On the Ethics of Corporate Social Responsibility – Considering the Paradigm of Industrial Metabolism

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ABSTRACT. This paper attempts to bridge business ethics to corporate social responsibility including the social and environmental dimensions. The objective of the paper is to suggest a conceptual methodology with which ethics of corporate environmental management tools can be considered. The method includes two stages that are required for a shift away from the current dominant unsustainable paradigm and toward a more sustainable paradigm. The first stage is paradigmatic, metaphoric and normative. The second stage is a practical stage, which in turn, is analytic, descriptive and positive. The method is applied to common industrial metabolism tools of ecological footprints (EF), environmental life cycle assessment (LCA) and industrial ecology (IE). The application shows that all three tools can be used in business ethics, in particular, when the first stage of the method is applied to their use.

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1. Introduction

There are two important new fields of business studies and business strategy that are emerging and that are based on the concept of sustainable development; corporate social responsibility and corporate environmental management. In 1987, the so called Brundtland report by the World Commisission on Environment and Development defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). While many authors disagree on the definition, the notion of sustainability has nevertheless become the basis of societal environmental discussion, environmental policy and environmental management. Perhaps we cannot determine the direction toward sustainability, but we can know the general direction away from unsustainable development. For example, in the ecological dimension of sustainability, it is not sustainable to use fossil fuels, because they are non-renewable. In the social dimension, the present day world is not one of equity between the rich and the poor countries. Sustainable development is commonly interpreted as simultaneous economic, social and ecological development of societal and economic systems.

Sustainable development is the basis of corporate social responsibility (Welford, 2002;

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Korhonen, 2002, 2003) and corporate environmental management (Welford, 2000). This paper attempts to bridge business ethics to corporate social responsibility including the social and environmental dimensions. *The objective of the paper is to develop a conceptual methodology with which ethics of corporate environmental management tools can be considered*. The method uses the Kuhnian model of a paradigm shift and its discussion in sustainability (Kuhn, 1962; Ehrenfeld, 2000).

The method includes two stages that are required for a shift away from the current dominant unsustainable paradigm and toward a more sustainable paradigm. The first stage is the paradigmatic, metaphoric and normative stage. The second stage is the practical stage, which, in turn, is analytic, descriptive and positive. In the first stage, social construction and challenging happens, e.g., challenging the current neoclassical economics paradigm that neglects sustainability (Korhonen, 2002). In the second stage, no more social construction occurs, and the practical tools and instruments are applied governed by the underlying assumptions and norms that have been constructed in the first stage. The method is applied to tools of ecological footprints (EF), environmental life cycle assessment (LCA) and industrial ecology (IE). These are commonly used in business responses to sustainability calls, particularly for environmental management. The application shows that all three tools can be used in business ethics if reflected on the two stages of the sustainability paradigm shift.

2. On bioeconomics, ecological economics and industrial metabolism

This part of the paper makes the argument that current research on corporate environmental management and sustainability in general lacks an ethical focus. This is because the origin of the current debate in business strategy and the environment, undoubtedly, is in the so called "bioeconomics" or ecological economics schools. In business studies these approaches have been developed under the field of industrial metabolism (Ayres and Simonis, 1994; Erkman, 1997). All of these schools of thought are very young, e.g., industrial metabolism originates in the late 1980s. Industrial metabolism is almost entirely focusing on the physical flows of matter and energy. Raw materials and fuels are used in industrial processes and wastes and emissions are released to the environment resulting in depleting resources and scarcity and creating disturbances and harm to biodiversity or to the ecosystem capacity to serve as the sink of wastes and emissions. The metabolism metaphor has its basis in the metabolic life of an organism in nature, which takes in food into its digestive system releasing wastes as its output.

In ecological economics, the human economic system is only a subsystem of the ecosystem (Daly, 1996; Costanza et al., 1997). The ecosystem is a non-growing and materially closed system. The subsystem is growing rapidly in terms of material and energy use from the environment and releasing increasing amounts of material and energy wastes back to nature. The subsystem, then, is materially closed. The parent ecosystem relies on infinite energy source of the sun. The economic subsystem relies mainly on non-renewable and emission intensive fossil fuels. In ecological economics, this fundamental difference between nature and the economic system (Ring, 1997) and the dependence of the economic subsystem on the parent ecosystem (Daly, 1996) are seen as the core challenges and focus points of sustainable development research.

The focus in ecological economics, as opposed to conventional neoclassical economics, is on the physical material and energy flows, not only on the abstract monetary flows. The problem is that material and energy flows in terms of their environmental impacts are often not known in the market system of monetary value (Costanza et al., 1998). Ecological economics emphasis on material and energy flows has yielded a wide range of analytical tools and instruments to measure and quantify the physical flows of matter and energy within and between industrial systems and ecosystems.

