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Environmental Management Practices: A Framework

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Abstract

The research reported in this paper develops a framework for environmental management practices (EMPs). Specifically, EMPs are grouped into the formal systems that integrate environmental procedures and processes that relate to the operational, tactical and strategic levels of a firm. Content analysis of the environmental reports of 45 multinational firms reveals the validity of the proposed EMP framework. The results of this qualitative study suggest many firms are emphasising a subset of practices at strategic and operational levels but tactical practices remain underutilised. The conceptual framework and results of this study can be used to develop measurement scales to guide additional research and to develop theory in the area of environmental management.

Keywords

Environmental management practices, Performance indicators, Strategy, Tactical, Operations, Content analysis, Theory development

Disciplines

Operations and Supply Chain Management | Organizational Behavior and Theory | Strategic Management Policy | Technology and Innovation

Comments

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Environmental Management Practices

A Framework

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The research reported in this paper develops a framework for environmental management practices (EMPs). Specifically, EMPs are grouped into the formal systems that integrate environmental procedures and processes that relate to the operational, tactical and strategic levels of a firm. Content analysis of the environmental reports of 45 multinational firms reveals the validity of the proposed EMP framework. The results of this qualitative study suggest many firms are emphasising a subset of practices at strategic and operational levels but tactical practices remain underutilised. The conceptual framework and results of this study can be used to develop measurement scales to guide additional research and to develop theory in the area of environmental management.

- Environmental management practices
- Performance indicators
- Strategy
- Tactical
- Operations
- Content analysis
- Theory development

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ENVIRONMENTAL MANAGEMENT PRACTICES (EMPs) ARE BEING EMPLOYED MORE widely as a result of changing business conditions that emphasise environmental performance. Consequently, meaningful and effective tools for measuring environmental performance are increasingly important because of the costs of new environmental technologies, the need for compliance with regulatory pressures and the need to address the concerns of external and internal stakeholders. Additionally, voluntary environmental initiatives such as ISO 14001 of the International Organisation for Standardisation (ISO) and the Business Principles for Sustainable Development of the International Chamber of Commerce (ICC) have impacted firms in recent years (GEMI 1997), causing them to emphasise environmental programmes and EMPs (Corbett and Kirsch 2001).

At present there are a number of different ways to label environmental programmes and systems. These labels include industrial ecology (Arthur D. Little 1991), environmental operations management (EOM; Gupta and Sharma 1996), environmentally conscious manufacturing (ECM; Sarkis and Rasheed 1995) and environmentally responsible manufacturing (ERM; Handfield and Melnyk 1995), to name a few. What these descriptive concepts have overlooked is a more comprehensive typology of the environmental activities corporations practise at multiple levels of the firm. For example, although there may be a number of specific practices that can be found within industrial ecology or environmentally responsible manufacturing, those same practices may not be found within environmental operations management or environmentally conscious manufacturing. The overlap between the different environmental concepts is a good indication of the importance given to these EMPs. The differences between these environmental concepts present an opportunity to better define EMPs.

For the purposes of this study, EMPs are defined as the formal systems that integrate environmental procedures and processes for the training of personnel, for monitoring and controlling environmental impacts and for summarising, integrating and reporting environmental performance. These practices are reported to internal and external stakeholders of the firm. EMPs are internally focused on operational-, tactical- and strategic-level practices that facilitate training, reporting to top management and the setting of environmental goals. The use of this information for external stakeholders is primarily found in annual reports, focuses on the outputs of the firm and is used to enhance the firm's image.

A review of the business literature reveals that academic research is focused mostly on high-level, strategic issues of EMPs relating to sustainable development or descriptions and analyses of specific environmental tools. Much of the research is largely anecdotal and derived from case studies, which do not provide a framework for a comprehensive evaluation of the environmental practices of a firm. The lack of a comprehensive and common definition of EMPs has impeded theory development and the dual objectives of measurement and comprehensive assessment of the impact of EMPs on performance. The research presented in this study is an attempt to fill this gap in the environmental practices literature.

In this paper we develop a framework for defining environmental practices that can be used for measurement and impact assessment purposes. The validity of the suggested framework is evaluated based on data collected from a sample of European and North American firms that have been early adopters of EMPs. The purpose of this study is to provide some insights into why firms are engaged in these activities and to present a more comprehensive framework of EMPs that can be used for the development of theory in the growing field of environmental business research.

In the remaining sections of this paper we review the literature (Section 1) and establish a framework for defining environmental practices comprehensively from a multi-dimensional, hierarchical approach (Section 2). In the next section we discuss

data collection (Section 3) and then provide an analysis and results (Section 4). Finally, in the concluding section, we discuss the results and their implications for future research (Section 5).

1 Literature review

In reviewing the business literature for the growing domain of EMPs, three common features become apparent. First, most articles focus on one of the three levels in which EMPs relate to decision-making: that is, the operational, tactical or strategic level. Second, articles tend to focus on one tool or technique or a small group of tools and techniques (e.g. see Miettinen and Hamalainen 1997). Last, many of the articles are anecdotal or conceptual and there tends to be a lack of empirical emphasis (e.g. Sharfman *et al.* 1997). The literature review presented here further illuminates these three levels of practices and demonstrates the need for a more comprehensive framework.

Before defining the operational, tactical and strategic levels of EMPs, it should be noted that the borders between them are sometimes fluid in practice. Timing, industry and even product family factors may bring about decisions or practices that span more than one level. However, establishing these borders is necessary, as each EMP can be classified as belonging to one of the levels. For the purpose of our discussion, operational decisions refer to the day-to-day decisions and practices of the firm and typically involve personnel at the shop-floor level. These practices include such concepts as scheduling and sequencing. Tactical decisions involve middle managers and affect the medium-term deployment of resources. Examples of tactical decisions include product design and aggregate production planning. Strategic decisions have a long-term impact on the direction of the firm. These decisions typically involve top-management goals and statements regarding how the firm will create value.

Table 1 is not all-inclusive, but presents relevant literature relating to EMPs, organised chronologically and by the principal focus of the articles. The review of the literature and presentation of this review is different from that in other studies involved in similar work such as Angell and Klassen 1999 and Sarkis 2001. Whereas the former studies reviewed the literature to demonstrate the integration of environmental issues into operations management and to identify gaps in the literature for pursuit of future research, our approach is to review the literature and demonstrate a hierarchical framework of environmental practices. As can be discerned from Table 1, the majority of the articles have tended to focus on strategic issues as they relate to the environmental posture of the firm. To a lesser extent, some empirical studies have focused on operational and tactical environmental practices. In reviewing these studies, we can identify multi-dimensional and sometimes overlapping levels of EMPs.

