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ENVIRONMENTAL MANAGEMENT ACCOUNTING: ROADBLOCKS ON THE WAY TO THE GREEN AND PLEASANT LAND

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Environmental management accounting (EMA) is concerned with the accounting information needs of managers in relation to corporate activities that affect the environment as well as environment-related impacts on the corporation. It is an area of practice and research that has developed rapidly in the last ten years. This paper briefly considers some of the main conceptual and practical problems encountered in environmental management accounting and challenges and opportunities for the future. It concludes with a call for further case based research studies into investment appraisal, costing and performance management aspects of environmental management accounting. Copyright © 2004 John Wiley & Sons, Ltd and ERP Environment.

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INTRODUCTION

Environmental management accounting (EMA; see Table 1) has received considerable attention in the past few years (Ansari *et al.*, 1997, pp. 4–5; Bennett and James, 1998b; Schaltegger and Burritt, 2000; Gray and Bebbington, 2001). Corporate environmental impacts and incidents are leading to larger monetary consequences for organizations that need to be managed (Schaltegger and Burritt, 2000, p. 31); promotion by international governments and bodies (e.g. Tellus Institute, the United Nations Division for Sustainable Development international experts group on Environmental Management Accounting (UNDSD EMA) and the United Nations Environment Programme (UNEP)) and voluntary acceptance by management of the need to address corporate environmental issues in order to maintain corporate legitimacy (Deegan, 2002). A range of EMA tools are now available for managers (Burritt *et al.*, 2002a; METI, 2002) and regular discussion of EMA

Table 1. What is environmental management accounting?

Source	Definition
Tellus Institute (Graff *et al.*, 1998, pp. 3–4)	Environmental management accounting is the way that businesses account for the material use and environmental costs of their business. Materials accounting is a means of tracking material flows through a facility in order to characterize inputs and outputs for purposes of evaluating both resource efficiency and environmental improvement opportunities. Environmental cost accounting is how environmental costs . . . are identified and allocated to the material flows or other physical aspects of a firm's operations.
International Federation of Accountants (IFAC, 1998, para. 1)	[Environmental management accounting is . . .] the management of environmental and economic performance through the development and implementation of appropriate environment-related accounting systems and practices. While this may include reporting and auditing in some companies, environmental management accounting typically involves life-cycle costing, full cost accounting, benefits assessment, and strategic planning for environmental management.
UNDSD EMA Initiative *http://www.un.org/esa/sustdev/estema1.htm* [19 December 2002]	*Environmental management accounting* serves as a mechanism to identify and measure the full spectrum of *environmental costs* of current production processes and the economic benefits of pollution prevention or cleaner processes, and to integrate these costs and benefits into day-to-day business decision-making.
Bennett and James (1998a, p. 33)	The generation, analysis and use of financial and non-financial information in order to optimize corporate environmental and economic performance and to achieve sustainable business.

developments at conferences and workshops is now the norm.

A fundamental 'environmental' criticism of conventional management accounting is that it largely ignores separate identification, classification, measurement and reporting of environmental information, especially environmental costs. Given the prior tendency of corporations not to highlight their environmental costs various studies have tried to establish

- what are environmental costs (see, e.g., UNDSD, 2001)?
- which environmental costs are potentially important (Bennett and James, 1997)? and
- are environmental costs significant (Ditz *et al.*, 1995)?

To help answer the questions environmental costs have been classified in several different ways. Five classifications seem to have received particular attention, based on

(i) conventional cost accounting (Horngren *et al.*, 2003; Schaltegger and Burritt, 2000) – job and process; direct and indirect; historical and standard; fixed and variable; ordinary and extraordinary;
(ii) measurability (USEPA, 1995a, p. 14) – conventional, indirect hidden, less tangible, contingent; and societal (externalities); measurability has been the focus of many case studies in environmental management accounting;
(iii) quality (Ansari *et al.*, 1997, p. 5) – prevention, assessment (appraisal), control (internal failure) and external failure;
(iv) life cycle and activity (Kreuze and Newell, 1994) – life cycle, research and develop-

ment, design, production, etc.; activity based, unit, batch, product sustaining and facility level costs; and

(v) target audience (Schaltegger and Burritt, 2000; Burritt *et al.*, 2002a, p. 32) – internal (managers and employees); external (shareholders, tax agencies, environment agencies, suppliers, creditors, general public, local communities, NGOs, etc.).

Relevance of environmental costs depends on a range of considerations. These include (i) the management function (e.g. decision making requires future environmental costs of different alternatives; control requires a comparison between expected and actual environmental costs; internal accountability is based on visibility of environmental costs); (ii) the specific decision being made (e.g. capital investment, capacity location or closure, product or process design); (iii) the role of the manager in the value chain (e.g. design or production); (iv) the responsibility level of the manager (e.g. top manager or purchasing manager) and (v) the appraisal system (e.g. individual rewards based on use of achieving budgeted environmental cost as a measure of individual performance).

No attempt is made here to provide a comprehensive review of the literature on EMA – for interested parties a useful starting point is provided by Mathews (1997, 2002) and Bennett and James (1998a), and a wide repository of published information on environmental management accounting is located on the EMARIC web site. Another diverse set of instructive information can be found in the papers of Bennett *et al.* (2002a) from conferences and workshops of EMAN Europe. Also, there is no detailed discussion of particular environmental management accounting-related tools, or environment-related performance indicators.

