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# **Accounting systems and environmental decision making: what costs, what benefits?**

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# Accounting systems and environmental decision making: what costs, what benefits?<sup>1</sup>

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*The environmental accounting literature covers both public and private, or corporate, fields. The needs of private firms differ from public organisations in that environmental accounting systems must pay for themselves. Stakeholder analysis and the so-called triple bottom line forget that shareholders (and regulators) must be satisfied. However, unsatisfied stakeholders can impact on the firm's financial prospects and on shareholder value. This leads to strategic accounting, which endogenises future environmental costs, and relates to corporate goodwill and social capital. Rethinking private environmental accounting shows how it can lead to more efficient corporate governance, and what role government can play.*

**Keywords:** Environmental accounting, corporate governance, shareholder value, stakeholder analysis

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This paper aims at bridging the knowledge gap that too often exists between academic economists and business practitioners in the field of environmental accounting. Hopefully, both can learn from each other, and from each other's literature, to the best interests of industry and environmental management.

## **1. Foundations of environmental accounting: finance, economics and society**

### **1.1. Definition, scope and purpose**

Corporate environmental accounting focuses on recording, analyzing and reporting (1) environmentally induced *financial* impacts, whether current or future and (2) *ecological* impacts of the firm's activities, whether current or future (see e.g. Schaltegger et al., 1996).

Environmental accounting can also refer to the activities, methods and systems needed or used for recording, analyzing and reporting such information. It is a key informational input for both efficient and effective environmental management<sup>2</sup>.

An extensive literature already exists on environmental accounting. This paper has no intention of duplicating this literature. In particular, one can mention the works of Schaltegger et al. (1996) in Switzerland and Germany and of Gray et al. (1993) in the UK, as well as the publications of the Environmental Accounting Project of the U.S. Environmental Protection Agency, of the World Resources Institute (Washington D.C.), of the Centre for Social and Environmental Accounting Research (CSEAR, University of Dundee, Scotland), of KPMG's National Environment Unit, and of Ellipson Ltd. (Switzerland). Here we propose to provide a point of view that seems to be generally lacking (but see Boyd, 1998): the economics of environmental accounting, while providing the reader with an overview of the practice of corporate environmental accounting.

The purpose is to allow our readers, including managers, to determine for any particular firm the value of environmental accounting. In practical terms, this should help decision makers make better sense of the available technical, legal and industrial organizations literature. To quote D. Pearce (1997: p. 122), "The vast literature on business and the environment is informative but unstructured". Managers need to decide how much the firm should be willing to spend on such activities and what amount and what quality of information should be produced and communicated to interested parties. Since each case will be different, it is important to understand what underpins the value of environmental accounting and reporting.

This paper also aims at understanding why and how environmental accounting has surfaced in the practice of an increasing number of business firms. This may be understood partly as a response to previously hidden costs and benefits that have been pushed to the surface by increased government regulation and social expectations about business responsibilities<sup>3</sup>. A second objective is to understand why these developments have been slow

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<sup>2</sup> *Efficiency* links back to financial impacts and aims at least cost environmental management. This leads to measuring *eco-efficiency* ratios (see infra). *Effectiveness* links back to ecological impacts and aims at successfully avoiding or repairing environmental damages. Costs can be kept low but ecological damage not be avoided (ineffective efficiency). Conversely, damage may be avoided but only at a very high cost, higher than the costs induced by the damage (inefficient effectiveness). Environmental accounting aims at finding ways to be "efficiently effective". The time span allowed for doing so is crucial.

<sup>3</sup> The terms 'responsibilities', 'liabilities' and 'accountability' will be used here with very precise meanings. *Responsibility* is taken as a moral or ethical term: one may feel responsible or not according to certain moral standards. *Liability* is taken as a legal term: one is liable or not according to existing law. *Accountability* is taken as a socio-economic term: one is accountable or not depending on what stakeholders expect and on how they are empowered to affect the firm's business. Here, liability is *de jure*, accountability is *de facto*. This view is meant

to come and are still largely in their infancy. That is to say, environmental accounting, and the correlative practices of reporting and auditing such accounts, present difficulties of their own that increase the costs or prevent the potential benefits from being fully captured. Some of the difficulties are technical, and relate for instance to measurement and compatibility problems, but others are social and institutional, and reflect specific functions and traditions of the accountancy profession<sup>4</sup>.

## 1.2. Benefits and costs

Such an aim calls for a preferred paradigm. Economics, like accounting, is concerned with benefits and costs. It should therefore come as a surprise both to economists and to accountants that the two fields have for so long ignored each other in their respective endeavours. Gray (1990) speaks of ‘psychopathic siblings’. In our view, this has been for two main reasons. One is institutional, in that economists were mainly academics, whereas accountants were mainly practitioners. Hence a language barrier between the two, as exemplified by the recent revival of ‘economic value-added’, alias ‘economic rent’, as both an accounting and a business management criterion (Grant, 1997). However, both from the practical and academic points of view, accounting is not devoid of institutional and conceptual links with another neighbouring discipline, finance, which owes much to economic theory.

The second reason lies in the definition of benefits and costs, and in the way they underlie the *measurement* of capital assets and liabilities. Accounting is concerned with money in, money out, and various money balances. If transactions do not translate into some form of monetary transfer, in or out, then they are outside the scope of accounting. To a large extent, this view reflects a stewardship approach (as defined e.g. in Brockington, 1995), with a focus on a specific stakeholder category: equity providers (Figge & Schaltegger, 2000). This focus is backward-looking and is concerned with how the funds entrusted to the firm have been cared for. By contrast economics, and in particular financial economics, is concerned with benefits and costs as driving forces for decision making. The focus is forward-looking and is concerned with whether resources are optimally managed. In other words, accounting and economics differ from this point of view in how benefits and costs are defined. When Milton Friedman famously declared: “The social responsibility of business is to increase its profits”, the heat was on, mainly on ethical grounds. In fact, the problem may well be an accounting one. What ‘profits’ are we talking about, what benefits and what costs? Depending on how we answer this question, we shall agree or disagree with Friedman.

One may conclude that there is no real opposition between the frameworks of economics and accounting, but rather a difference of emphasis and focus, a difference which, as we shall see, is on the decline<sup>5</sup>. Through financial consequences such as market impacts, financial provisions, stock values, and insurance and risk management, previously non-

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to tie in with policy instruments, respectively: education, regulation, and economic instruments. We focus here on accountability, noting that *potential future liabilities extend the firm’s current accountability*.

<sup>4</sup> See Antheaume, N. (1996), (In French) Accounting and environment: what future for accountancy and chartered accountants? *Revue Française de Comptabilité*, **284** (Dec.): 55-61; - Christophe, B. (1992), (In French) ‘The accountant faced with environmental accounting’, *Revue Française de Comptabilité*, **235** (June): 51-57; - Gray, R.H. (1990), *The greening of accountancy: the profession after Pearce*. Certified Accountants Publications Ltd., London; - Hopwood, A.G. and Miller, P. (eds.) (1994), *Accounting as a Social and Institutional Practice*. Cambridge University Press; - Perks, R.W. (1993), *Accounting & Society*, Chapman and Hall.

<sup>5</sup> Authors such as Edwards & Bell (1961), and much earlier J. Canning in 1929 and J. Stamp in 1921, long advocated for cooperation between the two disciplines.

measurable benefits and costs are coming to light and being, sometimes indirectly, measured or at least accounted for. As we shall see, finance theory seems to be ahead of accounting in providing an in-depth understanding of these phenomena.

Let us now try to make sense of current developments in environmental accounting.

### 1.3 Environmental accounting and the crisis of traditional accounting

Accounting was from its very beginnings in ancient Babylon a means of being accountable to owners and lenders<sup>6</sup>. The business community has used traditional double-entry bookkeeping for more than five centuries. Historians of accounting ascribe its invention to Luca Pacioli (1445-1514), an Italian Franciscan monk, who was also a mathematician<sup>7</sup>. Pacioli, at that time Professor of Theology at the University of Perugia, wrote a book entitled *Summa de Arithmetica, Geometria, Proportioni e Proportionalità* (1494), in which the basic principles of double-entry bookkeeping were laid down<sup>8</sup>. It was an important innovation of the early Italian Renaissance<sup>9</sup>, that brought about tremendous efficiency gains to managers and accountants. At that time, and even until comparatively very recently, accounting was still carried out mostly by handwriting, and accounting calculations were still performed by hand, or later with mechanical computers; it is only recently that electronic and personal computers have led to enormous efficiency gains in accounting operations with fast, decentralised, and large-scale computing capacity available to both larger and smaller organizations.

Contemporary accounting, however, is in crisis; Christophe (1992), for instance, mentions an “identity crisis”. This deserves some discussion. One can say that the profession, the standards and actual practice have been in crisis at least since the 1930s. But this crisis is only an aspect of the evolution of the business corporation since the depression of the 1930s. One of its aspects was that, before the 1929 crash, in the USA and elsewhere, disclosure of financial performance by quoted public companies was usually very imperfect, so that capital markets were not efficient in Fama’s sense. In his book on the crash of 1929, J.K. Galbraith<sup>10</sup> mentions some of the unethical practices of what one might call rogue managers in the 1920s. “Window dressing” practices, such as omitting negative elements in a balance sheet at the end of the exercise, were common at that time in the USA. These practices contributed to provide false and over-optimistic pictures of the financial performances of companies and investment funds to small shareholders. Combined with attempts to elementary prudential rules such as abuses in margin buying, they were fuelling bullish speculation that was out of proportion with the actual and expected profits of quoted firms. The negative experience of the great crash and of the depression of the 1930s that ensued lead the authorities, in the USA and elsewhere, to edict both disclosure rules and prudential rules aimed at protecting the economy against systemic risks, and at protecting small and minority shareholders against questionable practices. These disclosure rules enlarged the ethical responsibilities of the accounting profession toward promoting the information of shareholders at-large, rather than supplying information only to large shareholders and/or to the managers of the firms. From then on, the

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<sup>6</sup> An amazing example is how most of the Linear B inscriptions of Minoan Crete, in the 2<sup>nd</sup> millennium B.C., relate to accounting records, and how from these a picture emerges of the social structure of ancient Cretan civilisation.

