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On sustainability; the environment and management accounting*

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Following a review of the content of classic management accounting texts and the accounting research literature, this paper concludes that corporate accounting in general, and management accounting in particular, have ignored a wide range of non-market activities that are associated with private sector organizations and their impact on the biophysical environment. The formal decision analysis invoked in traditional management accounting neglects the social cost and benefits of corporate activities. Integrating environmental concerns into accounting will come in part from focusing on developments in other disciplines, particularly the natural and social sciences, which have a much longer history of analysing environmental problems. In this paper an analysis of the concept of sustainability and its relationships with decision-making is used to illustrate the multidisciplinary issues that are often involved when considering the environment. Such an analysis points towards additional developments for management decision-making and education, for example, social cost-benefit analysis and non-market valuation techniques. At the same time, this analysis also raises the issue of the scale of economic activity in relation to ecosystem capacity, and challenges some conventional wisdom, such as the practice of project analysis. The paper introduces a framework of analytical approaches to environmental resources within which to view existing and future accounting developments.

Key words: management accounting; environmental accounting; sustainability; ecosystems; decision-making.

1. Introduction

Mainstream corporate accounting tends to ignore a wide range of non-market activities which are associated with private sector organizations. Traditional accounting procedures concentrate on quantitative measures of economic transactions and ignore the social costs of environmental pollution, of resource exhaustion, or of project impact on cultural and ethical values (Bloom and Heymann, 1986). The formal decision analysis invoked in traditional management accounting[1] also typically neglects a wide range of non-market activities. Consideration of these items may be included as qualitative adjustments in project appraisal (SMAC, 1992, p. 11).

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[1] Taken here to mean that which is included in management accounting and finance textbooks under the topics of relevant costing (short-run) and capital budgeting (long-run).

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Although management accounting texts neglect the external effects of corporate activities, corporate decision-makers seem increasingly under pressure to consider the wider environmental impacts of their companies' activities. Such pressure comes not just from the need to satisfy public demand for greater social responsibility, but also from stricter environmental regulations. With regulators turning to market-based economic instruments and imposing legal liability for environmental damage, activities with adverse environmental impacts can now carry considerable financial implications for corporations.[2] Environmental regulations may also impose greater information requirements upon corporations. For example, the New Zealand *Resource Management Act* (1991) requires all applications for resource consents[3] to include 'an assessment of any actual or potential effects that the activity may have on the environment, and the ways in which any adverse effects may be mitigated' [s88 (4)(b)]. Montz and Dixon (1993) note that applicants will have to provide more detailed information on impacts than in the past because local authority planners have the power to delay applications on the grounds of insufficient information. In addition to liability concerns, corporate decision-makers may face increasing pressure to use environmental resources sustainably. In New Zealand, for example, the *Resource Management Act* (1991) creates a statutory obligation for local authorities to promote the sustainable management of environmental resources, so as to provide for future generations and protect the life-supporting capacity of the environment.

A number of possible reasons exist for management accounting to change to reflect the increasing requirements for environmental concerns to be included in corporate decision-making. If the role of management accountants is to support corporate decision systems, then currently management accounting is incomplete as generally practiced. By failing to include environmental impacts, management accounting potentially provides insufficient information to decision-makers to make informed decisions. Alternatively, if others (e.g. environmental engineers and scientists) are better suited to provide decision-makers with environmental impact information, management accountants should at least be aware of the possible constraints such information may place on their accounting analyses. Such an awareness may then facilitate the development of more integrated corporate decision support systems (Gray, 1990; Eckel and Fisher, 1992; ICAEW, 1992).

The purposes of this paper are firstly to examine the concept of environmental sustainability from a decision-making perspective. Secondly, the paper suggests a framework of decision approaches to environmental resources within which to

[2] The U.S. Environmental Protection Agency, for example, supports a number of market-based approaches to air pollution control, in particular, the Offset Policy and the Bubble Policy. See Hahn and Hester (1989), Tietenberg (1990) and Atkinson and Tietenberg (1991) for a review of these economic incentives to reduce pollution. In addition, an increasing number of environmental laws now create 'strict liability' for environmental damage, for examples, *The Comprehensive Environmental Responses, Compensation, and Liability Act* (1980)—commonly referred to as 'Superfund'—of the U.S. and the *Resource Management Act* (1991) of New Zealand. The imposition of such liability (which negates the need to demonstrate deliberate intent) effectively places an 'expected price' on environmentally adverse activities (Cropper and Oates, 1992). Such prices, which can be substantial—witness the Exxon-Valdez case costing Exxon in excess of US$ 900 million, are expected to create positive incentives for pollution-avoiding behaviour (Gringalunas and Opaluch, 1988).

[3] Resource consents are required to permit certain uses of land, subdivision of land, uses of coastal marine areas, uses of beds of rivers and lakes, uses of water, and discharges of contaminants into or onto air, water or land [*Resource Management Act* (1991) ss. 9–15].

examine past and possible future accounting developments concerning the environment. Finally, it should become clear from the paper that the implications for management accounting posed by the concept of sustainability are distinct and more radical than those that arise from the treatment of corporate environmental impacts.

2. Sustainability

A survey of the environmental literature reveals a host of different notions of value pertaining to environmental resources. Dixon and Sherman (1990, pp. 15–17) provide a summary of such disparate values as recreational, ecological, biodiversity, scientific, educational, consumptive, aesthetic, spiritual, cultural, historical, option, bequest, existence and others.[4] Few of these notions of value are specifically measurable in the prices of market transactions. Consequently, only a very few notions of value for environmental resources are currently included in business accounting information systems.

Although many diverse values may be held for environmental resources, there are some similarities in the basic overall foundations upon which valuation approaches to environmental resources rest. Fundamental to many environmental resource valuation approaches is the recognition that three sets (or dimensions) of values are involved. Drawing from the Environmental Impact Assessment literature, for example, Hundloe *et al.* (1990) claim that 'environment' should be broadly defined so that it at least encompasses ecological, sociological, and economic dimensions. Similarly, as illustrated in Figure 1, successful sustainable development or sustainable management requires the integration of economic, social and ecological goals (Barbier, 1987; Sadler, 1988; Dixon and Fallon, 1989; Haywood, 1991).

Although it might be generally accepted that 'sustainability' is about integrating social, economic and ecological values, less agreement exists on how such a concept is to be interpreted and, subsequently, how sustainability might be operationalized (Dixon and Fallon, 1989). Differences arise because varying degrees of emphasis are placed on the three fundamental sets of values and because different approaches are taken to the integration process. Dixon and Fallon (1989) point out that because earlier definitions of the concept of sustainability[5] were much narrower than the social–physical–economic concept referred to above, confusion and value entrenchments can arise when policy is formulated. Many, but not all, economists, for example, emphasize the importance of maintaining and improving human living standards, in which natural resources play only a part. Most ecologists, and a few economists, on the other hand, stress the integrity and preservation of entire ecological systems (see Toman, 1992).