These material and energy flows tools have been used in business strategy and in corporate environmental management under the field of industrial metabolism (Ayres and Simonis, 1994; Erkman, 1997). The ecological metaphor or analogy (see Ehrenfeld, 2003) has opened the eyes of managers to the fact that not only organisms in ecosystems, but also industrial firms and economic system consumers use input flows of matter and energy and produce metabolic wastes and emissions. The general objective is to reduce this throughput flow, because this would seem to reduce the environmental effects of the flows. Tools and approaches such as pollution prevention, cleaner production, best available technology, recycling and waste management have been developed in engineering communities and used in environmental management systems such as ISO 14001 standard and EU Eco-Management and Auditing Scheme that follow the quality management system philosophy of continuous improvement. In an environmental management system, engineering or natural science-type metabolism inventory studies (eco-balances or mass-balances) are first prepared, policy commitment of the management board is drawn up, goals, targets and quantitative and scheduled action-proposals are then suggested and implemented with determined responsibilities, control, auditing and follow-up mechanisms that aim for continuous improvement and for the repeat of the management system steps.

It is straightforward to conclude this part of the paper by noting four points. First, the sustainability debate in business strategy is very young, and up to date, mainly focused on the environmental dimension of sustainability. Second, the origin of the debate is in economics, in the ecological economics or bioeconomics schools, which emphasize the focus on the physical flows of matter and energy to include the largely neglected issue of sustainability into economic monetary analysis. Third, the approaches and tools used in the business community are gathered under the field of industrial metabolism, which measures and attempts to control the physical material and energy input and output flows of industrial firms and other economic actors. Finally, because of the above points, i.e., the material and energy flow focus, the ethical debate in corporate social responsibility and corporate environmental management remain, to a large extent, silent.

The next part of the paper suggests a conceptual method for enhancing the study of ethics in corporate sustainability. The method will then be applied to three common industrial metabolism tools to show its potential in conceptual terms.

3. The Kuhnian model of paradigm shift and its potential for ethics in industrial metabolism

"It might be argued that the word *paradigm* is one of the most abused and overused words in common parlance today" (Ehrenfeld, 2000, p. 234). However, analogously to Thomas Kuhn's sense of a scientific paradigm (Kuhn, 1962), it can be useful to consider the dominant social paradigm (DSP, Ehrenfeld, 1997) of modernity and to reflect the possibility of sustainability or sustainable development on this thinking. This kind of philosophy sees that the normal everyday action of social actors, public organisations, private companies and individuals, is carried out within a commonly held set of ideas and practices. This set of beliefs, norms and standard practices constitutes the paradigm of these actors and of various societal institutions. "Another way of stating this is that a paradigm is or contains a set of structures on top of which social action is created, or a vocabulary for describing things, or a story the actors tell about their place in the world" (Ehrenfeld, 2000, p. 234). DSP rests in the background and frames the action of social actors. Thus, it also guides the practice of environmental policy and the implementation of corporate environmental management and the use of the various tools, instruments and measures in policy and management.

It can be argued that the dominant social paradigm is not sustainable (Korhonen, 2002). Consider sustainability as something, which lasts forever and then consider the ecological dimension of economic development. There are numerous reports and documented scientific studies that support the argument that our way of life in the Western modernity is more toward unsustainability than sustainability. These documents are not discussed here. But it can be noted that we use non-renewable fossil fuels and we exceed the ability of ecosystems to bind the rising levels of carbon dioxide emissions (CO_2).

Approximately 80% of the world's energy consumption is based on non-renewable fuels (Williams, 1994). We will eventually run out of the natural capital of fossil fuels. Similarly, the emission generation resulting from the combustion of these fuels for energy is not sustainable. Nature can only bind and assimilate the emissions that arise from natural decay of biomass and from biomass combustion (if the reproduction rate of the biomass is not exceeded). Nature assimilates biological emissions into its growth and is not equipped to bind fossil fuel originated emissions. In the current form of economic development, sustainable ecological development is impossible. Accordingly and when put in a provocative way, the fossil fuel-based industry simply cannot contribute to sustainability.