<sup>7</sup> See R. Emmett Taylor, *No Royal Road: Luca Pacioli and his Times*, Ayer, London, 1981; and: Conference on Accounting and Economics, *Proceedings of the Conference on Accounting and Economics: In Honour of the 500<sup>th</sup> Anniversary of Luca Pacioli’s Summa de Arithmetica* (Siena, Italy, 1992), Garland.

<sup>8</sup> See D.P. Ellerman, ‘The Mathematics of Double Entry Bookkeeping’, *Mathematical Magazine*, 58, 1985, pp. 226-233. Notice it was only 2 years after Columbus, another Italian, ‘discovered’ America (1492).

<sup>9</sup> The Italian Renaissance was quite prolific in financial and banking innovations.

<sup>10</sup> J.K. Galbraith (1972), *The Great Crash, 1929*. Boston: Houghton Mifflin (3<sup>rd</sup> ed.).

ethical demands of stakeholders to the accounting profession gradually increased, with a sharp rise in the 1970s (see e.g. Calhoun et al., 1999). At that time, the ‘economic consequences’ movement raised its head (Zeff, 1978). Not coincidentally, the 1970s was also the decade when the social accountability of business corporations was questioned (Mintzberg, 1983). Indeed, it was in 1970 that Milton Friedman declared that ‘the social responsibility of business is to increase its profits’. To most analysts, the environmental responsibility of business may be seen as an aspect of enlarged social accountability (Bebbington & Gray, 1993).

Most of the debate in the 1970s that followed Friedman’s pronouncement, which appeared scandalous to some, inconsistent to others, focused on ethics. However, it is our contention that Friedman’s statement concerns accounting as much as, if not more than, ethics. One may agree or disagree with Friedman depending on how one defines and measures profits, benefits and costs. Even to a business corporation, this is not uncontroversial, as the long-standing debates in accounting standards demonstrate. As far as accounting *practices* are concerned, it is clear that under the social pressures of the 1970s they evolved and broadened their scope to the needs of stakeholders other than (large or small) shareholders. This went along with the demand for enlarged disclosure and for better information of shareholders, thus bridging the gap between them and the firm’s managers. Environmental accounting is part of the new social demand directed at accountants. It reflects the demands of stakeholders (including shareholders, customers, and communities at large) that are concerned with the environment.

As Gray et al. (1996) repeatedly point out, accounting and accountability always were intimately linked. The question then is: what are the accountability relationships? There are at least three types of players involved: the *accountees*, to whom accounts must be given, the *accountors*, or those held accountable by the accountees, and the *accountants*, who develop and use accounting techniques to ensure that the accountability relationship is achieved to the satisfaction of both parties. These two parties have also been seen, in the light of agency theory, as *principals* (the accountees) and *agents* (the accountors) (Power, 1991). Accountants may then be seen as intermediaries and their honorariums as transaction costs. Finally, there is that which is accounted for: loans, investments, trusts, goods. ‘Accountables’, a sum of money or some resource in kind, have been entrusted or lent by the accountee to the accountant.

Accounting is in crisis because accountability relationships have changed and because new accountees have appeared on the scene. Environmental accountability is one such novelty, but there are others, related to other social and ethical concerns (gender and racial discrimination, use of children labour in less developed countries, use of ‘dirty money’ by banks<sup>11</sup>, etc.). The existing accounting system is thus at odds with the demands from the new parties. This tension can be felt as a crisis. If so, the crisis we are talking about is but one of the aspects of a crisis of adaptation to a changing world. Since the 1970s, moreover, the accounting profession has been completely upset by changes that occurred at an astounding pace. Firstly, the technological evolution of the information-processing techniques has led to tremendous gains in efficiency: the “bookkeeper’s tally” has been replaced by personal computers, and information can be transferred almost instantly through Internet channels. Secondly, especially as regards large corporations, accounting services are now dominated by very large and global organizations, such as the “big five” of accounting and audit<sup>12</sup> (Arthur

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<sup>11</sup> For a number of years, Swiss banks have faced widespread criticism regarding ethics, even with impeccable financial management. In the case of *Crédit Suisse*, it is interesting to note, according to social ratings used by the ethical pension fund *Ethos* in Switzerland, an exemplary attitude toward the environment which is perhaps not mirrored by other social aspects of ethical behaviour.

<sup>12</sup> Which were the “big six” previous to the merger of *Price Waterhouse* and *Coopers and Lybrand* (2000).

Andersen, KPMG, Deloitte and Touche, Ernst and Young, and Price-Waterhouse-Coopers). Thirdly, the scope of accounting services has extended to a number of new services, including environmental accounting, auditing and reporting. Clearly, global organizations such as the “big five” are taking fast steps to overcome the crisis we are discussing: as far as environmental accounting and related services are concerned, they all have developed services in this new and still evolving area.

#### **1.4. The appearance of new accountees**

The foregoing suggests that the rise of public expectations regarding the environmental responsibilities of business, whether emanating from government, consumers or society at large, reflects the appearance of new accountees. In order to find out who they are, we must know who were the old ones to whom the traditional accounting system was tailored. It is to answer this type of question that stakeholder theory has emerged (Kelly et al., 1998). The various parties to an accountability relationship belong to and define a population of stakeholders. *Stakeholders can and should be defined as those individuals or organizations whose benefits and costs are affected, upwards or downwards, by the decisions of any given decision maker.* The surge in environmental concerns may thus be seen as a broadening of the stakeholder population.

At this stage, two issues emerge. One is that stakeholders are now demanding fair and transparent information about many aspects of the firm’s activities, including environmental aspects, in order to assess whether their utility or welfare is negatively affected, in which case they may want to claim compensation. But the notion of environmental responsibility (see footnote 3) is closely related to a duty or obligation to others whose corresponding rights are acknowledged and recognized. If a local neighbourhood is being polluted by a chemical firm and the health of the inhabitants is being seriously affected, then environmental responsibility of the firm would make no sense if these inhabitants were not seen by at least third parties (not necessarily the firm) as having a *right* to good health. Thus accounting and accountability are deeply rooted in the existing system of economic, social and political rights, of which property rights and health and safety entitlements are key components.

The other issue is the specific view of reality, and in particular of social and economic reality, that accounting systems claim to reflect but may not in fact reflect. Hines (1988) and Stamp (1993), for example, criticize the views of the American FASB (Financial Accounting Standards Board), as well as of their British, Australian and other counterparts around the world, when trying to elaborate a universal set of standard-setting accounting rules. As Hines and Stamp suggest, accounting and the profession are still struggling with reality ‘as it exists’. In one essential area, estimating the value of the firm through pure accounting techniques that traditionally estimate the equity as the difference between the value of assets and the amount of debts, are misleading because of hidden or non tangible liabilities and assets, such as the firm’s goodwill. This is especially true in the context of environmental concerns, because there are a number of hidden environmentally related liabilities and assets (see later in this paper). It is quite natural to think that accountants first developed accounting systems for the items easiest to measure: physical, tangible items and sums of money. Items like intangibles and goodwill are difficult to measure, and have not altogether been successfully tackled (Brockington, 1995). In other words, if the easiest items are accounted for first, later items are likely to be increasingly difficult and costly to account. Financial techniques, such as discounted cash flow techniques, in which the value of the firm is calculated as the sum of discounted expected cash flows, are relative latecomers on the accounting scene. Inasmuch as financial techniques include anticipatory estimates of future benefits and costs, risks and liabilities, they are more appealing than pure accounting methods which simply reflect *past*

benefits and costs, and they have become strong competitors of the more traditional accounting techniques<sup>13</sup>.

The profession is in crisis because (1) it cannot or does not feel entitled to acknowledge new stakeholders and new accountees, such as local communities, consumers, or even the global community, and (2) it has not yet fully developed the techniques to account for, measure and report to these new stakeholders. It may also be the case that (2) partly induces (1), insofar as it undermines the profession's expertise. A sort of competition between accounting and financial analyses appears as a sign of this crisis.

Our discussion applies entirely to the specific case of environmental accounting. The fact is that environmental monitoring and recording costs have fallen and that, as noticed above, accounting techniques have enormously developed. True, monitoring equipment can be very expensive, as are people qualified enough to make good use of it. But technological improvements have reduced the costs of equipment, and developed adequate hardware and software tools. In addition, firms have been gaining experience, increasing the efficiency of monitoring staff and organizational structures, in particular, of environmental management systems.

With the advent of environmental accounting, there are at least four types of difficulties encountered: a common framework with standard accounting practices; measurement problems; integration problems; and the issue of how far beyond its boundaries a firm is environmentally accountable. The next section examines the practical problems of environmental accounting along these lines.

## **2. The practice of environmental accounting**

### **2.1 Overview: the three stages of environmental accounting**

Corporate environmental accounting may be thought of as a broadening of traditional financial accounting toward environmental concerns. More precisely, environmental accounting may be considered as a three-stage pursuit: (1) introducing into accounting practices hitherto hidden environmental expenses and benefits (2) measuring the environmental impacts of the firm's activities and products, and (3) integrating the financial and ecological consequences of the firm's activities.