Recent New Zealand experience suggests that finding a common and acceptable practical approach to sustainability is likely to prove difficult. Within New Zealand

[4] For further discussion of these value concepts, see, for examples, Kellert (1984), Loomis and Walsh (1986), Rolston (1986), Bishop *et al.* (1987), Cross (1989), Mitchell and Carson (1989) and Pearce *et al.* (1989).

[5] At least two earlier definitions are suggested. Firstly, a purely physical concept for a single resource concerns defining the physical limits to biologically renewable resources such as fisheries. Such a concept seeks to determine the *maximum sustainable yield* from the resource. Secondly, a broader concept of sustainability is to apply the physical concept at the level of ecosystems. The latter approach recognizes that because of systems interactions, what would have been considered sustainable management of an individual resource may be found unsustainable in the context of the entire system.

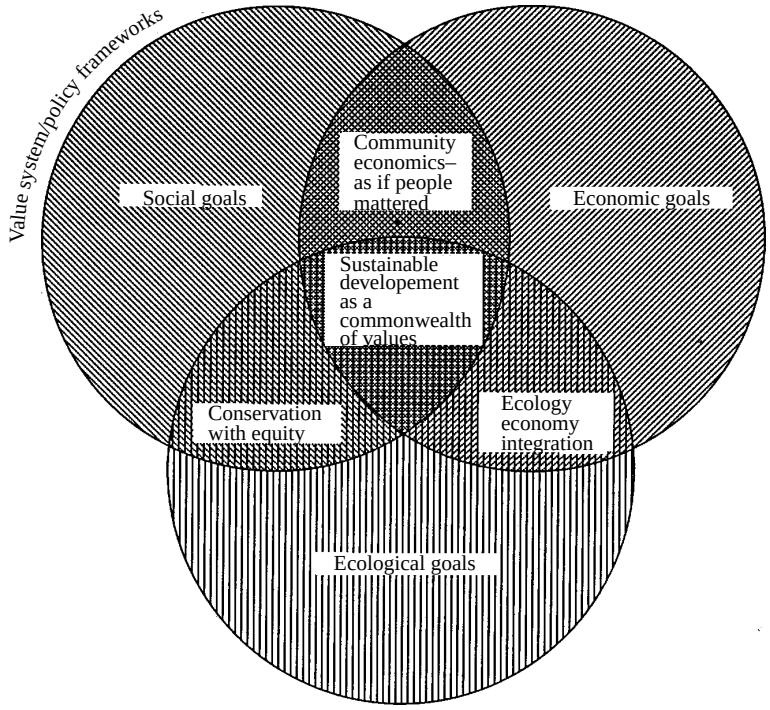

Figure 1. A systems perspective on sustainable development. Source: Sadler (1988).

both *The Environment Act* (1986) and the recent *Resource Management Act* (1991) contain enactments of sustainability. Indeed, the *Resource Management Act* has the overriding purpose of promoting the sustainable management of environmental resources.

Section 5(2) of the *Resource Management Act* states that 'sustainable management' means:

> 'managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while—
> (a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
> (b) safeguarding the life-supporting capacity of air; water, soil, and ecosystems; and
> (c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.'

The *Resource Management Act's* definition of sustainability, which clearly includes reference to economic, social and environmental values, draws much from the earlier international developments of the *World Conservation Strategy* (IUCN, 1980) and the World Commission on the Environment and Development (the 'Brundtland') report—*Our Common Future* (1987). The *World Conservation Strategy* claims a necessary condition for achieving sustainability is the maintenance of 'essential ecological processes and life support systems' and the preservation of 'genetic diversity', while *Our Common Future* emphasizes the importance of future generations, and defines sustainable development to be 'development that meets the needs

of the present without compromising the ability of future generations to meet their own needs'.

Less clear from the definition of sustainability in the *Resource Management Act*, however, is the process of integrating the economic, social and ecological values. Preliminary interpretations by some commentators suggest that the three elements included in section 5(2) paragraphs (a)–(c) are *constraints* on the use and development of natural and physical resources. Achieving social, economic and health and safety objectives should not occur at the expense of future generations, ecosystem integrity, or adverse impacts on the environment (Gow, 1991; Horsley, 1991). Gow refers to the notion of 'biophysical thresholds' or 'environmental bottom-lines' beyond which irreversible damage would result if development goes unchecked, while Horsley (1991) stresses the priority of biophysical systems over social and economic matters. Others see the biophysical objectives as equal to, or on the same plane as, the community well-being objectives, with a need for balance and trade-offs between all objectives (Johnson, 1991). The ambiguity surrounding section 5(2) and the possibility priority of biophysical objectives over economic and social objectives will remain until the New Zealand courts determine how (if at all) to implement such concepts in practice (see Fisher, 1991).

Exploring the fundamental value issues of environmentalism from a philosophical point of view, ethicists have focused on the nature of human morality and the scope of our responsibilities towards others, including non-human life.[6] Dower (1989, p. 35), for example, concludes that the result of such inquiry is to invite us to see the scope of our moral relationships as greatly broadened to include fellow human beings throughout the world (the *global* dimension), to include future generations (the *future* dimension), and to include non-human life or the world of nature as a whole (the *life* dimension). From an environmental economical perspective, Pearce *et al.* (1989, 1990) recognise that, to achieve sustainable development, increased emphasis needs to be placed on integrating: issues of *equity*, both within and across generations of peoples; considerations for the *environment*; and *futurity*—extended time horizons, in addition to economic considerations. Both Dower (1989) and Pearce *et al.* (1989, 1990), then, recognize and make explicit the importance of the added dimension of time, and the distinction this dimension brings out in social values between peoples now and peoples in the future. These two conceptions of the environment, and human interdependence with it, can be illustrated as shown in Figure 2.

Figure 2 illustrates the three continuous dimensions as time horizon, people, and environment. The three dimensions clearly suggest the limited extent of traditional decision-making when economic goals or solutions are sought. The traditional economic (and accounting) decision-making focus is often short-term (less than one generation) and narrow, both in terms of the affected people and the affected environment. Such tunnel vision and short-sightedness is due in part to limits placed on decision-makers by psychological and technological barriers. In some cases, humans simply do not have the information processing capacities and have to exclude some information in order to take decisions (Simon, 1957). In other cases, the information simply may not be available to process; that is, some effects of the

[6] See, for example, Callicott (1984, 1987), Dower (1989), Nash (1989), Passmore (1974) and Rolston (1986).

