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**GLOBALISATION, COMPETITIVENESS, GOVERNANCE
AND ENVIRONMENT :**

What prospects for a sustainable development?

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Abstract

GLOBALISATION, COMPETITIVENESS, GOVERNANCE AND ENVIRONMENT :

What prospects for a sustainable development?

The rise of concern about environmental degradation around the world (e.g. air pollution, traffic congestion, deforestation) and the emergence of increasingly wide-ranging environmental controls, can be considered an "unintentional repercussion" of competitive economic activity that, now, places pressure on firms to find new responses.

It is easy to identify instances of competitive activity that have adverse impacts on the environment. We can also, however, identify ways that competitive economic activity can evolve in ways respectful of environmental quality, and in some instances to provide a positive solution to environmental quality and sustainability issues. In this paper we lead to the following general questions. First, what are the social and technological preconditions necessary for the identification of *win-win strategies for firms*, that is (as defined by Porter and van der Linde 1995a, 1995b), business strategies that secure a healthy competitiveness while also achieving a desired level of environmental protection? Second, under what circumstances might competitive free-market business activity work in the directions of a *sustainable development*, that is, a form of economic activity that respects long-run concerns for the maintenance of ecological life-support systems and economic welfare prospects for future generations?

What is the connection between environmental strategies that are or might be adopted, and environmental policies and social legitimacy?

Today, sustainable development is often presented as a reconciliation between free-market economics, with its perceived benefits (productivity incentives, technological innovations, representing the basis for increased material wealth and consumer satisfaction), and the protection of environmental quality as a prerequisite for sustainable economic activity and direct source of general welfare. This view has implications for, and is reflected in changes of attitude by all the economic partners:

- In the private sector, firms have shifted (to varying extents) from a position of simple hostility towards environmental regulations -- perceived as obstacles and as the source of additional expenses -- to a more positive consideration of the environment as a strategic opportunity.
- Government agencies and scientists involved in environmental regulations have recently started giving more attention to the manner in which environmental objectives can be incorporated into standard business practices.
- Increasing numbers of "green consumers" or individuals concerned by the environment, express their support for environmental quality goals and for the principles of cross-generation equity, and for commercial practices and policies respectful of these ideals.

However, it cannot simply be assumed that these simultaneous changes in public attitudes, business policies and government regulations are going to guarantee the conditions for long-term ecological and economic sustainable development (Palmer, Oates and Portney, 1995). The risk remains that changes are made merely in response to certain environmental problems, while other and perhaps more serious environmental impacts are being overlooked. So in this paper we look with an open mind at the prospects for reconciling economic competitiveness with the priority of environmental protection.

- In part 1, we suggest a typology of business approaches to the environment -- what we can call firms' *environmental strategies* -- emerging from our reviewing of empirical studies covering various economic sectors.
- In part 2, we explain, using examples, the crucial role that environmental technological innovation can at times play in the search for a competitive edge and for an improvement in environmental performance.
- In part 3, we raise the question of how to modify the organisational structure of firms in order to operationalise the implementation of technological innovations aimed at linking competitiveness with sustainability.

In part 4, we seek to give an answer to the following question: what would be required in social and institutional terms in order to bring about a win-win relationship between healthy competition and the protection of the environment?

1. A simple typology of business strategies on the environment

Firms producing all kinds of goods and services are required to respond to controls that reflect increased concerns over health, safety, the quality of the environment and the preservation of natural resources. Environmental policies can be looked upon as simply causing additional expenses, as barriers to flexibility and, hence, as going against the grain of competitiveness. Nevertheless, the need for local, national and international environmental policies is an accepted fact. Moreover, and to an increasing extent, the private sector is actively involved in the negotiation and implementation of environmental policies. Existing analyses suggest that strategies implemented by firms with respect to the environment fall along a line between two extremes:

- (1) Firms pursuing a defensive strategy with respect to environmental issues. These are firms which view environmental restrictions as extra costs that must be kept to a minimum, or even reduced to zero whenever possible.
- (2) Firms opting for proactive or integrated environmental strategies. These firms anticipate new regulatory requirements and turn to their own advantage business opportunities provided by new research required to solve environmental problems.

Between these two extremes there is a wide spectrum of positions, such as the "follower" firms which adjust to new environmental regulations without participating in their drafting.