That (1) is a pertinent approach is clear: until quite recently, environmental facts were still either completely missing, hidden, or at best available only through some kind of tedious reprocessing of financial accounts.

But this is by no means the end of the story. Financial accounting is composed, and may be defined as quantitative information about financial assets, liabilities, inflows and outflows. This information is important and even fundamental within the utilitarian framework. Within this framework, and within the scope of financial accounting, the knowledge of environmentally related financial assets, liabilities, inflows and outflows can of course be of great importance.

From an environmentally oriented ethical point of view, which differs from the utilitarian point of view, (2) quantitative information about the state of the environment, and environmental inflows and outflows due to the activity of the firm, is also very important. This statement of environmental inflows and outflows with respect to the boundaries of the firm's physical production system is usually termed the firm's *ecobalance*.

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<sup>13</sup> See e.g. H. Kierkegaard (1997) who makes a strong case oriented towards measuring beforehand the potential insolvency of a firm. His ideas may be directly extended to account for environmental liabilities (see further).

However, an ecobalance as has just been defined is still not a pertinent tool to describe the environmental impacts of a product, rather than those due to a firm's production activity. The assessment of the ecological qualities of a given product necessarily rests upon an analysis of its environmental impacts throughout all the stages of its life. This means an analysis "*from cradle to grave*", that is, including the design, the production, the use, and the final disposal of the product. This is what is called the *Life Cycle Assessment* (LCA) of the product.

Finally (3), in order to judge a company's overall environmental performance, and answer questions like: has it been doing enough, has it done the right things? - the financial and environmental-impact aspects must be related and integrated.

It seems useful to give some details about the practical implementation of these three stages of environmental accounting.

(1) The first stage identifies, in both the balance sheet and the trading and profit & loss account of the company, the accounting increments relating to the environment. Thus, environmental liabilities, which are now being accounted for by most firms, and by all firms in certain countries, find their way into the balance sheet. For example, WMC Ltd. (Australia) entered provisions for future mine site rehabilitation costs in 1999 for \$87.7m, up from the 1998 figure of \$82.5m. These provisions represent cost accruals cumulatively over the expected lifetime of an operation. WMC also indicated in its (environmental) balance sheet the total current value of its rehabilitation liabilities, should it decide to relinquish all its operations immediately, a value of \$264m, again up from the previous year's \$250m. A further provision of \$167m was down for future contingent liabilities. The increase reflected expanded operations and a net increase in land disturbance, net of past rehabilitation. Capital expenditures for environmental control were also reported; for example, the installation of fume capture hoods at a nickel smelter.

In the trading and profit & loss account appear operating expenses for ongoing environmental management activities. For example, expenses relating to environmental 'induction', awareness building and training of staff, or to clean-up operations. Conversely, environmentally related income can appear in the form of special subsidies and government aid. The problems specific to the financial aspects of environmental accounting are reviewed hereafter.

(2) The second stage identifies, with respect to the firm's activities, environmental inflows and outflows in a manner that Christophe (1995) finds similar to management costing, where the aim is to be able to cost individual products and services, and thence the profitability of each. Recently, the literature has been suggesting that such accounting information would be much easier to generate by adopting activity-based costing (ABC) or budgeting (ABB) (Brimson & Antos, 1999). Interestingly, whereas ABC includes sensitive technical information that the firm may not wish to disclose to the outer world because of competition, its environmental counterpart, the *eco-balance*, is considered public information. The fact is, the purpose of an eco-balance is different from ABC. Its purpose is to show how much the firm impacts on the environment, what impacts are most important, and how these impacts are distributed. This input-output picture can remain public information to the extent that it is fairly aggregated: external stakeholders are only interested in the final impacts on the environment. More detailed descriptions of which processes generate more impacts can remain private information and guide managers towards process changes. We may note, however, that information on certain specific chemicals can be withheld if they might provide competitors with hints on production processes. WMC Ltd. provides eco-balances of both its total Australian operations and on a site-by-site basis.

The other aspect of environmental accounting goes beyond the boundaries of the firm and identifies environmental impacts of its products. Thus Volvo not only accounts for its

production impacts, in terms of resource use and air and water pollution, but also for the use and disposal of its products, in this case engines and vehicles. Clearly, energy consumption, efficiency and related gas emissions (CO<sub>2</sub>, CO, SO<sub>2</sub>, NO<sub>x</sub>) from their use is of concern to Volvo. This includes a concern for competitive advantage. Its efforts in developing alternative fuels, organizing the collection and recycling of used oils and greases, and recycling of used vehicle components is witness to its product life-cycle perspective. Sweden's former welfare policy, from cradle to grave, is mirrored in the Life Cycle Assessment (LCA) of products. Services can also adopt LCA. Banks like Crédit Suisse and UBS (also Swiss) have clear lending and financial policies for environmentally performing firms, the product then being the loan package. Insurance companies such as Swiss Re do likewise, where the product is the insurance deal struck with the client. Supermarket retailers, such as Migros (Switzerland), will strive to control suppliers, for example by imposing minimum packaging, use of efficient transportation, etc., and customers by promoting eco-labelling, encouraging recycling of packaging, aluminium cans, efficient home delivery to reduce total fuel use, etc. Accordingly, Volvo reports fuel consumption and efficiency curves of its various products and Migros of its recycling efficiency (paper, cartons, metals...) and proportion of green-labelled sales. Both also report on progress with environmental protection clauses in their contracts with suppliers (part of their EMS). The problems specific to LCA accounting are reviewed hereafter.

(3) Because it allows for performance assessment, measurement and integration are crucial to any decision making. Optimal decisions aim at maximizing or minimizing some performance indicator. If environmental performance is at stake, then not only financial, but environmental impact indicators are needed. The latter require monitoring and measurement technologies that can be very expensive, plus highly qualified, high pay personnel. Producing the information may be very costly, and would need to be justified in terms of its contribution to improved management decisions and, ultimately, to the firm's bottom line. Once measurements have been carried out, however, accounting methods are needed to organize, analyze and report this information. Because environmental impacts are so many and must be measured in physical terms, data aggregation becomes a problem. Without appropriate aggregation, its value to decision makers will be limited. Finally, environmental impact information must be able to be coupled with financial information linked to the firm's environmental management efforts. Again, such efforts need to be seen by shareholders and other stakeholders as justified.

## **2.2 Accounting for environmentally-related financial impacts**

As Schaltegger et al. (1996) and Schaltegger and Burritt (2000) discuss at length, there are two kinds of environmentally related accounts. One describes the financial impacts of environmental management (or lack thereof), the other the ecological impacts. In part, each is of interest to different stakeholders, though overlaps exist as in the case of employees and the taxation authorities.

Schaltegger calls the first type 'environmental accounts'<sup>14</sup>. Since this appellation usefully avoids confusion with standard costing and financial accounts, let us adopt it. Environmental accounts basically measure the firm's effort in managing the environment and in reducing potential risks. However, such effort may be wasted, poorly engineered, and ineffective. Having spent a million dollars on an environmental management system, possibly certified according to the ISO 14001 norms, does not guarantee that sulphur dioxide

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<sup>14</sup> More precisely, the authors distinguish between 'environmentally differentiated' management (or cost) accounts and 'environmentally differentiated' financial accounts. For our purpose here, we can lump these two together.

emissions will have fallen in the following three years. 'Ecological accounts' measure the firm's physical impact on the environment: emissions into the atmosphere and into water bodies, solid wastes, radioactivity. What are the difficulties associated with each?

It may be thought that at least for the 'environmental' (that is, financial) accounts things are fairly simple: don't they reflect traditional accounting systems that use monetary measurement units? This is hardly so. Firstly, allocating environmental costs, that is, costs to the firm from reducing damages or risks to the environment, is far from straightforward. For example, costs can be allocated according to any of the following three criteria: volume of emissions treated, toxicity of emissions treated, and environmental impact added of emissions<sup>15</sup>. Any systematic choice between them appears arbitrary. Schaltegger et al. conclude (p. 55) that it is a case by case decision. Obviously, this does not simplify standard-setting.

Secondly, allocating financial costs linked to environmental investments is even less straightforward. There is often an ambiguity as to how much of the investment can really be allocated to the environment. For example, an old and very polluting piece of equipment is scrapped and replaced by a new, less polluting one. If the equipment was becoming economically obsolete and would have been replaced regardless of environmental considerations, can the firm allocate the amount spent for the new equipment to its 'environmental investments' account? Sometimes, it is only a matter of labelling. An in-house training program aimed at ensuring maximum personnel safety and correct use of technology can be relabelled environmental training and the associated expenses counted as environmental expenses. The reality is that *many investments are multi-functional*: they may be partly aimed at reducing some environmental damage or risk, but it is not their sole purpose, nor perhaps their main purpose. For example, correct use of technology by staff is one way of reducing risks to the environment as well as risks to personal safety. In the case study section, we shall see why, because of this difficulty, WMC Ltd. decided in 1999 to abandon environmental cost allocations altogether! They are not the only ones. As a result, standard setting is just as necessary as it is difficult!

The first stage of environmental accounting is thus identifying, in both the balance sheet and the trading and profit and loss account of the company, the accounting increments related to the environment. Some of the elements of a typical balance sheet (Table 4.1) may be directly related to environmental management (Table 4.2).

