Managing in an Environmentally Constrained World

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In thinking about this issue, one comes to a fundamental question: Why are we concerned at all? Why have all of us gathered here, rather than simply continue to clean up what we should from the past, and control our emissions for the present and the future? The answer, I think, may be hinted at by several scenarios (which, although plausible given current trends, are intended to be hypothetical):

1. **The Dry Cleaning Scenario.** It is well known that the process of dry cleaning clothes results in the release of solvents, including chlorinated solvents. This occurs during the process, and after the clean clothes are brought home. The first remedial effort was to improve existing equipment and practices to reduce emissions. The second effort involved studying the customer, which revealed that in many cases (in the U.S., 50% of the time), the customer was really interested in having the clothes pressed, and just accepted the cleaning as ancillary. Accordingly, emissions were cut by offering pressing as a separate service. Finally, readjusting the cleaning process and solvent substitution (water based cleaning processes for some clothes) has further reduced emissions.

The real solution, though, results from asking why clothes are still made from types of cloth, and designed, so that they require dry cleaning. With all that is known today, why not simply design clothes so that they can all be washed in aqueous systems, without pressing?

The results? Environmental improvement. Less cost to consumers (who now wash all of their clothes themselves). Many small businesses are driven out of business as clothes requiring dry cleaning rapidly disappear. Unemployment. Stranded capital. An entire sector of small business disappears.

2. **The Digital Server.** Assume that digital server technology - where a large central server is linked into everyone's home through an interactive network - is deployed. Such servers can be built with more than enough capacity to hold the games, songs, videos, shows, music and other entertainment people desire. The stored material can then be accessed from people in their homes, who can record directly from the server. This significantly "dematerializes" the CD, computer disk, tape, film and other information storage industries: there is no more need to buy
new releases on CDs, for example, when the desired song or video can be obtained directly from the server, either for immediate play or recorded for future use.

Among the results? The environment is improved as the volume of information storage products collapses. The environmental impacts associated with making, packaging, shipping, storing, selling, and disposing of such articles are substantially reduced. Capital invested in production, transportation, and sale of such products is stranded. Consumer quality of life increases; they get the songs or videos they want conveniently, without having to pay for others they may not care for but which are on the same disk. Many small retail establishments - video rental stores, CD stores - are driven out of business, with accompanying unemployment.

3. The Material Management Firm. Many firms are currently involved in a material's trip through the economy, from the mining, extraction or harvesting firm; to the initial processor; to the using manufacturer; to the consumer; to the waste management firm. As governments and large manufacturing firms begin focusing on the lifecycle of materials, however, they will begin demanding a new supplier: one that provides the service of "materials management" for them. Some companies are already beginning to do this: Dow Chemical Company manages solvents for its industrial customers, for example. What is not generally recognized, however, is the fundamental nature of the impending shift, as previously very disparate sectors - from mining, to petroleum, to chemicals, to hazardous waste management - collapse into one.

The result? Many bankruptcies, much stranded capital investment, and enormous opportunities for firms with good strategic planning capabilities that can evolve themselves into full service material management operations. Again, there will be shifts in skill requirements: successful firms, for example, will require enhanced material sciences expertise. Because of the turmoil of colliding sectors and resulting business failures, at least transitory increases in unemployment in the affected sectors are likely.

4. The Functionality Economy. The European Union, moving beyond its imposition of post-consumer product takeback regulations, requires manufacturers in several sectors - automotive, electronics - to offer function, rather than products, for sale. Lease contracts for products are substituted for product sale, and the manufacturer or its representative is made responsible for managing the product and materials through its life. Robotic systems not only build, but disassemble products, and direct subassemblies and components into reuse or materials recycling systems.

The result? The very nature of industry changes. Low manufacturing costs can be negated by high end-of-life costs. Competitive advantage derives not from making and selling lots of products, but from successful service offerings based on products, and sophisticated financial management. Developing data and logistics
A number of other scenarios can be developed, but they all support one fundamental conclusion: environmental considerations are no longer "overhead" for firms, or for societies. They are strategic in every sense of the word. In the past, firms, individuals, and societies have treated environmental issues as ancillary to their primary activities, be it production, consumption, or running a stable, growing economy. Now, however, as the scenarios above indicate, environmental issues must be recognized as integral to our activities: to our consumption of products and employment opportunities as individuals; to the continuing prosperity of private firms; and to the stability of nations and societies. This raises two challenges, which I will now discuss: 1) creating a new intellectual framework within which environmental and economic considerations may be fully integrated, and 2) creating management systems within the firm (and similar ones within governments) which can respond to the new challenge of environment as strategic.

