & tobacco	2	3		1	6
Textile	2	4	1	1	8
Pulp & paper				3	3
Publishing & printing	3	3	3	5	14
Energy, oil products & nuclear fuel	1	1		1	3
Chemicals & fibres	3	6	5	5	19
Rubber & plastic	2	3			5
Non-ferrous mineral products	2	1		4	7
Metals	8	7	4	4	23
Machines & equipment	3	2	4	3	12
Electrical & optical equipment	5	3	2	3	13
Transport products	3	3	2	3	11
Other manufacturing	5	3	1	2	11
All sectors	39	39	22	35	135

As can be seen, the main sectors are metal-processing (n=23), chemicals and fibres (n=19), publishing and printing (n=14), electrical & optical equipment (n=13), and machines and equipment manufacture (n=12). With regard to the firms' size distribution it was found that 28,89% of the responding firms have less than 100 employees and another 28.89% of the replies came from medium-sized firms (100-249 employees). The group of larger firms (250-499 employees) has a share of 16.30% in the total of responses, and the group for largest firms (500 and more employees) is 25.93%. Again, there is a slight bias towards larger firms, compared with the UK manufacturing sector as a whole. According to Pacheco & Wehrmeyer (2001), approx. 25% of the responding firms are stock-listed companies, 20% are privately-owned firms and 40% are companies with privately held stock. Approximately 41% of the firms are totally independent, whereas almost half of them (49.3%) are in fully owned by another enterprise (Pacheco & Wehrmeyer 2001, p. 18).

8. Results

8.1 Factor analysis based on individual environmental management activities

A factor analysis (Principal Component Analysis) was carried out on the managerial operative activities administered in the questionnaire. Table 7 provides an overview of the results of this analysis for firms' managerial environmental activities. As can be seen from Table 7, four factors were identified in the Principal Component Analysis.

Table 7: Rotated Component Matrix for PCA on Managerial Activities

Item variable Factors	1	2	3	4
Taking environmental performance into account in selection of suppliers	0.157	0.165	0.696	0.231
Placing demands on suppliers to take environmental actions	0.171	0.166	0.655	0.268
Written environmental policy	0.819	0.170	0.03716	0.05939
Procedure for identification and evaluation of relevant legal requirements	0.793	0.04803	0.124	0.204
Initial environmental review	0.618	0.269	0.187	0.03441
Measurable environmental goals	0.603	0.523	0.328	0.04359
Programme to attain measurable environmental goals	0.563	0.555	0.364	-0.03970
Clearly defined responsibilities	0.586	0.133	0.322	0.006404
Environmental training programme	0.417	0.470	0.555	-0.04728
Environmental goals are part of a continuous improvement process	0.449	0.281	0.583	-0.05116
Environmental/HSE data in annual report	0.451	0.523	0.110	0.07010
Separate environmental/HSE report	0.355	0.568	0.05101	0.178
Auditing system to check the environmental programme	0.598	0.556	0.313	0.004432
Use of environmental performance indicators	0.369	0.670	0.201	0.08888
Benchmarking	0.04136	0.678	0.05128	0.275
Eco-labelling	0.07178	0.08284	0.105	0.585
Cooperation with suppliers/customers	0.326	-0.112	0.583	0.369
Informing consumers on environmental effects of products and production processes	0.001753	0.185	0.291	0.633
Market research on potential of green products	0.04953	0.09109	0.03895	0.791
Implementation of product life cycle analysis	-0.06077	0.472	0.429	0.07858

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 8 iterations.

The first factor shows high loadings on the following items[9]:

- 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
- Auditing system to check the environmental programme.

It can be interpreted as "Environmental Administration".

The second factor shows high loadings on the following items:

- Measurable environmental goals
- Program to attain measurable environmental goals
- Environmental/HSE data in annual report
- Separate environmental/HSE report
- Auditing system to check the environmental programme
- Adoption of environmental performance indicators
- Benchmarking.

It can be interpreted as "Environmental Performance".

The third factor shows high loadings on these items:

- Taking environmental performance into account in selection of suppliers
- Placing demands on suppliers to take environmental actions
- Environmental training programme
- Environmental goals are part of a continuous improvement process
- Cooperation with suppliers/customers.

It can therefore be labeled as "Focus on Suppliers".

Finally, the fourth factor shows high loadings on the following items:

- Eco-labelling
- Informing consumers on environmental effects of products and production processes
- Market research on potential of green products.

[9] The KMO measure for the factor analysis was 0.923 which is a sufficiently high value. In addition to this, the individual KMO measures based on the anti-image correlations on the main diagonal of the anti-image correlation matrix were all above 0.77. Therefore the correlation matrix of the data set is considered suitable.

It was interpreted and labeled as “Focus on Consumers”. The factor labels have partly been chosen, since the factors extracted are similar to those found by Harkai and Pataki (2001, p.31) which use the same labels. The first factor above explains 39.2%, the second 8.9%, the third 5.7% and the fourth 5.1% of the total variation encountered in the data.

8.2 Empirical identification of corporate environmental strategies based on the Environmental Shareholder Value concept

In the following, the results of a classification of firms on the basis of CES typologies are presented, based on the concept of Environmental Shareholder Value (Schaltegger & Figge 1998, 1999, 2000). On the basis of a checklist devloped by Figge (2001), which operationalizes the concept of the Environmental Shareholder Value (ESV), a set of questions were developed which asked the companies surveyed to evaluate the influence of their environmental management activities on the value drivers of shareholder value as identified by Rappaport (1995) as well as the value drivers of option value (Trigeorgis 1996). A factor analysis was carried out on eight items operationalising the concept of ESV. Prior to this, responses for each ESV item were standardized by subtracting from the item score the mean for the appropriate sector and country. Doing so is advocated for multi-industry samples by Aragon-Corea (1998, p. 559) who states that in this way, scores are more comparable between sectors since after standardisation, they provide a measure relative to industry mean. Since two countries are included in the research, separate calculation of sector means for each country was necessary. For each standardised ESV item, the mean score is zero.

By means of the factor analysis their responses could be condensed into two underlying factors:

- The first factor can be interpreted as the “value creation” by means of environmental management. This mainly refers to cost reductions, better control of capital-intensive investments and extension of product and process life-times. This factor is characterized by high agreement of respondents to the following items (and thus high factor loadings on the factor):
    - Through eco-products or eco-marketing we can achieve above-average market prices for our current products;
    - Eco-products or eco-marketing help us to sell more of our current products;
    - Environmental management helps us to have lower costs for our processes;

- Environmental management in our company leads to lower capital investments for our current processes;
- Environmental management in our company helps us to utilize better existing equipment;
- Environmental management in our company helps us to create a competitive advantage that is difficult to imitate;
- Environmental management helps our company to better predict its future investments.

- The second factor consists of only one item with a high positive factor loading which refers to variable costs:
  - Through environmental management the proportion of variable costs in our company is higher.