Following Ehrenfeld's development of the Kuhnian model of paradigm shift (2000), there are two stages in the required paradigm shift toward sustainability and away from current (unintended) unsustainability of the dominant social paradigm (see Ehrenfeld, 1997). The first stage is the paradigm stage. The second stage is the normal practice stage. The first stage is paradigmatic, metaphoric and normative and closely relates to our underlying world view or to the vocabulary with which we interpret the world. The second stage, the more practical stage, is analytical, positive and descriptive. In the first stage, values, culture and social construction are important, while in the second stage, metrics, instruments and practical tools are important. In the second stage, no further social construction or challenging of the norms and goals occurs, rather application of the norms and goals. In other words, the first stage is the stage of underlying assumptions or in case of environmental thinking the stage of "deep ecology" while the second stage is much more practical and instrumental.

From dividing the dominant social paradigm to the above two stages and suggesting that sustainable development too requires a change, which includes a change in both of these interdependent stages, one can consider the normative vs. the objective nature of sustainability (Boons and Roome, 2001; see Isenmann, 2003). It seems that few would argue sustainability not being a normative principle. It seems to be regarded as "good" to strive toward sustainable development and very often expressions of "should" or "ought to" are used in relation to statements of sustainability. On the other hand, some argue that this normative orientation should not endanger objective or impartial and thorough scientific analysis of the effects of economic systems cause/not cause on nature (Allenby, 1999). Boons and Roome (2001) maintain that sustainability is a human concept arising from and, if achieved, actualising in cultural systems. Therefore, sustainability is a normative concept and one cannot develop absolute objective analysis or "non-normative" analysis. Isenmann (2003) points out that actually everything known by man's oral or written record in culture, is based on interpretation, while Oliver et al. (2002) reflect on the work by anthropologists Ingold (e.g., 1993) arguing that direct perception of the world does not exist, rather we can only participate *from within* and interpret the world through participating into it in the everyday. This interpretation is always affected by values, norms, ideologies or world views, i.e., the normative dimension of our paradigm. Absolute objective analysis seems to very difficult to achieve in such ethically loaded questions as those in sustainability.

Sustainable development has an ethical dimension, because ethics is a cultural and normative phenomenon. This ethical dimension can be studied, in particular, when using the first stage of the above paradigm shift model, the metaphoric or paradigmatic stage. Ethics, of course, has other dimensions in studies on philosophy, which are beyond the scope of this paper. These include questions that relate, e.g., to issues of existentialism or those dealing with the life style of Western modernity (Oliver et al., 2002).

The mere quantification of the physical flows of matter and energy in the second stage of the paradigm shift may neglect the human side of the material and energy flows (Cohen-Rosenthal, 2000). Therefore, material and energy flow analysis may not be the best place to start when airing ethics in corporate sustainability studies. Material and energy flow analysis has a strong natural science or engineering orientation. Of course, this is not to argue engineering or natural science being "without ethics". The studies on industrial metabolism closely related field of industrial ecology (IE, Erkman, 1997; Frosch and Gallopoulos, 1989; Graedel and Allenby, 1995; Graedel, 1996; den Hond, 2000; Chertow, 2000) go further than industrial metabolism and use the metaphor and/or analogy (although these are not the same, see Ehrenfeld, 2003) of self-organised natural ecosystems (Spiegelman, 2003) that recycle materials and use waste energy in a network of plants, animals and bacteria of fungi. This model is used as a normative should in sustainability (Boons and Roome, 2001; Frosch and Gallopoulos, 1989; Allenby and Cooper, 1994; Graedel and Allenby, 1995), as a goal of industrial systems that are contrasting to this natural recycling model and wasteful. But the difficulty to include ethics in corporate sustainability remains. The ecosystem is a material and energy flow system and biology or biological ecology traditionally have not that much to say about ethics.

Cultural systems rely on culture as the information storage medium and on the oral, written or video record, while natural evolution and feed-back mechanisms rely on gene as the information storage medium and information moves much more slowly through reproduction (Norton et al., 1997). Humans are capable of intentional action, while nature is not, does not have culture and relies on self-organised evolution (Ehrenfeld, 2003). It is very difficult to derive ethical norms from a material and energy flow system and use these norms in fundamentally different cultural systems.

To conclude this part of the paper, it can be argued that the simplified Kuhnian-derived model of the two interdependent stages of the paradigm shift reveals that industrial metabolism, material and energy flow analysis or the ecological economics perspective lack ethical aspects. This is because of the natural science or engineering orientation and the direct focus on the physical flows of matter and energy in the analysis. It can then be suggested that it could be possible to enhance the development of discussion on ethics in corporate social responsibility and corporate environmental management by applying this two stage model to some of the tools of industrial metabolism. This will be studied next in the remaining parts of the paper.