1.1 Operational focus

Research dealing with EMPs from an operational perspective includes themes such as reduction (Hart and Gautam 1996), recycling, re-use of waste through product recovery management (PRM; Thierry *et al.* 1995), pollution prevention (Haines 1993; Royston 1980), emission reductions, employee involvement (Hanna *et al.* 2000) and advanced manufacturing technology (Klassen and Whybark 1999). Royston (1980) discusses economic ways to abate pollution by detecting waste in operating conditions, by establishing material, energy and water balances, by following legislative trends and by predicting future waste treatment costs in the light of present expenses. Some authors have extended these operational practices beyond the scope of a single business to the supply

<i>Reference</i>	<i>Principal issues examined</i>
	OPERATIONAL LEVEL
Royston 1980	<ul style="list-style-type: none"> ▶ Pollution abatement through waste detection ▶ Establishment of material, energy and water balances ▶ Waste detection in operations
Thierry <i>et al.</i> 1995	<ul style="list-style-type: none"> ▶ Product recovery management ▶ Maximisation of economic and ecological value
Klassen and Whybark 1999	<ul style="list-style-type: none"> ▶ Environmental technologies
Hart and Gautam 1996	<ul style="list-style-type: none"> ▶ The link between emission reduction and firm performance
Hanna <i>et al.</i> 2000	<ul style="list-style-type: none"> ▶ Employee involvement in process management and pollution prevention
Klassen 2000	<ul style="list-style-type: none"> ▶ Investments in manufacturing and advanced process technology ▶ Relationship between quality and pollution prevention
	OPERATIONAL AND TACTICAL LEVELS
Haines 1993	<ul style="list-style-type: none"> ▶ Environmental performance and total quality management
Min and Galle 1997	<ul style="list-style-type: none"> ▶ Green purchasing
Carter <i>et al.</i> 1998	<ul style="list-style-type: none"> ▶ Supply chain management practices ▶ Environmental purchasing
Narasimhan and Carter 1998	<ul style="list-style-type: none"> ▶ Environmental supply chain management
Montabon <i>et al.</i> 2000	<ul style="list-style-type: none"> ▶ Supply chain management and purchasing ▶ The ISO 14000 series
Sroufe <i>et al.</i> 2000	<ul style="list-style-type: none"> ▶ New product design processes ▶ Environmentally responsible manufacturing
Angell 2001	<ul style="list-style-type: none"> ▶ The link between the quality initiatives and environmental initiatives of winners of the Baldrige award
	TACTICAL LEVEL
Huang and Hunkeler 1995	<ul style="list-style-type: none"> ▶ Survey of life-cycle assessment and current practices
Epstein 1996	<ul style="list-style-type: none"> ▶ Life-cycle assessment ▶ Steps to better environmental management
Christman 2000	<ul style="list-style-type: none"> ▶ Complimentary assets (process innovation and implementation) ▶ Best practice and cost advantage
Geffen and Rothenberg 2000	<ul style="list-style-type: none"> ▶ Innovation and partnering with suppliers
Verschoor and Reijnders 2000	<ul style="list-style-type: none"> ▶ Environmental monitoring systems
	STRATEGIC LEVEL
Bowman and Haire 1975	<ul style="list-style-type: none"> ▶ Relationship between pollution prevention and corporate performance
McGuire <i>et al.</i> 1988	<ul style="list-style-type: none"> ▶ Corporate social responsibility
Kleiner 1991	<ul style="list-style-type: none"> ▶ Attempt to define 'greenness' ▶ Motivations to comply with regulations or to exercise environmental leadership
Stern 1991	<ul style="list-style-type: none"> ▶ Environmental reputation ▶ Implementation of environmental change
Barrett 1992	<ul style="list-style-type: none"> ▶ Use of game theory to discuss how environmental regulations are formed
Corbett and Van Wassenhove 1993	<ul style="list-style-type: none"> ▶ Firm responses to environmental issues ▶ Corporate environmental behaviour
Dauids 1994	<ul style="list-style-type: none"> ▶ Environmental reporting requirements

Table 1 TYPOLOGY OF ENVIRONMENTAL MANAGEMENT PRACTICES LITERATURE (continued opposite)

Reference	Principal issues examined
	STRATEGIC LEVEL (continued)
Dechant <i>et al.</i> 1994	<ul style="list-style-type: none"> ▶ Five-point plan for environmental responsibility ▶ Environmentalism as a part of organisational strategy
Frause and Colehour 1994	<ul style="list-style-type: none"> ▶ Establishing environmental commitment
Walley and Whitehead 1994	<ul style="list-style-type: none"> ▶ Refutation of the 'win-win' argument ▶ Highlighting of examples of environmental trade-offs
Gupta 1995	<ul style="list-style-type: none"> ▶ Strategic environmental management impacts on operations ▶ Source reduction, pollution prevention and technology
Hart 1995	<ul style="list-style-type: none"> ▶ Natural-resource-based view of the firm ▶ Environmental strategy
Porter and van der Linde 1995	<ul style="list-style-type: none"> ▶ Resource productivity ▶ Innovation offsets
Gallarotti 1996	<ul style="list-style-type: none"> ▶ Effects of stricter government regulations in developed nations ▶ Opportunities for profit from environmentally sound strategies
Klassen and McLaughlin 1996	<ul style="list-style-type: none"> ▶ Event-history analysis of environmental announcements and stock performance
Rondinelli and Vastag 1996	<ul style="list-style-type: none"> ▶ Corporate policy choices based on environmental risks
Sanchez 1997	<ul style="list-style-type: none"> ▶ Relationship between environmental regulation and firm innovation
Hart 1997	<ul style="list-style-type: none"> ▶ States of environmental strategy
Russo and Fouts 1997	<ul style="list-style-type: none"> ▶ Relationship between environmental performance and economic performance
Sharma 2000	<ul style="list-style-type: none"> ▶ Strategic issue interpretation ▶ Corporate choice of environmental strategy
Bansal and Roth 2000	<ul style="list-style-type: none"> ▶ Corporate ecological responsiveness

Table 1 (continued)

chain (Wu and Dunn 1995; Min and Galle 1997). After substantial amounts of waste have been eliminated from processes or supply chains, the next step is to sell as much of the residual for which there is a market as is possible. It appears that operational efforts should be made to convert residual pollutants into useful raw materials. Progressive companies have even gone to the extent of building their own treatment facilities so as to profit from the compatibility of their mixed waste.

Firms that are engaged in EMPs with the limited perspectives of adopting pollution prevention only, or of addressing only waste reduction and compliance, are at the earliest state of the evolutionary progression towards the larger goal of environmental sustainability. What has been overlooked by firms engaged only in operational practices such as design for environment (DfE; Sroufe *et al.* 2000), employee awareness and accountability (Chinander 2001) or product recovery management (Thierry *et al.* 1995) is a more comprehensive approach to the integration of EMPs.

1.2 Tactical focus

Research involving EMPs at the tactical level includes such themes as life-cycle assessment (LCA; Epstein 1996; Huang and Hunkeler 1995), short-term resource acquisition and deployment decisions, innovation and monitoring (Verschoor and Reijnders 2000) and a more comprehensive approach to purchasing and supply chain management (Carter Ellram and Ready 1998; Geffen and Rothenberg 2000; Montabon *et al.* 2000; Narasimhan and Carter 1998; van Hoek 1999).

Christman (2000) attempts to go beyond the boundary of tactical practices by examining how complementary assets such as an ability to be innovative and pollution prevention affects a firm's performance. The argument he presents is congruent with the research presented in this study in that Christman recognises that studying a small group of practices in isolation does not reflect the variety and interactions of the many possible EMPs.

To date, tactical research tends to examine a limited perspective of EMPs, such as process innovation, environmental innovation within the supply chain or tools such as LCA, while overlooking the ability of a firm to integrate operational and tactical practices with strategic implications. Although it is important to examine the efficacy of these individual practices, there needs to be a greater recognition of the wide variety, interaction and interdependency of EMPs available to the firm.