Financial accounting has to give a faithful picture of the value of the firm to the stakeholders, and especially to the shareholders and to the management of the firm. However, the financial condition of a firm determines its creditworthiness and its long-term survival, and is thus also of interest to stakeholders such as bankers and employees, among others. But there can be hidden liabilities and hidden assets related to the environment, which are of interest to a number of stakeholders. If the balance sheet is to describe faithfully the net value of the firm, or its equity, one must take into account hidden liabilities such as being liable for cleaning up some polluted property, even if the firm does not own it. This is now possible under environmental legislation that prevails in many countries, and in particular in the USA. In the USA, under the context of CERCLA, if the firm has used a piece of land for waste disposal while renting it, it becomes liable for cleaning up the polluted property thus created. This liability can be transferred to another company if it takes over the first company, as shown by Figure 4.1.

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<sup>15</sup> That is, volume times impact per unit of volume (Schaltegger, op.cit. p.54).

Table 4.1 – Typical simplified balance sheet for an industrial company

<b>LIABILITIES</b>	<b>ASSETS</b>
Long-term debts	Land and buildings Less: provisions
Medium-term debts	Plant and machinery Less: depreciation
Creditors	Stocks (raw materials, products)
Short-term debts	Debtors
<b>EQUITY</b>	Cash and cash-related assets
	Other financial assets
	Goodwill

Table 4.2 : Environmental items in the typical simplified balance sheet for an industrial company

<b>LIABILITIES</b>	<b>ASSETS</b>
Long-term debts covering environmental and related equipment	Contaminated land Less : provisions for rehabilitation
Medium-term debts covering environmental and related equipment	Anti-pollution and related equipment Less: special depreciation
Creditors (suppliers of environmental services...)	Stocks (raw materials, products) Materials to be recycled Ecological fuels Ecolabelled and other “green” products
Short-term debts covering environmental expenses	Other financial assets (including: shares of companies with environmental activities)
<b>INCREASE IN EQUITY DUE TO ENVIRONMENTAL MANAGEMENT</b>	
	Increase of goodwill due to “greening” of products (Decrease of goodwill due to environmental problems)

We now move on to discussing how to account for environmental costs and benefits. This means that environmental costs, savings and sales (meaning the sales of “green” products, possibly with ecolabels) have to be extracted from the standard financial accounting of the firm (and especially from the trading and loss and profit account).

There are several kinds of environmental costs. Direct costs are costs that are directly available from standard financial accounts, such as pollution prevention, recycling and rehabilitation costs. There are also direct costs of human resources and of capital, such as pollution prevention equipment and training. Other direct environmental costs include costs of environmental services and costs of insurance policies against environmental risks, costs of environmental certification and costs of environmental audits. However, many of these environmental costs are usually indirect costs, meaning that some cost allocation has to be carried out. In particular, capital costs seldom correspond only to pure pollution prevention or other environmental effects, because the latter are often only one aspect of the investment.

The same is true of maintenance costs and of the costs of human resources. Here, some cost allocation has to be carried out by trying to extract environmental costs among all other costs.

There are also direct benefits, such as the sales of “green” products, products with ecolabels and sales of recycled materials, or by-products that otherwise would have been disposed of as waste. Overheads have to be allocated between the various products as usual in order to single out some overheads and fixed costs related to these “green” products.

The above costs are simply conventional corporate costs that may be directly or indirectly allocated to the environment. But there also are hidden costs and benefits that are related to the environment. There are costs that have potentially been overlooked in conventional corporate management and identified as “image and relationship costs”, such as blows to the reputation of a firm due to environmental accidents or incidents and other negative events. Conversely, there are also hidden benefits due to events that affect positively the firm’s reputation. We finally end up with accounting for environmental costs and benefits extracted from the firm’s trading & loss and profit account.

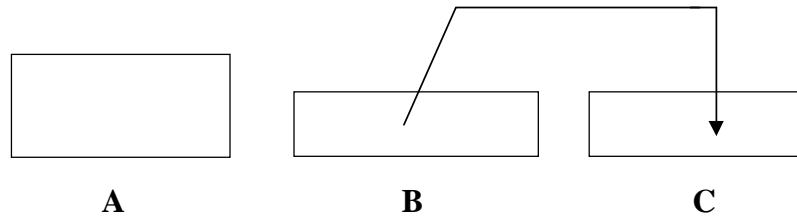
Clearly, the detail of these costs may be used for costing and management accounting. They constitute private information and hence a management tool which aims at assessing the financial impact of the environmental management of the firm.

As noticed by several authors societal costs, such as the costs of negative externalities, are usually overlooked in this approach, although some authors propose to include them in a more complete practice of accounting (Christophe, 1995). This is *full cost accounting* (FCA) which has been practised, for instance, by Ontario Hydro in Canada (EPA, 1995b). As the Ontario Hydro experience demonstrates, FCA aims at including and quantifying social costs. Costs imposed on society, through environmental impacts or otherwise, are identified and estimated, although they may not, at least directly, affect the firm’s bottom line (Estes, 1972). This includes benefits from the environment, such as clean air and water, biodiversity, a pristine ecosystem, or a beautiful landscape, that may be lost through economic activity (Cairncross, 1991). With FCA, the firm is clearly reflecting its responsibility to all of society, but here the measurement problems loom large, as non-market valuation techniques must be relied upon to estimate some of these costs (see O’Connor & Spash, 1999).

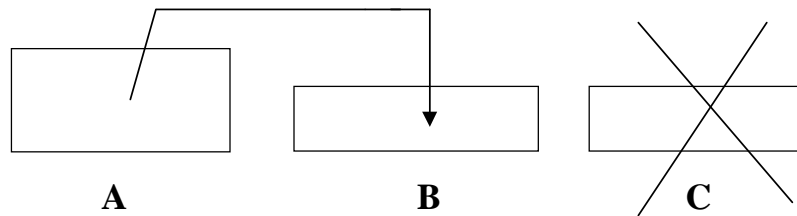
One may also ask how far a private firm needs to go down such a path. For a public utility, in which the state is the major shareholder, such accounting appears not only reasonable, but highly desirable (White et al., 1993). For a privately owned firm, or one where private interests are the major shareholders, this is more questionable. As will be examined in more detail later, it is less the social costs themselves that are relevant to a private firm than the consequences on the future value of its business of imposing such costs. This will be the essence of strategic accounting, a weak form of FCA appropriate for the private sector (see section 3.3).

The next stages of environmental accounting deal with ‘ecological accounting’ in Schaltegger et al.’s (1996) sense. First, we look at ecobalances for the activities of the firm, then for its products (LCA). This means accounting for the various environmental impacts of the firm’s activities and products. This was first done in relation to energy use (Jacques, Lesourd and Ruiz, 1988). Energy accounting is a quantitative evaluation of the various energy inputs for the various product lines and production units of the firm. Energy resources are closely linked to the environment given that they give rise to atmospheric emissions. Also, non-renewable energies, or fossil fuels, are exhaustible resources.

(1) Initially, firms A and B exist; B rents the piece of land C, using it for waste disposal.



(2) A takes over B, without the polluted piece of land C...



(3) A+B is not the owner of C, but it may still be liable for the costs of cleaning up C...

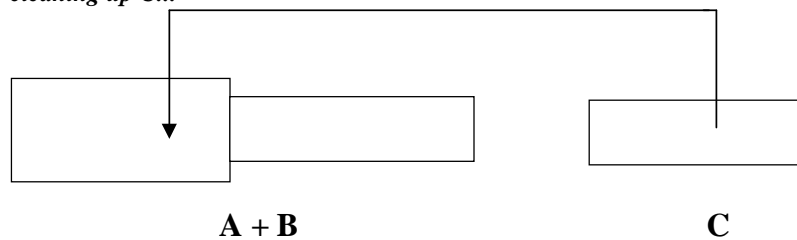


Figure 4.1: Example of a hidden liability (liability for cleaning up polluted property) to be taken into account in the balance sheet of firm B, which is taken over by firm A

Table 4.3 : Environmentally-related costs and benefits

<b>COSTS</b>	<b>BENEFITS</b>
Direct environmental costs	Supplementary sales due to “greening” of products
Indirect and allocated environmental costs	Sales of recycled by-products
(Savings in raw materials and other intermediary products)	Hidden environmental benefits
(Including : energy savings)	
(Relief in financial and interest costs related to environmentally related investments)	
(Relief in corporate tax related to environmentally related investments)	
Depreciation of pollution prevention and other environmentally-related equipment	
Other environmental provisions	
Hidden environmental costs	
<b>SUPPLEMENTARY NET AFTER-TAX PROFIT DUE TO ENVIRONMENTAL MANAGEMENT</b>	<b>OR: SUPPLEMENTARY NET AFTER-TAX LOSS DUE TO ENVIRONMENTAL MANAGEMENT</b>

We thus discuss energy accounting and give a more general description of ecobalances in the next section, first for activities, then for products.

### 2.3. Ecological accounting: towards activity and product ecobalances

#### *The pre-history of ecobalances: energy accounting*

The first appearance of “environmental accounting” depends on how we define it. If *energy accounting* is good enough, then soon after the first ‘oil shock’ in October 1973 companies started to monitor their energy consumption patterns. This was primarily motivated, of course, by cost reduction incentives brought about by the sudden increase in oil prices. At the same time, however, it was the first time that business started to draw up physical accounts of energy consumption alongside the corresponding monetary accounts. This was because of two reasons. Firstly, there was the convenient accounting basis provided by the laws of thermodynamics, whereby all energies can be converted into one another in terms of heat or work equivalents (depending on whether the First or the Second Principle is used (see Lesourd and Gousty, 1981; Jacques, Lesourd and Ruiz, 1988). In this respect, energy could be used as a physical numéraire, or accounting unit, for monitoring energy consumption and especially energy efficiency.