4. On industrial metabolism tools

In this part of the paper, three tools or instruments of industrial metabolism are introduced; Ecological footprints (EF), environmental life cycle assessment (LCA) and industrial ecosystems (IE). These are among the most commonly applied tools in corporate environmental management or sustainability management. After the introduction of the tools, the above two stage model of a sustainability paradigm shift is applied to these tools to conceptually study the potential of business ethics.

Ecological footprints

"The Ecological Footprint of a specified population or economy can be defined as the area of ecologically productive land (and water) in various classes – cropland, pasture, forests, etc. – that would be required on a continuous basis to (a) provide all the energy/material resources consumed, and (b) absorb all the wastes discharged by that population with prevailing technology, *wherever on Earth that land is located*" (Wackernagel and Rees, 1996, pp. 51–52, cited in Andersson and Lindroth, 2001, Italics in the original).

More thorough description and discussion of the concept can be found, e.g. in Wackernagel and Rees (1997, 1996) who have initiated ecological footprint analysis, or with several other articles (Andersson and Lindroth, 2001; Ferng, 2001; van den Bergh and Verbruggen, 1999). For the purposes of this conceptual article, it is sufficient to describe the concept in general terms. The ecological footprint (EF) is a physical material and energy flow measure. EF accounts for the flows of matter and energy to and from a specific economy or activity converted into corresponding land and water area needed to support these flows (van den Bergh and Verbruggen, 1999; Wackernagel and Rees, 1997). EF can be calculated for a given regional economy, for a nation or for an individual person. It shows, for example, in physical quantities, how much of the source and sink functions provided by natural capital are needed to sustain a regional economic system.

Consumption of natural capital is determined, for example, needed to food production or transportation, infrastructure or industrial production and then this use of natural capital is converted into a one-dimensional measure to show the land area needed to support the regional economy and its input and output flows. Land categories include, for example, crop land, pasture and productive forests. For example, the regional economy uses round-wood input from the local (or from other) forests to produce paper and the CO_2 assimilation or binding capacity of the growing trees (in the region or somewhere else) for its energy production and consumption (CO_2 emission generation). The regional economy may also use fossil fuels. This is converted to bioproductive land. It is possible to measure how big is the land area required to substitute the fossil fuels with biomass energy (Bicknell et al., 1998).

Ecological footprints of nations, individual persons or regions can then be calculated and compared. U.S.A. has a considerably higher EF (ha/person) than many developing countries such as India. Because of very high consumption per capita, U.S.A. exceeds the bioproductive capacity of its national territory, similarly as many densely populated countries such as Bangladesh and Japan (Andersson and Lindroth, 2001). Small ecological footprints are generally linked to poverty (Andersson and Lindroth, 2001). But it must be noted that although the ecological footprints for some demographically important countries – Bangladesh, China, Egypt, Ethiopia, India, Nigeria and Pakistan – are low, they still exceed the nationally available capacity (Andersson and Lindroth, 2001).

There are several important benefits that can be achieved if the ecological footprint concept and a tool is used to measure the success of environmental policy and management. First, it provides the policy maker with a physical measure of the material and energy flows. Although it aggregates qualitatively different flows, and hence, can reduce information (van den Bergh and Verbruggen, 1999), physical material and energy flow studies are important. Monetary measures fail to reflect various scarcities in natural capital and in non-market natural goods and services, and e.g. biodiversity (see Costanza et al., 1998). Note that the price of a timber log in the market cannot reflect the role of the tree as a part of the ecosystem biodiversity in the forests, e.g., as a nesting site for birds and insects etc.

But this is not to argue that monetary measures are not needed for studying the costs of policy implementation or of green technology investments etc. (for discussion, see Rennings and Wiggering, 1997). This is only to suggest a level of caution when the monetary measures are used directly to determine the value of natural ecosystems or natural capital. The human economic system effects to nature should be measured with physical material and energy flow indicators. In turn, when the costs of environmental policy or corporate environmental management implementation are considered, monetary measures may be important. For example, companies and decision-makers need to know how much does a water purification plant, recycling infrastructure or the closing of a landfill cost.

Second, EF may help in determining the ability of a regional economic or industrial system to adapt to the regional/local natural limiting factors. This is done by calculating the available natural resources and sink capacity within the territory and compare this to the level of use of these resources and services. EF may also help in studying the implications of trade for the regional sustainability, i.e. whether the source or sink functions are imported and exported between regions or nations (Andersson and Lindroth, 2001). In other words, studies of local and regional self-reliance may benefit from EF. Third, this locality principle of adaptation relates to equity between regions and between rich and poor countries, an important concern for sustainable development. Fourth, studies that consider whether the carrying capacity of a regional economy is exceeded or sustainable yield achieved are important for the availability of natural capital stocks and ecosystem services for future generations and future inhabitants of the regional economy. Therefore, the sustainable development principle of futurity may be better acknowledged in economic decision-making when using ecological footprint studies.