1.3 Strategic focus

Research involving EMPs from a strategic perspective relates to several major themes: corporate responsibility and social performance (Kleiner 1991; Frause and Colehour 1994; Wood 1991), improvements to corporate image and reporting (Davids 1994; Stern 1991), regulations (Barrett 1992; Gallarotti 1996), response to environmental issues and implementation of environmental strategy (Bansal and Roth 2000; Corbett and van Wassenhove 1993; Epstein 1996; Sharma 2000), sustainable development (Hart 1997) and a resource-based view of the firm (Hart 1995; Russo and Fouts 1997). Some of the earlier work in the field by Bowman and Haire (1975) and McGuire *et al.* (1988) discusses EMPs in the context of corporate social performance. Bowman and Haire evaluated annual reports of firms and found positive correlations between return on equity and activities in pollution control. Their work does not address the importance of operational and tactical EMPs that firms often use. Although evidence of the importance of EMPs in corporate social performance had previously been recognised (Wood 1991), the presence of many environmental issues in business research literature did not take place until the mid to late 1990s.

Some strategic-level research focuses on aggregate approaches to environmental business practices such as environmental responsibility, sustainability and resource productivity. Dechant *et al.* (1994) offer a plan for firms to become more environmentally responsible. Hart (1995, 1997) and Rondinelli and Vastag (1996) focus on sustainable development and business opportunities related to sustainability. Hart (1995, 1997) goes on to discuss environmental strategies, such as pollution prevention, product stewardship and development of clean technologies and sustainable development. In an influential and controversial article, Porter and van der Linde (1995) stress the idea of resource productivity and innovation offsets. They refer to innovations that allow firms to use a range of inputs more productively, thus offsetting the costs of environmental impact. According to Porter and van der Linde (1995: 125), 'innovation offsets can take many forms, including more efficient utilisation of particular inputs, better product yields and better products'. Sanchez (1997) also discusses the relationship between innovation and environmental regulation, arguing that managers can influence the effect of environmental regulation on their firm's tendency to innovate. This argument may be considered a parallel to Porter and van der Linde's (1995) argument that regulation can actually inspire innovation if the regulation is created properly.

Research involving the strategic level of the firm encompasses many topics but largely does not address opportunities to subsume other levels of EMPs. Much like the firms studied by Bansal and Roth (2000), research involving environmental strategy typically view environmental issues incrementally and in isolation at one level of the firm. Some articles have taken a more integrative approach to environmental practices. Walley and

Whitehead (1994) discuss a 'trade-off zone', where environmental benefits are weighed against value destruction. They also state that 'environmental issues can be broken down into three broad categories: strategic, operational and technical' (Walley and Whitehead 1994: 50), but they do not explain which EMPs should be in which categories. Gupta (1995) takes a similar approach to assessing the impact of EMPs, covering a wide range of topics and industry examples in discussing how 'environmental management' affects the operations function. Although Gupta attempts to take a more holistic approach, the primary focus is still at the operational level.

Klassen and McLaughlin (1996: 1,199) define environmental management as 'all efforts to minimise the negative environmental impact of the firm's products throughout their life-cycle'. This definition would indicate a need for an integrative view of the tactical, operational and strategic EMPs. Klassen and McLaughlin did not operationalise environmental practices into specific practices from which a firm could choose; instead, they used third-party environmental awards in attempting to measure environmental performance.

1.4 Summary of literature

In summary, many articles are conceptual in nature. The existing EMP literature has a lack of empirical emphasis and there is a dearth of comprehensive research exploring holistic EMPs involving operational, tactical and strategic practices. Of the empirical articles, there is a tendency to rely on third-party evaluations of environmental performance (e.g. the Kinder, Domini & Lydenberg ratings¹) or the use of secondary sources (e.g. the Toxics Release Inventory of the US Environmental Protection Agency [EPA]). A number of anecdotal papers have uncovered EMPs in specific industries, with some papers focusing on waste reduction, some on manufacturing and remanufacturing issues, and yet others on design or strategy. To a great extent, current research has not looked at EMPs from a holistic perspective. Here we find an opportunity to adopt an integrative framework that is based on reported practices and that can further be used to develop and test theories surrounding EMPs. A more comprehensive typology of EMPs demonstrates the importance of practices spanning the tactical, operational and strategic levels of the firm.

2 Environmental management practices

Based on the review of existing literature, knowledge of the researchers and discussions with managers having corporate responsibility for environmental issues, a list of operational, tactical and strategic EMPs was compiled. These practices are listed in the Appendix.

For this study, EMPs are classified as belonging to three categories: operational, tactical and strategic. These groupings represent an attempt to recognise that environmental practices pertain to diverse foci, represent different resource commitments and target a wide range of goals and objectives. For a firm to be committed to environmental management, it must be cognisant of holistic environmental concerns. If a firm is going to commit itself to an environmental initiative, it will be difficult for it to be fully successful unless activities across operational, tactical and strategic practices are co-ordinated and integrated. The three categories may be defined as follows:

1 KLD Research & Analytics, www.kld.com (2003).

- ▶ Operational practices. Operational practices can be grouped into three main categories:
 - Waste reduction, capturing a variety of practices involved in the reduction of material waste, including proactive and reactive recycling, substitution of less-hazardous alternatives, consumption of waste internally, remanufacturing and the finding of a market for waste materials
Resource reduction, involving the conservation of energy, reduction of packaging and the spreading of risk by utilising third-party providers of specialised environmental services
 - Resource allocation, relating to communication of environmental initiatives to operating personnel, money spent on environmental initiatives, the collection and dissemination of environmental information and the setting-up of rewards and incentives to promote environmentally conscious operations
- ▶ Tactical practices. Tactical practices generally involve three types of activity:
 - Supply chain management, involving supply chain management, environmental standards for suppliers, early supplier involvement and environmental audits of suppliers
 - Design and development, involving environmental design, product development, risk analysis, LCA, environmental management systems (EMSS) and environmental goals for design
 - Recognition of environmental performance, including participation in various environmental initiatives and any awards that might be garnered for environmental activities
- ▶ Strategic practices. Strategic practices specify how an organisation will utilise EMPs to compete and how these practices will be implemented and sustained. These are typically a set of objectives, plans and policies established by top managers such as executive officers and vice-presidents. Strategic practices comprise of policies, programmes and environmental awareness as they pertain to the competitive environment and generally refer to a longer time-frame than do operational or tactical practices:
 - Policies and programmes involve having an environmental corporate policy, employee training programmes, long-term planning horizons, mission statements and the presence of environmental departments.
 - Environmental awareness practices include strategic environmental alliances and surveillance of the marketplace for environmental information.

Taken together, these three categories of practices make up a decision set for firms. Although this decision set is not all-inclusive, general management theory would argue that the choices managers make along these three dimensions must be co-ordinated and integrated in order to achieve long-term success (Anthony and Govindarajan 1995). Of interest to practitioners and researchers is the question of how to measure these practices in order to assess their use, effectiveness and relationship to performance.

3 Data collection

Having defined a conceptual framework for EMPs, we then used this framework to compare EMPs across firms that are considered to be environmental leaders. The objective was to collect and analyse qualitative data to test the validity of our framework and to establish the basis for the development of more refined EMP measurement scales.

Our research design utilises secondary data sources and is an exploratory approach to defining and developing EMPs.

Although corporate environmental reports have been questioned as to a need for standardisation (Hopkinson and Whitaker 1998; Young 1996), these reports are 'valuable communication tools', as Jones *et al.* discussed (1999). It is argued that the reports are public statements of firm activities and reported environmental practices (Solomon and Lewis 2002). Further, when looking for EMP data from firms, there are very limited sources of information coming directly from firms (e.g. annual financial reports or annual environmental reports). The use of a mail survey to collect this information was considered. However, this method was rejected in order to avoid converting the survey into several languages, the associated costs and the growing survey fatigue of many practitioners. For the purpose of this study, environmental reports are considered to be public statements made by firms claiming the existence of EMPs within the firm's facilities. Based on these public statements, content analysis can provide new insights that may be available only through new approaches to data collection. Essentially, the nature of the phenomenon under investigation, its novelty and the void in previous research provide an opportunity for qualitative data analysis techniques such as content analysis to build frameworks and develop new theory (Miles and Huberman 1994).