In this paper, first, for those concerned with the development or promotion of EMA and the ways these have been addressed, a number of constraints or roadblocks are considered. Table 2 outlines a number of key 'environmental' criticisms of conventional management accounting, and considers the ways that such criticism is being addressed in theory and practice. The criticisms include the following:

- environmental costs are assumed not to be important;
- indirect environmental costs are lumped in with general business overheads;
- performance appraisal techniques are too narrow and short term in their focus;
- investment appraisal excludes environmental considerations;
- lack of attention to articulation of stocks and flows;
- the narrow focus on manufacturing;
- dominant financial accounting rules;
- motivational effects and
- absence of accounting for externalities.

Second, challenges and opportunities for the future of EMA are addressed, before conclusions are drawn in relation to potential research opportunities.

KEY PROBLEMS WITH CONVENTIONAL MANAGEMENT ACCOUNTING ON THE ROAD TO A GREEN AND PLEASANT LAND

Academics and practitioners are both responding to problems with conventional management accounting in their search for an improved system – environmental management accounting. These problems are outlined and responses briefly considered below.

Environmental costs are assumed not to be significant

The academic response: define environmental costs in five tiers (USEPA, 1995a). Separately identify and manage significant environmental costs (Ditz *et al.*, 1995).

The response from practice: the majority of cases only consider internal private

Table 2. The environment and criticisms of conventional management accounting

Number	Criticism of conventional management accounting	Way criticism is being addressed – concept	Way criticism is being addressed – practice
1	Environmental costs not considered to be significant	Classify environmental costs into five tiers (USEPA, 1995a). Separately identify and manage significant environmental costs (Ditz *et al.*, 1995)	Majority of cases only consider internal private environmental tier 0 (conventional) and tier 1 (hidden) environmental costs (Graff *et al.*, 1998, p. 11 – 39 cases across a range of industries)
2	Indirect environmental costs 'lumped in' with general business overheads and allocated to cost objects	Identify and measure direct environmental costs. Revise allocation bases separating out indirect environmental costs using activity based costing (resources consumed by activities) to reduce cross-subsidization of 'dirty' products, processes, sites and departments	Most cases address this issue
3	Performance appraisal. Too much focus on single, short term monetary measures of business performance, such as divisional income, product contribution margin and cost reduction. This leads to data manipulation	Balanced scorecard – including long term physical and monetary environmental measures	Insufficient attention to performance appraisal use of environmental management accounting data. Practical implementation of material flow cost accounting illustrates the ways in which accounting centre material costs are manipulated (e.g. by renaming high value materials and misposting, the volume used appears to decline in the cost centre costs) (Eco-effizienz, 2002, p. 2)
4	Investment appraisal excludes environmental considerations	Change cash flows, discount rate and include option values	Almost all projects calculate an NPV for the project. Graff *et al.* (1998, p. 12) – lowest NPV of 24 cases minus US$1.4 mn, highest US$11.6 mn, typical NPV US$10 000 to 100 000
5	Too great a focus on flows rather than stocks (e.g. periodic environmental impacts not environmental stocks, environmental cost reduction rather than profitability improvement)	Integrate accounts to articulate stocks and flows. Depreciation not articulated in UNDSD (2001, p. 6) – claimed to be 'no equivalent' of assets and liabilities in environmental management accounting. Valuation of liabilities in monetary terms for management decision making is examined by the USEPA (1996, p. 13) but only recommended for situations when they might make a difference to the investment appraisal	Environmental assets largely ignored (Earth Sanctuaries). Environmental liabilities not articulated but treated as part of financial accounting. State of Environment Reports not produced by corporations

6	Overemphasis on the costs of manufacturing (production) rather than on other parts of the value chain	Value chain analysis. Life cycle analysis and *life cycle costing* (cradle to grave) Integrated Product Policy (EC, 2001) Supply chain management (e.g. European Information and Communications Technology Industry Association to oblige or encourage producers to supply key data along the product chain in the electronics industry	Value chain analysis. Yakima-Olympia Corporation, a vertically integrated but non-logging forests product company has chosen between clear cutting with feller/skidder/buncher technology or harvester/forwarder technology (Shank and Govindarajan, 1992). Integrated Product Policy (IPP) introduced in European Communities to link business and other stakeholders IPP and supply chain management. For example, European Information and Communications Technology Industry Association to encourage producers to supply key data along the product chain in the electronics industry and End of Life Vehicles Directive leading to strategic alliance to gather information rematerials (International Material Data System)
7	Internal accounting being driven by external professional accountancy rules that ignore environmental impacts, rather than on internal needs for relevant environmental physical and monetary information (Kaplan, 1984)	Relevance of conventional management accounting lost (Kaplan, 1984; Johnson and Kaplan, 1987)	Relevance and use not generally addressed at this stage
8	Motivational issues	Poor motivation during planning, implementation and control (Otley, 2001)	Not widely explored in environmental management accounting
9	Little accounting for externalities (tier 4 'societal' costs) because they are not the direct concern of business (e.g. dryland salinity caused by land clearance) or sustainability	Regulatory mix of policy instruments extended to include self-regulation, collaboration and voluntary initiatives, with a sliding scale of enforcement penalties and policy reversion if business does not demonstrate voluntary commitment (Li, 2001). Introduce 'full cost accounting' environmental management accounting system as a way of reducing regulatory scrutiny and associated penalties.	Most case studies ignore externalities and focus on actual rather than expected private environmental costs of the business Where externalities are calculated (e.g. *ex post* values – travel cost, hedonic pricing, averting behaviour – *ex ante* values – contingent valuation, etc) the quality of information is poor but better than an estimate of zero (Graff, 1998, p. 12)

environmental tier 0 (conventional) and tier 1 (hidden) environmental costs (Graff *et al.*, 1998, p. 11–39 cases across a range of industries).