Life cycle assessment

Environmental life cycle assessment (LCA) has become perhaps the most widely used tool of practical environmental policy and industrial or corporate environmental management. It has been developed for some thirty years and an international journal (*International Journal of Life Cycle Assessment*) has been established. There are several international organisations that develop the methodology and organise conferences, e.g. Society of Environmental Toxicology and Chemistry (SETAC) and The International Organisation for Standardisation (ISO).

LCA is an important tool for decision-makers, public policy planners and corporate engineers and managers. Life cycle analogy alerts us to the "from gradle to grave" approach to the environmental impacts and resource use of a specific product, e.g. newspaper, a car or a plastic bottle. This means that the entire life of a certain product and all of the processes along the life cycle are studied, not only the traditional focus of environmental management, which still seems to be the production process. The life cycle is considered in terms of its resource and energy use as well as waste and emission generation. Raw material extraction processes, refining processes, production processes, distribution and transportation processes, consumption, end-disposal as well as possible recovery, re-use of recycling processes should all be taken into account in life cycle philosophy and thinking. In other words, LCA computer models quantify the material and energy input and outputs from each of the processes. These are used to evaluate the potential environmental effects caused by these flows. Despite the system boundary has to be drawn somewhere and the data requirements for "a perfect LCA" are enormous making it always incomplete, LCA has been important in extending the conventional approach in environmental management to an individual process to life cycle wide studies.

Industrial ecosystems

The theory on the concept of industrial ecology (IE, Frosch and Gallopoulos, 1989; Tibbs, 1992; Allenby and Cooper, 1994; Graedel and Allenby, 1995; Ayres and Ayres, 1996; Ehrenfeld, 1997; Ehrenfeld and Gertler, 1997; Cote and Cohen-Rosenthal, 1998, Ehrenfeld, 2000; Korhonen, 2001a, b, Oyewole, 2001) has become increasingly popular in the literature on environmental policy, industrial and corporate environmental management and environmental engineering. Also a new journal, *Industrial Ecology*, has been established and the *Journal of Cleaner Production* has adopted the concept as one of its major themes and devoted a special issue on industrial ecology in 1997. The second journal, *Progress in Industrial Ecology – An International Journal* has just been launched.

Industrial ecology's most commonly used practical application or tool is usually interpreted as local/regional eco-industrial parks, industrial recycling networks or "industrial ecosystems". Here the aim is to facilitate the emergence of a local/regional material and energy flow network of companies (and perhaps also other societal actors, e.g. consumers and public organisations) that use each other's waste material and waste energy flows to substitute for virgin resources and for virgin energy, e.g. for fossil fuels, and reduce the waste and emission generation from the system as a whole (waste is used as a resource with value). The natural ecosystem analogy is appealing as in local natural ecosystems, organisms and species cooperate and adapt to each other by using waste material and waste energy, i.e. by applying material cycles and energy cascades between them. Nature, of course, is driven solely by the (infinite) solar energy input. Some put it somewhat provocatively that "in nature there exists no such things as wastes" (for discussion, see Isenmann, 2003).

The idea of a network of material cycles and energy cascades (residual energy utilisation) that happens through cooperation and linkages between different firms located in the same region can be important for the practice of sustainability. Material flow analysis and material flow models (MFM), e.g. substance flow analysis (SFS), LCA or environmental accounting such as business eco-balances have showed the environmental benefits that can be gained in an industrial ecosystem (for case studies, see e.g., Swarz and Steininger, 1997; Chertow, 2000; Korhonen et al., 2001). These material flow models and analysis provide quantitative support for the assumption that the inputs from and outputs to the natural environmental can be reduced if successfully applying the industrial ecosystem models.

What is important is that this practical material and energy flow approach to networks or to entire systems can lower the risk of problem displacement from one part of the system to another, e.g. from a certain life cycle to another, from production to consumption or from one form of waste to another. Consider, how industrial point source emissions have been reduced in the industrial world by shifting the problem toward the more difficult to handle consumption emissions and wastes (Anderberg, 1998). Industrial ecosystem can also alert policy makers and managers to the importance of integrating production, consumption and recycling activities and processes into a one local system. This can reduce the overall consumption of energy and related carbon dioxide emissions (CO_2), note that often, in the industrial world, production is geographically separated from end-consumption. In addition, it may be easier to control the material flows when they are located in a one system than scattered over widespread regions or across countries.