Content analysis was performed on the public statements made by firms in corporate reports. Corporate environmental reports from 1997 and 1998 were collected from multinational companies identified as early adopters of EMPs. The primary criterion used to select the organisations in the study was that they had been recognised and commended for environmental performance in the popular press (*Fortune* 1993; *WSJ* 1997). In addition, some firms were selected based on our knowledge of the firms and their environmental practices. Initially, a list of 96 potential firms was developed. Corporate environmental reports were either downloaded from web pages or requested in hard copy from the individual firms. If a firm did not have a corporate environmental report they were subsequently eliminated from the study. This resulted in a sample of 45 firms, listed in Table 2 (for the composition of the sample by industry type, see Table 3). This 47% response rate (45 firms from a sample size of 96) agrees with the study of Internet-based environmental reporting by Jones *et al.* (1999), who found that 41% of the companies they studied provide little or no environmental information on their corporate websites.

Four student 'raters' were trained to perform the content analysis. Based on comments from Ahuvia (2001) and Neuendorf (2002), the use of student raters was deemed appropriate for manifest content analysis. The discussion in Ahuvia (2001) and Neuendorf (2002) indicates that the use of so-called 'expert' raters is not required for this type of study. Further, Ahuvia discusses that, in many situations, it is preferred that the raters be part of the intended audience of the text. In our study, the audience for the environmental reports is the general public.

The students attended two separate half-day training sessions in which they were briefed on the objectives of the research and trained on how to use the coding sheets used for data collection. In these sessions, the researchers explained the coding process for a sample firm given standard definitions. In between the sessions, the raters were given a subsample of environmental reports to code in order to practise (see the Appendix for the definitions and coding matrices). A rating for each environmental practice was captured on a five-point Likert scale, with 1 meaning a low intensity of involvement with the practice, and 5 meaning a high intensity of involvement. The level of intensity is a qualitative decision the raters made based on the amount of information on an EMP and the magnitude of the evidence for the EMP found within the corporate environmental report. Following the training sessions with the raters, each rater independently completed a coding sheet for each firm in the study based on the environmental reports.

▶ 3M	▶ H.B. Fuller
▶ ABB	▶ Hewlett Packard
▶ American Electric Power Company	▶ IBM
▶ Amoco Corp.	▶ International Paper Company
▶ ARCO	▶ ITT Corporation
▶ AT&T	▶ Johnson & Johnson
▶ Bang & Olufsen	▶ Mead Corporation
▶ BASF	▶ Mobil Corporation
▶ Bethlehem Steel Corporation	▶ Motorola
▶ Bristol-Myers Squibb	▶ Nestlé
▶ Chevron Corporation	▶ Novartis
▶ Compaq	▶ Raytheon
▶ Danfoss	▶ Rockwell
▶ Digital Equipment (Compaq)	▶ Shell Oil Corporation
▶ Dow Chemical Company	▶ SKF
▶ Dupont Company	▶ Statoil
▶ Eastman Chemical Company	▶ Texaco Inc.
▶ Electrolux Group	▶ Texas Instruments
▶ Exxon	▶ Union Camp
▶ Ford Motor Company	▶ Union Carbide Corp.
▶ General Motors Corporation	▶ Weyerhaeuser
▶ Georgia-Pacific	▶ Xerox
▶ Goodyear Tire and Rubber Company	

Table 2 THE 45 FIRMS STUDIED IN THE AUTHORS' SURVEY, LISTED ALPHABETICALLY

Industry	Firms	
	NO.	%
Chemical	5	11.1
Petroleum	8	17.8
Repetitive manufacturing	20	44.4
Pulp and paper	5	11.1
Power generation	2	4.4
Steel	2	4.4
Services	1	2.2
Other	2	4.4
Total	45	100

Note: percentages in the right-hand column do not sum exactly to 100.0 owing to rounding errors.

Table 3 INDUSTRY BREAKDOWN OF THE 45 FIRMS STUDIED IN THE AUTHORS' SURVEY

When all reports were coded, inter-rater reliability analysis was performed by means of standardised item alphas across the raters. Next, we reviewed the work of the raters for completeness and entered the coded data into a database.

4 Analysis and results

To establish reliability across raters of the corporate environmental reports, inter-rater reliabilities were calculated for each of the three planning levels (tactical, operational and strategic) with the standardised item alphas across the four raters as shown in Table 4. Reliability is supported, with the standardised item alphas across raters having single and average interclass correlations within the 95% confidence intervals and *F*-statistic values significant at the 0.05 level.

<i>EMP category</i>	<i>Standardised item alpha</i>	<i>F-statistic</i>
Tactical	0.9246	12.95
Operational	0.9602	24.49
Strategic	0.8572	7.15

Note: all reliabilities are significant at the 0.001 level

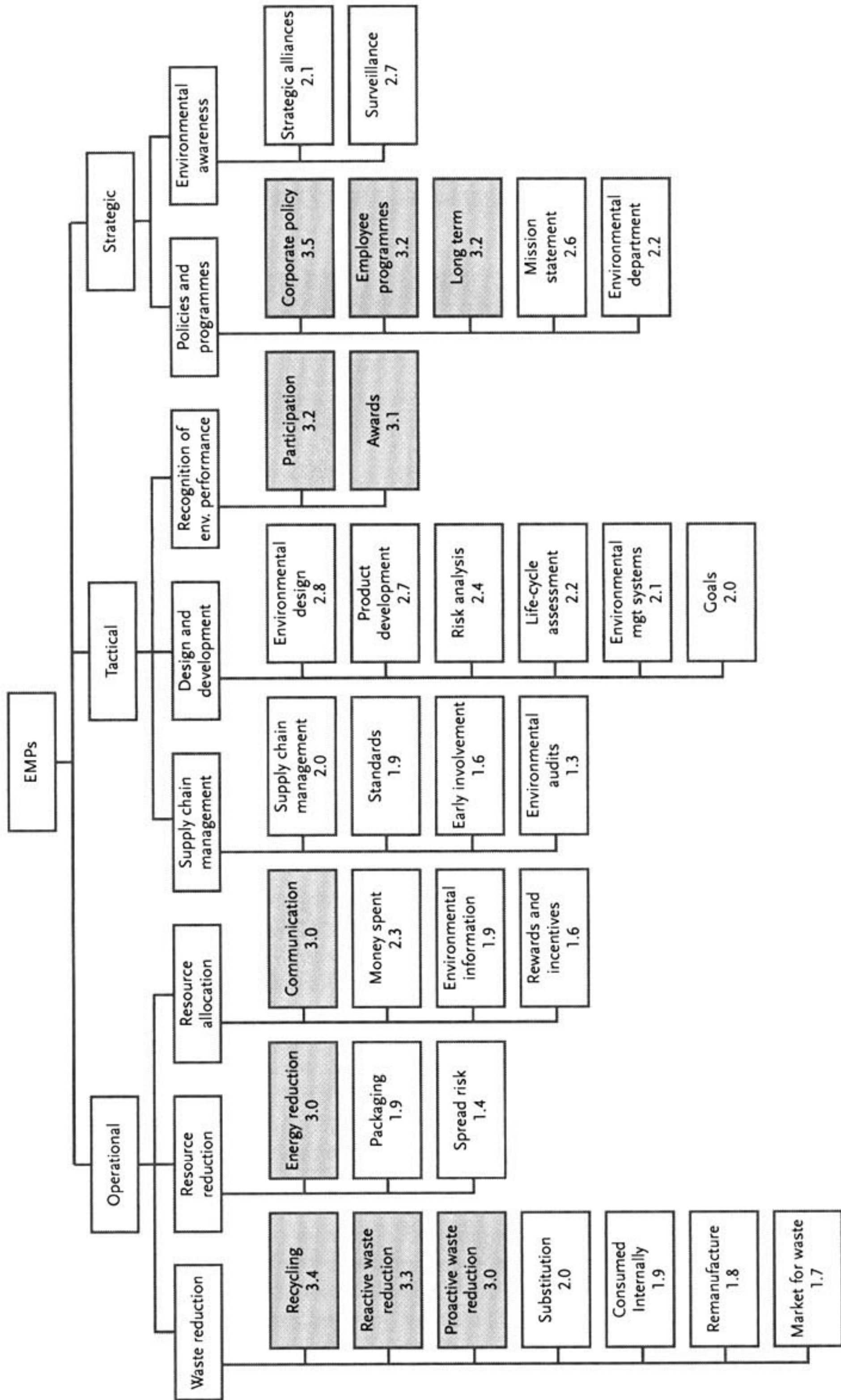
Table 4 INTER-RATER RELIABILITIES FOR EACH OF THE THREE ENVIRONMENTAL MANAGEMENT PRACTICE (EMP) CATEGORIES