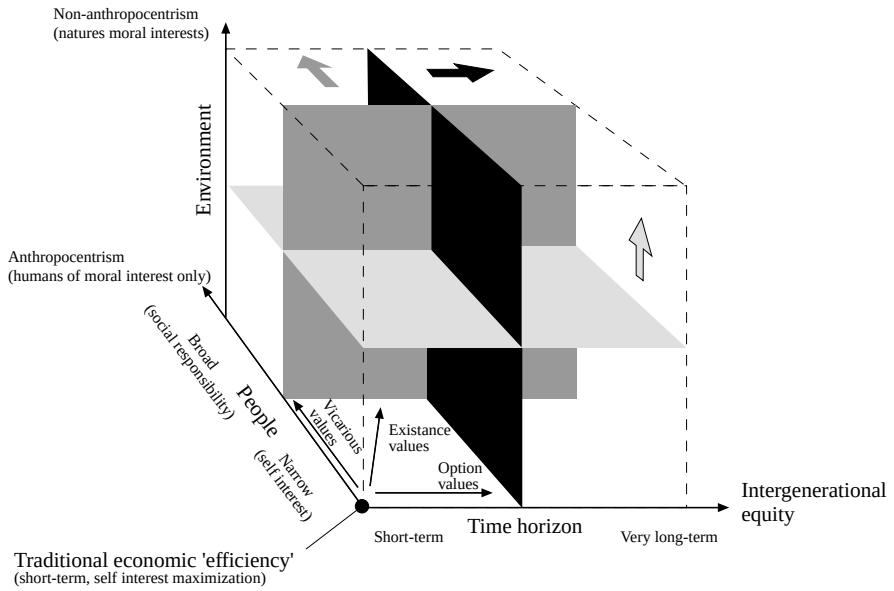

Figure 2. The dimensions of environmentalism and economic decision-making, (■), Sustainability constraint, based on social values; ( ), equity constraint, based on social values; (▨), sustainability constraint, based on ecological values.

decision may be completely unknown and unknowable to the decision-maker at the time of the decision. The narrow focus is also due in part to choice. Decision-makers may simply choose to exclude, or not seek out, information because they do not perceive its relevance to the decision, or because they consider it too costly to gather and process. Decision relevance is governed by the decision-makers' priorities, which are further shaped by both social values (as reflected in legal, other institutional and cultural arrangements) and individual values, which are shaped by culture, upbringing and education.

By seeking a broader perspective, the decision-makers' time horizons may be extended to include future generations. Those people considered in decisions may move from narrow constituency groups to much broader based community and society groups (social responsibility). Similarly, the environment may be viewed by decision-makers, not just from the perspective its 'use' provides for humans, but also from the broader position that nature has non-use value for humans, and value in itself.

Based on a recognition of the three dimensions and the basic values which underlie environmental resources, at least four main decision approaches to environmental resources may be identified: exploitationist, conservationist, naturalist-preservationist and extensionist-preservationist (Norton, 1989; see also Turner, 1991). These different approaches derive their identities from the relative emphasis people place on economic, social and ecological values.

3. Exploitationism—no accounting for nature

Norton (1989) characterizes the underlying value commitments of the exploitationist approach as largely based on two unquestioned assumptions or axioms: the axiom of material value, and the axiom of abundance. Under the axiom of material value, exploitationists view 'wilderness areas and raw natural resources as uncontrolled by humans, unproductive, and valueless until human labour is mixed with them. Transforming trees into lumber, wilderness into tillable land, and metal ores into tools, are all viewed without qualification as good acts' (Norton, 1989, p. 139–140). Under the axiom of abundance, 'exploitationists perceive no shortages of raw materials because value is only imparted to these resources by the addition of the truly scarce resource, human labour' (p. 140).

The conventional neoclassical economic approach to environmental resources, by giving pre-eminence to economic goals and in particular economic efficiency, stands on exploitationist values. Such an approach is based on the fundamental value premise that only individuals' preferences should count and has tended to consider only those preferences as revealed by individuals in their willingness-to-pay for goods and services in the market-place. Traditional economics, moreover, largely ignores the issues of distribution and the scale of economic activity. Distribution is usually considered best left to the political process, while scale, because of assumptions of substitution and technological change, has not been considered important in conventional analysis (Bishop, 1993). To the extent that people's values differ from the axioms of material value and abundance, social and ecological considerations are given little weight under the conventional approach. Consequently, environmental resources in conventional economic decision-making are either ignored (treated as having zero value) or considered only for their commercial use value.

Commercial use values can include the value of water as generating saleable electricity; the value of a fishery as producing saleable fish; the value of a forest as providing saleable lumber; and the value of natural areas as saleable recreation, for example, rights to ski or fish. Many early cost-benefit analysis (CBA) studies, applied to transport, hydro-electricity, and other similar projects, tended to be dominated by the commercial and market effects of such proposals (see Dasgupta and Pearce, 1972).

The conventional approach, when placed in the context of Figure 2, can be seen to be concerned with only those solutions and economic goals that fall within the front, lower, left-hand corner of the decision cube. Although the CBA of public works projects will likely take a broader perspective on the social (people) and time horizon dimensions that the CBA of private projects, both traditionally have taken a very limited view of the environment.

Conventional management accounting, as reflected in the content of the most popular texts and much research literature, seems entirely consistent with the conventional neoclassical economic and exploitationist approach to environmental resources. Hopper *et al.* (1987) are critical that conventional management accounting often fails to adequately address the social and political aspects involved. They suggest conventional texts do little more than pay lip service to the interaction of

economic and social values. Similar criticisms can be made from an environmental value perspective.[7]

The exploitationist attitude that pervades conventional management accounting does so not so much because of what management accounting assumes or includes, but largely because of what it leaves out and assumes away. Scapens (1984, 1990) suggests management accounting research normally follows the same core assumptions as neoclassical economics: that the decision-maker is a utility maximizer and that his/her actions are set within a system of competitive markets (1990, pp. 261–262). Management accounting, furthermore, by restricting its focus to market-based transactions, fails to accommodate alternative social and ecological values for environmental resources. Similarly, many potential ecological limits to environmental resources are ignored under the conventional approach since scarcity is communicated only through market prices. Implicitly, the conventional approach accepts the axioms of material value and abundance.

A brief review of over 20 management accounting and financial management texts, including classics by Anthony and Reece (1983), Brigham (1988), Brealy & Myers (1988), Drury (1988), Emmanuel *et al.* (1990), Ezzamel & Hart (1987), Horngren & Foster (1991) and Kaplan & Atkinson (1989), all of which cover both short-run and long-run decision problems, found little or no mention of how to include explicitly the non-market impacts of corporate activities in the decision analyses advocated.[8] Many of the texts do emphasize, however, that an important role of management accounting is to provide information relevant to support management decision-making, and some texts suggest that accountants could take more responsibility for providing information about non-market impacts.[9]

Often, the importance of not overlooking the so-called immeasurable or 'qualitative' factors of a decision is mentioned, but the texts provide little, if any, guidance as to how such factors could be assessed. Further, by excluding the non-market impacts of corporate decisions from almost all of the reinforcement and assignment examples, the texts under-emphasize any such qualitative factors. Consequently, the conventional decision analysis advocated in management accounting *excludes* any costs (or lost benefits) imposed on society by pollution and other environmental impacts of business firms.[10]

Some management accounting research, of course, does challenge the neoclassical underpinnings of the conventional approach. Nonetheless, most of this work addresses issues and assumptions other than those of material value and abundance. The behavioural and organizational management accounting literature, for

[7] One might also add that those texts which do adequately deal with the social aspects of management accounting may not necessarily cover the environmental aspects at all well. In terms of Figure 1, a comprehensive approach would be one that concerns the overlap of all three value bases: the economic, the social and the ecological.