5. Applying the Kuhnian model to industrial metabolism: Toward the ethics of material and energy flow tools

From the above, we can conclude with three reasons that show the difficulties when attempting to bring ethics into corporate sustainability, corporate social responsibility and corporate environmental management studies. First, this is difficult simply because traditionally the only corporate social responsibility in neoclassical economics-based business paradigm has been to make profits and compete in the markets (Hussain, 1999; Ahmed, 1998; see Friedman, 1962). Second, the task is further complicated, because corporate sustainability has mainly been concerned on the environmental dimension neglecting the other social issues, e.g., child labour, worker rights, equity between the rich and poor nations, community values, women's rights etc. Third, the tools used are usually physical material and energy flow tools, i.e., industrial metabolism tools.

This part of the paper attempts to take the above Kuhn-derived paradigm shift model and use it as a method to consider whether the industrial metabolism tools can be applied also for studying and revealing business ethics and ethical questions of corporate sustainability and corporate social and environmental responsibility. Ethics become particularly important, because, nowadays, many companies have already applied many of those environmental improvements that bring them direct and fast economic benefits (Hussain, 1999), i.e., the win-win situations can become scarce or seem scarce in the eyes of the manager under pressure from the shareholders to make profits (Hussain, 1999; see Porter and van der Linde, 1996). Now, as Hussain argues (1999), the manager who wants to put the environment before the economics of the firm or the (traditional) shareholder interest, may need to justify his/her position with ethical arguments, e.g., serving the larger society or all the stakeholders of the firm.

Ecological footprints and ethics

It is suggested here that ecological footprints can have potential also in the first stage in the required shift toward the sustainability paradigm, in the paradigm stage. This first stage, in particular, can be important in terms of business ethics. Consider the concepts of futurity, equity and locality. These, more or less, run counter to the dominant characteristics in the paradigm of Western modernity or the dominant economics paradigm of neoclassical economics. Modernity seems to be more orientated toward the conditions of mass production and unlimited growth, competition and globalisation. Because EF can help to measure, whether the local natural limiting factors are exceeded or substituted with cheap imports from the developing countries, it can contribute to the conditions of equity and locality. It may help to reconsider some of the basic principles of global free trade, which does not seem to be equal if the rich-poor countries relations are considered. As noted above, ecological footprints may also question the unlimited growth paradigm of modernity and of neoclassical economics. As a physical material and energy flow measure it may help to actually reveal, whether the reproduction rate of renewables is exceeded or not in a certain local/regional economy. If the regeneration capacity of renewable natural resources is not secured, future generations may have less resources than the present generation available to their use. Again, it seems that modern industrial and economic systems are not taking the futurity principle into account in this respect, note the dependence on non-renewable fuels.

To conclude this section, it is argued that also the first stage in the sustainability paradigm deserves attention with EF applications. The ecological footprint can be used to question our basic world view and our basic paradigm related to globalisation, free trade, competition or inequality, or unlimited growth and mass production. Eventually, this can be important for moving beyond mere small and incremental changes and achievements in environmental policy and management. Instead of only reducing the quantity of emissions while at the same time increasing their toxic contents, i.e., quantity vs. quality, or living a sustainable life in one part of the world by importing natural capital intensive products from other parts, the ecosystems and resources of which are depleting, more fundamental and basic thinking of the cultural conditions of modernity can be considered with ecological footprint analysis.

Life cycle assessment and ethics

For the purpose of illustrating the potential of LCA in the paradigm stage of sustainable development, consider the principles of equity and futurity (Welford, 1998) and the dominating social paradigm and its emphasis on the conditions of competition, mass production and rapid growth. The life of a certain product may often start in developing countries, which produce raw material intensive goods. The poor countries may need to extract raw materials from their forests to meet the demand set by the developed rich countries for mass production of a certain individual key product. This implies that in many cases, because of global trade, the poor countries have to sell the raw material with cheap prices and then buy expensive refined products from the rich countries.

Life cycle of a product extends over national borders. LCA can then reveal the relation of rich and poor countries and shed light on the principle of equity. In other words, LCA can show the possible unequal and unsustainable features of international trade. The economy of poor countries may eventually collapse, because lack of diversity in their economy that only focuses on certain key products and their mass production. Correspondingly, international trade may also put severe pressures on the natural resources in the developing countries.

