The need for cultural innovation to face the environmental challenge in business

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FOREWORD

This report is part of the theoretical background research for the project *Case 08 Responsible Companies* within the research-programme Productivity 2005 Industrial Ecology (P2005 IndEcol). The main focus of the project is organisational challenges connected to corporate environmental work.

Industrial ecology has so far mainly been approached and discussed by engineers and from natural scientists' point of view. This report should therefore be looked upon as an attempt to compensate for this imbalance, and as an early approach by social scientists to some of the very complex issues implicated by industrial ecology.

The theoretical work will be followed by more empirically based publications from the research project based on findings from three Norwegian manufacturing companies taking part in P2005 IndEcol. The main questions asked in the empirical investigation, are how environmental responsibility is manifested in the companies and what needs to be done to develop environmentally responsible corporate cultures.

ABSTRACT

Commercial organisations are the foundation walls of our modern economy. More than 200 years of industrial activity and the recent trend of globalisation have made them the most powerful institutions when it comes to resources, knowledge and ability to influence their surroundings. In spite of their strong position, business is not doing enough to meet the environmental challenge. The suggested 'solution' of eco-efficiency initiatives is a product of the same thinking that has created the problems and is not reaching deep enough. By using the concept of corporate culture, we will argue that companies not only passively adjust to their environment, but also may actively influence and shape the system they are a part of. In addition to the current focus on technological innovation and increased resource productivity, there is a need for a redefinition of industrial system borders, a redistribution of moral responsibility between the corporate and public sector, and development of new and overarching indicators of progress. Industrial ecology might in this respect be a promising framework to industrial reasoning that are more in line with sustainability

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1 INTRODUCTION

The industrial revolution and the following mass production have made 'comfort' and 'well-being' available not only for the elite, but also for the mass and common people in the Western world. Industrial organisations provide income for their owners and employees, fulfil customers' needs for services and goods, and contribute to societies' welfare. Commercial organisations are the foundation walls of the global economy, and the most powerful institutions when it comes to resources, knowledge and ability to influence their surroundings.

But more than 200 years of growing industrial activities have also had its negative effects. The efficiency of industrial mass production was proved with Henry Ford's introduction of the assembly line. A darker side of the modern production capacity was demonstrated in the rearmament during the First and Second World Wars. The nuclear bombing of Hiroshima and Nagasaki and the following nuclear arms race during the Cold War gave birth to a strong public concern of the potentially devastating effects of technological innovation underlying the process of industrialisation.

On the human side, phenomena such as alienation and monotonous work, child work and lack of labour's rights have been under debate. In Western societies there has been a great social awareness of these phenomena, and many of the problems have been solved or improved as a result of the work of interest groups, the rise of international co-operation, laws and economical development. It must be noted, however, that economic globalisation has produced an increased focus on the "export" of social problems to less developed areas of the world with lower standards than developed countries.

Pollution and degradation of the environment has not to the same extent been subject for an institutionalised discourse. The issues have, however, made their way into the public debate through what can be described as a slow process of awakening, being trigged by critical incidents during different stages of the development of modern society. Recent examples of such critical incidents are the gas leakage in Union Carbide's chemical factory in Bhopal - India, the nuclear power plant accident in Chernobyl, and the loss of the oil tanker Exxon Waldes outside Canada. Development of modern information- and communication technology, increased consumer-power and the rise of environmental organisations, has also contributed to this process.

Business' first response to the growing public concern about their negative impact on the environment can be described as 'reactive control' and 'end-of-pipe' solutions. Problems were dealt with only when they became visible, and the strategies in business were to deposit waste and to dilute pollution and spills. This response was reactive in the way that

business only dealt with the symptoms of the negative effects of their activities, not what caused the problems. During the 80's the focus within the leading companies shifted to preventive strategies. The concept of 'cleaner production' was introduced, and programmes to improve the use of energy and resources and reduce industrial waste, were started in several countries. What these initiatives had in common was that they mostly focused on technological improvements.

It is common to describe the introduction of the concept of 'sustainable development' in 1987 (WCED, 1987) as a turn of the tide within the world community's concern about environmental and social challenges. The negative dynamics between these two problem areas was introduced to the world as a threat to *Our common future* in a report with the same title, also called the Brundtland report after it's leader Gro Harlem Brundtland. This UN-report stated that the environmental problems and increasing poverty were serious threats to present and future generations, and that facing these issues in a proactive way is our civilisation's biggest challenge. The commission behind the report defined sustainable development quite loosely as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). In spite of the following debate on how to operationalise the concept, the report led to a widespread social acceptance and 'global consensus' of the need for a sustainable development.

Following the WCED report in 1987, the International Chamber of Commerce presented its *Business Charter for Sustainable Development – Principles for Environmental Management* in 1991. This was done as a lead to the UN Conference on Environment and Development in Rio 1992, where the overall goal was to develop international strategies on how to meet the challenges described in the WCED report. The Rio-Conference resulted in *Agenda 21*, an international action plan for sustainable development. The increasing public attention to these issues resulted in the foundation of international organisations like Business Council for Sustainable Development (BCSD) and the World Industry Council for the Environment (WICE). These two organisations merged into the World Business Council for Sustainable Development (WBCSD) in 1995.