1.1. Defensive environmental strategies

Traditionally up to the eighties, firms have regarded environmental performance requirements defensively, that is, as an additional constraint to be side-stepped if possible. According to a study by the European Commission's DG III (1995), firms most likely to engage in defensive strategies in Europe are major companies that are leaders in their field at home, but not multinationals, and, to a lesser extent, small and medium-sized firms. The sectors where this typically occurs are the machine, textile, food-processing, wood and paper, automobile and metallurgical industries. Within the EU, the tendency was particularly pronounced for some of the Mediterranean countries.

In traditional economic analysis, the damages done to the environment through production and consumption activity are « negative externalities » which mean there is a socially inefficient allocation of economic resources. The policy objective then is to « internalise » this negative impact by, for example, a tax on pollution or a requirement to introduce more expensive « cleaner » technology. Viewed statically, those mechanisms amount to an increase in the costs that polluting firms would

have to meet. Such additional costs may reduce the firm's ability to gain export-market shares or limiting its potential domestic-market penetration. Take, for example, the cement industry where competitiveness is based on the securing of margins, because the product is fungible and there is little possibility of brand differentiation, and also the technology changes slowly and is easily accessible to competitors, so that there can be little differentiation among products. Cement production involves substantial atmospheric pollutant emissions. Yet only very stringent controls on emissions would be sufficient to create an incentive for cement firms to look for a new manufacturing method for cement, or for a substitute product, by which means they could turn the strict environmental performance requirements to their competitive advantage.

To see how environmental performance can be a factor in competitiveness, it is useful to give some examples of different kinds of defensive strategies. First of all, firms may refrain from reporting their pollution-causing activities or from cutting back on the pollution they cause, simply in order to avoid the costs of such measures. Or they may make reluctant adjustment to environmental regulations after the fact.

For example, in the case of concern with sulphur and nitrogen oxide emissions causing acid rain, the reaction of automobile manufacturers has varied significantly from one country to the next. German manufacturers anticipated the arrival of controls requiring the use of catalytic converters, and indeed in some cases were pushing for such regulations (BMW announced that all of its cars would have catalytic converters starting with the 1989 models). By contrast, the French automobile industry was hostile to those measures. The German manufacturers had gained expertise in the technology. Not only were their cars ready to add converters (at low costs to owners), but also Bosch had a monopoly on some of the components of catalytic converters. The French automobile industry (in particular PSA) then declared that the proposed catalysers solution was a bad one, and offered instead to develop a clean engine. But rapid progress in regulations and the estimated 5-billion franc cost of the suggested research programme dissuaded the French from fighting for their point of view. They subsequently had to accept European regulations imposing catalysers and to meet the extra costs of adjustments in their car design and manufacturing processes (Faucheux, Noël 1990).

A more aggressive strategy is either to bypass or to block regulations. Firms may engage in transfers of production or in dumping practices to export markets where the safety or environmental regulations are non-existent or not enforced. An example involves some Western cement corporations, which have started operating subsidiaries in countries where regulations were virtually non-existent (Latin America) or where controls existed but were lightly enforced (Turkey, Poland, Hungary) (Gramond & Setbon 1996).

Historically, the adoption of environmental controls in industrialised countries is correlated with the phenomenon of hazardous waste being exported to developing countries and in the expansion of operations of highly polluting industries, such as leather, metallurgy or asbestos in these countries. However, according to several studies (Jacobs 1994, Sprenger 1995), if environmental considerations are sometimes a factor in decisions to relocate a firm, they are seldom the only one and seem to have, at least until now, always played a secondary role as compared to other factors such as labour costs, the availability of raw materials, barriers to trade, access to markets, etc. It should also be noted that defensive strategies, while sometimes profitable in the short run, can expose firms to high adjustment costs if changes in standards or market conditions should catch up with them. They can also be the cause of serious disruptions in the event of an accident. In 1984, prior to the Bhopal accident which caused the death of several thousand persons, Union Carbide was the world's tenth largest chemical firm. By 1994, it had fallen to 44th place (Cairncross 1995).

1.2. Proactive and integrating strategies of firms towards the environment

Some highly publicised accidents such as the Seveso toxic cloud release in Italy (see De Marchi 1997) and the Bophal disaster in India, have changed public and regulatory opinion so that firms are now obliged to take a more proactive position. A growing number of polluting firms have begun to consider environmental protection as not just a constraint but as providing a potential

competitive edge, owing to their competitive situation and falling margins as well as to the increase in consumer awareness of the ecology.