Furthermore, the concept of futurity (Welford, 1998) illustrates, perhaps the hidden potential of LCA to serve as a tool that can help to challenge the basic world view and the culture of modernity, i.e. to contribute to the first paradigm stage of sustainable development philosophy. Through use and consumption, the life of a produced product and its environmental effects can extend over decades, perhaps over centuries. Many environmental problems occur decades or centuries after the environmental intervention by societal or economic activity has occurred that is the cause of these problems (Ring, 1997). Hence, LCA can serve to help to reveal some of these effects as it attempts to study all of the processes in the product's life, also consumption, end-disposal and recovery, not only the production process. In principle, this can be a contribution to the sustainable development condition of futurity, i.e. taking the future generations and their possibilities to have access to natural resources and ecosystem services into account. As in the case of ecological footprints, also LCA has potential in terms of developing business ethics for sustainability.

Industrial ecosystems and ethics

For the potential of industrial ecology in the first stage of the required paradigm shift toward sustainability, consider the natural ecosystem metaphor in the concept. But now consider the ecosystem metaphor not only in terms of the recycling and cascading material and energy flow model, but also in terms of the more structural and organisational characteristics of ecosystems and potential "industrial ecosystems" (Korhonen, 2000a). The natural ecosystem metaphor provides us with such principles as diversity, interdependency, cooperation and locality (Korhonen, 2000a; Ehrenfeld, 2000, 2003). These, again, run counter to the neoclassical economics paradigm that seem to support such contrasting notions as mass production, unlimited growth, competition and globalisation, e.g., note the Friedman's famous notion (Friedman, 1962; Hussain, 1999; Ahmed, 1998) that the only social responsibility of business is to make profits and compete.

Ecosystems are able to sustain themselves (perhaps only observed long-lived or sustainable living systems, Ehrenfeld, 2000) through diversity in species, in organisms, and in their genetic variance. Instead of mass production and unlimited growth (Daly, 1996), diversity seems to be the building block and the core principle of system development in nature, and natural resources are rarely overconsumed in an ecosystem in a way that we use natural resources and endanger ecosystems' ability to recover. Ecosystem actors adapt to their surroundings, and although competition over scarce resources exists, cooperation seems to be more important for the system as a whole than competition. Ecosystems cannot substitute for local natural limiting factors with technology, trade or transportation or imports. They need to rely on the local reproduction rate of renewable natural resources and on the waste assimilation capacity of their local environment.

These metaphors and principles seem to be a fruitful source for challenging some of the social structures, values, norms and system organisation principles of the unsustainable global economic system. In other words, the concept of an industrial ecosystem can be used also for its potential in the first stage in the paradigm shift, not merely as a measurable and quantitative material and energy flow indicator or tool as with industrial recycling networks or eco-industrial parks in the second normal practice stage. However, this is not to suggest the superiority of the natural analogy or metaphor. It is certainly very attempting to "protect nature by learning from mother nature", but such an endeavour must be made with caution. As all other metaphors, IE is only beneficial if it can contribute to theory and concept building or if it can help to achieve something concrete in practice. In the next part we will consider this question a bit more thoroughly. It should also be noted that when challenging the dominant social paradigm of modernity by looking for sources that are outside this dominant paradigm also other systems or domains than nature can be studied. The natural system is only a one potential place. Similar sources can be found, perhaps in different cul-tures, indigenous cultures, village cultures, different religions, or arts and sports (Oliver et al., 2002).

The potential of applying the Kuhnian model of paradigm shift

As with ecological footprints and environmental life cycle assessment, also the concept of industrial ecology carries with itself important features that can perhaps contribute, not only to the second normal practice stage in the sustainability paradigm shift, but also to the metaphoric stage, the paradigm stage. It is easy to conclude that this stage is the place what is particularly important for including ethics in corporate sustainability management.

With industrial ecology we can conclude this section by showing what kind of risks may arise if the two stages in the paradigm shift are not adopted as each other's complements when the sustainable development policy and management tools or industrial metabolism tools are used and applied in policy and in corporate environmental management (and corporate social responsibility). Consider the industrial ecosystem approach, i.e. the efforts to achieve local/regional recycling networks of industrial (and other societal) actors. While technologies, combustion and incineration techniques, production techniques, waste treatment techniques and other technical infrastructure for material cycles and energy cascades may be in place in a certain local industrial system, the recycling network or the "industrial ecosystem" vision may still fail or may not be able to sustain itself over long term. This may be the case if the approach is not extended beyond the mere instrumental analysis and quantification of physical material and energy input-output flows of the firms in the network.