Indirect environmental costs are lumped in with general business overheads

The academic response: identify and measure direct environmental costs (USEPA, 1995a). Revise allocation bases separating out indirect environmental costs using activity based costing (resources consumed by activities) to reduce cross-subsidization of 'dirty' products, processes, sites and departments.

The response from practice: most case studies address this issue.

Performance appraisal techniques are too narrow and short term in their focus

The academic response: balanced scorecard – including long term physical and monetary environmental measures.

The response from practice: insufficient attention to use in performance appraisal of environmental management accounting data (Burritt *et al.*, 2002b).

Practical implementation of material flow cost accounting illustrates the ways in which cost centre material costs are manipulated (e.g. by renaming high value materials and misposting, the volume used appears to decline in the cost centre, thereby reducing costs) (Eco-effizienz, 2002, p. 2).

Investment appraisal excludes environmental considerations

The academic response: change cash flows, discount rate and include option values.

The response from practice: almost all projects calculate an NPV for the project, but most ignore option values. Graff *et al.* (1998, p. 12) – lowest NPV of 24 cases minus US$1.4 mn, highest US$11.6 mn, typical NPV US$10 000–100 000.

Lack of attention to articulation of stocks and flows

The academic response: integrate accounts to articulate stocks and flows (Schaltegger and Burritt, 2000). Lack of articulation remains; for example, UNDSD (2001, p. 6) claims there to be 'no equivalent' of assets and liabilities in environmental management accounting.

Valuation of liabilities in monetary terms for management decision making is examined by the USEPA (1996, p. 13) but only recommended for situations when they might make a difference to the investment appraisal.

The response from practice: environmental assets are largely ignored (for an exception see Earth Sanctuaries – Burritt and Cummings, 2002). Environmental liabilities are not articulated, instead being treated as part of financial accounting.

A narrow focus on manufacturing

The academic response: value chain analysis. Life cycle analysis and *life cycle costing* (cradle to grave). Integrated Product Policy (EC, 2001; new white paper is due in spring 2003). Supply chain management (e.g. European Information and Communications Technology Industry Association) to oblige or encourage producers to supply key data along the product chain in the electronics industry.

The response from practice: cases explore the wider focus. Value chain analysis. Yakima-Olympia Corporation, a vertically integrated but non-logging forests product company has chosen between clear cutting with feller/skidder/buncher technology or harvester/forwarder technology (Shank and Govindarajan, 1992).

Integrated Product Policy (IPP) introduced in European Communities to link business and other stakeholders.

IPP and supply chain management. For example, European Information and Communications Technology Industry Association to encourage producers to supply key data

along the product chain in the electronics industry and End of Life Vehicles Directive leading to strategic alliance to gather information about materials (International Material Data System).

Dominant financial accounting rules

The academic response: relevance of conventional management accounting lost because of financial accounting rule dominance (Kaplan, 1984; Johnson and Kaplan, 1987).

The response from practice: relevance and use of environmental management accounting is information not generally addressed at this stage.

Motivational effects

The academic response: poor motivation during planning, implementation and control (Otley, 2001).

The response from practice: not yet widely explored in environmental management accounting.

Absence of accounting for externalities and social cost issues (tier 4 social costs)

The academic response: regulatory mix of policy instruments extended to include self-regulation, collaboration and voluntary initiatives, with a sliding scale of enforcement penalties and policy reversion if business does not demonstrate voluntary commitment (Li, 2001). Introduce a 'full cost accounting' environmental management accounting system as a way of reducing regulatory scrutiny and associated penalties.

The response from practice: most case studies ignore externalities and focus on actual rather than expected private environmental costs of the business.

Where externalities are calculated (e.g. *ex post* values – travel cost, hedonic pricing, averting behaviour; *ex ante* values – contingent valuation, etc) the quality of information is poor but better than an estimate of zero (Graff *et al.*, 1998, p. 12).

Given the growing academic and practitioner interest in environmental management accounting, the availability of EMA tools and the promotion activities of various institutions, consideration needs to be given to the challenges that lie ahead. Ten of these are examined briefly in the next section.

SOME CHALLENGES FOR THE FUTURE

Inductive theory and the direction of case studies

A range of case studies in environmental management accounting is gradually being built up, based on experiences of organizations in practice (see Tables 3 and 4). Further case studies are being undertaken in each of the main categories – physical and monetary aspects of environmental cost analysis, investment appraisal, and performance management (including planning and control) in a range of countries and cultures. In time, the number should provide a sufficient base from which some generalizations can be drawn in relation to the observations of management practice in building up sustainable relationships and practices in situations of conflict, competition, cooperation and power differentials. For these purposes it is critical to build up relationships with organizations so that longitudinal research can be undertaken.