2   IS BUSINESS DOING ENOUGH?

Is then the reaction in business in accordance with the environmental challenge as we know it today? The total use of materials in heavily industrialised countries such as Japan, Germany and the United States e.g., rose by an average of 27.7% over the last 20 years. In the U.S. the energy consumption is expected to rise by 20 % the coming 20 years. Asia is expected to more than double its energy use within the same two decades. Most of the growth will be fossil fuel based (Day, 1998). Recent calculations from the World Resource Institute indicate that the annual natural resource consumption in highly industrialised countries like the US, Japan, the Netherlands and Germany has reached the staggering level of 45 – 85 metric tons per person (Adriaanse et al., 1997). In a recent report, Matthews et al. (2000) states that:

> "The resource efficiency gains brought about by the rise of e-commerce and the shift from heavy industries toward knowledge- and service-based industries have been more than offset by the tremendous scale of economic growth and consumer choices that favour energy- and material-intensive lifestyles," (WRI Press release, *http://www.wri.org/press/weightofnations.html*, September 2000)

Furthermore, the UN has estimated that the share of the world's population in countries undergoing moderate or high water stress could rise from presently one third to two thirds by 2025. Industrial water consumption is expected to double in this period if current growth rate continues (Raskin, 1997).

These are just a few examples that business has not been able to proactively face its own dysfunctionalities in spite of an increasingly stronger position in society and expanding knowledge about the problems of industrialisation. The response in business is still characterised by short-term 'win-win thinking' where environmental investments also must be economically attractive. Strategies of change have relied heavily on technological improvements, rather than organisational and cultural innovation. Business (and society in general) has so far not reached deep enough, namely to look at the paradox of steadily increasing use of resources and energy within a closed system on earth. This is not a new idea, but we would like to stress that the strategies and 'solutions' used so far are flawed in the sense that they are developed within the same system of thinking that created the problems.

3 SOME PROBLEMATIC NOTIONS OF MODERN SOCIETY

Our analysis of the environmental challenge has its point of departure within a social constructivist perspective, which in some fundamental ways breaks with the positivism inherent in many aspects of the currently dominating worldview (Burell and Morgan, 1979; Lincoln and Guba, 2000). It is often the case that environmental debates can be seen as a conflict between two equally plausible stories, the main reason being that arguments on both sides are socially constructed (Miller, 1999). Within the field of environmental sociology, similar analysis have been conducted on a wide range of environmental issues, showing that the social process of constructing problems is by far more important for their official recognition than the "actual" severity these issues pose to human society (Hannigan, 1995).

Seeing the present paradigm of reasoning as one of several possible conceptions of "reality", we track the roots of the environmental problems to some central tenets of today's thinking that has been given the status of unquestionable truths, and therefore serves as premises for the current framing of environmental problems and solutions. Shiva and Bandyopadhyay (1989) describes how today's paradigmatic hegemony can be seen as the result of a historical development of modernisation trough several centuries:

> "The ideology of the dominant patterns of development derives its driving force from a linear theory of progress, from a vision of historical evolution created in eighteenth and nineteenth century Western Europe and universalised throughout the world, especially in the post-war development decades. The linearity of history, pre-supposed in this theory of progress, created an ideology of development that equated development with economic growth, economic growth with expansion of the market economy, modernism with consumerism, and non-market economies with backwardness".

The deeply embedded notion of "progress" as a historic fact is within our framework contrasted with a more nuanced picture where progress or regress is defined as a result of giving normative priority to certain socially constructed indicators and ignoring others. When the power of a certain perspective grows to a critical level, this can lead to a potentially dangerous situation where such normative choices are disguised, with reference to the present development as "true" or as "the only realistic alternative". Related phenomena have been known to appear on all levels in society, and have

been described within different disciplines and traditions as prejudice, groupthink and ideological hegemony (Brown, 1986). They all serve one powerful function: to make a very complex reality simple and predictable. When breaking out of this sedative "blindness", one is faced with a flow of impressions that often arouse the very uncomfortable state of anxiety, being one of the most significant sources of resistance to human change.

Using a framework of analysis that relies on the concept of social constructions, one can easily be led into a fruitless state of relativism where all "truths" are deconstructed and "anything goes". It is our intention to show that the key to understanding the environmental challenge is exactly the opposite, namely to recognise that the images we construct of ourselves and the surrounding world will have to reflect the fundamental limits imposed on us from the carrying capacity of the planet. Our behaviour is rooted in a certain conception of reality, and as can be readily seen from the escalating environmental problems of today, this behaviour have implications that reach far beyond the confines of human society. As illustrated by the following quote from Herman Daly, one of the deeply embedded assumptions in the modern liberal economy can be seen as a system error when natural limits to human activity are taken into account:

> "To grow means "to increase naturally in size by the addition of material through assimilation or accretion." To develop means "to expand or realize the potential of; to bring gradually to a fuller, greater, or better state." When something grows it gets bigger. When something develops it gets different. The earth ecosystem develops (evolves), but it does not grow. Its subsystem, the economy, must eventually stop growing, but can continue to develop. The term "sustainable development" therefore makes sense for economy, but only if it is understood as "development without growth" (Daly, 1993, p 133)".