Since the 1980s, the world has witnessed the development of what Porter (1990) refers to as the new competitiveness paradigm based on a dynamic vision. According to this view, competitiveness at the industry level may well be achieved through higher productivity or lower prices, but also by the ability to provide different and better-quality products priced higher than others. Armed with this new concept of competitiveness, many firms take the view that, rather than maximising profits within a fixed set of environmental constraints, it is better to modify those constraints in order to gain a competitive advantage. In that perspective, environmental considerations may cause a firm to cease distributing an old product or to bring out a new one. They may also lead to the discovery and use of outlets for certain goods resulting from the manufacturing process. Under this technical arrangement, materials which used to be considered waste become by-products that can be sold. The environment hence introduces a new criterion for differentiating among products, including on the basis of the development of environmental standards or labels (ISO 14000 at the international level), as will be discussed below, or else causes changes in the properties of products, such as their useful life or their price-to-weight ratio. Leading European automobile manufacturers, for example, have been looking for a way to compute a recyclability index that could be used for business purposes. Concerns about the disposal of old vehicles have also given rise to discussions concerning the useful life of cars.

Commercial success then depends on a combination of technical expertise (innovative processes and products, life-cycle analysis), the attitude of consumers (demand for "green" products) and public relations. The firm, by developing a proactive strategy, does not limit its business exclusively to already existing market segments but also seeks to influence changes in consumer perceptions and demand (product differentiation, acceptance, changes in behaviour, etc.). Lastly, a proactive environmental strategy contributes to the firm gaining a more positive image. Firms today often refer to their responsibilities with regards to energy efficiency, the scarcity of resources, chemical waste, the disposal of polluting substances, waste management, recycling and nature conservation.

This kind of proactive strategy is evident among many large multinational corporations in the industries, especially those that see themselves threatened by environmental controls -- namely electrical utilities, chemical firms, oil refineries and water-treatment plants (survey by DG III, 1995). The strategy requires a considerable expenditure of time and financial resources by firms, including the hiring and employing of experts in various fields (political analysts, legal advisers, consultants on technical feasibility, market researchers, lobbyists, etc.). This high cost means that the practice is principally limited to large companies as well as to industry associations in which firms have a shared interest, in particular with respect to control measures.

The famous example of Du Pont can be cited. Anticipating that regulations on CFCs were unavoidable, the company, one of the world's leading chemical firms and the largest manufacturer of CFC, had been conducting research into CFC substitutes since 1975 in order to obtain a decisive advantage in the distribution and manufacturing of those substitutes when the moment was right.

Another example is that of Arco, the world's eighth-ranking oil company. Having developed a major research and development program starting in 1988, it put out a clean automobile fuel at the end of 1990. Arco had sales in 1990 of 19.9 billion dollars, or four times its total for 1986. Similar results were reported for 1992 and 1993. The company owes its success to a proactive environmental strategy which led it to bring out a new product that ended up influencing and anticipating environmental regulations (including some 1990 amendments to the Clean Air Act) in order to obtain a competitive edge in the highly competitive oil industry (Piasecki 1995).

1.3. The follower strategy regarding the environment

This strategy lies midway between the two extremes mentioned above. A follower is a firm that does not make the running with new innovations or lobbying for regulatory change, but adjusts purposefully to the new ground rules. Such behaviour can be motivated for a variety of reasons -- as on grounds of legitimacy, in order to avoid future accusations, or to secure future markets, or else simply to avoid being a loser in tomorrow's competitive race. For example, in the field of waste disposal, European automobile manufacturers are now preparing for new guidelines being progressively introduced at the European Union level (1991 Amendment to the 1975 general directive, and 1991 Directive on hazardous waste), without seeking to change those directives. They are also making ready to respond to provisions concerning packaging and priority waste as defined by the European Commission, which includes automobile carcasses (see Seret 1996). The case of European cement manufacturers can also be cited. Despite a generally defensive approach to regulations concerning their main business, they have grasped at one significant advantage which could be gained from environmental controls. This is to develop their very minor side-business of waste disposal for industrial liquids and solids with a high and low energy content, such as hydrocarbon sludge, tar, pitch, solvents, varnishes, distillation residues, spent oils, tyres, residue from automobile-body crushing (see Faucheux, O'Connor 1997).