This provides us with the second reason, that cost reduction implied engineering re-assessment of energy systems and energy wastage. Alongside the economics, made visible through monetary cost accounting (e.g. in dollars), the engineering requirements were made visible through physical energy accounting (e.g. in gigajoules or  $10^9$  Joules). The

development potential was made visible through the difference between the thermodynamic limit or Carnot efficiency and the current energy efficiency (Lesourd and Gousty, 1981).

Energy accounting is amenable to easy aggregation because of the thermodynamic principle allowing all energies to be converted into heat equivalents (measured in BTUs, megajoules, kilowatt-hours, or tonnes of oil equivalent). The common shared property is the generation of heat. Although universally in use, this approach is not correct, on thermodynamic grounds, when work or power rather than heat is of interest. In that case, an exact aggregation principle (the exergy principle), based on the second law of thermodynamics, is usually preferable (Lesourd and Gousty, 1981). However, aggregation is of interest only in the case of interrelated energy consumptions in a complex technical system, and exergy is thus mainly an engineering concept. In the practice of energy accounting, if unrelated sources of energy are used, from the management point of view, aggregation may be unnecessary. An example of energy accounting, taken from the work of Jacques, Lesourd and Ruiz (1988) is given in Table 4.1 hereafter for a hotel company in a Mediterranean country.

This example of energy accounting is only a particular case of environmental accounting, which might encompass such energy figures, whether with aggregation or with no aggregation. Inasmuch as the case study developed in this example was originally aimed at evaluating the impacts of using solar energy in that hotel company, we are indeed very close to environmental concerns.

One may object that this energy accounting example cannot really be classified as environmental accounting, in that, for example, no account was made for greenhouse gas impacts of energy consumption. This however would be missing the point, in that energy accounting was just a first step in the business of revealing previously hidden costs (of energy wastage) and benefits (of energy savings). If carbon credits had been introduced as a policy back in the 1970s, it is more than likely that energy and environmental accounting would have developed in closer symbiosis, and much quicker. By contrast, if no oil shocks had happened in 1973 or 1979, and energy had remained very cheap throughout, it is likely that environmental impact accounting, in terms of atmospheric carbon accumulation, might have preceded energy cost accounting<sup>16</sup>.

#### *Ecological impacts of activities: towards ecobalance accounting*

Be as it may, in the mid-1980s, partly in reaction to the Reagan and Thatcher administrations' "all business" approach to policy, partly in response to new measurements made by the scientific community, environmental impact awareness rose sharply in North America, in Western Europe (particularly in Northern countries), in Australia and in New Zealand. Pollution and pollution abatement became the catchwords of the day. The need for pollution monitoring systems and cost minimization strategies hit top priority. In a way, pollution abatement played the role that energy saving had played in the 1970s, in that it turned the light beam towards cost reductions, initiating a second wave of accounting needs, at first targeted to management (or costing) accounts.

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<sup>16</sup>Environmental accounting began indeed to be a concern at the end of the 1980's, when energy was comparatively cheap..

Table 4.4 : Energy accounting for a hotel company

Hotels	A		B		C	
	Previous year	Base year	Previous year	Base year	Previous year	Base year
Guest nights	14859	14061	22338	36582	29374	28555
Electricity	183044 kWh 658958 MJ	174591 kWh 628528 MJ	347621 kWh 1251436 MJ	378502 kWh 1362607 MJ	144851 kWh 521464 MJ	143049 kWh 514976 MJ
LPG (Butane)	610 kg 28060 MJ	685 kg 31501 MJ	1288 kg 59248 MJ	1867 kg 85891 MJ	112 kg 5152 MJ	109 kg 5000 MJ
Gas oil	977982* 982350 MJ	765400* 769500 MJ	1262996* 1261260 MJ	1451336* 1450000 MJ	315792* 311540 MJ	306160* 305620 MJ
Total GJ (rounded)	1665	1425	2574	2900	842	826
MJ / Bed night	112	101	115	79	29	29

\* Imperial gallons (4.54 litre)

(Source : Jacques, Lesourd and Ruiz, 1988, pp. 339-340)

This time, however, there was no practical equivalent to thermodynamic energy conversions. It was hard to see how an equivalence principle could be drawn between tonnes of carbon emitted into the atmosphere and kilograms of mercury washed out into the ocean at Minamata, Japan<sup>17</sup>. This time, would-be environmental accountants were faced with as many material balance accounts as there were materials being emitted or washed out into the environment. On the one hand, there seemed no practical way of bringing all these accounts together into one consolidated account, and, furthermore, there seemed to be no easy way to correlate existing monetary and financial accounts with these disparate materials balance accounts. This explains why energy accounting never attracted much attention outside engineering and cost management departments, whereas the wider-based environmental accounting issues have hit the whole accounting profession, much of the business world, and even the political sphere.

There is yet another crucial difference between the energy accounting of the 1970s and the environmental accounting of the 1990s and beyond. The former was concentrated around cost-reduction, which directly affected the 'bottom line' and profits. The stakeholders were the same as those concerned by 'business as usual': the owners of the firm, investors and shareholders, top management, and government, insofar as it wanted to reduce energy imports into the national economy. Because greenhouse gas and other environmental impacts were not yet a concern for the general public, both customers and consumers, no 'value' was placed on carbon and other greenhouse gas emissions. The situation changed in the mid-1980s and became prevalent in the 1990s. This time, new stakeholders appeared in the picture who were not the traditional ones, at least in the eyes of business managers. Concomitantly, environmental pressure groups, NGOs and widespread publicity over industrial environmental disasters like Bhopal and Exxon Valdez put new pressure on business firms and started to

<sup>17</sup> Some ecologists, in the wake of Howard T. Odum (see *Environmental Accounting*, 1996), would dissent from this view. They claim to have found such a universal principle, based on *solar energy equivalents* and on the maintenance of biological life on earth. Though worthy of study, their view appears inappropriate for the corporate world, at least for the present. But see applications in Hall, C.A.S., Cleveland, C.J. and Kaufman, R. (1992), *Energy and resource quality: the ecology of the economic process*. New York: Wiley.

reveal previously hidden costs and liabilities. In the USA, a legal innovation introduced retroactive liability for site contamination and clean-up (the US Superfund scheme), while development of the Internet and information networks around the world facilitated the role of watchdogs over the environmental doings of companies. Shell was a noteworthy example following the Brent Spar and Nigerian events. In short, the new stakeholders created new accountabilities for companies, which in turn created new pressures for environmental accounting.

Meanwhile, some of the equipment installed and know-how acquired for energy monitoring and recording was already in place when the need for a broader accounting framework was felt. To that extent, although we know of no studies that have actually investigated this, energy accounting helped reduce the costs of implementing environmental accounting systems.

Nevertheless, with ecological accounting, technical difficulties loom large. The first is one of consolidation, or aggregation<sup>18</sup>. Accounts in physical units, such as gigajoules of heat, tonnes of carbon dioxide, and kilograms of mercury cannot be added together. It is like adding apples and oranges. Thus in accounting for the environmental impacts of the firm, accountants (or whoever is given the task) are faced with as many separate accounts as there are impacts. One may ask: so what? Where is the problem? The problem is this. If an investment reduces the emission of greenhouse gases by a certain amount, say 100 tonnes of CO<sub>2</sub> equivalents, but increases the use of clean fresh water by say 5000 m<sup>3</sup>, are we to see this change as a net gain or a net loss with respect to environmental impacts? In other words, how do you compare tonnes of atmospheric emissions to water use? The simple answer is: you cannot. Luckily however, this is not always the case.

There is a way of adding apples and oranges, say 5 apples and 3 oranges. One can answer: 8 pieces of fruit. This answer is much less trivial than one might think. It is based on a trick economists and financial analysts use all the time, that of 'aggregation'. Aggregation is not (or not only) addition. As a first approximation, aggregation consists of bringing together items of different sorts or qualities under the same heading (e.g. 'fruit') before adding them up. This implies that they share some common feature that makes them comparable and opposable to other categories (e.g. 'vegetables'). Before highlighting the implications, it is useful to notice that any item, be it apples or oranges, is itself a category of disparate things. There are different sorts of apples and oranges, as there are different sorts of 'people', 'birds' and 'trees'. Within any category, one can think of finer categories until one is left with the individual samples. Aggregation can then be understood as the process by which objects of different categories are brought together under a broader category due to some common shared property that makes them comparable. A couple of examples will illustrate this concept.

An exact analogy exists for greenhouse gas accounting with the concept of 'CO<sub>2</sub> equivalents'. Methane, nitrogen oxides and carbon monoxide share with carbon dioxide the property of inducing a warming greenhouse effect as they accumulate in the earth's atmosphere. With respect to this specific property, an equivalence can be established on chemical grounds such that one kilogram of nitrogen oxide, say, is equivalent to 310 kilograms of carbon dioxide, because that one kg of NO<sub>x</sub> contributes to global warming about 310 times more than one kg of carbon dioxide. Burritt (1995) develops similar lines for the 'ozone regime', in terms of ozone depletion potential.

This type of aggregation may be called 'functional aggregation' in that it brings together items that share a same function: heat generation for energy equivalents, greenhouse-warming potential for CO<sub>2</sub> equivalents. If the environment could be affected in only one way,

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<sup>18</sup> See Schaltegger & Burritt, 2000, for further details on this.

say through atmospheric temperature, then CO<sub>2</sub> equivalents would allow aggregation of all ecological accounts into one master account, and life would be easy - at least, the accountant's life. Unfortunately, the environment is itself a very broad category and can be affected in many different ways. There will be many different 'functions' (or contributions to environmental quality), each function demanding a different aggregation principle. Usual patterns of aggregation for atmospheric pollutants are given in Table 4.5. As atmospheric pollutants, global warming, acidification and ozone depletion can each be subject to meaningful aggregation (see Manton & Jasper, 1998).