The challenge of establishing some channel of communication between what has been labelled "eco-systems" and the highly complex systems of human symbols and mental images is not to be underestimated (Luhman, 1989). Through creativity and cultural, technological accumulation of knowledge we have seemingly detached ourselves from the immediate resource limitations that hinder other species from the reproductive success humans have experienced in modern times. However, this anthropocentric worldview is now changing into a scenario where the fundamental connection between human well-being and the state of the non-human world will have to guide the re-design and innovation of human institutions (McDonough and Braungart, 1998). Again, this forces us to confront one of the central notions of western culture where human societies and "nature" is seen as two distinct entities, making the systematic destruction of natural eco-systems to one of the primary driving forces behind what has been

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described as "civilisation" and "development". This conception of reality can lead to illustrative paradoxes. In some limited areas such as national parks it is strictly forbidden to contaminate the "natural" surroundings with litter, while the "civilised" waste dump outside New York has entered the rather exclusive category of human constructions visible from space.

Another example of a problematic notion of modern society as conceptualised in the western or westernised part of the world is the relationship between the corporate sector and society at large. Particularly in the light of the recent development towards a global liberalisation and the accompanying change of the power balance between common and corporate interests, new challenges arise for businesses that want to act socially responsible. International competition within the globalised economy makes it more demanding to survive within national economies where social and labour costs are significantly higher than competing regions, and this development puts pressure on environmental legislation and labour rights. Thus, for those who do not profit from increased shareholder value, the instrumental thinking of international business becomes a problem when the interests of large groups in society are left to the invisible hand of the free market (Martin and Schumann, 1997).

The public sector is not operating as a coherent body in these matters, but at least partly the state has traditionally been given the role of defending its inhabitants from individuals or organisations who are following agendas that directly or indirectly threaten our common interests. When considering the enormous challenges facing human societies in the transition towards sustainability, it can be argued that we simply cannot afford the corporate sector to act as a "state in the state" with its own goals and priorities. History has shown us that certain tasks need the concerted efforts of all actors in society if we are to succeed, and the question is whether or not the issue at stake is deemed important enough to generate a strong moral demand also on the corporate sector.

3.1   Critique of sustainable development and eco-efficiency

In the years following the launching of the concept "sustainable development" on the international agenda, various actors in society have tried to bring the overall message from the Brundtland commission down to a more concrete level. The WBCSD and other leading corporate actors are now operating with a definition where sustainable development contains social, economic and ecological aspects:

> "Sustainable development involves the simultaneous pursuit of economic prosperity, environmental quality and social equity" (*http://www.wbcsd.ch/*, June 2000).

A potential internal conflict between these goals is typically not addressed, and in most discussions the principle of economic growth is treated as a premise not under debate. In contrast to this view, natural limits can be seen as *absolute,* in the sense that human institutions, including the economy must be based on dynamic equilibrium rather than exponential principles (Daly, 1996). The "locomotive" hypothesis from the Brundtland report where continued economic growth in the industrialized world is seen as a prerequisite for economic development in the developing countries may not be consistent with this understanding. Ehrenfeld (2000) introduces the concept of "sustainability" which in many ways breaks with the dominant way of thinking about these challenges:

> "Sustainability is a possible way of living or being in which individuals, firms, governments, and other institutions act responsibly in taking care of the future as if it belonged to them today, in equitably sharing the ecological resources on which the survival of human and other species depends, and in assuring that all who live today and in the future will be able to flourish, that is, to satisfy their needs and human aspirations" (Ehrenfeld, 2000 p. 5).

Ehrenfeld states that "sustainable development" as defined by the Brundtland commission is only a variant of the current economic development paradigm where the actors are seen as utility maximisers, rather than moral human beings.

After the Rio Conference in 1992, there has been a strong focus on the concept "eco-efficiency" as business' response to the call for sustainable development (Schmidheiny, 1992). WBCSD has been the prominent body in launching this perspective, which in a very short time has been embraced by many of the leading actors within the corporate world. The basic idea is "to produce more with less", hereby reducing the adverse environmental impact of economic activity. It is however important to note that the concept is of a relative nature, in the sense that it focuses on improvements per unit produced, not on the total level of environmental damage from industrial activity. This makes eco-efficiency compatible with the long-term strategic interests of business, where unlimited growth still is the leading motive.

Despite the great efforts made within the framework of eco-efficiency, the improvements in relative environmental performance is by far cancelled by the steadily increasing consumption levels associated with economic growth (Ehrenfeld, 2000; Matthews et al., 2000, UNEP, 1999: McDonough & Braungart, 1998; DesJardins 1998). It is highly unlikely that we can get ourselves out of the present unsustainable situation by making existing patterns of production and consumption more effective, given the radical reductions in material and energy consumption that are necessary in order to reach ecologically sustainable levels at a global scale (Day, 1998). It is not

solving any environmental problems to decrease the environmental impact of a certain product by 20 percent if the sales volume increases by 30 percent, even though this calculation makes perfect sense for the bottom line of the individual company.