Bouma and van der Veen (2002, p. 279) observe that 'Most research in environmental management accounting is prescriptive, contributing to the further development of tools, and often based on a limited number of case studies. Empirical research in environmental management accounting (e.g. Bouma and Walters, 1998) is scarce and is focused more on describing the current state of implementation than on analysing or critically evaluating the effectiveness of the new tools'. Their

Table 3. Environmental management accounting tools available to support management

Focus of environmental management accounting tool	Environmental management accounting tool – concept	Environmental management accounting tool – practical examples
Costing analysis	Identification and allocation of environmental costs (USEPA, 1995a, p. 35)	The common focus of many case studies in environmental management accounting in many countries
	Life cycle costing considers costs traceable to the organization that produced the polluting product (USEPA, 1995a, p. 14; Kreuze and Newell, 1994; Bennett and James, 1997, p. 34; Parker, 2000). Brings suppliers and disposal of product into decision making	European Union take-back provisions (PwC, 2002) based on legislation enacted by the European Commission to address pollution resulting from vehicles that have reached the end of their useful life. Known as the EU End-of-Life Vehicle (ELV) Directive it aims to reduce the percentage of each ELV going to landfill from 25 to 5% by 2015. Free take-back is required. Knowledge about costs and physical data will be critical
	Activity based costing (ABC) (Kreuze and Newell, 1994; Schaltegger and Muller, 1998) recognizes drivers of consumption of environmental resources and allocates to cost objects	Different allocation drivers discussed at an electroplating operation (Haveman and Foecke, 1998). Pohang Iron and Steel Corporation (POSCO), South Korea (Byung-Wook Lee *et al.*, 2002, p. 180) ABC to be introduced
	Hierarchical environmental cost analysis (GEMI, 1994; USEPA, 1995a, p. 19)	The common focus of many case studies in environmental management accounting in many countries
	Material flow cost accounting. Important for business that has a high proportion of materials cost in its overall operating costs (Bennett and James, 1997, p. 34; Strobel and Redman, 1998)	Many cases in Germany, Austria and Japan
	Full environmental cost accounting (FCA), for externalities (USEPA, 1995a, p. 30). Call for renewed effort (Bennett and James, 1997, p. 34; Bebbington *et al.*, 2001; Mathews and Lockhart, 2001)	1995. No examples found of full integration of all internal and external environmental costs into product costing system (USEPA, 1995, p. 26). Ontario Hydro cited as committed to use FCA information in decision making. 2001. BSO/Origin (Dutch), Anglian Water, Wessex Water (UK), Landcare Research (New Zealand) Ltd, Baxter, Interface 'experiments' with FCA are discussed by Bebbington *et al.* (2001) and Howes (2002), but the general response in practice is very limited indeed
	Environmental risk management (USEPA, 1995b, p. 24)	Sensitivity analysis applied to environmental costs at AT&T (USEPA, 1995c)
Investment appraisal	Total cost assessment, multi-criterion assessment, environmental risk assessment (USEPA, 1995b). Pollution prevention (P2/Finance) software developed by Tellus Institute	Ontario Hydro (multi-criteria) Niagara Mohawk Power (option screening)

Table 3. (Continued)

Performance management	Environmental performance indices for business units and facilities	Niagara Mohawk Power's Environmental Performance Index (USEPA, 1995b, p. 37) measures compliance, waste and investments in environmental enhancement (Miakisz, 1992) Rhone-Poulenc, France. Chemicals. Environmental index (Gray and Bebbington, 2001, pp. 103, 147). Monitors waste and forms the basis for charging all waste management costs to line management. Bristol-Myers Squibb, pharmaceuticals, plans to build environmental cost analyses into existing systems of corporate and divisional financial performance review (Parker, 2000, p. 55)
	Individual incentives to achieve environmental goals and track progress	1995. No evidence of a link between poor environmental performance and pay received in most companies (USEPA, 1995b, p. 40). Browning-Ferris Industries (solid waste handlers) is cited as one company using such incentives for up to 33% of pay (USEPA, 1995b, p. 41). 2002. Only a minority of companies collected environmental management accounting information in Japan and Australia in 1998 and few in Japan saw monetary, physical or qualitative information as being relevant to individual staff appraisal (Burritt *et al.*, 2002b, p. 22). Higher figures for were found for Germany, but there was considerable uncertainty about the practicability of environmental cost measures
	Balanced scorecard model of performance evaluation (Kaplan and Norton, 1996) measures performance along a number of dimensions. Internal Waste Tax (Burritt, 1997)	Dow Chemicals, Michigan Division (USEPA, 1995b, p. 43). Internal tax imposed on all waste from plants brought to landfill. Lead to process improvements and reductions in solid waste

recommendation is to gain insight into the spread of EMA practices and to apply EMA theory to the adoption and effectiveness of EMA practices (Bouma and Walters, 1998, p. 279). As a starting point, Bouma and Walters (1998, p. 289) attempt this in the context of environmental cost using contingency theory and institutional theory at operational, model, coalition and value levels. The analysis could be extended to each of the tools of environmental management accounting embodied in a comprehensive system (Burritt *et al.*, 2002a).

Small and medium sized enterprises (SMES) and enterprises in developing countries

Case studies tend to focus on self-selecting organizations (but notice exceptions, e.g. Ditz *et al.*, 1995), usually large or environmentally sensitive organizations, or multi-nationals looking to improve their legitimacy with stakeholders. In larger companies divisional organizational structures can be used to educate and train managers in environmental awareness and later, having internalized this