If European evidence is generalisable, then the "follower" strategy seems to have been adopted by a majority of firms. A survey of a large number of firms made in 1995 by the European Commission's DG-III, revealed that more than half of the firms surveyed implemented measures in response to environmental regulations, from simple registration to the installation of capital-intensive pollution fighting equipment. But most of these (55 percent of the firms in the study), regardless of their industry, deal with environmental problems only to the extent required by regulations, and no more¹. The main reason for this seems to be that environmental performance is usually perceived by small companies as a problem of compliance associated with non-productive expenditures.

These conclusions are corroborated by a 1994 survey done in the south of England, of 175 firms (medium-sized and large) in the chemical and pharmaceutical industries and in the financial and information services sectors (Garrod & Chadwick 1996). One of the conclusions of this survey (which had only a 15-percent response rate and so has to be regarded with circumspection) was that the primary motivation for pursuing environmental strategies is to obtain cost reductions (by way of recycling, for instance) and to comply with the law. Very few firms declared having radically changed their approach to the environment by adopting a proactive strategy. Most sought instead to incorporate the issue into their existing policies. This situation seems comparable to what has been observed in the United States (cf. Frosh 1995). For France in particular, it has been noted there that (1) only a minority of firms have become aware of the opportunities that are afforded by the consideration of environmental issues in management areas; (2) most measures, when implemented, are taken by large corporations; (3) the majority of small and medium-sized firms do not take any action with respect to the environment unless forced to do so, on the grounds of cost, personnel or diversification considerations (Chailloux 1996).

2. Environmental technology innovation

A close connection exists, in theoretical terms, between technological change, industrial competitiveness and sustainable development (Skea 1994, Faucheux 1997). This section reviews those links, focusing mainly on long-term changes in environmental technology. *Environmental technology* as we use the term, refers to all techniques, processes and products playing an important role in reducing pressures on scarce natural resources, in reducing pollution flows, and in the prevention and reduction of environmental hazards.

¹ (For another indication of this, see van den Hove and O'Connor 1997).

2.1. Technological innovation : A key variable in win-win strategies

A dynamic competitiveness process is characterised by changes in technological as well as marketing opportunities. Inherent in this are elements of unpredictability, incomplete information and organisational inertia. But , while specific innovations and decisions may be unpredictable, maintaining competitiveness may depend on organisational features that enhance creativity and responsiveness to newly perceived opportunities.

The importance of this cannot be stressed too much. According to studies made by the Japanese government (MITI), some 40 percent of the world's production of goods and services over the first half of the twenty-first century may be from environment- or energy-linked products and technologies. This forecast explains why, for almost 20 years, Japan has been making the development of these technologies a priority, followed at some distance by Germany, The Netherlands, Sweden and Denmark (see MITI 1988; Miller and Moore 1994; Erkman 1996). In this context, innovation potential is seen as closely related to political choices, social conditions and economic institutions. Sustainable development depends on trajectories of sustained innovation and associated institutional changes that yield continually improved environmental performance as well as new market opportunities.

The links between environmental technology innovation and competitiveness prospects can be explored by identifying the different sorts of objectives or improvements that the innovations may attain (cf. Coenen, Klein-Vielhauer, Meyer 1996). For example, performance improvements may be achieved in regard to pollution control, or problems associated with the end of the life-cycle of products, or repairing ecological damage and rehabilitating ecosystems, or the monitoring and controlling the quality of the environment, reducing technological and ecological hazards, improved efficiency in use of natural resources, and so on (Valenduc, Vendramin 1996). The significance of innovation for competitiveness depends not only on the significance of the environmental performance, but also on the way that the innovation is incorporated within the production or service provision system. In this regard it is useful to make two distinctions:

- (1) between add-on (or « end-of-pipe ») technologies and integrated technologies;
- (2) between an incremental innovation and a radical innovation, which introduces the issue of the dynamics of technology (acceptance, penetration, saturation, etc.) over an extended period.