A much stronger focus is needed on the total environmental impact of industrial activity on different levels in society, as this parameter is of a much larger ecological relevance than efficiency indicators focusing on relative improvements. This understanding implies absolute reductions in resource consumption with adverse ecological impact, as intended in the international agreements concerning reduction of green house gasses and substances harming the ozone layer.

It can surely be argued that the eco-efficiency framework is an important first step in a long-term transition of our modern economy. It also sounds strategically smart to act within the premises of the current worldview rather than scaring corporate actors off the field with radical and controversial ideas. On the other hand, one can be sure that the rate of innovation needed, will not be smaller as the global resource base continues to diminish, making the challenge for business even tougher than a concerted attempt at present.

Also, the social dimension of just distribution of global resources is absent in the eco-efficiency framework as currently defined (Welford, 1999). If one accepts the premise of limited resources in a closed system, it is therefore not sufficient to adopt a "less bad" strategy in the rich part of the world as this will continue to decrease the available ecological space for necessary developments in poor nations. It follows from this line of reasoning that a principle of economic growth cannot be given priority over fundamental, life supporting natural systems, even though this may imply a very controversial re-structuring of our modern economy.

3.2 The need for cultural change in business

As argued, the problem in business is that the environmental problems are being framed and attacked within the same framework that created the problems. Welford (1997) claims that the framing of environmental problems has been carefully adapted to existing goals and values in order to avoid a threatening disturbance of the status quo. This framing process is one central element of what can be described as the culture of an organisation. The culture is in a broad sense a result of the companies' efforts to adjust to its environment. In this continuous struggle to survive, solutions that prove to work are being adopted as 'the right way of doing things and seeing the world'. Over time, such solutions or 'basic assumptions about the company and the world around it', are being taken for granted and not questioned. The basic assumptions become the socially constructed truth of the company and its world. Based on the basic assumptions, the value system, physical

surroundings and symbols of the company are being built, maintained, and changed (Schein, 1992; Hatch, 1993, 1997).

It is, however, inadequate to describe the relationship between a company and its surroundings only as the company's passive assimilation to the bigger system. Companies adjust to their surroundings based on their way of defining them. But by defining the system and acting towards it in a particular way, companies also stabilise and strengthen the bigger system they are a part of. The system is not an entity in itself, but a product of the way actors within it define and act towards it. Companies with cultures that are well adjusted to the overall system, can be seen as the foundation walls of the structures surrounding them.

Within sociology, the phenomenon of self-fulfilling prophecies is called the 'Thomas theorem' after the sociologist G. I. Thomas. The theorem describes the interplay between the definition of a situation and the actual results that may follow. In Thomas' words it states that 'If men define situations as real, they are real in their consequences' (Merton, 1967). Companies that define their surroundings as hostile and competitive and build their organisational culture on this assumption, tend to take an aggressive 'grow and beat the others' strategy. Such a strategy may give the company financial surplus in the short run, and in that way strengthen the members' believes that only growth will secure their future survival.

The problem with the way business has met the environmental challenge so far is that they have looked for the solutions within the existing basic assumptions of their cultures. As an immediate response it is rational to base the solution of a problem on a world-view that has proved its functionality before. Meeting the environmental challenge with eco-efficiency initiatives and technological improvements may improve the companies' short-term financial situation, but such 'solutions' will not solve the problems, only postpone them (Day, 1998; McDonough and Braungart, 1998).

Argyris and Schön (1978, 1996) describe organisational learning based on existing basic assumptions as *single-loop learning*. The question asked within this kind of learning is whether one is doing things right. In other words, the goal is given, and changes are only instrumental in relation to this goal. So what is needed in business is cultural change or what Argyris and Schön describe as *double-loop learning*. Double-loop learning means questioning the governing basic assumptions and the standard way of doing things. This means going outside the governing framework when looking for solutions. Looking for new and till now, radical ways of solving the environmental problems, also involves questioning the overall system that business is a part of. To find new and good environmental solutions, business therefore needs to be aware of their role as caretakers and foundation walls of a system that is not sustainable in its present form. The following quote from Argyris & Schön (1978) illustrates that the ability of double loop learning can be seen as a prerequisite for effective functioning in a steadily changing modern society:

> Unless people acting as agents for organizations and societies are able to learn how to detect and correct double-loop errors, the survival of the society may be in doubt… We begin to suspect that there is no stable state awaiting us over the horizon. Our very power to solve problems seems to multiply problems. Our organizations live in economic, political and technological environments that are predictably unstable. The requirement for organisational learning is not an occasional, sporadic phenomenon, but is continuous and endemic to our security (p5).

Two questions are of relevance for double-loop solving of environmental problems in business. Firstly, is business responsible for changing the system they are a part of? And, secondly, why is it so difficult to achieve double loop learning? The question of responsibility is much debated within business ethics (see e.g. Dahl, 2000; DesJardins, 1998). Our view is that business clearly is responsible to change themselves and thereby the system. As argued above, business has a uniquely strong position in today's society, and given that business itself is partly causing environmental problems, they must also be held responsible for solving them. It is a fact that business through massive advertising efforts plays an essential role in generating new consumer needs, and in many cases this is at odds with necessary reductions in resource consumption in the industrialised world. Most companies are, however, not willing to acknowledge this responsibility, arguing that they simply respond to market demand.