Table 4. Some available case studies in environmental management accounting

Source	Number of EMA Cases Presented	Sector/Industry/Name (if available)
ICAA, EA, VicEPA, Sydney, October 2002[1]	• 4 Australian	• Private/Education/Methodist Ladies College, Perth • Private/Plastic Injection/Cormack Manufacturing • Private/Internal services to divisions/AMP Services • Private/Wool manufacturing – carbonising/Michell Group
UN DSD EMA, Lund Sweden, December 2002[2]	• 12 Austrian • 1 Zimbabwe • 1 South Africa • 5 Costa Rica • 1 Romania • 1 Hungary • 1 Slovakia • 2 South Korea	• Private/Banking, Brewery, Energy, Pulp and Paper, Galvanising, Skiing, Water Treatment • Private/Particle and fibreboard/Zimboard Mutare • Private/Mining, – 4 sectors • Private/Poultry, Labels, PVC products, coffee mill, pasta/Pipasa, Etipres, Resintech, Coopronarango, Roma Prince • Public sector/Water authority • Private/Chemicals/Nitrokemia • Private/Cardboard production • Private/Steel, health care/POSCO, Yuhan-Kimberley
UN DSD EMA, Bristol UK, February (UNDSD2002b, 2)	• 1 Canada • 3 Slovakia	• Private/Pulp and paper mill/Mackenzie paper Division, Abitibi-Consolidated Corporation • Private/Pulp and paper; railway carriage repair; cardboard manufacturer
EMAN Europe, Bristol, UK, February 2002	• 11 Austria • 14 UK	• Private/Pilot projects • Private/Survey
Kokubu and Nakajima (2003) /IMU	• 6 Japan	• Private/Various/Material flow costing in: Nitto Denko, Canon, Tanabe Seiyaku, Takiron, Nippon Paint, Shionogi
Gago (2002)	• 11 Spain	• Private/Wood boards, bricks, wood pulp, oil refining/Co-generation of energy supply in unnamed companies
EMAN Asia Pacific, Kobe, Japan September 2001	• 3 Korea • 1 Philippines	• Private/steel, electronics, chemicals/POSCO, Samsung, LG Chemicals • Private/conglomerate/Lopez Group
Graff *et al.* (1998)	• 39 Cases	• Private/Chemicals; metal finishing, fabrication; printing; electronics; paper; electrical utilities, other./24 capital investments; 9 product/process costing; 6 strategic planning
Bennett and James (1998b) The Green Bottom Line (pp. 294–372) – various authors	• USA • Canada • Switzerland • USA • UK	• Private/medical products and technologies (Cost-benefit analysis)/Baxter International • Public sector/Ontario Hydro • Private/Electric utility (Full cost accounting), machinery and engineering (Identification of environmental costs)/Sultzer Hydro • Private/(Xerox Ltd/Packaging use by document company (Product life cycle costing) • Private/waste disposal in agrochemicals division (Conventional tracking and allocation)/Xeneca

[1] Available at the Department of Environment and Heritage web site *http://www.deh.gov.au/industry/finance/publications/project.html.*
[2] Available by contacting the United Nations Expert Working Group through *http://www.un.org/esa/sustdev/sdissues/technology/estema1.htm.*

awareness, they will be equipped to run the total business.

Existing case studies in environmental management accounting are useful for understanding environmental costs, material flows and the potential for environmental management accounting. However, if the vast majority of businesses (small and medium sized and in developing countries) are not engaged in the process a holistic approach to addressing corporate environmental issues will not result, one that is essential if environmental problems are to be enthusiastically and successfully addressed. Diffusion of environmental management accounting (see e.g. Osborn *et al.*, 2002) requires the 'succession' factor with SMEs and developing countries to be taken into account.

Beyond win–win

Theoretical developments are needed to help guide practice and policy makers beyond win–win outcomes. The conventional view that many environmental impacts of business lead to net costs to business, and will not lead to win–win outcomes, has not gone away. Case studies look for the win–win outcome, only implicitly considering choice situations when there is a net cost to the business. Case studies where there is a trade-off between environmental and economic, or environmental and social, outcomes would be invaluable, because they would help generate a new mind set for managers where it is permitted for the environment to be seen as the key pillar of sustainability on some occasions.

Is pure physical information environmental management accounting information?

Balanced scorecards can be relevant for particular purposes, for example calculation of various eco-efficiency, eco-effectiveness and eco-equity measures. However, engendering a philosophy of corporate conservation of environmental resources may require a periodic, sequential focus solely on environmental indicators. In these circumstances relevant scorecards will be more important than balanced scorecards. For example, through ecological footprints[1] (Barrett and Scott, 2001) and rucksacks[2] (Chambers and Lewis, 2001), business may wish to empower its employees with the thought that their actions can help conserve the environment in their workplace, or make customers aware of their environmental footprint when, for example, they take a flight (e.g. the SAS emission calculator at http://sasems.port.se). In Australia, VictoriaEPA (2002) has established a series of pilot partnerships to investigate the potential development and application of eco-footprints to business, and to develop a robust method as a tool to measure and communicate the progress of business towards sustainability (see http://www.epa.vic.gov.au/eco-footprint/paint_factory.asp).

The implication is that pure physical information can be regarded as environmental management accounting, but that this would only form part of comprehensive system. Effort has been put into establishing whether information for accountants and environmental managers is systematically gathered and used. Using a

[1] Footprints are useful because they provide a single measure of environmental performance, represent a bottom up indicator of sustainability and can be linked with other performance measures, such as eco-efficiency. However, as with all indicators of environmental performance, poor data quality is a problem, boundaries to life cycle analysis are arbitrary and the focus is on resource consumption rather than pollution. Disaggregate information may be more useful (e.g. when assessing a renewable energy proposal).