[8] Although the 20 or so texts are neither an exhaustive set, nor the result of random sample, they are nevertheless clearly indicative of an absence of environmental considerations. A list of the texts reviewed is provided at the end of this paper. From a review of over 20 finance texts, Hawley (1991, p. 711) has similarly reported that the content of major undergraduate and MBA texts fails to deal with issues of business ethics and social responsibility in an adequate manner.

[9] See, for example, Arnold and Hope, (1983, pp. 47–49), Drury (1988, p. 257) and Hilton (1991, pp. 539–541).

[10] It is always possible of course that educators make up for the textbook absences by bringing additional materials into their courses. However, preliminary results from a survey of Australasian accounting and finance educators suggest the grounds for each optimism are quite weak (Brown and Milne, unpublished data).

example, drawing on psychology and socio-psychology, challenges the notion of maximizing behaviour and provides valuable insights to management accounting in its wider organizational context.[11] The focus of this work, however, is still largely economic. By drawing on sociology, much recent work has also addressed the distributional inadequacies of the conventional management accounting approach.[12] While such work certainly provides a deeper understanding of some of the social and political aspects of management accounting, the assumptions of material value and abundance still remain largely unchallenged in the research literature.[13] For management accounting to reflect that some peoples' values differ from the axioms of material value and abundance, or that such axioms are potentially false, researchers need to broaden their focus and consider management accounting in an integrated ecological, social and economic context.

4. Conservationism—accounting for externalities

In characterizing the value commitments of the conservationist approach, Norton (1989) draws on the values espoused by early U.S. conservationists. For example, Gifford Pinchot (the first official U.S. Forester) described his goal as promoting 'the greatest good for the greatest number in the longest run' (Fox, 1981, p. 111 cited in Norton, 1989, p. 141). John Muir is similarly exemplified for founding and sustaining the Sierra Club by promoting the human benefits of wilderness recreation. The conservationist perspective, then, clearly expands upon the narrow pursuit of economic objectives for environmental resources. As Norton (1989) points out, Pinchot's stated goal highlights the tension between economic, social and ecological goals for natural resources.

At least two different decision approaches can be identified which attempt to give effect to the conservationist perspective: environmental impact analyses (EIA), and extended cost-benefit analyses. In different ways, both of these approaches are attempts to deal with social and environmental externalities in the sense they capture information on impacts which go beyond the decision-entity that creates them. EIAs set out the relevant environmental factors in the form of a descriptive analysis with the information expressed in either declarative or biophysical non-monetary quantifications. Cost-benefit analysis attempts to financially quantify (or monetarize) all known impacts. In terms of Figure 1, both these approaches are attempts to occupy the middle ground between ecological and economic (and to some extent, social) goals, with EIA coming from a biophysical science framework, and CBA from an economic framework.[14]

[11] For a review of this literature, see, for example, Otley (1984), Powell (1987) and Northcott (1991).
[12] For a review of the impact of sociology on management accounting research, see, for example, Roslender (1990) and Puxty (1993).
[13] Although deeply concerned with the interaction of economic and social values, issues of equity, and the exploitation of labour, Marxist economics also treats environmental resources as 'gifts of nature'. Marxist economics expressly excludes many environmental resources from its analysis because they are not commodities—they are not exchanged in the market place and, more importantly, they are not 'the result of human labour being applied to production' (Gouverneur, 1983, pp. 22–23; also see Tinker, 1985, pp. 154–155). Consequently, conventional Marxist economics had very little to say on environmental resources. Whether Marxist economics could be extended to include environmental resources is debatable, especially given its basic premise that value is derived from human labour.
[14] A criticism sometimes leveled at the EIA approach, however, is that it often fails to make explicit the value judgements of decision-makers when comparing biophysical quantities with economic (financial) quantities (Hundloe *et al.*, 1990).

Cost-benefit analyses have been extended to include a much wider range of benefits associated with environmental resources than under the conventional approach. These non-market benefits have included non-commercial recreational use, options for future use, and benefits derived from the preservation of environmental resources (see Pearce *et al.*, 1989; Pearce and Turner, 1990). Under the extended approach a wider basis for the expression of individuals' preferences is provided by utilizing non-market valuation mechanisms developed in environmental economics.[15] To derive accurate non-market values those individuals likely to be affected by the social and environmental impacts of a decision need to be consulted by analysts. In this sense, non-market valuation techniques do provide for a wider input to decision-making than simply relying on expert judgement. To the extent that individuals express a preference for them, then, social and ecological values will be incorporated in the decision-making framework.

Numerous applications of extended CBA have been made in public decision settings including health, safety and environmental quality regulatory decision-making. In the U.S.A., for example, the Environmental Protection Agency (EPA) expanded its investigations into the benefits and costs of existing and potential air and water pollution control programs.[16] Other applications of extended CBA have been made to development projects in Asia, Africa, Japan and Brazil.[17]

The discussion of environmental externalities in the business accounting literature, for the most part, has tended to focus on 'social reporting' and 'social auditing' rather than on information for management decision-making. The social accounting literature has long argued that private companies *should* report on the impact that their activities have on the physical environment.[18] During the 1970s a number of models were proposed which extended financial (monetary) quantification and external reporting (in corporate annual reports) to include the social impacts of private organizations (see, for example, Linowes, 1972; Dilley and Weygandt, 1973; Estes, 1976; Abt, 1977). In critical reviews of the developments, both Jensen (1976) and Gray *et al.* (1987) raise concerns about their operational feasibility. The proposals are criticized for failing to examine the pragmatic issues of implementation and for failing to meet a major requirement of traditional financial accounting practice—objectivity[19] (Jensen, 1976, p. 43; Gray *et al.*, 1987, p. 202).

[15] For a comprehensive review of these techniques, see Milne (1991).

[16] For a discussion of the arguments in support of using cost-benefit analysis in the policy decision process at the EPA, see Fisher *et al.* (1987). For a critical review of this wider development see Baram (1980). For a review of some of the case studies undertaken at the EPA, see Freeman (1982) and Kneese (1984). Also, see Barde and Pearce (1991) for an overview of applications of extended CBA to environmental policy in other countries including Germany, Italy, Norway and the U.K.

[17] See, for example, Dixon and Hufschmidt (1986) and Pearce *et al.* (1990).

[18] See, for example, Linowes (1972), Dilley and Weygandt (1973), Ullman (1976), Estes (1976), Dierkes and Preston (1977) and more recently Gray (1990) and Owen (1991). In addition, other work has focused on analysing the disclosures of environmental impacts made in some corporate annual reports. See for example, Wiseman (1982), Freedman and Jaggi (1986), Rockness *et al.* (1986) and Freedman and Wasley (1990).