This factor has therefore been termed “risk reduction”, since variable costs are strongly linked to the risk exposure of a company (Figge 2001). Higher variable costs in this imply a lower risk for the company, and therefore a high score on this factor corresponds to a lower environmental risk exposure of the firm. Table 7 below provides information about the variance explained by each factor.

Table 7: Variance explained by factors in Environmental Shareholder Value factor analysis

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.570	44.624	44.624	3.479	43.486	43.486
2	1.125	14.067	58.692	1.216	15.206	58.692
3	0.902	11.272	69.964			
4	0.578	7.225	77.189			
5	0.545	6.818	84.006			
6	0.505	6.309	90.316			
7	0.458	5.731	96.047			
8	0.316	3.953	100.00			

Extraction Method: Principal Component Analysis.

The percentage values provided under the heading “Extraction Sums of Squared Loadings” for each factor refer to the share of the total variance which is explained by the respective factor. The variance explained indicates how much of the variability encountered in the total of the initial variables is explained by the respective factor (Backhaus et al. 2000, 308). For example, the factor "risk reduction" (i.e. the 2nd factor) explains approx. 14% of the total variation in the data. Overall, approx. 59% of the total variation encountered in the data is explained by the three factors extracted.

The following Table 8 reproduces the rotated component matrix of the factor analysis, providing information about the factor loadings of each item on the two relevant factors.

Table 8: Rotated component matrix for Environmental Shareholder Value factor analysis[10]

	Component/Factor	
Item variable	1	2
Through eco-products or eco-marketing we can achieve above-average market prices for our current products (variable code: Q20MSTND)	0.629	0.381
Environmental management helps us to have lower costs for our processes (Q20OSTND)	0.673	-0.434
Eco-products or eco-marketing help us to sell more of our current products (Q20PSTND)	0.694	0.377
Environmental management in our company leads to lower capital investments for our current processes (Q20QSTND)	0.744	0.04846
Environmental management in our company helps us to utilize better existing equipment (Q20RSTND)	0.754	-0.02057
Environmental management in our company helps us to create a competitive advantage that is difficult to imitate (Q20SSTND)	0.729	0.174
Through environmental management the proportion of variable costs in our company is higher (Q20USTND)	0.08587	0.840
Environmental management helps our company to better predict its future investments (Q20XSTND)	0.699	0.04871

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 3 iterations.

A reliability coefficient could only be calculated for the first factor (since for interpretation purposes, for the second factor, only one item was considered – however, when calculating

[10] The KMO measure for the factor analysis was 0.835 which is a sufficiently high value. In addition to this, the individual KMO measures based on the anti-image correlations on the main diagonal of the anti-image correlation matrix were all above 0.6. Therefore the correlation matrix of the data set is considered suitable for carrying out a factor analysis on the data set.

the factor scores for the second factor, the regression method was used and thus the factor loadings for all other items were taken into account). Table 9 reports the results of the item-total statistics of Factor 1.

Table 9: Item-total Statistics for Factor 1 "value creation"

Item-total Statistics

Variable Code (see Table 8 for description)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
Q20MSTND	-,0309	14,7891	,5509	,8128
Q20OSTND	-,0348	14,5927	,4692	,8288
Q20PSTND	-,0242	14,4207	,6243	,8015
Q20QSTND	-,0166	14,7612	,6190	,8034
Q20RSTND	-,0201	14,2459	,6210	,8016
Q20SSTND	-,0118	13,8620	,6259	,8005
Q20XSTND	-,0233	14,5973	,5648	,8107

Reliability Coefficients
N of Cases = 276,0 N of Items = 7
Alpha = ,8313

As can be seen from Table 9, the Alpha is greater 0.8 and also greater than all other Alphas if one item would be deleted. Therefore, the factor is considered sufficiently consistent to be used in the cluster analysis.

The above two factors identified on the basis of the Environmental Shareholder Value items are basic dimensions, according to which firms can be classified with regard to their corporate environmental management behaviour. Per definition, the factors derived in a factor analysis are not correlated with one another. In order to identify groups of firms with similar behaviour (i.e. based on a similar profile in terms of the degree to which the different strategic orientations are pursued by a firm) cluster analysis is an appropriate method to define groups of firms with similar values on the above two factors.

According to (Hair et al. 1998, p. 473) "cluster analysis is the name for a group of multivariate techniques whose primary purpose is to group objects based on the characteristics they possess". According to them, whilst factor analysis is mainly concerned with grouping variables, cluster analysis groups objects. Because of this the researcher's definition of the cluster variate (i.e. the set of variables which represent the characteristics that are used to compare objects, e.g. firms, in the analysis). Hair et al. (1998) state that cluster analysis is descriptive, atheoretical and noninferential and is mainly used as an exploratory technique. Therefore it seems suitable to establish groups of firms with different environmental strategies.

In the current research, cluster analysis was based on the Ward linkage procedure for generating clusters. Ward's method is a "Hierarchical clustering procedure in which the similarity used to join clusters is calculated as the sum of squares between the two clusters summed over all variables. This method has the tendency to result in clusters of approximately equal size due to its minimization of within-group variation." (Hair et al. 1998, p. 473).

According to Backhaus et al. (2000, p. 366), the Ward procedure is suitable if the variables are uncorrelated. This is the case for the above factors. In addition to that, in order to apply the Ward procedure, variables need to be measured on an interval scale, outliers should not exist in the data, the number of elements in each group should be of about equal size, groups should have about even spread and the use of a distance measure is appropriate for establishing similarity of cases (Backhaus et al. 2000, p. 366).

To identify the optimal number of clusters, the algorithm underlying the Ward linkage procedure is based on an improvement of the variance criterion during an incremental change of the clusters. The variance criterion states that the optimal number of clusters is achieved if a further reduction of the number of clusters would result in a considerable increase of the heterogeneity (Kirchgeorg 1990). If the Ward procedure uses the squared Euclidian distance to measure the distances between the objects to be clustered, then use of the Elbow criterion is appropriate which states the optimal number of clusters to be such, that the sum of error squares is minimally increased (Backhaus et al. 2000, p. 360). The Ward linkage procedure is to be preferred over other procedures, since it has been shown in simulations to achieve very good partitions, i.e. to assign cases to the "right" cluster. It is therefore a very reliable fusioning algorithm (Bergs 1981). Based on the Ward procedure and the squared Euclidian distance measure to gauge the distances between the objects to be clustered, the optimal cluster solution should be determined using the Elbow criterion (Backhaus et al. 2000). The cluster analysis as described was carried out on the the two environmental shareholder value factors derived in the factor analyses described above. The result was that the 2-cluster solution was found to be optimal according to the Elbow criterion. Figure 2 below shows the resulting distribution of the two clusters in a coordinate system whose axes are defined by the two factors derived in the factor analysis.