[2] Recall that an ecological rucksack is the material input used to obtain a product (service) minus the weight of the product itself. The material input is defined as the life cycle wide total quantity (in kg) of natural material moved (physically displaced) by humans in order to generate a product or service (EEA, 1999). The rucksack identifies hidden material movement. For example, in order to make one ton of aluminium it takes about 4.8 tons of bauxite. In order to extract one ton of bauxite, however, some 0.6 tons of topsoil must typically be removed. So far, this makes for a 'rucksack' of $(4.8 \times 1.6) - 1 = 6.8$ tons of moved material per ton of aluminium. To make the aluminium, however, various other materials are also required as auxiliary inputs. The total 'rucksack', counting these materials but not the materials moved to provide energy for the processes, has been estimated by Wuppertal Institute researchers at some 8.6 tons per ton of aluminium. The rucksack must be identified prior to any costing process or competitive advantage.

narrow definition of environmental management accounting relating to internal decision support provided by financial data, Bartolomeo *et al.* (2000, p. 39) summarized the situation in Germany, Italy, the Netherlands and the UK and compared this with the USA. They found from a series of case studies in Europe that the financial benefits of introducing comprehensive environmental management accounting systems are not usually justified. Instead, they suggest that business piggy-back environment management accounting on other systematic changes, such as the introduction of activity based costing.

It was also noted that in the UK and US business tends to look for short term monetary gains from environmental projects, whereas in Germany, Italy and the Netherlands longer term benefits of eco-balancing and broad stakeholder responsibility are to the fore (Bartolomeo *et al.*, 2000, p. 47), although there is some evidence of convergence. In contrast, evidence in Australia (Wilmshurst and Frost, 2001, p. 143) indicates that the basic structure for recording *monetary* environmental information already exists, even though environmental costs are not separately recorded in practice. But there is little active involvement by accountants in corporate environmental management either individually, or as members of the environmental management team.

What remains as an issue is identification of the circumstances in which a comprehensive environmental management accounting system is, or should be, of benefit to the business (see Solomons, 1965, for an early insight and Johnson and Kaplan, 1987, and Kaplan and Norton, 1996, for recent views).

Software systems

Development of cheap but reliable and high quality software systems will be one aid to the take-up of environmental management accounting by smaller businesses. In a useful survey, the following questions were addressed (USEPA, 1995b).

- What tools and software systems encourage and allow a comprehensive coverage of environmental costs?
- What tools and software systems support life-cycle costing (LCC)?
- What directions might software and tool developers explore to critically evaluate and modify their products in light of new information and needs?
- What are appropriate research directions based on the current state and limitations of the available tools and software?

An up to date summary of developments since 1995 is overdue. Current packages such as the PT Laser Systems Dynamics Model can be used to integrate environmental and materials balance analysis, full cost accounting, life cycle economic evaluation of options and sensitivity/influence analysis (see http://www.sylvatica.com/ptlaser.htm). Another program, TCAce, currently under revision (see http://www.earthshift.com/tcace.htm), makes provision for all tiers of environmental costs, including societal costs. Software packages are only as good as the quality of the information that they produce and the links between quality of data and available software need to be synthesized for practitioners (e.g. the practice of using averaging of data is a criticism of life cycle assessment packages) (Schaltegger and Burritt, 2000, p. 249). Studies providing practical guidance with and lessons on implementation of software would be invaluable for the acceptance of environmental management accounting by business, and of the role of the internet in environmental management accounting, could be examined.

Is the distinction between internal and external stakeholders useful?

The contention that environmental management accounting has a focus on internal uses of information is complicated when it is recognized that as part of the management

process detailed internal information is sometimes shared with management of some parties conventionally considered to be outside the organization: for example, provision of information to suppliers and customers as part of the business process (Schaltegger *et al.*, 2002).

For example, studies of environmental supply chain management explore this relationship. McDaniel (2000) provides practical guidance for managers of environmental issues through establishing partnerships, alliances and cooperations with upstream and downstream activities (suppliers, distributors, shippers, customers etc.). The study observes that most supply chain managers do not focus on environmental concerns, one reason being that the frequency and magnitude of environmental costs are hidden by cost accounting systems (McDaniel, 2000, p. iv). Without information about these environmental costs management decisions related to converting suppliers into *service providers* are unlikely to occur. For example, a chemical service provider might purchase and deliver chemicals, charge out drums, repackage chemicals and deliver chemicals to the point of use, provide data for some environmental reports, undertake research for chemical substitutes, process efficiency improvements and manage waste disposal (Votta *et al.*, 1998; Whaley and Johnson, 2001). Perceived environmental advantages from converting supplies into services, and growing take-back requirements in Europe and elsewhere, encourage further studies in the cross-over between internal and external relationships (Lippmann, 2001, p. 14).

Internal and external stakeholder issues also arise in the context of understanding the difference between environmental management accounting and environmental cost accounting. For example, Howes (2002, p. 3) provides an introduction and practical guide to environmental cost accounting divided into two parts – internal environmental cost accounting and external environmental cost accounting. Analysis is not based on the conventional distinction between accounting information for internal and external stakeholders. Internal is taken to mean actual environment related expenditure, while external is taken to mean *calculated estimates* of externalities that would be needed to reduce business environmental impacts to a socially acceptable level (Howes, 2002, p. 27).

Another example also illustrates the problems that exist with basic terminological issues. UNDSD (2001, p. 5) suggests that cost accounting is also called management accounting and is the central tool for internal management decisions. Yet it is also argued that cost accounting is based on data obtained from financial accounting, and the UNDSD acknowledges that financial accounting is mainly designed for meeting the needs of external rather than internal stakeholders. In contrast, Ansari *et al.* (1997, p. 19) suggest that environmental costs should be measured from the perspective of quality management – based on prevention, appraisal, internal and external failure categories. No recognition is given to the possible impact of financial accounting, through external cost accounting rules (or standards), on the resulting figures. Finally, Schaltegger and Burritt (2000, pp. 107–109) suggest that environmental cost accounting should be a core component of environmental management accounting, while recognizing that financial accounting practice, through the imposition of arbitrary rules in cost accounting, can adversely influence management accounting information.