[19] Although social cost and benefit estimates rarely reduce to single, undisputed, measurements, it should also be recognized that relevance and completeness are two other criteria for financial accounting and reporting (AICPA, 1973; Carsberg *et al.*, 1974; FASB, 1980). Furthermore, it is easily demonstrated that many procedures currently accepted and practiced within financial accounting and reporting fall short of the criterion of objectivity. For example, the simple depreciation of a long-lived fixed asset requires the *subjective* estimates of useful economic life and value on disposal. By failing to include estimates of the environmental impact of businesses on the grounds of objectivity, external corporate reports will often be an incomplete record of the activities of business.

The conclusions of Jensen (1976) and Gray *et al.* (1987) need to be viewed carefully. They are, on the whole, confined to the *external reporting* of social costs and benefits. Indeed, Gray *et al.* (1987, p. 130) recognize that financially quantified social impact information may be potentially very useful for management decision-making; and that internal management reports provide a particularly useful area for experimenting with the financial quantification of individual aspects of corporate social performance.

To date, however, little research has appeared on extending internal information systems to incorporate the social costs and benefits associated with corporate activities. Some early exceptions include a paper by Brooks (1979), which outlines the case for cost-benefit analysis by management accountants, and the monograph by Burke (1984) on incorporating labour displacement cost and benefit information into a decision on whether or not to shut down a plant. Mathews (1984) has advocated including the wider non-market activities into a formal decision-making and reporting framework as 'total impact accounting'. Similarly, Harte and Owen (1987) support attempts to measure the social and economic impact of plant closures on local communities. Both Jensen (1976, p. 186) and Dierkes and Preston (1977, p. 20) have also identified the possible contribution of willingness-to-pay (subjective valuation) measures to ascertain social costs and benefits as a basis for formal decision-making procedures. More recently, Maunders and Burritt (1991) suggest a possible way forward in integrating accounting and ecology was for 'radical modification of the present value-based approach, in which prices were based on ''existence values'' ' (p. 24). Milne (1991) similarly proposes that non-market valuation techniques could be used by management accountants to capture corporate environmental impacts.

Although the possibilities of utilizing extended cost-benefit approaches have been seen for some time, the accounting professions and practice have appeared reluctant to do so. Nonetheless, professional accountancy bodies are now recognizing that our present accounting systems are inadequate to incorporate the effects of corporate environmental impacts, and need to change (see, for example, Kestigian, 1989; Gray, 1990; SMAC, 1992; ICAEW, 1992; CICA, 1992).

Environmental developments from the professional accounting communities appear to favour modifications to the existing accounting system. Harkshaw (1991), for example, claims that the existing principles of accrual and contingency accounting provide for the recognition, accrual and disclosure of liabilities arising from past or current corporate environmental activities (see also Surma and Vondra, 1992; Zuber and Berry, 1992). Rubenstein (1989, 1992) similarly argues for the increased reporting of contingent liabilities, but recognizes this as only a first step, and much more radical departures from the traditional accounting model are required if the full costs of resource consumption, as opposed to the costs of purchasing resources, are to be recorded. Most of the developments, however, seem to be putting the cart before the horse. They are, for the most part, concerned with identifying and classifying accounts and where to report environmental impact damage. Financial estimates of impact damage are assumed to be readily available and consequently the authors remain silent on *how* to derive estimates (in monetary terms or otherwise) of such impact damage. Moreover, such developments tend to be reactive and centred on past activities detrimental to the environment (Stone, 1994).

To *prevent* socially irresponsible decisions from occurring, rather than merely reporting and evaluating the resulting damage, internal social accounting systems need to be developed (Preston, 1981). Importantly, this proactive focus did appear in some early developments and is now appearing in professional practice developments. Gray (1990), for example, proposed a number of possible extensions to business information systems, including: developing an environmental department and policies; introducing ethical and environmental audits; and undertaking a resource flow input-output analysis. More recently, with progressive non-financial management accounting developments, these proposals have been extended to include accounting for energy usage, waste elimination, pollution prevention, recycling and life-cycle costing (Gray *et al.*, 1993; Stone, 1994). In addition, Stone (1994) reports that the U.S. EPA, through its 'Design for the Environment' programme, is calling for business to modify management accounting systems to fully and explicitly account for environmental costs. Although it is too early for specific developments to have arisen, Stone suggests the U.S. accounting professions (AICPA and IMA) are responding positively.[20]

Although the developments outlined above offer a promising start, they are, on the whole, conservation based. Such developments are means to obtain more from less: they are, in Stone's (1994, p. 3) terms, pursuing 'eco-efficiency'. Eco-efficient solutions, however, are not necessarily sustainable solutions. Although proposals for changes to accounting are now emerging, difficult questions on how to balance the cost of man-made capital and natural capital, and how to assess the potential of natural capital to provide for a continuing and sustainable future, remain to be adequately addressed.

5. Naturalist-preservationism—accounting for sustainability

In articulating the approach of the naturalist-preservationist, Norton (1989) draws almost exclusively on the writings of Aldo Leopold. Leopold was concerned with the impact of human activity on broader ecosystems. Although Leopold's 'land ethic' led to an explicit questioning of human obligations toward the land community, Norton suggests Leopold adopted a human-orientated approach to support environmental protection. Leopold argued that any decent culture must be capable of passing on an undefiled earth to all future generations, and concluded that the utilitarian criterion of maximizing production over indefinite time must be supplemented with additional safeguards.

To argue why people should adopt the naturalist-preservationist approach to environmental resources, Norton modifies Rawls' (1971) theory of justice, and, in particular, Rawls' veil of ignorance. In a fair and just society, Norton argues, if people value their existence, are unsure that they will be born, and if they are born, are ignorant of the generation it will be, then they will choose (rationally) to formulate rules which protect the resource base for each generation.

The naturalist-preservationist position, accepting that ecosystems are stressed by unrestrained economic exploitation, 'amounts in practice to an assertion that there are certain *pre-emptive constraints* placed on the pursuit of economic criteria for

[20] In conjunction with the EPA, the U.S. Chamber of Commerce, The Business Roundtable, and the Association for Total Cost Management, the AICPA and IMA, converted a 'Workshop on Accounting and Capital Budgeting for Environmental Costs' in December, 1993. See, Stone (1994) for more details.

resource use' (Norton, 1989, p. 145). Norton suggests such a position implies a two-stage approach. First, in order to fulfill our duties to future generations, ecological information on ecosystems needs to determine constraints. Second, economic considerations are used to determine which acceptable modes of exploitation will provide for human well-being in the present.

Some economists (in particular Daly, 1974; Daly and Cobb, 1989; Norgaard, 1985, 1989, 1992; but see also Bromley, 1989 and Pearce *et al.*, 1990) have recognized that reliance on only individualistic preferences as revealed or stated through willingness-to-pay may not be sufficient to include the social values embodied in the notion of sustainability. Sustainability, as was noted earlier, involves the integration of economic, social and ecological values. Daly (1992) suggests sustainability involves maintaining: a sustainable scale of economic activity relative to its ecological life support systems; a fair distribution of resources and opportunities, not only between the current generation of humans, but also between present and future generations; and an efficient allocation of resources over time that adequately accounts for natural capital.