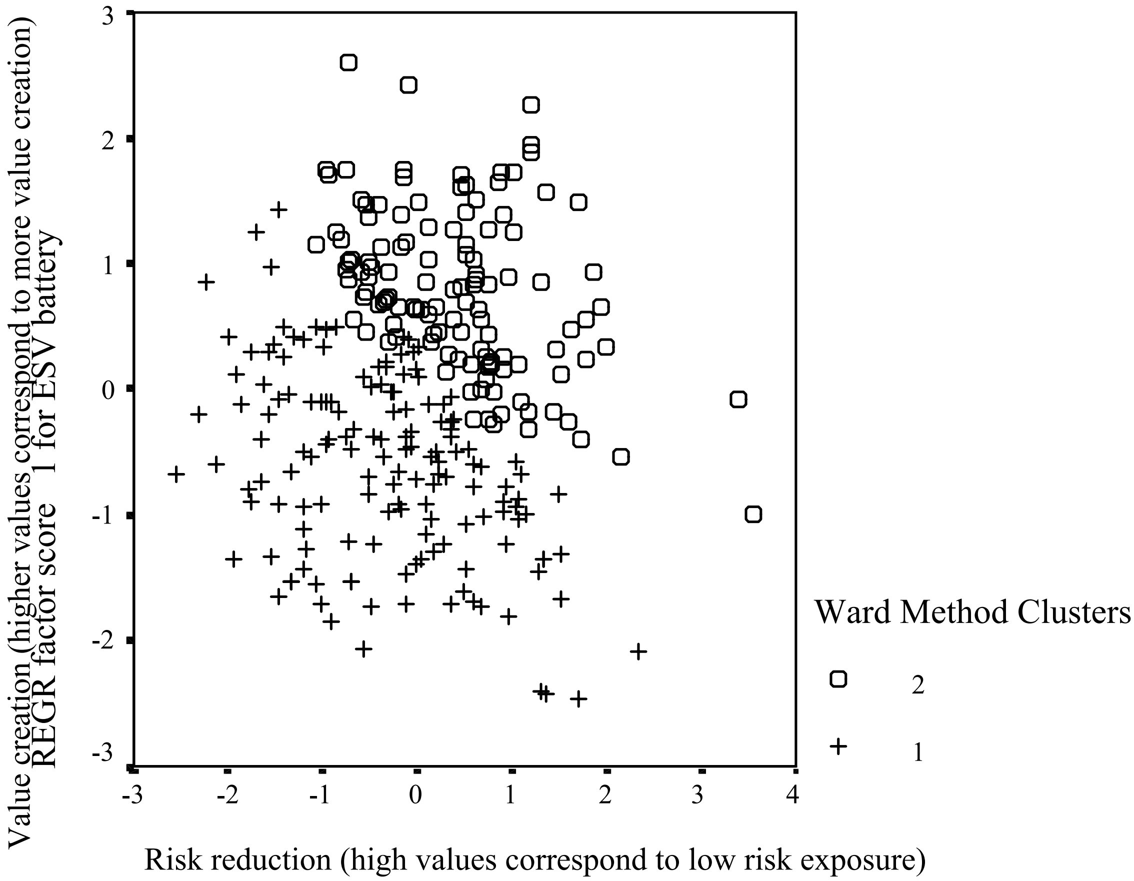

Figure 2: Solution of the cluster analysis for environmental shareholder value factors

Using the same cluster analysis method as described above, a cluster analysis was also carried out based on the eight individual items used to carry out the factor analysis for environmental shareholder value. Other than for the factors, the items can be differently correlated amongst each other, which makes a cluster analysis using the Ward procedure less appropriate due to unequal weight of items in the cluster analysis. However, the results can be compared, providing an indication to the degree of sensitivity which has been done in Table 10 below. As can be seen, in both cases, the 2-Cluster solution which emerged as the optimal solution, is overlapping to a very high degree. This validates the results.

Table 10: Crosstabulation of factor-based and item-based solutions of cluster analysis

		Cluster solution Ward method (item-based)		Total
		1	2	
Cluster solution Ward method (factor-based)	1	137	16	153
	2	16	107	123
Total		153	123	276

The results of the cluster analysis (based on the two factors) is validated further in two ways.

Firstly, the resulting scatterplot shown in Figure 2 is analysed to ascertain that any emerging patterns fit with the theory behind environmental shareholder value. From the scatterplot it can be seen that there is very good agreement of the cluster solution with the theory. A separation line can be imagined running from the top left to the bottom right of the scatter plot. Such a diagonal separation line is also what can be expected from the theory behind environmental shareholder value. The quadrant in the top right of Figure 2 in this would be a “win-win quadrant” where firms simultaneously achieve above average value creation and above average risk reduction. The two quadrants in the top left and the bottom right of the scatter plot are each cut in half by the imagined separation line.

The upper triangles of these two quadrants are those where trade-offs are positive. This means, that firms are above average on one factor, but at the “cost” of being below average on the other factor. However, the degree to which they are below average on this second factor is relatively less than the degree to which firms are above average on the other factor.

In the lower triangles of the two quadrants, the opposite is the case, i.e. trade-offs are negative. This means that firms pay a relatively higher “price” (in terms of being below average) on one factor for being above average on the other factor. Finally, the quadrant in the bottom left represents those firms, that are below average on both factors. From these considerations it can be seen, that the cluster analysis separates well between the group of firms whose corporate environmental strategies are found empirically to either create value or to reduce risk (or both) and the group of firms whose strategies are either not creating much value or are not reducing much their risk, or even worse, do not contribute to either.

Secondly, to validate the cluster solution derived, t-tests were carried out on those items of the questionnaire battery which were not used in the factor and cluster analyses. According to Hair et al. (1998) this validation procedure assesses criterion validity (also called predictive validity) which is the “Ability of clusters to show the expected differences on a variable not used to form the clusters.” (Hair et al. 1998, p. 470). Here this would mean that for the remaining ESV items, values should be significantly higher (based on e.g. t-tests or non-parametric Mann-Whitney tests) for the cluster of ESV-oriented firms. This analysis is summarized in Tables 11 and 12 below. As would be expected from theory, mean scores on each item were significantly higher for the cases allocated to cluster 2, i.e. for those firm with a high ESV orientation.