The question of how to get out of the single-loop into a more constructive process of double-loop learning is also complex. One reason is, as we have discussed earlier, that the existing basic assumptions and business cultures have proved their functionality within an economy based on economic growth and no limits. Basic assumptions about the world that has secured financial survival over time are difficult to change – they work as self-fulfilling prophecies (Schein, 1992). Another important factor influencing this issue is that there is little tradition or history in business for problem solving at such an overall level that this kind of double-loop problems solving demands. In a system where business historically has been protected by limited liability and responsibility only for its own profit (DesJardins, 1998; Broberg, 1996), it is difficult to handle a situation where responsibility is being reframed beyond traditional borders. As argued by Shrivastava (1995), the necessary change will be deep, not restricted to surface adjustments:

> To make corporations responsible in this deep sense is a challenging task. It is not a surface, cosmetic, rhetorical, acceptance of responsibility. Instead, this type of CSR (Corporate social responsibility) must be institutionalised within companies, and

within the broader society in which companies operate. It must guide the choice of products, production technologies, strategies, structures, resource allocations, systems and procedures, and stakeholder communications. In must be inculcated as a deep cultural trait. (p. 222).

Challenging and changing basic assumptions can be associated with a lot of pain and anxiety. The cultural "looking glasses" on an organisation can thus oversimplify or create an incorrect picture of the surroundings, threatening its future survival. In cases where the basic cultural assumptions do not reflect the world around the organisation, changes will force its way through critical incidents where the organisational members experience that their current worldview is inadequate (Schein, 1992). In order to address the underlying causes of the present environmental and resource challenges, business will have to go through a process where the dominating definitions of problems and solutions are reframed.

Haas (1990) also describes two different modes of organisational change where "adaptation" is used to describe behaviour where implicit theories are not examined, while "learning" can involve a redefinition of the ultimate purpose of the organisation. It can be of critical importance that an organization changes its way of conceptualizing problems, and whether this change leads to institutional changes that increases (or decreases) the legitimacy and authority enjoyed by the organization (Haas, 1990). Thus, industry will have to face that their way of dealing with the environmental challenge so far has been incremental and that continued action based on the present worldview can be seen as a threat against their legitimacy and authority in society. The process of change will be painful, but when realising that the "less bad" strategies are not good enough the innovation potential of the corporate world is not to be underestimated.

4   INDUSTRIAL ECOLOGY: AN OPERATIONAL FRAMEWORK FOR A SUSTAINABLE INDUSTRY

In the remaining part of this report, we will sketch some of the basic notions of a new approach to industrial environmental challenges, with main reference to the framework of industrial ecology. Central to the discussion is the anticipation of changed expectations towards industry as a result of the unsustainable nature of the present development. Global and local problem escalation will most likely generate a demand for industrial cultural innovation, in addition to the current reliance on technological improvements and eco-efficiency. We argue that parts of the solution to the present challenges can be found through a redefinition of industrial system borders, changed indicators of progress that reflects natural limits and a new distribution of responsibility between the actors in society.

4.1   Introducing the concept of industrial ecology

If one accepts that ecosystem carrying capacity is the ultimate limitation for all living organisms on planet earth, it follows that the basic principles of nature will apply also for human societies. Adhering to patterns of behaviour that explicitly break with these rules will eventually produce a local, regional or global system reaction. In the search for a sustainable way of living, it therefore seems intelligent to design human institutions that use natural systems as an analogy. In 1989, *industrial ecology* was presented to the National Academy of Sciences in the US, as a new approach to environmental thinking in relation to industrial environmental behaviour.

   As is the case with many new and developing fields, there is an ongoing discussion on the scope and content of the approach. Some describe industrial ecology merely as a way of systematising present environmental strategies within business, while others describe it as a fundamentally new paradigm to the environmental challenge (O'Rourke et.al., 1996). Tibbs (1992) has described the following basic tenets as central to industrial ecology.

- Improving the metabolic pathways of industrial processes and materials use
- Creating loop-closing industrial ecosystems
- Dematerialising industrial output

- Systematising patterns of energy use
- Balancing industrial input and output to natural ecosystem capacity
- Aligning policy to conform with long-term industrial system evolution
- Creating new action-coordinating structures, communicative linkages and information

In the writing of among others John Ehrenfeld, the ambition of industrial ecology clearly is to address the fundamental weaknesses of the existing worldview and replace them with a new institutional framework that is adjusted to a system with limited carrying capacity (Ehrenfeld, 1994, 1998). Furthermore, Ehrenfeld (2000) claims that the new elements of industrial ecology can be summed up in three key words; connectedness, cooperation and community. In many ways these concepts represents the opposite of what we see in the present industrial system where reductionist knowledge within hierarchical structures, competition and individuality are governing values. Industrial ecology can in this respect be seen as an attempt to create a new mental model for industrial activity that builds on a cyclic, rather than linear understanding of resource flows in society (Ehrenfeld, 1994). This new perspective holds a promise to reduce what are currently being experienced as problematic consequences of human activity, and it is only through the dynamic interplay between humans acting on this model and "reality" that final value judgements about its usefulness can be made