2.2. Add-on (end-of-pipe) technologies versus Integrated technologies

Much of the new environmental technology can be considered to be of the "natural capital augmenting" type. That is, it either seeks to improve the productivity of natural resources or else make it possible to reduce the adverse effects of pollution and waste corresponding to a given level of production of goods and services. In this connection, it is useful to distinguish between the following:

- (1) *Add-on, or end-of-process technology*, is any modification made *ex post* to a production or machine use process that alters its environmental performance. It frequently consists of incremental changes to existing technology, that include processes and products for waste separation, storage and disposal, such as incinerating techniques for industrial waste or systems for cleaning up contaminated soil. The techniques do not prevent the creation of polluting substances, rather they are employed for reducing the impact of the toxic substances through controlling the final destination and form of the emissions. One problem is that such measures frequently shift the environmental problem from one place to another (e.g. toxic solid wastes rather than toxic smoke) instead of eliminating it.

During the past 20 years, many firms have incorporated this sort of end-of-pipe technology, either to help their own business comply with regulations (if they cause pollution), or in order to provide a service (acting as a part of the cleanup sector) ensuring that others may comply *ex-post* with regulations.

(2) *Integrated technologies, also referred to as clean technologies* (see Duchin, Lange and Kell 1995; Frosh 1995), are new production or service methods whose whole conception is to reduce environmental harm. Rather than, for example, capturing polluting substances after they have been produced (as with the end-of-process technologies), the ideal is not to produce the harmful substance at all, or to produce less of it, or a less harmful one.

Here, the consideration of environmental issues has the potential of acting as a factor of technical change for the entire productive chain associated with a product. This allows the prioritising, if desired, of specific environmental performance criteria such as the availability of inputs over time or environmental impacts at the various stages of a product's life-cycle (see Figure 1). Research and development can aim at progressive improvements in any designated direction.

European car manufacturers, for example, already incorporate from the design stage onwards, various criteria having to do with the end of the useful life of vehicles. These include:

- (1) Substitution mechanisms among new raw materials tending to limit the varieties of materials used (in particular in the case of polymers); increased use of certain plastics (polyolefins); preference given to parts made out of a single material rather than composites.
- (2) Substitution mechanisms between new and regenerated raw materials.
- (3) Reduced toxicity of products. Certain substances have been given special attention, including asbestos, CFC gases, PVC or heavy metals.
- (4) The generalised labelling of plastic parts, for easier disassembly and sorting (Chailloux 1996, Serret 1996).

The technical aspects of the manufacturing process can also be affected, leading to an alteration of existing techniques (addition of technology, equipment alterations) or to the development of new processes. This can give rise, for example, to a re-examination of technical aspects having to do with the assembly stage, in light of the new notion of "disassembly". Xerox, for example, has become a leader in component products which can be disassembled. Canon has innovated by inventing recyclable and reusable cartridges.

Investment in integrated environmental technology is part of a proactive environmental strategy which can, in the long run, turn out to be a win-win approach. The competitive advantage of the innovation gives access to, or creates, a specific market segment.

2.3. Incremental innovations / radical innovations

The question may be asked whether integrated technologies can generate a new impulse to innovation in favour of genuinely sustainable growth, which goes beyond mere environmental-protection imperatives. In order to answer the question, another distinction may usefully be introduced, between "incremental" and "radical" innovations (Freeman, Soete 1987). This distinction does not apply exclusively to environmental technology, but rather comes from evolutionary theory of technology change.

(1) *Incremental innovations* are improvements to products or manufacturing techniques occurring continuously throughout the history of the class of technology. They do not result in major transformations but are essential to secure productivity improvements, gain market share, or deal with fashion trends. For example, the successive versions of existing software programs represent incremental innovations.

(2) *Radical innovations* cause breaks in the continuity of evolving processes or products, leading to the transformation of methods of production or distribution. They serve as a starting point for the development of new technical systems or new technological trajectories. The convergence of several new technical systems, at a time of economic recession, causes a turnaround and makes it possible for

a new business cycle to start. The personal computer and the CD-ROM are examples of radical innovations.

Most environmental technology innovations, whether add-on or integrated, belong to the category of incremental innovations. Nevertheless, radical innovations also can occur in response to environmental objectives. Chlorine-free chemical processes, organic fuels and photovoltaic energy generation would fall into that category, because their introduction can have far-reaching consequences for economy-wide production and consumption and lifestyles.