The issues of scale and distribution, along with issues of irreversible impacts, cumulative impacts, thresholds, and other matters associated with sustaining life-supporting ecosystems (see, for example, Baines *et al.*, 1988), imply very important limitations for conventional economic analysis and the market allocation mechanism (Toman *et al.*, 1993; Costanza and Folke, 1994). Norgaard (1992) makes the point, for example, that 'while internalising externalities certainly increases efficiency, it need not increase sustainability' (p. 94). Moreover, 'valuations of nonmarket goods and services are based on the preferences of the *current* generation and benefits accruing to future generations are discounted in net present value calculations to reflect what they are *currently* worth' (p. 94). Sustainability, then, can not be guaranteed under the extended decision approaches discussed in the previous section.

In addition to conventional policies promoting efficiency, policies which recognize the distribution of resources and the relevance of constraints on renewable resource flows will require some form of social consensus (Constanza and Loomis, 1994) or collective intervention (Toman *et al.*, 1993). Sustainability requires that values for environmental resources are to be based on shared social norms, public preferences, or some concept of social justice which are claimed to reflect the social and communal aspects of human nature.[21] Such notions are based on the idea that individuals make decisions in two distinct contexts: 'private' decisions which reflect the individual's interests and 'public' decisions in which individuals act with responsibility for fellow beings and for future generations (Pearce *et al.*, 1990).

Dixon and Fallon (1989) suggest a number of issues need to addressed if constraints that provide for intergenerational equity are to be determined. Presented in question form they include:

- How should we give effect to the preferences of future generations?
- What do we leave future generations to ensure they are not worse off?
- Will there be sufficient resources to go around?
- How far into the future do we worry about?
- Are there some patterns of resource use that should be accepted

[21] See, for example, Sagoff (1988), Singer (1988) and Turner (1988).

irrespective of losing or saving the resource? e.g. is species extinction absolutely out of the question?
- How should we determine possibilities for substitution, technology, diversity?

A number of constrained approaches are possible based on different assumptions of the substitutability of man-made capital for natural capital (see Turner, 1993). Generally though, these constrained approaches advocate some caution in assumptions of resource substitution and technical progress, and involve modifications that set minimum levels of sustainable resources within which all decisions regarding resource use must be made.[22]

Recognizing constraints on environmental resources

To recognize limits on environmental resources, Pearce *et al.* (1990) suggest two possible constraints: a weak and a strong sustainability criterion. The weak sustainability criterion requires that the discounted present value of the net environmental costs across all projects within a portfolio of possible projects be non-negative. The strong sustainability criterion requires that the net environmental costs across all projects be non-negative for all time periods over which the portfolio extends.

Pearce *et al.* (1990) claim that applying either of the sustainability constraints at the level of single project decision-making would be unworkable. At this level, the projects supported as feasible are only those with either no (discounted) net environmental costs, or, more restricting, only those projects with no net environmental costs in each and every time period over which such projects extend. When applied to a set of projects, however, the sustainability criteria are considered more likely to be feasible. A practical interpretation of such criteria is that decision-makers overseeing a portfolio of projects could require the adoption of *shadow projects*. Shadow projects are environmentally beneficial projects designed to compensate for all of the environmentally degrading projects within a portfolio.[23] For example, in order to contain pollution levels in a river system within sustainable limits, several firms' projects may be scrutinized by a regional 'catchment'

[22] In addition to explicit constraints on cost-benefit analyses, other approaches to recognize future generations have included proposals to modify conventional discounting procedures (see, for example, Solow, 1974; Sandler and Smith, 1976, 1977; Krutilla and Fisher, 1985, chapter 4; Howarth and Norgaard, 1990). While some of these approaches are improvements on conventional discounting, in terms of benefiting future generations (see, for example, Krutilla and Fisher, 1985), others may in fact encourage a greater throughput of resources to the detriment of future generations (Pearce *et al.*, 1990). Moreover, none of the modified discounting approaches are technically capable of guaranteeing the preservation of environmental resources for future generations in the way the constrained approaches propose. For more detail on the issues of discounting and the preservation of environmental resources, see Page (1977, 1983), Krutilla and Fisher (1985, chapter 4), Pearce *et al.*, (1990, chapter 5) and Wright (1988, 1990).

[23] An alternative to the shadow project approach, and also one which attempts to recognize future generations, is to set safe minimum standards for environmental resources (Ciricacy-Wantrup, 1968; Bishop, 1978; see also Tisdell, 1989). The safe minimum standard, which explicitly acknowledges that the environmental losses created by development projects are often irreversible and more uncertain than the economic benefits, advocates a 'minimax regret' solution. Essentially such a decision rule advocates not developing unless the economic benefits are very large and certain, or unless the environmental costs are very small and certain. Caution is urged where doubt exists over the size or the possibility of environmental losses.

authority. In the event of the projects being considered and accepted, a 'cleansing' project may be required to make good any excessive pollution.[24]

A common thread which runs through Pearce *et al.*'s constrained approach and the earlier proposals to extend cost-benefit analyses is their reliance on environmental economics to determine the outcome. All of the approaches rely on market and non-market valuation techniques to determine the net environmental costs. As such, it may be legitimate to worry that the future of some environmental entities may be precarious if they have no claims beyond those that derive directly from current human caring (Randall, 1987; Gren *et al.*, 1994; Costanza and Loomis, 1994).

These concerns have resulted in calls for economic thinking and the CBA framework to be modified and constrained directly by ecological values (see Norgaard, 1985; Barbier, 1987, 1989; Sadler, 1992).[25] This type of approach seeks to expand the focus to include not only value for ecosystems based on short-term perceptions and preferences, but also long-term estimates of ecosystem services that may be derived from scientific studies of the role of ecosystems in the overall system, without direct reference to current human preferences (Costanza and Folke, 1994).

Broader ecosystem-based approaches, however, require an understanding of cumulative environmental change, along with a recognition that ecological responses are often nonlinear, discontinuous, synergistic and subject to thresholds, all of which make predicting ecosystem changes to human activity very difficult in practice (Baines *et al.*, 1988; Contant and Wiggins, 1991; Cocklin *et al.*, 1992). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Cocklin *et al.* (1992, p. 32), for example, are critical that traditional project-based environmental impact assessments, which adopt inappropriate time and space boundaries, and often assume the independence of projects, lead to what has been termed by Odum (1982), the 'tyranny of small decisions'.

In light of such limitations, many commentators now propose cumulative effects assessments based on such regional ecological criteria as vegetation patterns, soil classifications and watershed boundaries (see, for example, Rees, 1988; James *et al.*, 1983; Sonntag *et al.*, 1987). Using geographic information systems and remote sensing, the most likely practical outcome of such proposals involves systematically monitoring natural system changes (through various significant chemical, but

[24] Similarly, in New Zealand recently, a peat mining company was only granted permission to mine a peat bog on condition the company contributed $NZ 30,000 towards protecting another peat bog. The contribution enabled the Department of Conservation to buy and protect a relatively large and unmodified area of typical wetland by creating a peatland reserve (*The Southland Times*, Saturday, 12 February 1994, p. 11).