As the name indicates, industrial ecology can be seen as a metaphor of how to design industrial systems at different levels (Erkman, 1997). If we look closer at the root of the metaphor, the biological ecosystem, we see that two of its main characteristics are mutual dependency among living organisms and effective utilisation of by-products. All the biological organisms are a part of a bigger system, and what are leftovers from one organism is a valuable resource for another part of the ecosystem. The implication of industrial ecology is then an industrial system where companies are mutually depending on each other in the way that what is waste for one company is raw-material for another. The consequence is improved use of resources and closing of material loops with natural cycles as models.

Gradel and Allenby (1995: 8), two central theoreticians within the field, claims that "No firms exist in a vacuum". All industrial activities are connected in thousands of transactions and other actions, and in their impact on the environment. This calls for inter-organisational cooperation and value chain management, which can be seen as two important elements of industrial ecology. Inter-organisational cooperation can imply a redefinition of the concept of corporate responsibility and an expanding of today's industrial system borders. Value chain management can be stimulated by driving forces (market demand, technology, legislation), enhancing environmental performance from the actors.

Although the industrial symbiosis of the eco-park Kalundborg in Denmark is by several described as an industrial system in accordance with industrial ecology (Ehrenfeld and Gertler, 1997; Engberg, 1993), the great majority of industrial activity in today's society is at odds with the intentions behind this approach. As discussed above, it is not solving any environmental problems to increase the resource productivity on process/product level if the overall production and consumption patterns are not balanced with natural ecosystem capacity. While the majority of industrial ecology research so far has focused on material flows within specific industrial processes and life cycle analysis of products, we argue that the scope of the field should also include the human dimensions of industrial activity and its relations with the surrounding world. Below we will address some notions that are of a cultural, rather than technological nature, pointing out some directions for industrial innovation that transcends the currently dominating eco-efficiency approach.

4.2   Expanded system borders of industrial activity

As previously discussed, the conception of human society and its production systems as a realm besides or above nature can be seen as a major obstacle for the introduction of sustainable production and consumption patterns. In contrast to this open, limitless worldview, human institutions can be designed to mimic the cyclic nature of biological systems. An important task in this respect is to make a distinction between biotic and abiotic loops within industrial activity, where it is of major importance to close cycles that have adverse biological impact. As discussed by McDonough and Braungart (1998) the modern industrial system and the present environmental problems can in some respects be seen as a fundamental design failure, where the complexity and vulnerability of biological systems have been seriously underestimated. When a wide array of globally spread chemicals now are suspected to influence hormonal cycles with potentially devastating effects on essential mechanisms such as reproduction and fertility, this illustrates in a frightening way the inadequacy of earlier and present industrial reasoning.

New guidelines imply a redefinition of industrial system borders to encompass both a longer time frame and extended material and immaterial cycles, and also involve new forms of co-operation between companies along and across product life cycles. Compared to earlier strategies of industrial environmental work, one can identify a gradual expansion along organisational and temporal axes, as described by Fet (1998). This development can be expected to continue, making the overall interests of society and future generations central to sustainable industrial decision-

making. Different intermediate positions, among others industrial ecology, can be identified through these dimensions.
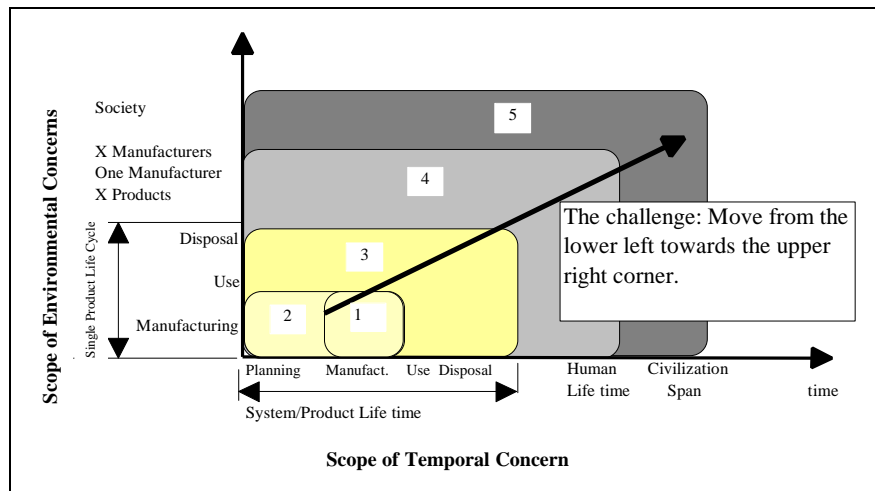

Figure 1 . Different levels of environmental performance can be related to strategies of various scope of environmental and temporal concern, as specified below (Fet, 1998, modified from Bras, 1996)

1. Environmental Engineering.
2. Pollution Prevention.
3. Environmentally Conscious Design and Manufacturing.
4. Industrial Ecology.
5. Sustainable Development.