In summary, there is progress in understanding the links between environmental management accounting, management accounting and financial accounting. However, links between environmental cost accounting and environmental management accounting remain confusing and open to further clarification through research into and assessment of the internal/external classification of environmental management accounting information use.

Performance management

Performance measurement and appraisal systems are described by Gray and Bebbington (2001, p. 59) as the points at which, if the organization is serious about environmental impact, consideration of the environment flows into all procedures and policies of a business:

> Most *critically* environmental issues must become a core factor in the design and operation of the financial system and the system of performance appraisal, incentives and rewards.

Gray and Bebbington (2001, p. 59) observe that there has been a great deal of empty rhetoric in this area.

Performance appraisal that does not include environment-related impacts of individuals and organizational units (profit centres or cost objects) is unlikely to produce the behaviour desired by a committed top management. This area clearly deserves further research work. Use of environmental indicators in performance appraisal systems remains at an early stage of development.

Should business try to assess externalities?

A gap continues to exist between the theory of full cost accounting (e.g. Bebbington *et al.*, 2001) and the practice whereby business does not commit to identifying externalities.

Slow adoption of full cost accounting for externalities is linked to the competitive process. For example, Ontario Hydro, an energy provider, was cited as an exemplar of an organization that identified and accounted for externalities in its planning and investment decisions (Epstein, 1996; Boone and Howes, 1996; Mathews and Lockhart, 2001). These full costs were seen as the cost of doing business, but corporatization and competition mean that consideration of externalities becomes a luxury.

A number of ways of encouraging business to include externalities in their decision making have been suggested (Bebbington *et al.*, 2001, p. 16; Gray, 2001, pp. 12–14), but lack of adoption in a competitive situation means that non-voluntary approaches are likely to be needed.

One question raised is whether environmental management accounting is a voluntary management tool designed to help managers, or a tool of social policy where government imposes its way. In the USA cost accounting standards, specific measurement rules, were introduced to stop adverse payouts to companies that used accounting fiction when claiming money against government contracts – yet management accounting is still portrayed as a voluntary initiative. Involvement of various groups in the promotion of environmental management accounting could be because of the desire for externalities to be internalized when they otherwise would not, hence, if voluntary suasion does not work, *full cost accounting* rules of engagement for corporations are likely to be introduced as part of the fluid regulatory mix and enforcement pyramid. Interplay between the various stakeholders in the drive for socially desirable outcomes from corporate existence is another challenge for environmental management accounting. The debate between those who feel corporations should operate free of government intervention once market rules have been established (e.g. the establishment of tradable property rights), and those who recognize the environmental damage already perpetrated on society by this system, will continue.

Tier 4 'societal' costs appear to be assessed by only a very small number of organizations. The lack of voluntary interest in externalities costing (tier 4 societal costs) by business has received renewed academic attention and a call for action and further government initiatives (Mathews and Lockhart, 2001; Bebbington *et al.*, 2001). The argument put forward is that the internalization of externalities and its reflection in environmental accounts is too important to be left to managers. Their focus is on what EMA information is of use only to themselves – increased productivity, profitability and con-

tinuing legitimacy of the business (Ditz *et al.*, 1995, p. 21).

Costing

Academics have long considered the problems of cost allocation. Thomas (1974) terms certain allocations 'incorrigible'; that is to say, no theoretical justification can be provided for dividing the common cost of a single input to two outputs (e.g. linking the cost of electricity for powering the production plant with individual units of output can only be based on an arbitrary rule of thumb). Zimmerman (1979) suggests that cost allocations can serve as a proxy for hard-to-observe opportunity costs, to motivate managers. Burritt (1997) argues that accurate identification of non-direct and traceable environmental cost is spurious and could mislead unless the management purpose is deliberate and transparent.

The US General Accounting Office (1992) recognized the problem that conventional management accounting systems did not trace environmental costs to specific production processes, instead including them as part of a general overhead to be absorbed by all production.

When environmental costs are large, such costs are allocated through a general absorption rate to all production processes, leading to the undercosting and cross-subsidizing of relatively dirty production processes (Hamner and Stinson, 1995). Tracing of environmental costs to processes, rather than hiding them in general overhead charges, is seen as one way of encouraging cleaner production.

Kreuze and Newell (1994, p. 38) applied similar thinking to the encouragement of 'cleaner' products. Revised *cost allocation* procedures are seen as one way to promote clean products and reduce the sale of dirty products. Kreuze and Newell (1994) illustrate their argument using activity based costing and life cycle costing.

Although separation of a common cost (e.g. depreciation of integrated production technology) into environmental and commercial elements will always be arbitrary it is becoming the norm that where environmental costs form a significant part of total operating costs an attempt should be made to separate them from general overheads and, instead, trace or allocate them to products. Activity based costing is often suggested as a way of avoiding arbitrary cost allocations, but at the unit of output level cost allocation remains a problem (the second round of allocations from activities to products). In the first round of allocations a number of cost drivers are identified instead of the conventional single cost driver, and so resource use and associated costings are more accurate, but arbitrary cost allocation remains. Integrated Product Policy is likely to accelerate this trend.