This raises the important point that environmental technology innovations often result from radical innovations made in other technical fields, such as synthetic chemicals, new materials, biotechnology, electronic data processing, etc. In part this may be because of relatively low investment in environmental research (Valenduc, Vendramin 1996), but it also shows the transversal character of discovery and innovation. For these reasons, improvements in environmental performance can be expected as one product of a strong research/innovation culture, not just through the specification of environmental goals. This may be an important lesson for regulatory policy.

2.4. Advantages and shortcomings of environmental innovation

Environmental technology innovation provides many competitive advantages but is also held back by many obstacles. The advantages of environmental technology innovation include the following:

- (1) *Opportunities for reducing costs.* Environmental technology provides opportunities for lowering production and distribution costs by making use of potential increases in ecological efficiency. Integrated technology can help reduce production costs and increase productivity, a great deal more so than add-on technology.
- (2) *Quality improvements.* Environmental technology innovation is easily made part of the "total quality management" approach (ISO 9000). There are even references today to "total quality environmental management" (ISO 14000). The US-based multinational corporation 3M provides a perfect illustration of this trend, with its Pollution Prevention Pays (3P) program, whereby every project must fulfil four criteria: eliminate or reduce a polluting substance, contribute to the environment through energy savings or a more efficient use of manufacturing materials and resources, demonstrate an ability for technological innovation and save money by reducing cleanup costs (Shrivastava 1995a).
- (3) *Competitive advantages.* As indicated earlier, environmental technology innovation may provide firms with an opportunity to pursue unique and exclusive strategies. A small or medium-sized business can gain a competitive edge and become a leader within a strategic market segment. Examples of this were cited earlier. The Body Shop is another. The company has created a genuinely "green" business within a cosmetics industry that used to be dominated by major multinational chemical corporations.
- (4) *Social responsibility.* Environmental technology innovation makes savings possible in public health-care budgets and helps firms gain social acceptance and legitimacy in the marketplace.
- (5) *The possibility of influencing legislation.* Firms developing or implementing environmental technology innovation have the possibility of influencing legislation to their benefit. This can in turn give them a competitive edge over others in the industry. For example, Germany's head start in regulations applicable to the cement industry and their implementation has enabled German cement manufacturers to develop and make use of the latest end-of-process technology, while at the same time conducting research into integrated technology for recycling and reusing gaseous emissions, as well as for improving energy efficiency (OECD 1993). At the same time, the German cement industry, by

pushing for European regulations, has secured a medium- and long-term competitive advantage in certain segments of the market.

Japan is one country where the importance of the competitive advantage has been well appreciated. The general policy there has been to encourage industry through fiscal and research incentives to develop a wide environmental technology "portfolio", so as to ensure that there is flexibility of response in the face of unpredictable economic and environmental changes. It is further presumed that such a portfolio will enhance Japanese international competitiveness in the medium and long run (5 to 50 years ahead), during which period environmental technology innovation is expected to play a crucial role. Outside of Japan, many large corporations, including chemical companies such as Du Pont and Dow, have also seen the advantages of this flexibility and acquired considerable expertise in various fields of environmental technology (recycling, waste and water treatment, disposal of toxic waste, risk management, etc.).

With so many potential benefits at stake, why do not more firms invest sooner in environmental technology innovation? In fact, many obstacles stand in their way (Shrivastava 1995a, 1995b). Among those obstacles are the fact that environmental performance is only one axes of possible competitive advantage and an ambiguous one at that. Environmental policy is marked by complicated, vague and contradictory regulations (in particular for different jurisdictions, i.e. local, regional, European, etc.). Added to this is the inertia displayed by many firms. All this said, two particular hindrances are the following:

(1) *Lack of environmental expertise and information.* Technological solutions have not yet been found for certain environmental problems, and there is uncertainty as what the regulatory obligations may be. Under such circumstances, many firms have chosen to wait because they are not in a position to finance basic research nor to take too many investment risks if policy changes leave them in a cul-de-sac. In the European Commission DG III report (1995) referred to above, more than 75 percent of those polled (the percentage was significantly lower in Germany and The Netherlands) stated the desire for additional and clearer information about environmental regulations and available technological solutions.