Extended producer responsibility (EPR) can be seen as a way of expanding the system borders of industrial activity. It is a strategy where the issue of loop closing is addressed in a systematic way. Lindhquist and Lifset (1997) describe EPR as

> "… the notion that the producer bear some responsibility for the environmental impact of their products, throughout the products life-cycle, including upstream impact arising from choice of materials, from manufacturing processes, and especially from the management of the waste arising at the end of the products life".

EPR has several implications for the value chain of the product. Among other things, it means that environmental issues should be taken into

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consideration during the design phase, minimising recycling costs and promoting long-lived products. Corporations that are currently profiting from selling short-lived products will then face increased costs from generating larger amounts of waste than their competitors. The general idea is to give an advantage to companies with responsible design policies.

While the present operationalisation of the EPR-concept in countries such as Norway and the EU does not solve the problems of excessive consumption and resource depletion, one can easily imagine more radical versions of this scheme where producers will have to qualify the introduction of resource intensive products on a market with absolute material limits. Only those companies that can prove a responsible treatment of their full product life cycle will be given licence to operate, e.g. through a tradable quotas regime that can address macro level reductions in ecologically significant areas and scales. This can also serve as a strong motivation for a transition towards the "functional" economy (von Weizäcker et al. 1997), at least for certain product groups where it is adequate to replace the physical product with functions requiring less material and energy per unit of service delivered to the consumer. It is however of crucial importance that national and international environmental policy targets the total and absolute level of resource consumption, not only relying on efficiency indicators of a relative nature.

4.3 Business and society – a new distribution of responsibility for our common interest?

According to the position of among others Friedman (1962), it is a fundamental misunderstanding to ascribe business other responsibilities than to produce surplus for its owners. The argument relies heavily on a sharp distinction between commercial motives and politics, the last being definitely outside the sphere of corporate activity (DesJardins, 1998). However, many corporations have shown a strong will and ability to influence the political system in a direction that serves their own goals and priorities, while simultaneously proclaiming limited responsibility and no political ambitions when positive action is wanted on societal issues such as ecological degradation and a fair distribution of resources (Welford, 1997). This paradoxical state of affairs have two logical solutions, either corporate interests refrain from exercising political influence all together, or they must be prepared to take an extended responsibility for the societal consequences of their actions (Reich, 1998).

There is good reason to believe that corporations should and must take action to an extent that will change the traditional division of labour and responsibility between the public and private sector. In addition to technical

and economical dimensions included in the present conceptualisation of EPR, the environmental challenge contains a moral dimension that also needs to be addressed, both in its own right and as a pragmatic strategy for business survival in a transparent information society. Concepts such as corporate social responsibility (CSR) (WBCSD, 1999) and corporate citizenship (McIntosh, 1998) have been developed in order to describe how business ethics can be developed to include other values than purely economical considerations. Following the apparent success of quality control (ISO 9000) and environmental management systems such as ISO 14000 and EMAS, a new social accountability standard (SA 8000) have been developed, with special focus on child labour, workers rights, health and safety issues (McIntosh, 1998). Investors are now increasingly focusing on these dimensions of corporate activity, and a wide array of social and ethical funds have emerged in recent years. The volume of so-called socially responsible investments in the US rose from $ 639 billion to $2.16 trillion in the period 1995 – 1999, and adds up to 13% of the total investment assets under professional management in the US economy in 1999 (Social investment forum, 1999). While this development is a positive one, the dominant motives for concepts such as CSR have so far been criticized for being mostly out of PR considerations, without any deep commitment to a more fundamental change in industrial reasoning (Welford, 1997). Even though leading industrial actors argue that they have implemented a so called "triple bottom line" (McIntosh, 1998), it is quite clear that economic considerations still serve as premises for environmental and social work also within the most proactive companies. DesJardins (1998) challenges what he describes as a neo-classical economic reasoning now dominating the corporate field. Sustainability must be implemented as a "moral minimum" that constrains economic activity, and within these limits given by natural ecosystem carrying capacity business is free to pursue profits. In his discussion of different versions of corporate social responsibility, DesJardin (1998) argues that relying on standard market economics and economic growth will not solve the environmental and social challenges we are facing. The invisible hand of the market is not left much credibility, making the neo-classical position of Friedman (1962) more an obstacle for sustainable development than a solution. DesJardins (1998) further argues that:

> "Economic growth, understood as continued satisfaction of whatever preferences get expressed in the market, remains an implicit value of the neoclassical model. However, we have strong evidence to suggest such unconstrained demand will not solve the dilemma created by poverty, population growth, and environmental destruction. I wish to argue that significant environmental considerations, like other significant moral responsibilities, must be incorporated within the moral minimum and thus serve as a real

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moral limit on both business activities and consumer demand"(p. 829).