*Table 4.5 : Environmental (atmospheric) impact accounting equivalents*

	<b>Global Warming Potential</b>	<b>Acidification Potential</b>	<b>Ozone Depletion Potential</b>
Units:	CO <sub>2</sub> -equivalents	SO <sub>2</sub> -equivalents	CFC11-equivalents
CO <sub>2</sub>	1	0	0
CH <sub>4</sub>	21	0 ?	0 ?
CFCs (CFC12)	8500	0	0.82
HCFCs (HCFC22)	1700	0	0.04
Halons (halon 1301)	5600	0	12
SO <sub>2</sub>	0	1	0
NO <sub>x</sub>	310	0.7	0

Given our current knowledge, there is no universal aggregation principle that is not uncontroversial<sup>19</sup>. A system of 'environmental impact points' (EIP), which aggregates all environmental impacts, was developed by Müller-Wenk (1978) in 1972 and is being experimented in the German speaking countries: it is described below in section 2.4. But for the time being, given the diversity of environmental impacts from modern businesses, environmental accounts will remain many and unconsolidated. Environmental managers and other stakeholders will have to contend with an array of curves and graphs that indicate converging or diverging trends in various environmental impacts: sulphur dioxide emissions vs. greenhouse gas emissions vs. energy consumption vs. water consumption vs. lead and mercury emissions, etc. etc. Presumably, one would wish to see improvements in all indicators at the same time. As this is unlikely to be the case all the time, judgmental trade-offs, backed by scientific advice, will have to be made.

Overall, ecological accounting means quantitatively determining a set of distinct, and not directly related, impacts on the environment. It ensues that comparison of the environmental impacts of the activity of a company over time, or of the activities of several companies, is essentially a multicriteria pursuit<sup>20</sup>.

#### *Ecological impacts of products: accounting for Life-Cycle Assessment*

Environmentally motivated stakeholders in the firm's landscape are increasing the scope of its responsibilities. Increased accountability and liabilities are pushing for an expansion of the accounting framework. Its most tangible expression appears as *Life Cycle Assessment* (LCA)<sup>21</sup>. LCA considers all resource uses and environmental impacts of a given product from

<sup>19</sup> We must again mention Howard T. Odum's claim to the contrary. See note 17.

<sup>20</sup> The idea is to reveal the otherwise implicit weights that decision makers place on different environmental impacts. See, for further developments, Dale et al., 1999.

<sup>21</sup> For other (similar) expressions and their definitions, see Schaltegger et al. 1996, Box 4.4 p. 51. 'Product eco-balance' has also been used, particularly in France and Germany.

its inception and design through production and distribution to use and disposal. The question LCA asks is, just how far a firm's accountability extends in what it buys to its suppliers and what it sells to its customers?

The answer depends to a large extent on the law. The firm's liabilities are at stake. But laws change and they sometimes change unexpectedly. It is often in the firm's interests to be proactive and not wait to be under the law's pressure. The answer could be: 'the firm is not responsible<sup>22</sup> if it has no knowledge of how inputs are manufactured and outputs consumed'. Does the answer depend on the information available to the firm? The current trend in most countries is that the rule that increasingly applies echoes the old Roman adage: no one is deemed to ignore the law. Likewise, no firm will be deemed to ignore the environmental impact of its products over their life cycle. This is nothing less than a moral obligation to be informed and an incentive to expand the accounting system.

LCA runs counter to most of what traditional accounting systems were designed to do, which is to ignore anything that happens outside the legal boundaries of the firm. A product before it was bought or after it was sold was of no business to the firm. The first difficulty is therefore a psychological and perhaps a cultural one: acknowledging new responsibilities, facing the 'this is none of our business' reaction. The second is that different products have different life cycles, so that the boundary of the firm (or at least of its liabilities) is no longer fixed, but may vary with every product. A rigorous conceptual framework is needed, as proposed by Fava et al. (1992). This introduces a new dimension of complexity which leads to the third, technical difficulty. As Pohl et al. (1996, p.13) conclude, "The total error in LCA can easily become larger than the calculated differences of ecological impacts of products and services". At this level of imprecision, LCA is unlikely to be taken up seriously by decision makers; innovative techniques need to be implemented (Bailey, 1991).

The shortcomings of LCA point to an urgent need for standardization, which the International Standards Organization (ISO) has been answering by developing the ISO 14040 norms. ISO defines three stages in LCA. The second stage, inventory analysis, quantifies the inputs from and the outputs to the environment at every stage of production from 'cradle to grave', from design to final waste disposal. As underscored by Schaltegger (1997) and others, the problem at this stage is that information is not of equal quality across the life cycle: that related to processes happening within the firm, or close to it, the so-called 'foreground data', can be precise and reliable; information related to upstream or downstream processes depend on suppliers' and customers' disclosure policies, or, alternatively, on industry averages, the so-called 'background data'. These, to quote Johnson and Kaplan (1987) in a different context, are 'too late, too aggregated, and too distorted to be relevant'. Some, like Schaltegger (1997), advise against their use altogether, and recommend focusing on site-specific, controllable information (also Schaltegger & Sturm, 1992). Most of the critiques Schaltegger and others formulate (Pohl et al., 1996; Fava et al., 1992; Bailey, 1991) pertain to the implementation of LCA, rather than to its fundamental principles. They intend to facilitate the generation of solutions by practitioners.

Fortunately, a non-negligible part of LCA can be carried out *within* the firm. In a LCA study of the production of the French newspaper '*Le Monde*', Rafenberg and Mayer (1998) show the sequence of operations leading to energy and materials wastage and to excessive environmental impacts. Interestingly, this study showed how organizational and institutional factors, here the role of unions, played a major role by inhibiting an environmentally efficient investment, because it would have taxed the working habits of the workforce.

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<sup>22</sup> Following our initial definitions, responsibility here provides an argument meant to change existing law. Liabilities on the other hand reflect current law.

## 2.4 Eco-financial integration for assessing environmental management performance

### *Eco-efficiency indicators*

Given the above difficulties in measuring financial and ecological impacts, it is hardly surprising that it is no easy matter to judge of a firm's environmental performance. Is it 'doing enough' for the environment? Is it doing it efficiently? These and other related questions link the firm's efforts to its environmental achievements. At first sight, given that there are many possible cost and financial allocations as well as many different ecological impacts, the number of impact to effort performance ratios would be bewildering. This problem has been given careful consideration especially in the German-speaking countries (Germany, Switzerland, Austria), and a number of synthetic ratios have been developed and are being experimented by a number of companies, again mostly in German speaking countries. In Switzerland, the federal OFEFP has helped develop the methodology (OFEFP, 1991).

Müller-Wenk (1978) first conceived of environmental performance indicators for business firms in 1972. The concept may be related to Leibenstein's so-called *X-efficiency* of firms<sup>23</sup>, which describes the degree to which a firm's current input-output efficiency approaches the best possible efficiency given current technological knowledge. Schaltegger and Sturm (1992), in Switzerland, developed Müller-Wenk's ideas into an operational set of indicators that have been publicised and put into practice through Bank Sarasin & Co.'s 'Sustainability Research Procedure'® (Schaltegger & Figge, 1998) and Ellipson Ltd., an environmental management consulting firm based in Bern, Switzerland (Sturm & Müller, 1998). Schaltegger et al. (1996) provide an overview and distinguish between flow-efficiency based indicators and investment oriented indicators. A common concept is that of EIA, *environmental impact added*. It measures the additional impact on the environment from an activity or set of activities over a period of time, such as a month or a year.

In the category of flow-efficiency indicators, which are operations and cost management oriented, ecological efficiency is defined as the ratio of an economically desired output to EIA. The output can either be a product (e.g. cars) or a function (e.g. transport). *Ecological product efficiency* will measure number of product units per EIA (or equivalently, number of EIA units per product unit produced). For example, number of cars produced per gigajoule of energy consumed and per tonne of CO<sub>2</sub>-equivalent emitted (or, average quantity of energy and carbon-dioxide per car produced). *Ecological function efficiency* is a broader concept in that it allows for product substitution subject to a given economic demand. The quantity of energy consumed and carbon dioxide emitted will be related e.g. to number of kilometre-persons transported. It is obvious that bicycles will always be more efficient than petrol-based cars, although speed can also be factored into the ratio<sup>24</sup>. Because such efficiency ratios will vary depending on what product or function one chooses, a more general indicator, *eco-efficiency*, was developed, which relates economic value added (EVA) to EIA. Different stakeholders will weight the numerator and denominator differently, so that the indicator appears as

$$\text{Eco-efficiency} = \frac{w_1 \times \text{EVA}}{w_2 \times \text{EIA}}$$

If  $w_1 = w_2$  then economic and ecological aspects of decision making are given equal weights. The ratio can be used as an indicator of sustainable growth, when EVA increases and EIA does not increase, or decreases. Depending on the relative weights, either economic growth or

<sup>23</sup> Leibenstein, H., 1966. Allocative efficiency versus X-efficiency. *American Economic Review*, 56: 392-415.

<sup>24</sup> By relating EIA to number of km-persons transported per hour. Note however that other economic characteristics, such as comfort and protection from the weather, are excluded from this measure.

environmental protection will rank as a higher priority. Schaltegger & Burritt (2000) discuss the implications. As we shall see in section 3, this view assumes independence between numerator and denominator. Yet, ecological impacts affect economic outcomes, and thus EVA, not only as a function of past decisions, but also of current and planned decisions.