Table 11 Group Statistics for t-tests

Variable name	*Ward Method cluster*	*N*	*Mean*	*Std. Dev.*	*Std. Error Mean*
Q20MSTND	1	153	-0.4703	0.6012	0.04860
	2	123	0.5938	0.7557	0.06814
Q20NSTND	1	153	-0.4031	0.7201	0.05822
	2	122	0.5033	0.7092	0.06421
Q20OSTND	1	153	-0.2566	0.0294	0.08322
	2	123	0.3369	0.8467	0.07634
Q20PSTND	1	153	-0.4865	0.6108	0.04938
	2	123	0.5990	0.7021	0.06330
Q20QSTND	1	153	-0.4179	0.6067	0.04905
	2	123	0.4966	0.6974	0.06288
Q20RSTND	1	153	-0.4045	0.8089	0.06540
	2	123	0.4878	0.6999	0.06311
Q20SSTND	1	153	-0.4995	0.7695	0.06221
	2	123	0.5872	0.7816	0.07048
Q20TSTND	1	153	-0.4239	0.8922	0.07213
	2	123	0.4830	0.7929	0.07149
Q20USTND	1	153	-0.2827	0.8687	0.07023
	2	123	0.3527	0.6838	0.06166
Q20WSTND	1	152	-0.2828	0.7407	0.06008
	2	123	0.3299	0.7471	0.06736
Q20XSTND	1	153	-0.3807	0.7878	0.06369
	2	123	0.4655	0.7489	0.06752
Q20YSTND	1	153	-0.3791	0.6792	0.05491
	2	123	0.4458	0.7043	0.06351
Q20VSTND	1	153	-0.2351	0.6782	0.05483
	2	123	0.2836	0.6466	0.05830

Table 12: Independent Samples Test (equal variances assumed/not assumed as appropriate)

Item variable	*Equal variances*	*Levene's Test for Equality of Variances*		*t-test for Equality of Means*				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Q20MSTND	assumed	5.814	0.017	-13.030	274	<0.001	-1.0641	0.08167
	not assumed			-12.715	229.951	<0.001	-1.0641	0.08369
Q20NSTND	assumed	0.510	0.476	-10.440	273	<0.001	-0.9064	0.08682
	not assumed			-10.458	261.201	<0.001	-0.9064	0.08667
Q20OSTND	assumed	8.685	0.003	-5.146	274	<0.001	-0.5936	0.1153
	not assumed			-5.256	273.848	<0.001	-0.5936	0.1129
Q20PSTND	assumed	2.252	0.135	-13.726	274	<0.001	-1.0855	0.07908
	not assumed			-13.521	243.338	<0.001	-1.0855	0.08029
Q20QSTND	assumed	3.524	0.062	-11.641	274	<0.001	-0.9145	0.07856
	not assumed			-11.467	243.329	<0.001	-0.9145	0.07975
Q20RSTND	assumed	2.301	0.130	-9.666	274	<0.001	-0.8923	0.09232
	not assumed			-9.818	272.494	<0.001	-0.8923	0.09088
Q20SSTND	assumed	0.517	0.473	-11.580	274	<0.001	-1.0867	0.09384
	not assumed			-11.560	259.651	<0.001	-1.0867	0.09400
Q20TSTND	assumed	2.087	0.150	-8.816	274	<0.001	-0.9069	0.1029
	not assumed			-8.930	271.224	<0.001	-0.9069	0.1016
Q20USTND	assumed	10.550	0.001	-6.626	274	<0.001	-0.6353	0.09588
	not assumed			-6.798	273.890	<0.001	-0.6353	0.09346
Q20WSTND	assumed	<0.001	0.983	-6.795	273	<0.001	-0.6128	0.09018
	not assumed			-6.789	260.247	<0.001	-0.6128	0.09026
Q20XSTND	assumed	2.260	0.134	-9.067	274	<0.001	-0.8463	0.09334
	not assumed			-9.117	266.406	<0.001	-0.8463	0.09282
Q20YSTND	assumed	0.029	0.864	-9.865	274	<0.001	-0.8250	0.08362
	not assumed			-9.826	257.221	<0.001	-0.8250	0.08395
Q20VSTND	assumed	1.399	0.238	-6.448	274	<0.001	-0.5187	0.08045
	not assumed			-6.482	266.130	<0.001	-0.5187	0.08003

The two (successful) validation steps described so far are important, since the items based on the ESV framework are used for the first time in empirical research, and it is thus necessary to ascertain, that they distinguish well between different corporate environmental strategies. Overall, it was possible to identify a cluster of firms with high ESV orientation and one with low ESV orientation in the data and to validate these.

Association between influence factors and adoption of corporate environmental strategies

Assuming that analyzing corporate environmental strategies based on the cluster analysis carried out above is suitable for this research, these are in the following used to address the questions of country, firm size and sector influences raised in Chapter 3. These were:

(v) Is there a link between firm size and firms' strategic orientation / environmental management approach?

(vi) Is there a link between country location and strategic orientation / environmental management approach?

(vii) Is there a link between sector membership and strategic orientation / environmental management approach?

(viii) Is there a link between types of corporate environmental strategies and patterns of observable environmental activities (based on the factors derived above for corporate organizational environmental activities)?

To analyse the effect of country location, sector membership and firm size crosstabulations of these variables with the strategy clusters derived above were made. Subsequently, Chi-Square tests were carried out to establish whether significant associations between any of the influence factors and firms' strategic orientations exist. As the following Table 13 shows, the *clusters are very equally distributed across the two countries*.

Table 13: Crosstabulation of country location and strategic orientation

	Strategic orientation based on cluster analysis		Total
Country	Cluster 1 (low ESV)	Cluster 2 (high ESV)	
UK	73 (47.7%)	50 (40.7%)	123 (44.6%)
Germany	80 (52.3%)	73 (59.3%)	153 (55.4%)
Total	153 (100%)	123 (100%)	276 (100%)

As can be seen from Table 13 about equal shares of firms in Germany and the UK have either a proactive (i.e. high ESV orientation) or reactive (i.e. low ESV orientation) strategy.

The Chi-Square test reported in the next Table 14 which was carried out on the figures from Table 13 also confirms that no significant association exists between country location of a firm and its strategic orientation (i.e. high/low ESV orientation).[11]

Table 14: Test for significant association of country location and strategic orientation

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.376	1	0.241		
Continuity Correction	1.105	1	0.293		
Likelihood Ratio	1.379	1	0.240		
Fisher's Exact Test				0.273	0.147
Linear-by-Linear Association	1.371	1	0.242		
N of Valid Cases	276				

Tests computed only for a 2x2 table. No cells (0.0%) have expected count less than 5. The minimum expected count is 54.82.

Overall, with regard to CES, no significant association with country location was found. The following Table 15 shows the crosstabulation between industry sectors and strategic orientation.

[11] Tests were also carried out on the figures reported in Table 13 based on directional measures (Goodman and Kruskal tau, Uncertainty Coefficient) and based on symmetric measures (Cramer’s V and Contingency Coefficient). In both cases, the respective test statistics were not found to be significant either.