[25] Here I am drawing out the (perhaps subtle) distinction between sustainability constraints that may be determined by reference to social values from those that may be determined by direct reference to ecological values. The distinction arises from different notions of sustainability mentioned previously. For example, ecology might suggest a physical minimum flow for a particular river catchment, yet the local community may determine a minimum flow which is even lower (perhaps because of risk aversion or concerns over the accuracy of the scientific information).

mainly biotic indicators) and development activities (through appropriate planning processes) at regional levels of analysis and over extended periods of time.[26]

Exactly how these new and developing ecological approaches can be used to promote sustainable development is yet to be worked out. Sadler (1992) suggests that given the unlikely ability of ecological science (or an unwillingness of ecologists) to establish precise regional thresholds for ecological resilience and integrity, ecological information is best used to follow precautionary principles in protecting the resource base and assimilative-waste capacities of environmental resources.

The constrained decision approaches can be illustrated using the three dimensional diagram in Figure 2. Such approaches may be captured by introducing equity and sustainability constraints based on social values—shown as the two vertical planes in Figure 2, and by sustainability constraints based on ecological values—shown as the horizontal plane in Figure 2. Theoretically, to achieve the goals of intra- and intergenerational equity, the decision-maker is constrained to consider only those solutions that occur in the upper rear right-hand quadrant of the decision cube.

With the exception of Gray (1992) and Bebbington *et al.* (1994), accounting has yet to examine the implications of sustainability for its discipline. Following Daly, Turner and other ecological economists, Gray (1992) suggests one way forward is to consider different environmental resources in terms of their ability to meet the needs of the future. He refers to 'critical natural capital', 'sustainable natural capital', and 'man-made capital', and in this regard makes an important start on the question of what is to be left to future generations to ensure they are not worse off. For example, Gray sees critical natural capital as inviolate, and implies it should be protected at all costs. Many issues remain unanswered, however. For example, what should be included in the critical category? Who should decide such matters and how?

Gray (1992) also suggests a way forward is to translate the concept of sustainability to the level of the individual organization and bring it into accounting. While such an approach may well increase the awareness of organizational decision-makers, and increase the transparency of organizations, it may not necessarily produce sustainability. For example, the reporting of a wider range of past corporate impacts to wider constituencies may help improve intragenerational equity, but may not help ensure desired changes in future actions are taken to aid future generations.

It was noted earlier that focusing on single projects or single resources may be insufficient to guarantee sustainability at broader systems levels. Similarly, the firm level most likely will be too narrow. For example, the sustainable use of a river catchment would require a single firm not only to track its cumulative impacts on the resource but also those of all other firms using the resource. Accounting for such cumulative effects, even in physical terms, may place excessive information requirements and costs on single firms. In fact, given the likely need for systematic regional ecological monitoring, and the need to integrate such information with

[26] In the U.S.A. for example, the EPA has initiated an Environmental Monitoring and Assessment Program. Running since 1990, the programme aims to assess the comparative degree of cumulative environmental damage from all types of harm across regions of the country (Messer, 1994). To do so, the programme is undertaking long-term monitoring of landscape characteristics, estuarine resources, forest resources and lakes, streams and wetlands.

information on economic and social outcomes, businesses alone are not capable of providing the necessary information systems to implement sustainability. As a start, research into a greater integration of firm-based (largely economic) information with community (social) information and regionally developed ecological information appears necessary. In terms of efficiency and social equity, research also needs to consider at what level (e.g. community, regional, national) such integrated information is best developed and used.

In addition to arguing for new information systems, advocates of sustainability argue for new and alternative decision-making arrangements. In decisions concerning the 'necessary' preservation of resources and cessation of economic activities, sole reliance on the judgements of the market, business, or the government are believed unacceptable (see, for example, Young, 1992). Consequently, questions must also remain about the role of business decision-makers and others in implementing sustainability. For instance, should business be delegated the kind of social equity (both intra- and intergenerational) judgements that sustainability implies?

Bebbington *et al.* (1994), for example, report that while some business managers expressed concern about whether it was legitimate for business corporations to deal with the social issues of sustainability, others believed they are capable of implementing sustainability. Even with a broader based and more appropriate information system, are businesses capable of the perhaps necessary self-imposed sacrifices for future generations? Some argue that business has for too long been permitted to make these kind of judgements on behalf of communities, and, by doing so inappropriately, is part of the problem. The Schumacher Society, for example, express their concerns for sustainability as the need for the removal of perpetual corporate property rights with a move to common property rights (community trusts with restrictive covenants) for common property resources (see, for example, Benello *et al.*, 1989).

The tension between economic, social and ecological desires may be no less of an issue with community-based decision initiatives, but, arguably, such conflicts are more widely confronted and debated. Whether such collective decision-making can result in communities subjugating the social and economic desires of their current members, when such desires clearly contravene ecological thresholds and threaten the social and economic needs of future community members, is open to question. In the name of work and wages, communities may pay no more respect to known ecological constraints and future generations than do business managers in the name of profits. More often, the ability of the current generation to harm irrevocably ecosystems and future generations will be uncertain, and possibly unknown. Consequently, people's social values may prove a serious impediment to obtaining sustainable outcomes to the extent they do not really challenge the exploitationists' axiom of abundance, when in fact it is false. Moreover, business decision-makers may find it extremely difficult to give effect to the notion of sustainability, when faced, on the one hand, with social values that demand exploitationist outcomes for environmental resources, and, on the other hand, with social values that demand preservationist outcomes. Nonetheless, the concept of sustainability does seem to call for wider community participation in yet-to-be-taken corporate actions.

Sustainability poses a number of challenges for management accounting and business decision-making. Conventional project-based assessment, no matter how

well extended with environmental impact information, is no longer sufficient if it fails to consider the project's cumulative effect on the carrying capacity of ecosystems. Consequently, the benchmarks of profitability and efficiency, although necessary conditions, are not sufficient. Regard must also be given to scale of the throughput such projects entail. Although no doubt difficult to determine ecosystem capacities and thresholds in practice, project analyses must *first* demonstrate the proposed developments are prudently within the cumulative thresholds of effected ecosystems. Sustainable outcomes require the rationing of scarce ecosystem capacities, and the presumption of such an approach is that the ecosystems are the going concerns, not the economic project. To recognize the limits of ecosystems, it seems appropriate to develop regionally-based initiatives in which the entity and going concern concepts are applied, not to companies, but to natural entities—to rivers, lakes and forests.

In addition to an ecological decision focus, if management accounting is to fully embrace the concept of sustainability management accounting researchers also need to consider broader, more participative and consultative decision processes than currently exist. To give effect to the social equity considerations, and represent and integrate the social, economic and ecological values that arise from development proposals, regional or community forums are worthy of consideration. Such forums may provide for a process of confronting and debating value differences, and, perhaps, generate revised proposals which lessen differences with acceptable outcomes. Whether initiated from firm-community partnerships, or required by legislation (e.g. New Zealand's *Resource Management Act*), businesses may have to develop their plans in consultation with their local communities if outcomes consistent with the concept of sustainability are to be achieved.