Recognizing the political, legal, technical, economic and social setting of information use

In general, environmental management accounting appears to be part of the reinvention of management accounting. As such it has largely been presented in a technical way – use certain tools to derive environmental management accounting information (e.g. activity based costing, life cycle costing etc.). But accounting information is part of the political planning and control process. Setting budgets and standards is a political bargaining process, so *behavioural* considerations are important when looking at the way environmental management accounting information is used.

The control system should motivate deliberate planning through the setting of realistic budgets, motivate commitment to putting the plans into action and motivate a positive attitude towards the performance measurements used by top management to gain and maintain effective control. Environmental management accounting may have the right tools but not produce the desired results because of *behavioural problems* – further studies are needed in this area.

For example, can some of these problems be avoided or overcome through: top management commitment to environmental goals and support for implementing an environmental responsibility accounting system where clear areas of responsibility for environmental impacts are defined; managers being involved in formulating the targets for which they will be held responsible; and the introduction of positive incentive systems to reward target achievement, rather than conventional negative information produced by conventional budgetary control systems? Or is it the case that a radical change in the structure of ownership and control is required to move towards behavioural responses by managers that encourage conservation of the environment and improved environmental performance?

CONCLUDING COMMENT

Debate is likely to continue about these issues, in particular: which environmental costs are relevant to business and which should be recognized and measured; the process by which externalities might be included in environmental management accounting systems; and inequalities brought about through EMA.

Some other issues for case studies involving costing, investment appraisal and performance evaluation include the following.

- *Investment appraisal.* The importance of constraints on extending the duration of investments, environmental impacts and costs needs to be addressed. For example, can environmental management accounting be used to demonstrate the need for developing countries to address environmental obsolescence of plant and equipment, even in the face of economic viability? Political considerations may influence the last word here as intangibles such as, for example, opportunity costs of forgone environmental protection opportunities (Schaltegger and Burritt, 2002), cannot be exploited in some political settings, whereas a clean production facility leaves a positive tangible reminder to voters and may be easier to exploit.

  Cleaner manufacturing technology – clearer understanding of the role of environmental management accounting in the process of integration of organizational participants and areas is needed (e.g. to move from conventional supply *push* of new engineering systems, leading to adverse environmental impacts) to demand pull systems based on customer demand (reduces inventory levels and associated use of space, employees trained to improve environmental quality, closer cooperation with suppliers, design of cleaner products, elimination of non-value adding activities etc.).
- *Costing.* Study of the impact of costing systems on dematerialization. For example, standard costs are useful in engineered cost situations (where input–output relationships are well known). Standard costing is affected by continual improvement of engineered relationships. Inflexible use of standard costs *in practice* may act as a barrier to material reduction (e.g. the mix of material and labour may not be approached in a flexible way – when use of higher quality labour can lead to less waste in material use, leading to a positive environmental effect and a competitive advantage).

  Also, although conventional cost classifications have been used as a way of organizing information about the environment, not all conventional notions have been stressed as much as they might. For example management issues associated with the difference between *engineered and discretionary* costs play a role in the overall success of *dematerialization* issues where engineered costs are converted into discretionary costs, but can lead to a larger proportion of manipulable discretionary costs.

  Likewise, reducing rework, spoiled output, scrap and waste are desirable environmental and economic goals. All three,

rework, scrap and waste, lead to wasted resources but there are multiple causes related to the quality of materials used, duration and quality of machinery and manufacturing methods used, inadequate training of the worker, etc. Tracking of costs, such as material flows, may help identify scope for reduced material use, but only an understanding of the multiple causes (technical and behavioural) will help improve control and actions that lead to reduced environmental impacts and better performance.

- *Performance management*. Benchmarking is increasing in importance as a way of comparing performance against competition. Benchmarking passes ownership of any changes in environmental best practice over to the managers that undertake the benchmarking exercise and it sets difficult to obtain, but achievable, targets that motivate better environmental and economic performance.

  The 'vibe of the thing' is towards development of easier to quantify monetary environmental performance measures as the main bottom line of concern to managers, with a focus on buying as cheaply as possible (economy), as few inputs as possible (efficiency – see Stone, 1995) and minimal concern for desired environmental outputs and outcomes (effectiveness). The balanced scorecard holds up promise here, for increasing *stakeholder* value, placing environmental interests within it based on acceptable sets of *environmental indicators* and at the same time beginning to focus on the inevitable conflicts with other stakeholders.

Additional research studies are needed that

- provide relevant environmental information for practical decisions that involve corporate environmental impacts within local government and other commercial government operations and non-profit organizations;
- incorporate long-term (strategic) considerations in the corporate decision making, planning and control processes (short and long term);
- use an articulated framework that incorporates information about environmental stocks (e.g. monetary assets and liabilities and physical inventories of species and materials) as well as environmental flows;
- avoid arbitrary cost allocation mechanisms that encourage relatively adverse environmental outcomes (e.g. undercosting of dirty products and processes) and, possibly under the guise of the precautionary principle, introduce cost allocation mechanisms that encourage and lead to better environmental outcomes (Burritt, 1997, p. 91) and
- move towards the integration of environmental indicators in individual, group and sub-unit performance and all aspects of the corporate value chain – for example, integration of ecological footprints.

To encourage broad dissemination to, and take-up by, a wide range of organizations, environmental management accounting systems need to be relevant to the issues at hand, available at low cost, provide simple integration with existing management accounting systems or environmental management systems and be reliable.

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