Table 15: Crosstabulation of industry membership and strategic orientation

	Strategic orientation based on cluster analysis		*Total*
Sector of industry	Cluster 1 (low ESV)	Cluster 2 (high ESV)	
food & tobacco	13	11	24
Textile	12	9	21
Pulp & paper	3	1	4
Publishing & printing	17	8	25
Energy, oil products & nuclear fuel	2	1	3
Chemicals & fibres	16	10	26
Rubber & plastic	5	5	10
Non-ferrous mineral products	7	8	15
Metals	21	19	40
Machines & equipment	16	16	32
Electrical & optical equipment	16	16	32
Transport products	14	9	23
Other manufacturing	11	10	21
Total	153	123	276

The Chi-Square test results in Table 16 confirms that *no significant association exists between strategic orientation (i.e. high/low ESV orientation) and sector membership*.[12]

Table 16: Test for significant association of sector membership and strategic orientation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.648	12	0.969
Likelihood Ratio	4.737	12	0.966
Linear-by-Linear Association	0.627	1	0.429
N of Valid Cases	276		

Five cells (19.2%) have expected count less than 5. The minimum expected count is 1.34.

[12] Tests were also carried out on the figures reported in Table 15 based on directional measures (Goodman and Kruskal tau, Uncertainty Coefficient) and based on symmetric measures (Cramer's V and Contingency Coefficient). In both cases, the respective test statistics were not found to be significant either.

Overall, as for country location, no significant association was found between sector membership and strategy orientation of firms (as identified in the cluster analysis). Finally turning to the influence of firm size, the following Table 17 shows the crosstabulation between firm size categories and strategic orientation.

Table 17: Crosstabulation of firm size and strategic orientation

Number of Employees	Strategic orientation based on cluster analysis		Total
	Cluster 1 (low ESV)	Cluster 2 (high ESV)	
10-99	38	29	67
100-249	50	39	89
>250	65	55	120
Total	153	123	276

The Chi-Square test reported in Table 18 confirms that *no significant association exists between strategic orientation (i.e. high/low ESV orientation) and firm size*.[13]

Table 18: Test for significant association of firm size and strategic orientation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.143	2	0.931
Likelihood Ratio	0.143	2	0.931
Linear-by-Linear Association	0.129	1	0.719
N of Valid Cases	276		

No cells (0,0%) have expected count less than 5. The minimum expected count is 29,86.

In summary, regarding the first three of the research questions formulated in Chapter 3, the answer to them is negative. *No significant association was found of firms' strategic orientation (as operationalised by the cluster analyses on the environmental shareholder*

[13] Tests were also carried out on the figures reported in Table 17 based on directional measures (Goodman and Kruskal tau, Uncertainty Coefficient) and based on symmetric measures (Cramer's V and Contingency Coefficient). In both cases, the respective test statistics were not found to be significant either. In addition to that parametric and non-parametric tests (Mann-Whitney, Wilcoxon W, Z, Kolmogorov-Smirnov and Wald-Wolfowitz test) were carried out on the number of people employed as a continuous variable. For none of these, test statistics were significant, assuring, that the choice of firm size categories did not affect Chi-Square test results.

value factors) to country location, industry sector membership and firm size. The implications of these results will be discussed in the next chapter. Prior to this, the *fourth research question* regarding the the *interaction between corporate environmental strategy orientation and organisational environmental activities* of firms (as operationalised by the four underlying factors of environmental management orientation derived above) shall be analysed. The error bars in the following Figure 3 show how the factor mean values for the four factors of organizational environmental activities relate to the two CES cluster groups identified. As can be seen from the non-overlapping error bars, factor scores differ significantly between the two groups only in case of the Supplier Focus factor.

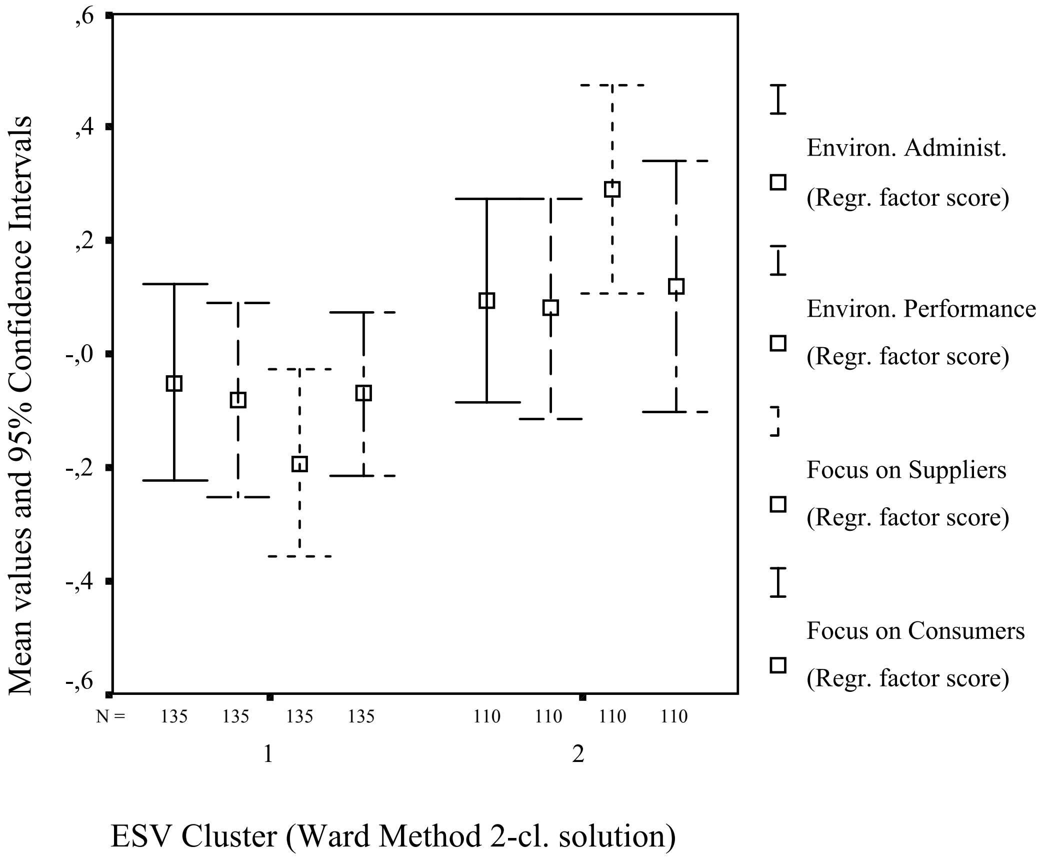

Figure 3: Error bars for environmental activity factors for different cluster groups

Tables 19 and 20 confirm the findings of Figure 3 that only the differences for the factor "Focus on Suppliers" are significantly different between the two clusters. This means, that *firms with a stronger ESV orientation have significantly higher levels of activities towards suppliers*, e.g. concerning taking environmental performance into account in selection of suppliers, placing demands on suppliers to take environmental actions, and with regard to the level of cooperation with suppliers/customers. However, what is noteworthy is that also on all other factors *firms with stronger ESV orientation have higher activity levels, though not at a significant level*.