The results help to highlight key practices by showing the extent to which individual practices are reported. These practices are indicated by average intensity-of-involvement scores of at least a 3.0. With the Likert scale from 1 (low intensity) to 5 (high intensity), a value of 3.0 was chosen as the cut-off for important practices because it is the mid-point of the intensity scale used by the coders. The practices scoring equal to or greater than 3.0 include waste reduction, resource reduction, resource allocation, recognition, environmental policies and programmes. These EMPs are shown shaded in Figure 1. Specifically, the overall data analysis indicates operational practices such as recycling and proactive and reactive waste reduction, energy reduction and communication of environmental information are the more prevalent practices. Key tactical practices include telling stakeholders that the firm is doing well through the announcement of participation in environmental programmes and awards for this participation. Important strategic practices involve corporate environmental policy, the use of employee programmes and taking a long-term approach to environmental practices.

This typology of EMPs shows that strategic corporate environmental policy received the highest average score of all EMPs, suggesting the importance with which these firms view the development of a corporate environmental policy. Employee programmes to increase awareness of environmental responsibility and a long-term commitment to environmental management also received relatively high scores. Operational practices involving recycling, energy reduction and waste reduction received relatively high average scores, ranging from 3.0 to 3.4. All these practices are relatively easy to implement and quantify, which may account for the prevalence of their use.

The results also indicate that operational practices such as the reporting of environmental information through accounting, the tracking of this information and the rewarding of environmental projects scored relatively low. Based on conversations with managers, the low score for the reporting of environmental information may be attributable to proprietary reasons. The low scores received by rewards and incentives for environmental projects in our study seems to indicate that firms may have these incentive systems in place but do not place much emphasis on reporting these incentives in their environmental reports.

In general, the tactical-level practices are relatively less prevalent than are operational or strategic practices. In the design and development category, environmental design



Practices awarded average scores greater than or equal to 3.0 are shaded.

Figure 1 OVERALL SCORES AWARDED TO THE ENVIRONMENTAL MANAGEMENT PRACTICES (EMPs) OF THE 45 FIRMS SURVEYED

and product developments received moderate emphasis. However, supply chain management practices receive relatively low scores. Tools and techniques such as LCA, EMSs, risk analysis and environmental audits of suppliers and supply chain partners received low scores, suggesting that the potential offered by these techniques remains essentially untapped. Firms looking to improve their performance and 'bottom line' impact might want to stress these, as yet, underdeveloped areas of EMPs.

Despite an increase in academic research and practitioner interest in supply chain management (Mabert and Vendataramanan 1998; Narasimhan and Carter 1998), the supply chain practices studied in this research score relatively low. An interesting result highlighted in Figure 1 is that tactical practices involving supply chain management receive low scores. There are several possible reasons for the low scores for supply chain practices. This may be a reflection of the fact that many firms are still experiencing a learning-curve effect with regard to supply chain management and EMPs. It is possible that other practices to gather 'low-hanging fruit' have more emphasis, or that the timing of our study and the firms involved suggests that firms are at the early stages of integrating EMPs. Additionally, this may be reflective of the sample in that the firms and industries studied may be vertically integrated and own their supply chain members. Also, the reporting of waste reduction and incremental improvement of operational practices may supersede involvement in supply chain management. This is a sign for researchers that more work remains to be done in the area of environmental supply chain management.

Overall, the qualitative information from our content analysis supports the validity of the observation that firms that have been considered leaders in environmental practices are involved in these practices at multiple levels of the firm. Although strategic and operational-level practices are reported more frequently than are tactical-level practices, all the firms studied are involved in EMPs at multiple levels of the firm. To a certain degree, this is consistent with the literature, which tends to concentrate on EMPs at the operational and strategic level while paying less attention to the tactical level. Also, the fact that all of the EMPs were being used to some degree is an interesting result, as one possibility for this study was that some of the EMPs might have been rated as being used very little. Clearly, this did not occur. The firms involved in this study are very large and thus may have an influence on a variety of other firms in their supply chains. Perhaps the size and influence of these firms will cause EMPs to spread to their supply chain partners.

5 Conclusions

The research presented in this paper contributes to environmental management by establishing a comprehensive framework for EMPs. Our framework clearly indicates that a wide variety of EMPs exist and that practices can be found at multiple levels of the firm. Within this paper we have discussed how EMPs can help firms if there is a more comprehensive approach to integrating the practices at all levels compared with an approach that focuses on a single practice or a single level of practices. Our results study show that the EMPs are multi-dimensional and include tactical, operational and strategic activities. It is the combination of these three levels of management practices that help to identify the commitment of a firm to EMPs. Thus, for a firm to claim to be good at environmental management, EMPs should be integrated into monitoring, measuring and managing all levels of the firm. Without this type of an approach, firms will fall short of effectively integrating EMPs and may not realise the full potential of their environmental efforts.

Future research should further refine and operationalise the EMP construct presented here, investigate the extent to which all three levels of practices are necessary before firms realise both environmental and financial improvements in performance and attempt to find the optimal combination of EMPs for specific types of firms or industries.

Limitations of the study include its limited generalisability, the accuracy of corporate environmental reporting, the sample size and the relatively young state of research in the field of EMPs. The generalisability of our findings is limited by the sample size and state of corporate environmental reporting. The accuracy of corporate environmental reporting has been questioned in the past. Given the difficulty in collecting environmental information, there remains conflict in the environmental business research field as to what represents a valid source of information for EMPs. The approach taken in this study is that corporate environmental reports are reliable public statements about EMPs. Though the sample size was small relative to research based on surveys, the relatively new field of research involving EMPs calls for new and unique qualitative and exploratory approaches to content analysis and theory development.