Intellectual Framework

Having a useful and appropriate intellectual framework is important when trying to understand the shift of environmental issues from overhead to strategic. Such a framework, based on the developing science of industrial ecology, is presented in Figure 1, attached. The vision towards which our efforts are directed is an economy which is also environmentally sustainable, commonly known as "sustainable development," or development which supports our current needs without compromising the needs of our descendants. Sustainable development is, however, ambiguous and undefined. It must thus be supported by developing the objective, multidisciplinary field of industrial ecology, which studies industrial and economic systems and their linkages with fundamental natural systems. Industrial ecology may be thought of as "the science of sustainability." The industrial ecology infrastructure is more applied yet. It includes the legal and economic policies, the tools, the data and information resources, by which society supports the efforts of individuals and firms to implement the principles of industrial ecology. Finally, there is the level of initiatives which can and are being implemented now, such as Design for Environment (DFE) practices for manufacturing firms, sustainable agriculture using Integrated Pest Management (IPM) systems, and developing the capability to begin research on industrial ecology problems at such national R&D institutions as Lawrence Livermore National Laboratory in the United States.

Managing Environmental Issues Strategically

In general, companies that learn to think strategically about the environment will be the same companies that have been successful in other critical competitive areas. They will see in the current confused state of environmental policies,
regulations and debate not just a difficult challenge, but an opportunity to serve their customers, and themselves. Experience at leading firms such as AT&T, IBM and Xerox, however, do provide some pointers which may be broadly applicable.

1. Implementing DFE and other practices based on industrial ecology is not a traditional Environment and Safety organization function, and should not be entrusted to that organization. It involves technology, corporate business and strategic planning, and marketing; not the usual overhead functions which E&S departments are comfortable and familiar with. Indeed, in extreme cases the E&S organization might try to derail DFE as a challenge to their supremacy in their field.

2. When starting a DFE or industrial ecology program, it should be regarded as a new and important corporate thrust, and staffed with people who are intended to become experts. It should not simply be assigned to existing, often overworked, staff. Moreover, it should draw primarily from those with business and engineering expertise, not just environmental expertise.

3. Expect confusion, as the field is new and rapidly evolving. Assign people who are comfortable with - or better yet, who thrive on - change, not those for whom change is a threat. View projects as opportunities to learn, rather than as exercises designed to produce demonstrably valid results: in many cases, the data do not yet justify certainty.

4. Start with projects that are both small enough to be easily done, and offer the opportunity for early successes. A few good internal case studies can help a firm accept DFE and industrial ecology as useful, rather than a complicated and frightening drain on resources.

5. Link existing business goals with DFE and industrial ecology goals. To the extent there is a conflict, be prepared to evaluate the alternatives. For example, if you are a mining firm and your strategic plan does not contemplate competition from waste management firms, you may need to rethink it. As usual, questions regarding, for example, timing, capital availability, market positioning, competitive analysis, and collaborations and partnerships, must also be part of any reanalysis.

6. It is critical to link the firm's DFE and industrial ecology activity with its foreign strategy and international activities. The rapid development of national eco-labels such as Germany's Blue Angel, and international standards such as the ISO 14000 standards now under development, mean that firms in a global marketplace can no longer ignore them. Moreover, environmental requirements can be used in ways which improperly impact trade, a possibility which firms sophisticated in DFE and industrial ecology can better guard against.

Summing up, it is true that environmental issues appear confusing and complex. They can be managed, however, by recognizing that much of the
confusion arises from the transition of such issues from overhead to strategic for the firm, and for society. Moreover, the rapidly evolving field of industrial ecology can be used to create an intellectual framework, and the underlying understanding, to make sense of the changing environment. Moving forward on the basis of this understanding not only helps the firm, but contributes to the creation of a sustainable economy for ourselves, our children, and our grandchildren.
INDUSTRIAL ECOLOGY FRAMEWORK

SUSTAINABLE DEVELOPMENT

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INDUSTRIAL ECOLOGY

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INDUSTRIAL ECOLOGY INFRASTRUCTURE

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SHORT TERM INITIATIVES

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LONG TERM INITIATIVES

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DESIGN FOR ENVIRONMENT

SUSTAINABLE AGRICULTURE AND FORESTRY

SUSTAINABLE ENERGY SYSTEMS

INDUSTRIAL ECOLOGY R&D AGENDA

MATERIALS MODELS AND DATABASES

COMPREHENSIVE RISK ASSESSMENTS AND RISK PRIORITIZATION