In principle, we know that recycling can be important for sustainable development. But do we need the natural ecosystem metaphor to tell this to us? It is argued here, that the strength of the metaphor is that it provides us also with more metaphoric and paradigmatic aspects of recycling networks than consideration of waste management or energy production techniques. These relate, for example, to the culture of the participating firms in the network. If the culture is mainly one of competition and not toward interdependency and cooperation, the advanced machines and combustion techniques may not be enough for the system to succeed in recycling. Correspondingly, there must be sufficient diversity in the actors involved in order to continuously find new users for waste flows. If one key actor departs, the system may fail without sufficient diversity. With diversity, perhaps, certain other actor(s) can fulfil the place of the missing actors and the system can recover and continue the cooperative recycling activity. Further, if the natural ecosystem metaphor of locality is not taken into account, the recycling system may be advanced in recycling production wastes but exports its products to distant countries, where they will eventually result in harmful wastes after consumption. This consumes energy and makes the product life cycle difficult to monitor, measure and manage. The locality principle could inform us about these environmentally risky inter-regional material and energy flows as well as their implications for equity and for foreign stakeholders and the ethical considerations that need to be taken into account.

According to our presentation, the metaphors of diversity, locality and interdependency belong to the paradigm stage. The material cycles and energy cascades as viewed from the direct perspective of physical material and energy flow quantities, in turn, belong to the second stage of the sustainability paradigm shift, the normal practice stage. Without the practice stage, sustainable development will remain as "a mere desired outcome" in various policy statements, and no implementation, and therefore, no concrete reductions in resource input and waste and emission outputs of industrial activity will be achieved. On the other hand, without the paradigm stage and the metaphor toward a sustainability culture, we may lack a road map that would tell us the direction to which the practical tools and instruments should be applied. Without considering the cultural aspects of sustainability, ethics will be very difficult to include in corporate sustainability management.

6. What this conceptual argument cannot do?

This paper's purpose is to air the important concern of sustainability in business literature and show the difficulties to use ethics in the current debate. It is obvious, that the industrial metabolism tools discussed in the paper and in the literature referred to have little, if any, consideration about ethics when looking at the way in which they are currently used in corporate environmental or sustainability management. Because of this, it would not be very practical to use the conceptual orientation of this particular paper in practical case studies to try and prove the gains of our suggested approach and method. There is a need for an initial conceptual exploration before practical case study testing.

Furthermore, our paper cannot do much in practical terms, because this is a conceptual paper. We do not have empirical materials, e.g., from interviews, participative observation etc, with which the preferences, interests, values and mind-sets of those actors and individuals, managers or environmental engineers, who actually use the industrial metabolism tools in the everyday of business, could be considered and studied. These tasks are challenges for future research. Hopefully, the conceptual attempt in this particular paper serves the purpose of providing a basis for these more developed and practical studies, with which the success/failure of the suggested conceptual approach to include ethics in corporate sustainability management can be measured and tested.

7. Conclusion

This paper has attempted to contribute to the emerging fields of business strategy of corporate social responsibility and corporate environmental management. Both these fields are based on the concept of sustainable development. The Kuhnian model of paradigm shift has been used to develop a conceptual method with which the potential for ethics in sustainability management could be considered. Accordingly, it has been argued that sustainability has two stages, the paradigm stage and the normal practice stage. The first stage is paradigmatic, metaphoric and normative, while the second stage is analytic and descriptive. In the first stage, culture and social construction are important. In the second stage, metrics, indicators, measures and tools are important. Most of the environmental policy and corporate environmental management tools are used for their potential in the second stage. Such tools include environmental accounting, eco-balances, material flow analysis, substance flow analysis and life cycle assessment etc.

All of these tools derive from bioeconomics or ecological economics and belong to the field of industrial metabolism studies. Industrial metabolism studies focus on the physical flows of matter and energy within and between the natural ecosystems and industrial systems. The literature referred to in this paper shows that these engineering and natural science originated tools for economics and business, have little, if any contribution to the effort to include ethics into sustainability management development.

We considered three tools or instruments that are commonly used in industrial metabolism in conceptual terms. Ecological footprints, environmental life cycle assessment and industrial ecology were discussed. The Kuhnian model for paradigm shift with its two stages was used as a method to analyse these tools conceptually. The potential to develop ethics of sustainability management lies, in particular, in the first stage.

It has been argued in this paper that the three tools carry with themselves important potential that can be used in the first stage in the paradigm shift toward sustainability, the paradigm stage. This implies that such a new way to approach these tools can also contribute to business ethics. The tools alert policy makers and corporate managers to such principles as equity, futurity, locality, diversity and cooperation. Whether we should use the technical and instrumental tools of sustainable development also for their paradigmatic and metaphoric potential in corporate social responsibility and corporate environmental management is also an ethical question.

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