### *Environmental investment appraisal and eco-financial integration*

For environmental investments, Schaltegger et al. (1996) propose *ecological payback period* (EPP), defined as the ratio of the EIA caused with the investment to the annual reduction of EIA expected through the investment, and the *ecological rate of return* (ERR), defined as the EIA reduced over the total life span of the investment to the EIA caused with the investment. In the first case, the investment is environmentally beneficial if the life-span of the investment is larger than the EPP, and in the second case if the ratio is greater than one<sup>25</sup>. Müller et al. (1996) then go on to show how eco-efficiency can be interpreted and evaluated from the viewpoint of financial analysis, and why it is correlated with stock-market valuation (see also Cohen et al., 1997).

The previous point sheds some light on the problem of account integration. We saw that there is no simple way to integrate the many different ecological impact accounts. We specify ‘no simple way’, because there are ways. For example, Müller-Wenk, as previously noted, originally developed (in 1972) a system of ‘environmental impact points’, or EIPs, capable of aggregating all ecological impacts and integrating them with financial accounts, using e.g. EVA/EIA ratios (in \$/EIP units)<sup>26</sup>. This point system is based on elaborate ecological impact science and aims to determine relative ‘environmental stress’. The higher the stress, the larger the number of points. Stress is generally defined, locally or globally, in relation to a specific environment’s carrying capacity<sup>27</sup>. As Miyazaki (1998) points out, these EIPs play the role of ‘ecological prices’ in that they measure the relative scarcity of the environmental asset impacted. The problem with this approach is that, to corporate stakeholders, and in particular to managers, the process underpinning the allocation of EIPs to different impacts is not transparent, nor does it relate easily to what they already know: it is likely to be met with suspicion. Secondly, such a system would need strong backing by government, with widespread standardization and monitoring. Enforcement costs may be too high with uncooperative companies. As a result, a compromise must be struck between transparency and integration. For some time yet to come, environmental managers are stuck with an array of graphs and indicators. Expertise will continue to be needed to integrate ecological and financial performance indicators.

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<sup>25</sup> Schaltegger et al. (1996), p. 182, point out that end-of-pipe investments not only produce ERRs that are less than one, but, more often than not, less than zero, indicating a net damage to the environment (a worsening of the environmental indicator). Blanket regulatory policies are often to blame for this. From the firm’s point of view, end-of-pipe investments may still make sense in terms of *marginal compliance costs*. That is, if the standard is a maximum daily emission of 100 units, and in site A emissions increase from 30 to 80 while in site B they decrease from 120 to 90, the overall EIA is an increase of 20 units, but financial liabilities will have decreased by 20 units times their unit compliance cost. This means policy design was sub-optimal.

<sup>26</sup> Note the parallel between ‘economic value added’ and ‘environmental impact added’. The relationship can be traced back at least to Georgescu-Roegen’s 1971 book: *Entropy and the Economic Process* (published a year before Müller-Wenk’s 1972 work) where, on thermodynamic grounds, he placed much importance on the notion of EVA.

<sup>27</sup> ‘Carrying capacity’ is a rather involved ecological concept. Basically, it measures the level of stress beyond which the system (e.g. forest, wetland, population) loses its resilience and breaks down: the forest does not regenerate, the wetland disappears, the species (locally or globally) goes extinct. ‘Resilience’ measures the capacity of an ecosystem to survive some shock and recover its previous functions.

But then, this is also the case with standard financial accounts. In both cases, managers are not entirely free to choose their preferred indicators: the economic and policy context exert a strong influence. The difference lies in the modes of communication. The reading (and, for that matter, the writing) of financial accounts are almost entirely dictated by market and tax considerations, both of which use direct monetary values. In the case of environmental accounting, non-market feedbacks that do not have a readily computable monetary value are important. This leads to the concept of strategic accounting which includes managing the risks of potential non-market feedbacks (see section 3.3).

There are other dimensions of account integration: not only within the firm, but also within an industry, a professional organization, or a country, and across nations of the world. Numerous accountancy organizations are involved in standard-setting: in America, the AICPA; in the UK, the ACCA; in Australia, the ASCPA; and management accountants. Concerns with standardization reflect the need for reliability and comparability.

### **3. The future of environmental accounting and the issue of contingent liabilities**

#### **3.1 Valuing environmental liabilities as part of a company's total value**

Environmental accounting standards and practices have been developed so as to create as little deviation as possible from financial accounting standards and practices. This has been the impetus behind the success in the German-speaking countries, with authors like Figge and Schaltegger, as well as with other developments in the USA and elsewhere, in connection to EPA's Environmental Accounting Program. Ironically, this is happening as financial accounting standards are themselves in turmoil, and under increasing pressure from financial economists. Environmental accounting is anchoring itself to a moving ship. This may in fact be for the best. In what follows, we summarise the key points at stake and how we believe they will affect the future of environmental accounting.

It is probably safe to say that the current debates in financial accounting revolve around the issue of the valuation of a company. As is well known, there is a 'valuation gap' between valuing a company through the 'book value' of its assets and liabilities and valuing it through its expected market value, a value that is realised, or revealed, when the company is taken over by another company. Standard wisdom interprets the valuation gap as the company's goodwill: intangible assets such as clientele, reputation, corporate image, social and political networks, and so forth. The problem is, the gap can be quite large and not just a minor residual. As a result, valuing a company using the book value of its assets and liabilities makes for a poor predictor of the company's current value on the market, and in particular on the stock market. Furthermore, as Kierkegaard (1997) points out, it makes for a poor predictor of a company's insolvency. One cannot predict if, and when, it may go bankrupt.

This valuation gap may be viewed from two angles. Firstly, it should appear natural that the sum total of a company's net assets, or equity, should not equal its market value. This is because a company is more than just a collection of buildings, machines, patents and real estate properties: the linear aggregation principle, fundamental to accounting practice, cannot apply to goodwill (Ijiri, 1967). Increasingly, it is the experience, the skills and the know-how of its management and workforce, and how they use the company's tangible assets, that create value. The value of the whole is (often much) larger than the sum total of its parts. This is the classical view from organizations theory: a business is a living organism. This translates in the accounting realm into a conflict between a backward-looking and a forward-looking valuation principle. Many assets are individually valued using their purchase cost, while others are valued using other approaches. This methodological diversity leads to inconsistencies that

have traditionally been dealt with through a jungle of conventional rules. Valuing a company as a whole, however, can only consistently be done in a forward-looking manner, by estimating the discounted sum of all future earnings and expenses resulting from the company's expected activities, inclusive of the liquidation value of its net assets. If, however, there are no prospects for future activity, valuation is done at book value and the company is valued at its 'break-up value'.

Surely, the two approaches can be subsumed if one considers the likelihood of the 'going concern' hypothesis. This standard hypothesis of traditional accounting assumes that the company will continue operating for an indefinite future. Special and separate accounting standards are used for break-up and liquidation. Realistically, however, the going concern hypothesis is true only to some degree of probability. As it tends towards zero (that is, the company is sure to cease its activities very soon), the break-up valuation method must be chosen; as the probability tends to one (the company is very unlikely to cease its activities in the foreseeable future), the future discounted cash-flow method must be used. Presumably, one can use both methods by weighting them by the relative probabilities of going concern and cessation of activities. Because the weighting would be controversial, special rules carrying liability must be enforced that create disincentives for over- or under-estimation.

Having thus set the stage, accounting for environmental (or ecological) impacts introduces a new twist. It introduces a dissymmetry between future assets and future liabilities. Environmental damages may lead to very large liabilities. Many of the benefits expected from environmental management come as a reduction of environmental liabilities, which in turn translate into lower current financial and insurance costs. Here we are concerned with their implications for accounting. The point is, environmental liabilities can only be completely valued in a forward-looking manner. Given that environmental liabilities put the company's solvency and survival at stake, their build-up is creating mounting pressures to reorganise financial accounting around a forward-looking model. Using Kierkegaard's (1997) concept, a firm's environmental liabilities can determine its financial *solvency*<sup>28</sup>. Point number one.

Point number two: environmental liabilities are not only potentially huge; they may also be uncertain and contingent upon future events. As often as not, environmental liabilities are contingent liabilities. Bailey (1996) identifies compliance liabilities, remediation liabilities, compensation liabilities, and penalties and fines for non-compliance and damages. Just as financial statements in the 1920s underestimated a company's real (financial) liabilities, a lack of transparency that contributed to the 1929 crash, today's practices underestimate a company's real environmental liabilities. When uncertain or contingent, current accounting standards and practices do not include them in financial statements other than in the form of qualitative footnotes. If environmental accounting is to make any credible progress, it must find a way to quantify and include environmental liabilities in the main body of financial statements.

### **3.2 Progress using shareholder and stakeholder value concepts**

The concept of shareholder value (Rappaport, 1986) seems to open a way forward. In the 1990s, it gained ground among accountants and managers. Shareholder value is usually measured as follows:

Shareholder Value = Sum of all future discounted cash flows – Borrowed capital

or:

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<sup>28</sup> Solvency, as opposed to liquidity, describes the capacity to honour all long term debts and liabilities.

$$\text{Shareholder Value} = \sum_{t=1}^{\infty} \left\{ \text{FCF}_t * \left[ \frac{1}{(1+i)^t} \right] \right\} - \text{BC}$$

where  $\text{FCF}_t$  are the free cash flows of future earnings,  $[1/(1+i)^t]$  is the discount factor, and  $i$  is the discount rate. Shareholder value measures the market value of the equity owners' share in the company (whether the company is quoted on the stock market or not). As discussed by many authors (e.g. Ehrbar, 1998), it is a future-oriented long-term value concept. Thus, it can account for environmental liabilities, *provided they have been translated into financial terms*. Indeed, the concept has gained favour as 'green' or environmental shareholder value, the features of which are studied by Schaltegger & Figge (1998). Although the links between environmental performance and shareholder value have been questioned, they appear on balance to be real (Blumberg et al., 1996; Cohen et al., 1997; Reed, 1998). Environmental performance is considered to contribute to shareholder value in the form of economic value added (EVA), its incremental translation (see Grant, 1997). Even so, shareholder value, green or otherwise, now appears to some to be too narrow a concept (e.g. Hill, 1997).