Table 19: Group Statistics for t-tests on factor scores

Variable name	*Ward cl.*	*N*	*Mean*	*Std. Deviation*	*Std. Error Mean*
REGR factor score Env. Admin.	1	135	-0.050473005	1.0257100	0.08827906
	2	110	0.09466629	0.9593318	0.09146870
REGR factor score Env. Perf.	1	135	-0.082113448	0.9982954	0.08591958
	2	110	0.07976478	1.0363813	0.09881508
REGR factor score Supplier Focus	1	135	-0.01927118	0.9724983	0.08369933
	2	110	0.2918121	0.9713219	0.09261191
REGR factor score Cons. Focus	1	135	-0.070741420	0.8550157	0.07358803
	2	110	0.1189071	1.1721705	0.1117621

Table 20: Independent Samples Test (equal variances assumed/not assumed as appropriate)

Vari-able	*Equal varian-ces*	*Levene's Test for Equality of Variances*		*t-test for Equality of Means*						
		F	Sig.	t	df	Sig. 2-tail.	Mean Diff.	Std. Error Diff.	95% Confidence Interval of Difference	
									Lower	Upper
Env. Admin	assumed	2.353	0.126	-1.134	243	0.258	-0.145	0.128	-0.397	0.107
	not ass.			-1.142	238.388	0.255	-0.145	0.128	-0.396	0.105
Env Perf	assumed	0.679	0.411	-1.241	243	0.216	-0.162	0.130	-0.419	0.095
	not ass.			-1.236	229.440	0.218	-0.162	0.131	-0.420	0.096
Supplier Focus	assumed	0.016	0.901	-3.881	243	<0.001	-0.485	0.125	-0.730	-0.239
	not ass.			-3.881	233.217	<0.001	-0.485	0.125	-0.730	-0.239
Cons. Focus	assumed	16.415	<0.001	-1.462	243	0.145	-0.190	0.130	-0.445	0.066
	not ass.			-1.417	194.293	0.158	-0.190	0.134	-0.454	0.074

9. Discussion, conclusions and alleys for future research

Based on the item battery developed for Environmental Shareholder Value, two underlying factors could be identified using Principal Component Analysis. These were *better processes and production optimization as well as product market and market position improvement* and a factor reflecting *low risk* based mainly on variable costs. This result fits well with theoretical reasoning which proposes to analyse environmental management activities from an economic point of view in terms of the expected value (i.e. the mean) of returns of such activities as well as the risk (i.e. the variance) attached to these returns (Reinhard 1999). Using the above two factors, cluster analysis was applied to identify two very different strategy orientations one representing a high degree of environmental shareholder orientation and the other one a comparatively much lower degree. This also fits very well with the reasoning behind the environmental shareholder value concept (Schaltegger & Figge 1998, 1999, 2000) and was further more validated with additional data. It was found that no significant differences exist between the two clusters identified with regard to firms' country location, industry sector membership or with firm size. This is a necessary, but likely not sufficient condition for unique development path and it strongly makes the case for the argument, that internal factors shape strategy choices much more than external ones (Wehrmeyer et al. 2002 arrive at a very similar conclusion).

Finally, a link was found between environmental activities and the level of ESV orientation (i.e. ESV-oriented firms are more active on all four factors at the operational level), but only for factor "Supplier Focus" this link was found to be significant. Therefore, future research should take into to a larger degree than done so far aspects of environmental supply chain management (Clift 1998; Porter & Esty 1998), since this result indicates that clear differences exist between different CES types with regard to supply chain activities. Also, the impact of different strategic orientations on firms' environmental and economic perfomance is of key importance (see e.g. Wagner 2001) and should be researched in more detail. This particular concerns the interaction of business strategies and corporate environmental strategies and their relationship to firms' environmental performance, and economic performance (see e.g. Porter & van der Linde 1995, Schmidheiny & BCSD 1992). Economic theory provides different perspectives on the relationship between environmental and economic performance from which different predictions about the relationship can be derived. With regard to empirical analyses, Schaltegger and Synnestvedt (2002) argue that this is particularly important. They consider the frequent lack of theoretical foundations for empirical studies regarding the relationship between environmental and economic performance at least equally important as the statistical and data issues discussed. In the current discussion about the relationship between environmental and economic performance of firms it is often argued that there is a conflict between competitiveness of firms (and hence economic performance) and their environmental performance (Walley and Whitehead 1994).[14] For example, this is because at the level of a specific industry, the share of environmental costs in total manufacturing costs might be considerably higher than average (Luken 1997). Also industries upstream in the production chain (such as primary resource extraction or primary manufacturing) have been shown to give rise to environmental impacts disproportionate to the value added associated with their production activities (Clift 1998). Because firms have focused in the past on end-of-pipe technologies as the major approach towards pollution control and environmental performance improvements in general, environmental investments were often seen as an extra cost (Cohen et. al. 1995). In conclusion, the argument made by the sceptical voices is that firms in industries with higher environmental impacts face a competitive disadvantage if stringent environmental regulation burdens them with higher environmental compliance costs, relative to total manufacturing or production costs. This is the commonly held view of neo-classical environmental economics which argues that the purpose of environmental regulation is to correct for negative externalities (which diminish social welfare) and that consequently environmental regulation (in internalizing the costs of the negative externality according to the polluter-pays-principle) will generally impose costs on the polluter (usually a firm).

Only recently has the notion (termed the “revisionist” view) emerged that improved environmental performance is a potential source for competitive advantage as it can lead to more efficient processes, improvements in productivity, lower costs of compliance and new market opportunities (Porter 1991; Porter and van der Linde 1995; Sinclair-Desgagné 1999; Landis Gabel & Sinclair-Desgagné 2001). In this “revisionist” view, environmental regulation is considered “… an industrial policy instrument aimed at increasing the competitiveness of firms, the underlying for this statement being this being that well-designed environmental regulation could force firms to seek innovations that would turn out to be both privately and socially profitable (Sinclair-Desgagné 1999, p. 2)”. The “revisionist” view expands traditional neo-classical environmental economics in assuming that “the link between environmental regulatory policy and the allocation of environmental

[14] Environmental performance is here understood conceptionally as a firm's total impacts on the natural environment, resulting from its total resource consumption and emissions.

resources is complex, multi-step, and imperfect (Landis Gabel & Sinclair-Desgangé 2001). A number of reasons underpin this view. Firstly, as Landis Gabel & Sinclair-Desgagné (2001) argues that it would be "… inconsistent, albeit convenient, to assume that markets are flawed but that firms are perfect (p. 149) and introduces the concept of organizational failures. According to him, these failures "… are analogous in many respects to the probmes of externalities in … market-mediated transactions (Landis Gabel & Sinclair-Desgagné 2001, p. 150)" and " … are relevant to the firm's management as well … since their manifestation is frequently unachieved profit potential (Landis Gabel & Sinclair-Desgagné 2001, p. 150)". Organisational failures are thought to be systematic and caused by e.g. perverse incentives, imperfect information, moral hazard, hidden actions and strategic behaviour. At the same time, (firm-internal, quasi-regulatory) instruments are at hand to address such failures, including contract design, centralization and decentralization of authority, task allocation decisions, accounting systems and monitoring technologies (Landis Gabel & Sinclair-Desgagné 2001). Organisational failure can be seen as a necessary precondition for the existence of so-called "low-hanging fruits" (i.e. cheap incremental innovations). However, "standard neoclassical-economics models [..] do not support the systematic presence of low-hanging fruits (Sinclair-Desgagné 1999, p. 3)" since in these models "[..] innovation itself is not free, and if one prices managerial time and all other inputs correctly at their opportunity costs, it should be come clear that putting stronger environmental requirements on polluting firms generally increases their production cost more than their revenue (Sinclair-Desgagné 1999, p. 2)".