Managers should find the results of this study interesting since the EMPs described in this study are some of the same practices and performance measures that constitute an EMS, and the practices a firm would want to use to benchmark and track. EMSS are directly related to ISO 14001 certification standards, and this was highlighted by several firms in this study as either an achievement or a future goal. Thus, the reported EMPs of a firm can give managers insights into what performance measures and practices are important to stakeholders. Further, this paper shows the importance of looking at operational, tactical and strategic practices simultaneously, rather than just looking at one particular level of practice. Much the same as TQM is described as a philosophy, this type of holistic view of EMPs should help improve and enhance a holistic philosophy of environmental management.

To varying degrees, all the EMPs developed within the EMP framework are used in the firms studied. This would indicate the EMP framework has captured an extensive set of environmental practices. However, in the overall sample averages, none of the EMPs scored a value of 4.0 or greater. These two facts seem to indicate that, although there is definite industry interest in using EMPs, firms are perhaps being either cautious or slow in embracing them. This may indicate that firms are waiting for clear evidence that the cost–benefit ratios of various EMPs are favourable before committing fully to all EMPs, or it may indicate they are committing only to those practices they perceive will have the greatest impact on the firm.

EMPs also affect corporate image and reputation among consumers. For firms seeking a better corporate image, it is reasonable to argue that firms should be able to do two things. First, a firm should be able to measure the extent to which EMPs are adopted relative to its peer group of firms (principal competitors) and, second, it would be useful for firms to identify which of the EMPs are particularly useful in delivering competitive advantage. For research in this area to proceed beyond conceptual discussion of EMPs to development of explanatory and prescriptive models relating EMPs to performance, it is essential to develop a comprehensive view of EMPs.

TQM has been described as a philosophy and a way of transforming an organisation (Curkovic *et al.* 2000). In much the same way, EMPs subsume a philosophy that seeks a similar transformation in the environmental area and subsumes tools and techniques such as recycling, waste reduction, LCA, risk analysis, communication, environmental recognition, corporate policy, mission statements and long-term planning.

As presented here, EMPs are varied and extensive. These practices are available across operational, tactical and strategic levels. Ideally, to better achieve environmental goals, a firm should pursue practices at all three levels. Overall, operational practices are more prevalent than are strategic and tactical practices in the firms looked at in this study.

However, researchers have been concentrating more on the strategic benefits stemming from EMPs. By explicating a framework that includes operational, tactical and strategic levels of the firm, this paper will help practitioners and researchers to develop a more complete picture of EMPs and to integrate this into their future work. Researchers can use the EMP framework to operationalise environmental practice constructs at three levels of the firm. These new constructs can be used to test individual relationships between the constructs, environmental performance and firm performance. Additionally, the EMP framework can be used to find 'best-in-class' firms and to target specific practices having the greatest impact on firm performance.

References

- Ahuvia, A. (2001) 'Traditional, Interpretive and Reception Based Content Analyses: Improving the Ability of Content Analysis to Address Issues of Pragmatic and Theoretical Concerns', *Social Indicators Research* 54.2: 139-72.
- Angell, L. (2001) 'Comparing the Environmental and Quality Initiatives of Baldrige Award Winners', *Production and Operations Management* 10.3 (Autumn 2001): 306-26.
- and R. Klassen (1999) 'Integrating Environmental Issues into the Mainstream: An Agenda for Research in Operations Management', *Journal of Operations Management* 17: 575-98.
- Anthony, R., and V. Govindarajan (1995) *Management Control Systems* (Chicago: Irwin).
- Arthur D. Little (1991) *Industrial Ecology: An Environmental Agenda for Industry* (Cambridge, MA: Arthur D. Little, Centre for Environmental Assurance).
- Bansal, P., and K. Roth (2000) 'Why Corporations Go Green: A Model of Ecological Responsiveness', *Academy of Management Journal* 43.4: 717-36.
- Barrett, S. (1992) 'Strategy and the Environment', *Columbia Journal of World Business* 27: 202-209.
- Bowman, E., and H. Haire (1975) 'A Strategic Posture toward Corporate Social Responsibility', *California Management Review* 8.2: 49.
- Carter, C., L. Ellram and K. Ready (1998) 'Environmental Purchasing', *International Journal of Purchasing and Materials Management* 34.4: 28-28.
- Chinander, K. (2001) 'Aligning Accountability and Awareness for Environmental Performance in Operations', *Production and Operations Management* 10.3: 276-91.
- Christman, P. (2000) 'Effects of Best Practices of Environmental Management on Cost Advantage: The Role of Complimentary Assets', *The Academy of Management Journal* 43.4: 663-80.
- Corbett, C.J., and D.A. Kirsch (2001) 'International Diffusion of ISO 14001', *Production and Operations Management* 10.3 (Autumn 2001): 327-42.
- and L.K. van Wassenhove (1993) 'The Green Fee: Internalising and Operationalising Environmental Issues', *California Management Review* 36.1: 116-29.
- Curkovic, S., S.A. Melnyk, R.B. Handfield and R.J. Calantone (2000) 'Investigating the Linkage between Total Quality Management and Environmentally Responsible Manufacturing', *IEEE Transactions on Engineering Management* 47.4 (November 2000): 1-21.
- Dauids, M. (1994) 'Environmental Strategies: Lean and Green', *Journal of Business Strategy* 15.2 (March/April 1994): 18-19.
- Dechant, K., and B. Altman (1994) 'Environmental Leadership: From Compliance to Competitive Advantage', *Academy of Management Executive* 8.3: 7.
- Epstein, M. (1996) 'You've Got a Great Environmental Strategy: Now What?', *Business Horizons* 39.5: 53-59.
- Fortune* (1993) 'Who Scores Best on the Environment?', *Fortune* 128.2 (26 July 1993): 114.
- Frause, B., and J. Colehour (1994) 'Hot Air, Fast Bucks or True Commitment? Strategies for Transferring Environmental Commitment into a Competitive Advantage', *Total Quality Environmental Management* 3.3: 325-36.
- Gallarotti, G.M. (1996) 'It Pays to be Green: The Managerial Incentive Structure and Environmental Strategy', *Journal of World Business* 30.4: 38-58.
- Geffen, C., and S. Rothenberg (2000) 'Suppliers and Environmental Innovation: The Automotive Paint Process', *International Journal of Operations and Production Management* 20.2: 166-86.
- GEMI (Global Environmental Management Initiative) (1997) *Measuring Environmental Performance: A Primer and Survey of Metrics in Use* (Washington, DC: GEMI).
- Gupta, M. (1995) 'Environmental Management and its Impact on the Operations Function', *International Journal of Operations and Production Management* 15.8: 34-51.