This line of reasoning is supported by Ehrenfeld (1994) who introduces the idea of "the visible foot" to compensate for the lacking regulation within a free market economy. The traditional picture of corporate activity as a response to consumer demand can easily be contrasted with the opposite understanding where corporations introduce new products, and through advertising generate new "needs" resulting in more consumption. Thus, business is not only a passive, reactive agent within the modern consumer culture, but is actively sustaining the primary mechanisms in which global resource scarcity arises. Framing the challenge in this way will also leave industry with a moral responsibility where the answer for highly industrialised countries probably will be closer to "produce less with less" than the current eco-efficiency slogan "produce more with less". DesJardin (1998) further argues that a socially responsible business should feel responsible for satisfying both current and future consumer demand, keeping the total level of resource use within the interests produced by natural eco-systems and not limiting the available amount of natural capital for coming generations to utilize.

4.4   Integrating goals on different levels in society

When discussing the environmental challenge in today's society, one is promptly faced with the complexity and interwoven nature of the issues at stake. Individuals, corporations and nations all play their part in the dynamic interplay that is at the root of our present problems, and it is futile to ignore some actors at the cost of others. The Netherlands, being one of the leading nations on so called covenant agreements in an European context, have demonstrated how the combination of absolute reduction targets on a national level and flexible agreements within different branches can lead to promising results (VROM, 1998). Connecting environmental management systems at corporate level with national environmental policy plans has been one of the important strategies in the Dutch approach to the integration of corporate and societal agendas.

It is increasingly understood that the impetus of change must penetrate agendas on all levels in society if the change towards sustainability is going to be successful. As mentioned earlier, it can be argued that the present criteria of progress does not reflect the cyclic thinking necessary for long term survival in a system with limited resources and restoration capacity. Traditionally, negative environmental impacts have been given the status of "externalities" not included in the equation when short term profitability of

investments are being calculated. New indicators of success are therefore needed on all levels in society, and these measures of sustainability needs to be co-ordinated locally, regionally and globally according to their ecological, social or economical importance. Tools such as full-cost or total-cost accounting can be used to demonstrate how important expenses on firm and societal level has been systematically ignored within traditional economic reasoning (Ehrenfeld, 1994). Using these methods as guidelines in business decision-making will certainly render many of today's investments unprofitable.

At a corporate level, the concept of a "triple bottom line" is illustrating how social and ecological considerations are starting to challenge economy as the only valid and relevant decision-making criteria. The business world is, however, still reluctant to engage in discussions that are not compatible with a growth based ideology, and tend to focus on relative, rather than absolute measures where their own economical interests might be subordinated environmental or equity concerns. At a national level, governments will have to face the controversial, but existing conflict between traditional economic growth and the necessary reductions in environmental impact from our non-sustainable production and consumption patterns. Large scale environmental degradation will be expressed as a "positive" development when GNP is considered alone. Therefore, the implementation of sustainability indexes in long term planning is highly needed in order to visualise the insufficiency of relying on aggregated economic activity as an indicator for human progress (Slesser, et al, 1998).

5 CONCLUSION

We have argued that the negative side-effects of more than 200 years of growing industrial activity in the form of environmental problems and unjust distribution of resources are getting more and more obvious to us. The introduction of the concept of "sustainable development" in 1987 and the following Rio conference in 1992, in many ways represented a global consensus that environmental degradation and resource equity are the biggest challenges faced by human beings today. Business is starting to address these issues, but the current reliance on technological improvements and eco-efficiency is not changing the unsustainable trends in today's society. At macro level, most indicators of resource-use show an increase in absolute figures, the dominant improvements being reduced growth rate within some areas. Given the moral right of poor nations to increase their share of the global resource base, it is highly unlikely that the current "less bad"-strategy adopted by the industrialised countries will be sufficient in the long run.

The dominant western paradigm is still based on the modernistic assumption that we are living in an open system with no limits to growth. There is a need for cultural innovation, both within the corporate sector and society at large. We have argued that industrial ecology represents an alternative way of dealing with the environmental challenge, and offered some notions that can guide the re-thinking of corporate activity within some areas central to achieving the goal of sustainability. The fundamental assumption is that we live in a closed system, and that the idea of unlimited growth must be replaced by cyclic thinking. In addition to technological innovation and increased resource productivity, this implies a redefinition of industrial system borders, a redistribution of moral responsibility between the corporate and public sector, and development of new and overarching indicators of progress.

When questioning underlying "truths", and ascribing problems to the fundamental character of systems on different levels, one is most likely invoking a lot of pain, confusion and frustration among the involved actors. It can therefore be argued that the transformation towards a sustainable society will not happen before the individual and collective anxiety for the ecological or social consequences of today's development exceeds the anxiety for questioning deeply rooted assumptions in the dominating worldview. Our scepticism towards the sufficiency of present environmental strategies within the corporate sector should not be interpreted as an attempt to dismiss these actors from the current debate about how to achieve a sustainable society. While corporate reasoning in many cases seems to be at odds with a sustainable future (Robertson, 1996), it is probably also true that this sector holds the key to the radical innovations and creativity necessary

in order to reach an ecologically sound society (Ehrenfeld, 1994). Governments and consumers therefore need to create a climate that produces the necessary motivation for change, and this also implies a re-orientation of political and individual priorities.

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