As early as 1984, Freeman highlighted the stakeholder approach to business strategy. Shareholders or equity owners are not the company's only stakeholders. Also included are other providers of financial services (lenders, insurers, investors), providers of labour (employees, sub-contractors), of goods and services (suppliers), of cash payments (customers and consumers), and of public services (government), each stakeholder demanding in turn some form of payment, in cash or otherwise. A stakeholder is any individual or organization whose costs and benefits are affected, upwards or downwards, by the company's decisions. The company's environmental impacts affect many, if not all, of its stakeholders. Therefore, an extension of the shareholder value concept to that of 'stakeholder value' is an improvement when it comes to the company's environmental liabilities. A further extension is naturally that of 'green' or environmental stakeholder value and its incremental derivative, stakeholder value added. These concepts, their measurement, and their implications are presented, in a general setting, by Figge & Schaltegger<sup>29</sup> (2000). To our knowledge, however, the explicit link between stakeholder value and environmental liabilities has not yet been made.

The reason for this is that, although the framework for including environmental liabilities, especially those contingent on future events, now exists, their actual measurement still remains problematic. Quality groundwork is provided by Bailey (1996), of the United States Environmental Accounting Program, and by Figge (1998), in connection with Bank Sarasin & Co. (Switzerland). Bailey describes the tools available for their computation while Figge clarifies some conceptual issues, albeit from a bank's perspective. The missing ingredient, in our view, is the concept of strategic accounting.

### 3.3 Strategic accounting, and the bridge to finance and economics

Strategic accounting is still a new concept. Brouters & Roosen (1999) argue for such a need in a rapidly changing business environment, but their notion is different from what we have in mind here. Our notion of strategic accounting stems from Estes' (1972) socio-economic accounting in relation to a firm's external diseconomies, and from stakeholder theory as it impacts on shareholder value (Schaltegger & Figge, 2000). *We define strategic accounting as the quantification of the financial impacts on the company's shareholder value from action taken by its various stakeholders in response to its current or planned decisions*. It is inherently future-oriented, long-term and probabilistic. For example, although large commercial benefits

<sup>29</sup> It must be said here that thinking and practice in German-speaking countries are ahead of their English-speaking counterparts in environmental accounting. Key authors include Stefan Schaltegger and Frank Figge (University of Lüneburg), Andreas Sturm and Kaspar Müller (Ellipson Ltd.), among others.

are a major incentive, a company's planned decision is expected to negatively affect employees, so that it should expect increases in absenteeism, strikes, accidents & incidents, theft, internal strife, conflict, and information hoarding, and a corresponding decline in productivity, initiative, and internal co-operation. From past experience and a good understanding of current politics, such reactions, as well as their financial impacts on the firm, can be probabilistically estimated. If employees become dissatisfied, future commercial benefits expected from the decision must be reduced by the (contingent) liabilities employees now represent. The same case may be made for consumers, government and host populations if a company fails to avoid environmental damage.

Figure 4.2 outlines the difference between standard (non-strategic) and strategic accounting. The difference is the more important the more irreversible the (expected) outcomes of a decision. For totally reversible decisions, that is, incurring zero reversibility costs, strategic accounting has no *raison d'être*. This combination of uncertainty and (some degree of) irreversibility makes the quantification problem similar in principle to that of valuing a financial option. The company must then decide what risks it is willing to take. For so-called 'rare' events that follow a Poisson process, such as nuclear accidents and chemical spills, estimating the parameters necessary for identifying their probability distribution may be difficult. Even in this case, however, the mere reckoning of the possible financial impacts provides an incentive for the company to adopt a precautionary approach.

At present, strategic accounting would appear to be costly, given the level of expertise required by financial analysis techniques. Experience and software development will presumably reduce these costs, but systematic stakeholder consultation may yet be the most efficient strategy. As for its benefits, strategic accounting further consolidates the links between accounting, finance and economics. The requirements of forward-looking environmental accounting, it seems, will have helped build stronger bridges across artificially segregated disciplines, harnessing their synergy. Here too, the environment may have acted as a catalyst.

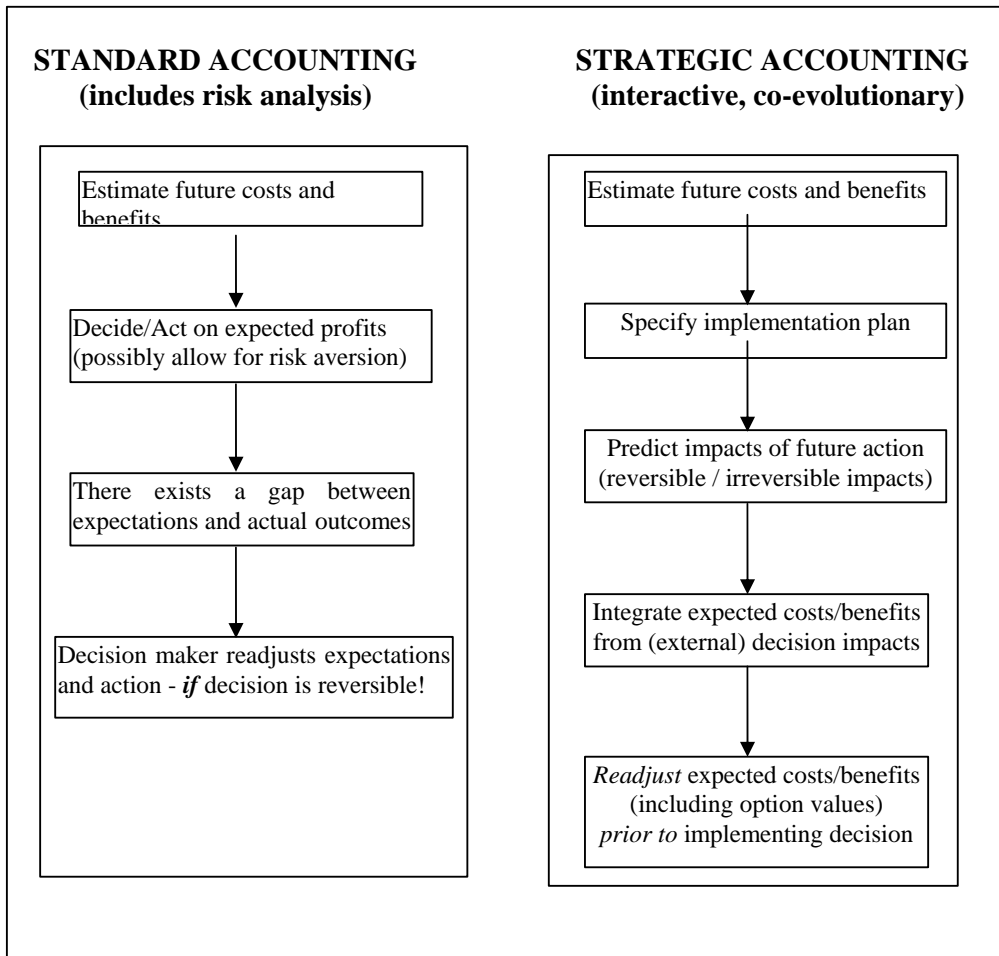


Figure 4.2 - The difference between standard accounting and strategic accounting

## 4. Conclusions

If the business community wishes to capitalize on the potential benefits of environmental management (EM), it needs to identify where those benefits are, and if there are any. Firms want to avoid unnecessary costs but also want to avoid missing out on potential benefits that may give them a competitive edge. Environmental accounting produces the information necessary for firms to decide how far they want to get involved in EM, and how.

The evidence from the 1990s is that an increasing number of firms have taken up EM, but in an imperfect way, and still only a small number of them, mainly large corporations. This paper has tried to clarify the role of accounting in this process, while reviewing its technical and institutional challenges.

Technically, environmental accounting has first to contend with measurement issues. Problems of cost allocation blur the financial impacts of EM, or lack thereof. Problems of aggregation and monetary valuation limit the usefulness of accounting for the firm's physical impacts on the environment. Secondly, in order to be of practical use, environmental accounting needs to mould itself into the framework of standard financial accounting. This is because assessing environmental performance requires the integration of financial and

ecological data, so as to answer questions like: is the firm doing enough? Is it spending its money in a way useful to the environment? This paper has tried to review the solutions being brought to these problems.

Institutionally, business accountants must face these challenges with, until very recently, few guidelines, standards or experience. At the same time, environmental accounting must contend with the strong pressures for change weighing on financial accounting. The tradition of using backward-looking methods and of valuing assets and liabilities 'at book value' is giving way to forward-looking approaches such as shareholder value and economic value added. Slowly but surely, the influence of financial economics is growing in accounting.

This trend is epitomised by the growing importance of environmental liabilities. Not only are they often huge; they may be uncertain and contingent on future events. Environmental accounting will be of definite value to managers when it can include such liabilities. We propose a notion of strategic accounting the purpose of which is precisely to be able to include contingent environmental liabilities. Already, tools from financial economics are being reviewed for this purpose. But perhaps the best way to reduce their cost, and even their need, is for managers to include as a standard business practice systematic consultation with the firm's stakeholders. Rather than a 'triple bottom line', stakeholders are understood to influence explicitly the financial performance of the firm. In this sense, strategic environmental accounting appears as a step towards accounting for sustainable business.

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