(2) *Development costs.* Although technical solutions may be available, the cost of implementing them may still be high. When this happens, some firms -- especially small and medium-sized ones -- prefer to adopt a wait-and-see attitude. Capital investment for environmental technology takes longer to pay for itself than most investment outlays. This can act as a disincentive for firms that are ruled by requirements of short-term performance. Furthermore, given a firm's limited financial resources, different types of capital expenditures compete for funds.

An example is the European pesticide industry. Data supplied by the agrochemical sector reveals that research and development expenditures have increased considerably over the past ten years and environmental testing accounts for a significant share of the costs. Environmental and toxicological tests reportedly combine to account for between 25 and 40 percent of R&D expenditures, estimated at some 150 million dollars per molecule (Nadai 1996a, 1996b). Yet, in the case of agricultural chemicals, market conditions make it impossible to earn an adequate return on investment in environmental technology. The European Crop Protection Association reports that profit margins at agrochemical firms operating in the European Union over the past twenty years fell to 6.8 percent of sales in 1990, from 10.5 percent in 1981, and it is claimed that environmental regulations were the primary cause of the drop. The situation has led a growing number of firms to put pressure on governments to improve patenting and to extend the life of patents. This would, however, result in a trade-off between the profitability of innovations and their availability.

These many examples show that the commercial advantages that can be gained from a proactive environmental strategy depend a great deal on the type of technological innovation concerned, as well as the regulatory and market conditions.

3. Organisational structures for win-win strategies

In a firm, the process of environmental technology innovation can require changes in working relationships and result in the need for new research and monitoring. Consideration of environmental issues can occur at several levels. It can involve the creation of a specialised field with its own structures, the addition of an extra variable to an organisational chart or the implementation of environment-specific concepts throughout management. In-house discussions can result in the creation of new departments (environment division, recycling division, etc.) and cause the inclusion of an additional parameter at existing ones. The environment can also cause the business of the firm to evolve or be a catalyst for new activities. Major innovations can also result in external organisational changes, such as in the case of the establishment of new connections for obtaining raw materials and semi-finished inputs, as well as new marketing strategies (in particular in the case of product innovations) and measures aimed at recycling and processing waste. Many changes can then be introduced by means of vertical and/or horizontal integration, through the setting up of new co-operation alliances among firms and within sectors, and even, as will be discussed in part 4 below, through new types of agreements between firms and governments (Martin and Garcia 1997).

3.1. Changing the internal organisation of firms

A simple way to discuss organisational change of firms is in terms of the structure of the market (S), the behaviour of firms (B) and performance (P), as proposed by Bain (1951). These three elements can be seen as interactive over time. For example, a firm's profitability, market share or environmental performance has an impact on its subsequent strategies (or behaviour), which can contribute to modifying market structures. The Du Pont Corporation, for example, adopted early on a particular research strategy (behaviour) when it elected to emphasise research into CFC substitutes. Subsequently, a strong negotiating activity (in support of regulations on the reduction of CFC emissions) enabled Du Pont to improve its performance by securing a competitive edge in the new market conditions and structures that changed to its advantage.

Changes in the market structure generally go hand-in-hand with changes in a firm's internal organisation. The trend is particularly visible in the chemical industry. Rhône-Poulenc, ICI, Bayer, Union Carbide and Ciba, for instance, have added special "environment" horizontal divisions and, at the same time, created incentives (e.g. the Proforis employee-motivation programme, or PRISE) to ensure that activities are horizontally co-ordinated (Chailloux 1996).

The trend is also in evidence in the automobile industry. For example, Renault has focused on the disposal of used vehicles and created new structures as a result (recycling programmes). Also, while Renault's policies were until recently based on four considerations, i.e., quality, cost, time and weight, recycling has now been added. In addition, the French automotive manufacturer, which used to operate according to a matrix-like business structure, has now included recycling as part of its projects as well as operations.

Consideration of environmental issues can cause a firm's business to change dramatically, and/or result in its expanding into new fields. For example Ricoh, an electronics company, which single-handedly developed a substitute for a polystyrene that is easier to recycle, to be used in packaging. The company has developed a cardboard-based packaging with the same properties as packaging made of polystyrene. Ricoh has improved its cardboard packaging so that its electronic components will cause less environmental pollution (Persson, Luttrupp, Ritzen and Abermark 1995).