6. Extensionist-preservationism—non-accounting for nature

The extensionist-preservationist position comes from a belief that, even if adequate safeguards are put in place to protect the future interests of all future generations, there are legitimate interests which may not be protected. These values are the interests of nature for itself, which, it is argued, cannot be reduced to human values (Norton, 1989, p. 147). Some extenionist-preservationists refer to such values as 'intrinsic values'.

The extensionist position, as with the naturalist position, rejects the notion that environmental decisions can be taken solely on the basis of individuals' preference orderings. The extensionist position, however, goes much further in that it requires decision rules that provide for protecting the independent value of nature. Articulating such rules seems to be particularly difficult and Norton (1989) suggests, has so far prevented the development of an operationalizable formula for integrating human and non-human interests into a model for environmental decision making.

Certainly the notion of intrinsic value implies a much more radical decision-making approach than those discussed previously. The intrinsic value of resources, as claimed by 'deep ecologists', is value which resides 'in' the resource itself and is completely independent of human existence. Naess (1973), for example, has argued for the equal right of all species to live and blossom into their own unique forms.

This and other similar positions have been described philosophically as non-anthropocentric. Non-anthropocentrism rejects the notion that all things non-human are only of instrumental value to humans, and would confer intrinsic value on non-human beings (Callicott, 1984). Deep ecologists argue that relying on economics is 'technocratic' and contributes to the problem of environmental degradation not its solution (see Devall, 1980). Such a position then places ecological values at the forefront, perhaps at the expense of social values, and abandons the cost-benefit framework (Turner, 1991). In terms of Figure 2, this can be viewed as a raising of the sustainability constraint based on ecological values to such a level that all economic solutions are removed from consideration and social-based constraints are overridden.

Often, however, it is unclear whether claims for such constraints are based on the science and study of ecosystems or are based on grounds of sacrosanctity.[27] Kiernan (1990), for example, claims 'I saw my temple ransacked' when referring to the hydroelectric development in south west Tasmania which flooded Lake Peddar in the 1970s. He states, 'I have loved many of the wild places it has been my good fortune to glimpse. But only at Lake Peddar did I feel loved in return' (p. 20). For deep ecologists, the only answer to environmental degradation is a revolutionary change in people's attitudes. Placing willingness-to-pay measures on nature is rejected as a demeaning exercise. As Cross (1989) points out, however, this deep ecology approach implicitly values nature at zero or infinity and, more importantly, retards the needed development in abilities to incorporate the intangible. Furthermore, it remains an open philosophical question whether nature can have value beyond human beings, some claim such a concept is untenable.[28]

In terms of accounting, both Hines (1991) and Cooper (1992) seem to take the extensionist-preservationist position, when rejecting the idea of including environmental resource values into accounting. Both writers seem concerned that if environmental issues are taken up by accountants with instrumental frameworks, such matters will become trivialized and demeaned. In this sense, both Hines (1991) and Cooper (1992) seem to come from a more spiritual perspective. Certainly these perspectives provide valuable insights into the possible dangers of attempting to integrate economic, environmental and social goals for environmental resources, but, from a pragmatic point of view, they offer decision-makers few alternatives.

In the absence of alternatives, there is always a danger that such a posture may in fact lead to no action at all. Moreover, as Norton (1989) makes clear, although Aldo Leopold recognized non-anthropocentrism as an important influence, he explicitly chose to support environmental policy directives on an anthropocentric basis because such a basis reaches a wider audience. Leopold reasoned the non-anthropocentric position will not be persuasive in policy discussions because 'to most men [sic] of affairs, this reason is too intangible to either accept or reject as a guide to human conduct' (Leopold, 1979 cited in Norton, 1989, p. 142).

[27] McPhee (1990), for example, refers to extreme conservationists as 'druids'—religious figures who sacrifice people and workship trees.
[28] See, for example, Callicott (1984) and Rolston (1986).

8. Summary and conclusions

From a review of the conventional wisdom, as depicted in the textbooks and research literature, management accounting currently ignores the environmental impacts of private business firms. This paper suggests that increased consideration of the environment in management accounting can be made by taking a multidisciplinary focus. The concept of sustainability is examined from a decision-making perspective to demonstrate the complexity and multidisciplinary nature of the issues often involved with the environment. By recognizing economic values, social values and ecological values for environmental resources, a three dimensional framework is developed by which to conceptualize sustainable decision-making. In addition, to examine the implications of the environment and sustainability for management accounting, four main decision approaches are identified: no accounting for nature; accounting for externalities; accounting for sustainability; and non-accounting for nature.

This paper argues that management accounting, as it currently stands, is largely consistent with the first of these approaches in which narrow economic objectives for environmental resources are largely pursued. Values for environmental resources beyond those that arise from commercial transactions are excluded from the decision tools advocated within conventional management accounting. To move beyond such a limited perspective, the paper identifies two potential decision approaches: accounting for externalities and accounting for sustainability. The last of the approaches—non-accounting for nature, however, offers little for those seeking to modify management accounting because it entirely rejects the place of accounting and economic analysis in issues of environmental resources.

To include externalities, management accounting requires additional mechanisms to capture the wider non-market impacts of projects. Recognized possible mechanisms which do seem to be a logical extension of the widely advocated discounted cash flow analyses include the extended cost-benefit analyses and non-market valuation techniques developed by applied-micro-economists. A remaining research challenge, however, is how to adapt such techniques for use by management accounting practice. Developments in management accounting practice have appeared to favour other, non-financial, mechanisms which seek to provide information on how to reduce and reuse non-productive outputs. Such approaches, and others which seek to make explicit the environmental impacts of private organizations, also seem worthy of further research.

Developing management accounting to be consistent with the concept of sustainability is a much more difficult prospect. Sustainability raises the issue of the scale of the economic activity in relation to the ability of natural ecosystems to continue to support such levels of activity indefinitely. It is briefly noted that manipulations to discounting procedures appear unable to deal with issues of scale, and could be seriously counterproductive. Sustainability appears to require approaches which determine constraints on economic activity based on ecological information from regional long-term monitoring. The acceptance of ecosystem-based approaches to handle issues of scale, however, seriously calls into question the validity of project-based assessments to account for sustainability. Consequently, unless they are integrated with mechanisms that recognize potential ecological

limits, even recent management accounting developments that expand their focus to capture environmental externalities will prove insufficient. Research initiatives on such integrated information systems are clearly worthy of further consideration.

Sustainability requires the subordination of traditional economic criteria to criteria based on social and ecological values. Criteria based on existing social values, to the extent they assume unlimited resources, will also need replacing. Achieving such changes may prove serious impediments to obtaining decision processes that promote the sustainable use of environmental resources. It may be difficult for accountants and others to accept that profitable and efficient projects are not acceptable when such projects are, or risk, violating critical ecological functions.

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Appendix 1
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