Opposed to traditional neoclassical economics, in the "revisionist" view companies facing higher costs for polluting activities have an incentive to research new technologies and production approaches that can ultimately reduce the costs of compliance since innovations also result in lower production costs e.g. lower input costs due to enhanced resource productivity (Porter & van der Linde 1995). In addition to this companies can gain ``first mover advantages'' from selling their new solutions and innovations to other firms (Esty and Porter, 1998). According to the "revisionist" logic, in a dynamic, longer-term perspective, the ability to innovate and to develop new technologies and production approaches is a greater determinant of competitiveness than traditional factors of competitive advantage (Porter and van der Linde, 1995). The existence of low-hanging fruits "[..] is logically most likely in situations where the firm is far from the efficiency frontier, where the burden of the compliance cost is light, and where the shift to the frontier can be made cheaply (Landis Gabel & Sinclair-Desgangé 2001, p. 152). Based on the two contrasting views outlined so far, two specifications of the direct relationship between environmental performance (measured in terms of resource consumption and emission levels) and economic performance (measured in terms of stock market performance or financial ratios) can be proposed (Wagner 2000). A first possible specification (referring to the "traditionalist" view) would be that the relationship between the two is uniformly negative. This reflects the view of neo-classical economic theory, where pollution abatement measures are predicted to increase production costs and are assumed to have increasing marginal costs (i.e. pollution abatement and environmental performance improvements are assumed to have decreasing marginal net benefits), whereas no cheap innovations are possible. This situation is depicted in Figure 4 below, where high environmental performance (e.g. low normalised emissions and inputs) correspond to low economic performance (i.e. low normalised profitability or market performance) and vice versa.[15] Generally, economic performance would be required, under the circumstances of Figure 4, to be monotonously decreasing with increasing environmental performance, i.e. the first derivative (of economic performance differentiated to environmental performance) is always negative. In addition to that, the second derivative is required to be negative, representing an increasing negative marginal impact of increasing environmental on economic performance.

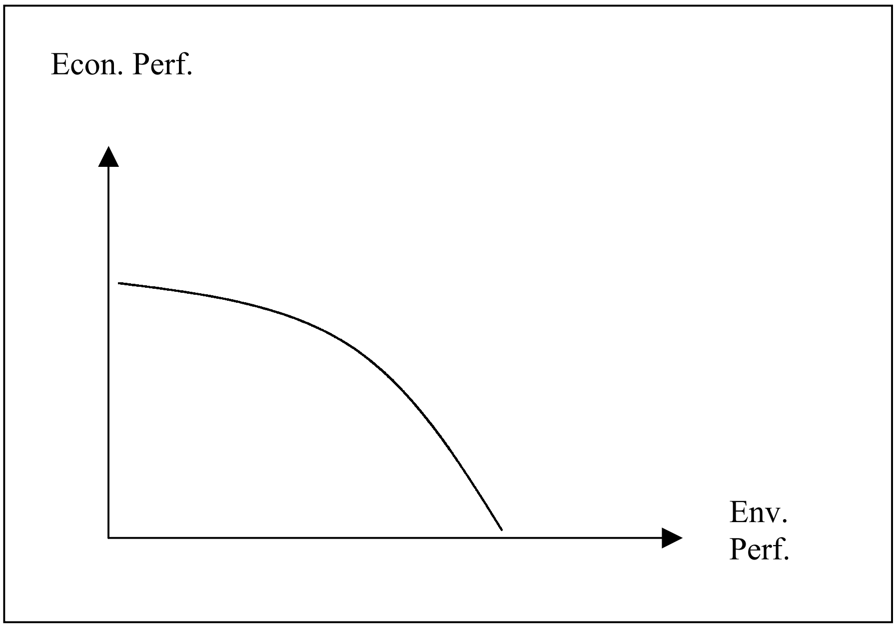

Figure 4: The "traditionalist" view

[15] In the figures, environmental performance can be either an aggregate index of emissions and inputs, or an environmental rating and economic performance can be an individual financial ratio or an aggregate index of financial ratios or stock-market performance.

Under the "revisionist" view, the expected shape of the relationship over the whole spectrum of environmental performance would be an inversely U-shaped curve with an optimum point (i.e. a level of environmental performance, where the benefits for economic performance net the costs for achieving this level are maximised over the whole spectrum). This curve (shown in Figure 5) is upward-sloping for firms with environmental performance below the optimum (which per definition is the point where economic performance is maximized). This means that the benefits reaped from increased environmental performance increase continuously for lower levels of environmental performance. The increasing part of the curve holds up to a certain point around or slightly above average environmental performance[16]. Beyond this point, the relationship is likely represented by a downward sloping curve. The inversely U-shaped curve has a monotonously decreasing first derivative and a negative second derivative (i.e. a decreaseing positive / increasing negative marginal impact on economic performance from increasing environmental performance). In this, the part of the curve which lies to the left of its optimum point is characterised by a positive first derivative and the part of the curve which lies to the right of its optimum is characterised by a negative first derivative and a negative second derivative. This specification of the relationship (representing the “revisionist” view) is depicted in Figure 5.[17]