- and K. Sharma (1996) 'Environmental Operations Management: An Opportunity for Improvement', *Production and Inventory Management Journal* 3/1996: 40-46.
- Haines, R.W. (1993) 'Environmental Performance Indicators: Balancing Compliance with Business Economics', *Total Quality Environmental Management* 2.4 (Summer 1993): 367-72.
- Handfield, R., and S. Melnyk (1995) 'Environmentally Responsible Manufacturing', paper presented at the APICS Conference, Orlando, FL, Autumn 1995.
- Hanna, M., W. Newman and P. Johnson (2000) 'Linking Operational and Environmental Improvement through Employee Involvement', *International Journal of Operations and Production Management* 20.2: 148-65.
- Hart, S.L. (1995) 'A Natural-Resource-Based View of the Firm', *Academy of Management Review* 20.4: 986-1,014.
- (1997) 'Beyond Greening: Strategies for a Sustainable World', *Harvard Business Review* 75.1: 66.
- and A. Gautam (1996) 'Does it Pay to be Green? An Empirical Examination of the Relationship between Emission Reduction and Firm Performance', *Business Strategy and the Environment* 5: 30-37.
- Huang, E.A., and D.J. Hunkeler (1995) 'Using Life Cycle Assessments in Large Corporations: A Survey of Current Practices', *Total Quality Environmental Management* 5.2 (Winter 1995): 35-47.
- Hopkinson, P., and M. Whitaker (1998) *Corporate Environmental Reporting and the UNEP/Sustainability Benchmarking Tool* (Bradford, UK: Sustainable Business Publications, University of Bradford).
- Jones, K., T. Alabaster and K. Hetherington (1999) 'Internet-Based Environmental Reporting: Current Trends', *Greener Management International* 26 (Summer 1999): 69-90.
- Klassen, R.D. (2000) 'Explaining the Linkage between Investment in Manufacturing and Environmental Technologies', *International Journal of Operations and Production Management* 20.2: 127-47.
- and C.P. McLaughlin (1996) 'The Impact of Environmental Management on Firm Performance', *Management Science* 42.8 (August 1996): 1,199-214.
- and C. Whybark (1999) 'Environmental Management in Operations: The Selection of Environmental Technologies', *Decision Sciences* 30.9: 601-31.
- Kleiner, A. (1991) 'What Does it Mean to be Green?', *Harvard Business Review* 69.4: 38-47.
- Mabert, V.A., and M.A. Vendataramanan (1998) 'Special Research Focus on Supply Chain Linkages: Challenges for Design and Management in the 21st Century', *Decision Sciences* 29.3: 537-52.
- McGuire, J.B., A. Sungren and T. Schneeweis (1988) 'Corporate Social Responsibility and Firm Performance', *Academy of Management Journal* 31.4: 854-72.
- Miettinen, P., and R. Hamalainen (1997) 'How to Benefit from Decision Analysis in Environmental Life Cycle Assessment (LCA)', *European Journal of Operational Research* 102.2 (16 October 1997): 279-94.
- Miles, M.B., and M.A. Huberman (1994) *Qualitative Data Analysis* (Thousand Oaks, CA: Sage, 2nd edn).
- Min, H., and W.P. Galle (1997) 'Green Purchasing Strategies: Trends and Implications', *International Journal of Purchasing and Materials Management* 33.3: 10-17.
- Montabon, F., S. Melnyk, R. Sroufe and R. Calantone (2000) 'ISO 14000: Assessing its Perceived Impact on Corporate Purchasing Performance', *Journal of Supply Chain Management* 36.2: 4-16.
- Narasimhan, R., and J. Carter (1998) *Environmental Supply Chain Management* (Tempe, AZ: Centre for Advanced Purchasing Studies).
- Neuendorf, K. (2002) *The Content Analysis Guidebook* (Thousand Oaks, CA: Sage).
- Porter, M., and C. van der Linde (1995) 'Green and Competitive: Ending the Stalemate', *Harvard Business Review* 73.5: 120-34.
- Rondinelli, D., and G. Vastag (1996) 'International Environmental Standards and Corporate Policies: An Integrative Framework', *California Management Review* 39.1: 106-22.
- Royston, M.G. (1980) 'Making Pollution Prevention Pay', *Harvard Business Review* 58.6: 6-22.
- Russo, M., and P. Fouts (1997) 'A Resource-Based Perspective on Corporate Environmental Performance and Profitability', *Academy of Management Journal* 40.3: 534.
- Sanchez, C. (1997) 'Environmental Regulation and Firm-Level Innovation', *Business and Society* 36.2: 140.
- Sarkis, J. (2001) 'Manufacturing's Role in Corporate Environmental Sustainability', *International Journal of Operations and Production Management* 21.5-6: 666-86.
- and A. Rasheed (1995) 'Greening the Manufacturing Function', *Business Horizons* 38.5: 17-27.
- Sharfman, M., R. Ellington and M. Meo (1997) 'The Next Step in Becoming "Green": Life-cycle Oriented Environmental Management', *Business Horizons* 40.3 (May/June 1997): 13-22.
- Sharma, S. (2000) 'Management Interpretations and Organisational Context as Predictors of Corporate Choice of Environmental Strategy', *Academy of Management Journal* 43.4: 681-98.
- Solomon, A., and L. Lewis (2002) 'Incentives and Disincentives for Corporate Environmental Disclosure', *Business Strategy and the Environment* 11: 154-69.
- Sroufe, R., S. Curkovic, F. Montabon and S. Melnyk (2000) 'The New Product Design Process and Design for Environment: Crossing the Chasm', *International Journal of Operations and Production Management* 20.2: 267-91.

- Stern, A.J. (1991) 'The Case of Environmental Impasse', *Harvard Business Review* 69.3: 14-24.
- Thierry, M., M. Salomon, J. van Nunen and L. van Wassenhove (1995) 'Strategic Issues in Product Recovery Management', *California Management Review* 37.2: 114-28.
- Van Hoek, R.I. (1999) 'From Reversed Logistics to Green Supply Chains', *Supply Chain Management* 4.3: 129.
- Verschoor, A.H., and L. Reijnders (2000) 'The Environmental Monitoring of Large International Companies: How and What is Monitored and Why', *Journal of Cleaner Production* 9: 43-55.
- Walley, N., and B. Whitehead (1994) 'It's Not Easy Being Green', *Harvard Business Review* 72.3 (May/June 1994): 46-52.
- Wood, D.J. (1991) 'Corporate Social Performance Revisited', *Academy of Management Review* 16.4: 691-718.
- WSJ (*Wall Street Journal*) (1997) 'How Do You Protect an Earth in the Balance? With a Balanced Approach. We're Committed to a Healthy Environment and a Healthy Economy' (three-page advertisement), *Wall Street Journal*, 9 June 1997.
- Wu, H.J., and S.C. Dunn (1995) 'Environmentally Responsible Logistics Systems', *International Journal of Physical Distribution and Logistics Management* 25.2: 20-38.
- Young, C.W. (1996) 'Environmental Performance Indicators for Business', *Eco-management and Auditing* 3: 113-25.

Appendix

A.1 Environmental management practices: definitions and coding sheet

Please remember that there are no right or wrong answers to the report evaluations. We simply need your evaluation of the intensity of involvement by a firm in the following activities and practices.

Key words are in *italics*

Firm:

Rater:

A.1.1 Operational practices

Definitions

1. Recycling: Are they doing it? (yes/no) How long (number of years) have they been doing it? Scope of recycling (office paper [low] vs. production process [high])?
2. Waste reduction (proactive): *Pollution prevention, proactive* Talk in terms of proactive approaches to pollution prevention. Elimination of waste before it is produced. More specific to pollution prevention.
3. Waste reduction (reactive): *Emissions, Reduction* Talk in terms of 'reactive' approaches to reducing waste, i.e., scrubbers, and incinerators, and treatment of waste.
4. Remanufacturing: *Remanufacturing* Rebuilding a product where some of the parts or components are recovered or replaced.
5. Substitution: *Substitution* Replacing a material that can cause environmental problems with another material which is not problematic
6. Consume internally: consume waste or scrap internally. Sometimes done for the generation of electricity, recycle waste into other products.