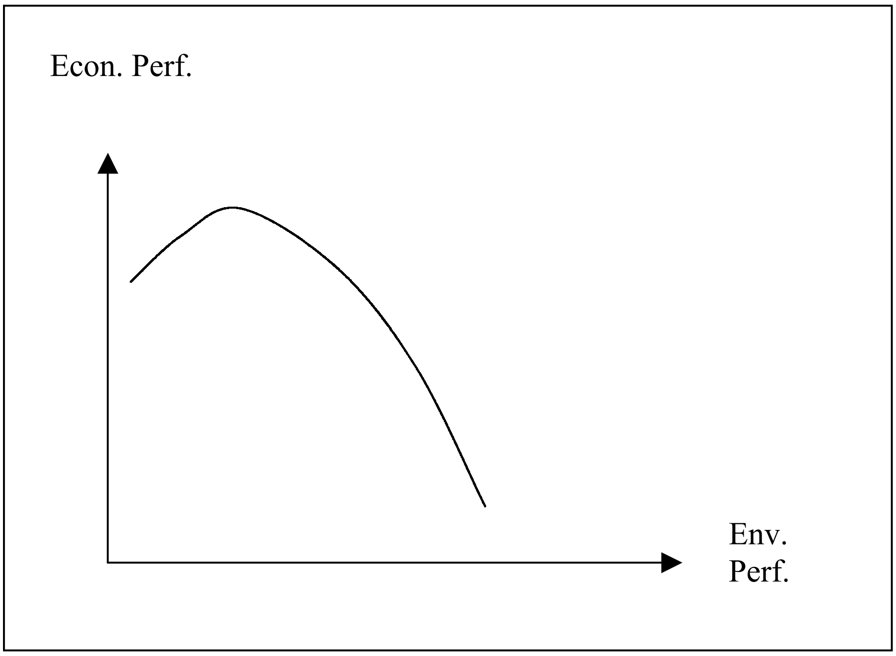

Figure 5: Synthesis of the "traditionalist" and " revisionist" views

[16] It is interesting , where exactly the optimum (i.e. economically efficient) level of environmental performance lies, since this would shed considerable light on the degree to which ‘pollution prevention pays’. However, this is beyond the scope of this exposition of possible specifications and will not be analysed further.
[17] The environmental performance and the economic performance axis are defined as before.

The theoretical literature on the relationship between environmental and economic performance has certainly been much shaped by the work of Porter (1991) and Porter and van der Linde (1995) pointing to the possibility of a positive relationship between environmental and economic performance at the firm level. This proposition (also referred to as the "revisionist" view) has however been challenged. The critics (which adhere to the "conventional" or "traditionalist" view) predict a negative relationship between environmental and economic performance (see e.g. Palmer et al. 1995). Taking a broader view, the two views represent extremes on a continuum, and more recent theoretical contributions to the discussion on the relationship take a more differentiated view (Simpson & Bradford 1996; Romstad 1998; Xepapadeas & De Zeeuw 1999).

The theoretical literature allows to conclude that approaches in economic theory (particularly standard microeconomic theory and the theoretical reasoning behind the Porter hypothesis) propose the relationship between environmental and economic performance to be either monotonously decreasing (as depicted in Figure 4) or to be an inversely U-shaped (i.e. concave) relationship (as depicted in Figure 5). Following the argument made by Schaltegger and Synnestvedt (2002) a inversely U-shaped curve would represent the “best” possible case for the relationship between environmental and economic performance, since it allows for the existence of win-win situations with profitable environmental performance improvement activities, thus referring to the “revisionist” view. On the other hand, a monotonously falling curve would represent the “traditionalist” view. This would correspond to a situation where environmental performance improvements can only increase costs and reduce profits. Under such conditions, the optimal level of environmental performance would be the one prescribed by environmental regulations, i.e. compliance without over-compliance. In summary, the analysis of the theoretical literature on the relationship between environmental and economic performance has therefore resulted in two possible specifications of the relationship between environmental and economic performance, corresponding the “traditionalist”, and the “revisionist” views developed in economic theory. In the future, more attention should be paid to the empirical analysis of this relationship, as well as the influence enviornmental management acitivities and corporate environmental strategies have in this. A possible framework which could form the basis of such analyses and which was first presented in Wagner (2001) is shown in Figure 6. The model in Figure 6 shows the factors considered most important to cause a certain level of environmental and economic performance.

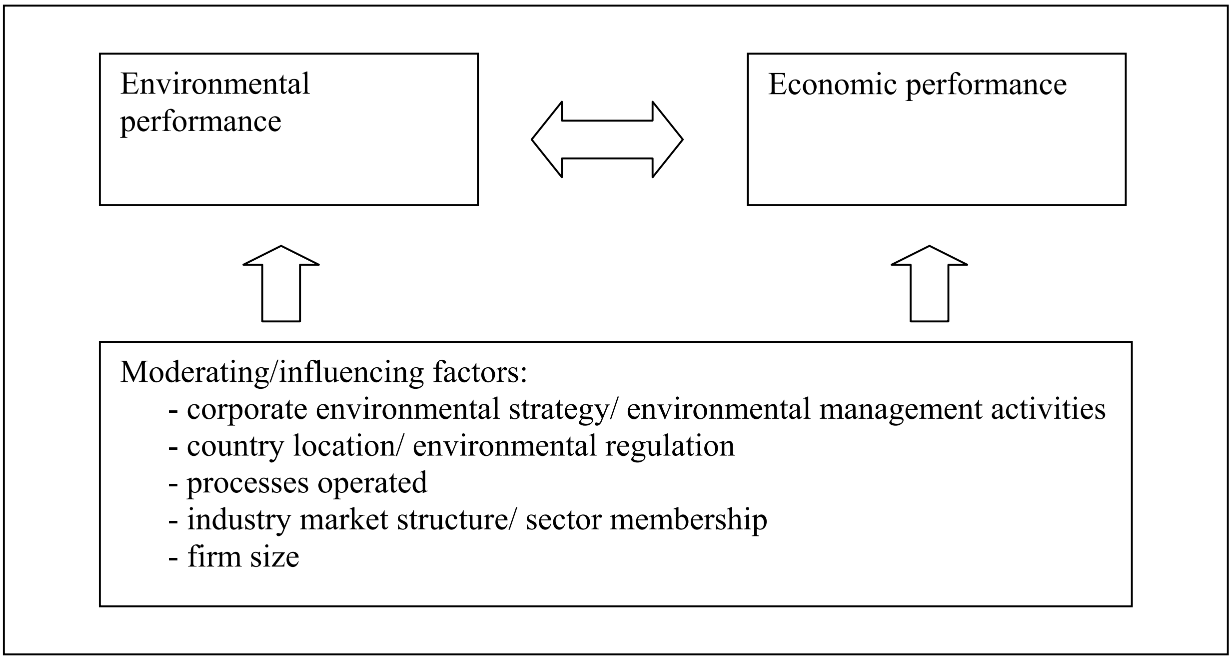

Figure 6: Initial model for the interaction of environmental and economic performance

In the most general form it should be assumed that each of these factors have a simultaneous influence on environmental and economic performance. However, it may well be possible, that each factor can be considered to have a predominant influence on either environmental or economic performance, since the key factors influencing most directly and strongly environmental performance are possibly relatively distinct to these that influence economic performance. Next to the different influences (in terms of directness and strength) the factors at the bottom level have on environmental and economic performance, there is one noteworthy aspect. The (moderating/influencing) factors can also interact amongst each other. For example, firm size could have an influence on corporate environmental strategies/management. If the influences and interaction between any two moderating factors are very direct and/or very strong, they need to be taken into account. They can only be neglected, if the interaction between any two moderating factors are very weak or not significant. As was shown in this paper concerning the interaction of three of the factors, firm size, country location and sector membership with corporate environmental strategies (CES), no significant interaction or association was found. Also, there seems to be only limited interaction between CES and environmental management activities.

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