7. Packaging: *Returnable packaging, Reduced packaging, Recyclable packaging, Environmentally responsible packaging* Using packaging and pallets that can be returned after they are finished being used. New alternative to packaging.
8. Spreading risk: shifting responsibility for environmental problems to a third party or expert better able to deal with issues.
9. Creating a market for waste products: treating waste as an input to another product that can be made and sold at a profit.
10. Energy: *Energy conservation, Efficiency, Recovery, Fuel recovery* Capturing energy that was a previous emission in the form of steam, or heat. Installing energy-efficient equipment, or equipment that can capture previously released energy. Could also include proactive approaches to reduce fuel consumption for logistics activities.
11. Money spent on environmental initiatives: *Resource allocation*, Any statistics or numbers given on resources allocated to environmental activities, or projects?
12. Environmental information: *Cost accounting, Tracking, Capturing* This would include accounting for environmental costs, attempting to put a cost on environmental programmes and projects.
13. Rewards as incentive for environmental project: do they have employee or supplier incentive programmes that reward ideas for environmental improvement?

Coding sheet

<i>Attribute</i>	<i>Yes or no?</i>	<i>Objective measure</i>	<i>Intensity scale*</i>	<i>Notes, page numbers</i>
1. Recycling				
2. Waste reduction (proactive)				
3. Waste reduction (reactive)				
4. Remanufacturing				
5. Substitution				
6. Consume internally				
7. Packaging				
8. Spreading risk				
9. Market for waste				
10. Energy				
11. Money spent on environmental initiatives				
12. Environmental information				
13. Rewards as incentives for environmental project				

* 1 = low; 5 = high

Table A1 OPERATIONAL PRACTICES: CODING SHEET

A.1.2 Tactical practices

Definitions

14. Supply chain management: *Suppliers* When making sourcing decisions are there criteria that include or exclude suppliers based on environmental dimensions? How specific is description of evaluation procedure?
15. Early supplier involvement: *Suppliers* Are suppliers involved in new product design? (yes/no)
16. Environmental standards for suppliers: *Suppliers* (yes/no)
17. Environmental audits of suppliers: *Suppliers, Audit* (yes/no) Are suppliers audited on environmental dimensions?
18. Environmental awards and recognition: *Awards, Corporate citizen* Recognition by government bodies (Federal, State and local), magazines and environmental groups for environmental achievement.
19. Environmental participation: *ISO 14000, Eco-Management and Audit Scheme (EMAS), EPA 33/50, Green Lights, Green Seal, Waste Wise* Participation in OSHA voluntary protection programmes (VPPs), EPA voluntary programmes, ISO 14000
20. Use of life-cycle analysis or design for environment: *Life-cycle (LCA)* (yes/no)
21. Product development and innovation: *Research, Technology transfer, Products and services, Integrate, New product design* Is the company investing in environmental R&D? Number of new products or the extent of product modifications driven by environmental considerations. Environmental factors drive innovation.
22. Design: *Eco-efficient products, Eco-design, Process improvement* Do they mention the stages in which environmental checks are performed? Percentage of products that use environmentally sensitive design processes.
23. Specific design targets: *Goals* Percentage of improvements. Do they quantify environmental design goals?
24. Environmental risk analysis: *Risk, Audit, Prior assessment* Do they assess the risks of materials to the environment, to people?
25. Environmental management systems (EMSS): also called Environmental management information systems (EMISs) If the company is ISO 14000-certified they will have an EMS. Do they talk about an EMS, or EMIS?
26. Communication: communications with stakeholders (stockholders, employees, customers, supplier and community) as to the environmental impacts of the firm and/or the environmental efforts and activities of the firm. How well do they get the word out?

Coding sheet

Attribute	Yes or no?	Objective measure	Intensity scale*	Notes, page numbers
14. Supply chain management				
15. Early supplier involvement				
16. Environmental standards for suppliers				
17. Environmental audits of suppliers				
18. Environmental awards and recognition				
19. Environmental participation				
20. Use of life-cycle analysis or design for environment				
21. Product development and innovation				
22. Design				
23. Specific design targets				
24. Environmental risk analysis				
25. Environmental management systems				
26. Communication				

* 1 = low; 5 = high

Table A2 TACTICAL PRACTICES: CODING SHEET**A.1.3 Strategic practices****Definitions**

27. Integration with long-term business strategy: *Long term, 10-year plan, 20-year plan, Sustainable development, Emergency preparedness, Compliance and reporting, Focused*
28. Corporate policies and procedures: *Integrated management, Precautionary approaches* Extent? Level of detail, extent of involvement throughout the organisation. Compliance, commitment to exceed compliance.
29. Environmental mission statement: *Corporate priority, Strategic, Leadership Mission* or vision statement.
30. Employee programmes: *Education, Employee programmes, Training, Hours of training* Do they mention training programmes, suggestion programmes and the benefits of the programmes? Vague (1) or specific terms (5)? (e.g. x hours of employee training per year, or the number of employees with environmental training)
31. Environmental department or teams (Existence and extent of formal organisational structure): *Environmental team* How high is it in corporate hierarchy? How large a budget does it have? Where do they report to? Number of people?

32. Surveillance of the market for environmental issues: CFC- or PVC-free cars. Do they look for opportunities in the future for environmentally friendly opportunities?
33. Strategic alliances: *Alliances* Alliances with other firms to jointly work on environmental projects.

Coding sheet

Attribute	Yes or no?	Objective measure	Intensity scale*	Notes, page numbers
27. Integration with long-term business strategy				
28. Corporate policies and procedures				
29. Environmental mission statement				
30. Employee programmes				
31. Environmental department or teams				
32. Surveillance of the market for environmental issues				
33. Strategic alliances				

* 1 = low; 5 = high

Table A3 STRATEGIC PRACTICES: CODING SHEET

A.1.4 Performance measures

Definitions

34. Reduction in significant environmental incidents: *Impact* Reduce or prevent the number of spills, or accidents.
35. Environmental certification: ISO 14000, EMAS, Green Seal.
36. Continuous improvement: *Continuous improvement* The firm talks about continuously setting new goals and meeting these goals.
37. Recycling performance: *Recycling* Recycling performance in term of goals met, percentage reductions in recycling of materials (solid, liquid and gas).
38. Customer and shareholder perception of environmental performance: *Customer advise* Do they collect and use feedback from the surrounding community and interest groups?
39. Independent audits of environmental performance: How extensive is it? Independent assessment of performance (outcomes). Who receives the report? (Board, government) How extensively is report published?
40. Waste reduction: categories of waste reduction (solids, liquids, gases) 1 = not in compliance, 5 = exceeding compliance. Numbers given for emission reductions, output measures. How well are they doing relative to goals?

- 41. Resource consumption (water, energy, steam, solids, fuel): usually discuss the reduction in resources consumed for manufacturing practices.
- 42. Cost savings for environmental projects and activities: objective numbers given for the amount of money saved due to proactive environmental activities.
- 43. Return on assets
- 44. Return on investments
- 45. Operating earnings
- 46. Sales growth
- 47. Innovation performance (products): overall, how well have they done in introducing innovations and are they constantly looking for innovations?
- 48. Innovation performance (process): overall, how well have they done in introducing innovations and are they constantly looking for innovations?

Coding sheet

<i>Attribute</i>	<i>Yes or no?</i>	<i>Objective measure</i>	<i>Intensity scale*</i>	<i>Notes, page numbers</i>
34. Reduction in significant environmental incidents				
35. Environmental certification				
36. Continuous improvement				
37. Recycling performance				
38. Customer and shareholder perception of environmental performance				
39. Independent audits of environmental performance				
40. Waste reduction				
41. Resource consumption				
42. Cost savings for environmental projects and activities				
43. Return on assets				
44. Return on investment				
45. Operating earnings				
46. Sales growth				
47. Innovation performance (product)				
48. Innovation performance (process)				

* 1 = low; 5 = high

Table A4 ENVIRONMENTAL, FINANCIAL AND MARKET PERFORMANCE: CODING SHEET