3.2. Changing the external organisation in response to the environment

Environmental technology innovation can, equally, provoke external organisational changes. The environment here becomes a factor in the evolution of relationships between firms and others they

do business with, either vertically (as in the case of industries and business contacts upstream or downstream from production), or else horizontally (companies in the same sector), or even with respect to links with other entities (government, consumers, etc.)

For example, influenced in part by questions of liability in relation to environmental impacts and accidental damages, insurance companies and other financial institutions are revising their relations with business firms. For insurance companies, environmental hazards belong to a special category of risks (Schmidheiny 1992), not just because accidental damages can be very severe but also because of the uncertainties associated with gradual pollution, occurring over a long period of time. Likewise, banks have been expanding the scope of their management audits to include environmental aspects, in particular in the case of mergers and acquisitions or in connection with the creation of environmental funds.

Other changes in relations among participants at the various stages of an industrial process can be identified. Changes in relations with "upstream" participants in the system (subcontractors and suppliers) provide a vivid example of this, bringing about stronger links and demands for evidence of the environmental quality of goods. Many factors are contributing to this, including the certification procedures required of suppliers in certain instances. In the automobile industry, for example, the fact that manufacturers are taking into consideration the disposal of scrapped vehicles has had repercussions for all firms operating upstream, whether they are parts suppliers or processors and chemical companies supplying raw materials. Giving consideration to the environment and in particular to the disposal of used products has also resulted in the development of a new set of interconnections between firms operating downstream from manufacturers. It can lead to the joint creation of business entities. For example, a joint project by PSA, Compagnie Française des Ferrailles (CFF) and the Vicat cement company resulted in the creation of a facility for pre-industrial applications at Saint-Pierre de Chandieu. In addition, the organisation of the sector has tended to put more emphasis on quality (merger of two trade associations of scrap yard companies in 1995) (Chailloux 1996, Serret 1996). Finally, the growth of certain environmental-policy instruments such as voluntary agreements also illustrates this trend. The French master agreement of March 1993 on the processing of scrapped cars was signed jointly by representatives of the automobile industry and the government.

In the case of horizontal relations among firms in the same line of business, mergers can be encouraged in order to achieve greater concentration and economies of scale. Given the unpredictability of environmental developments and the importance of capital outlays for environmental protection, co-operation is particularly attractive for firms pursuing a proactive environmental strategy. Many categories of agreements call for a sharing of environmental risks and costs. Alliance strategies range from simple co-operation agreements to mergers and acquisitions. Their typology can be derived from examples taken from various industries and countries.

(1) *Co-operation agreements for the development of new processes.* France's Rhône-Poulenc and Sweden's Kenura set up a jointly-owned subsidiary in 1990 to look for more efficient and cheaper ways of fighting water pollution. In September 1992, SITA (a subsidiary of Lyonnaise des Eaux) and Rhône-Poulenc jointly created TERIS to develop their know-how in the treatment of industrial waste. The principal manufacturers of CFC have formed a strategic alliance known as ICOLP (for Industry Co-operative for Ozone Layer Protection) to develop substitutes. There are also co-operation agreements between European cement makers and parts manufacturers, for the development of new processes and to conduct basic research into combustion and flame control. One of the objectives of the research is to measure the influence of the type of burner and fuel used on the production of NO_x, in order to develop burners with lower emissions of NO_x (Gramond, Setbon 1996).

(2) *Co-operation agreements for the development of new products.* Siemens and Bayer have developed catalytic converters for the denitrification of flue gases in order to lower nitrogen oxide emissions. Elbo, the public authority operating the Athens bus system, and Rhône-Poulenc have designed a catalytic converter for diesel engines which cuts back on exhaust fumes.

(3) *Co-operation agreements for the recycling of packaging and products.* Eco-emballages is a company founded in 1992 in France by a group of packaging firms and manufacturers and distributors of packaging materials. In the automobile industry, the issue of scrapping vehicles has been the object of several agreements involving either just manufacturers or other industry firms as well. Agreements on the development of a recycling network have been signed, such as the 1994 pact between Renault, BMW and Fiat, which Rover later joined. Research agreements have in addition been signed by French manufacturers and some of their competitors (the 1995 agreement between Renault and Mercedes-Benz).

(4) *Mergers and acquisitions.* This type of strategy can be justified by a desire on the part of firms to focus on their core business and to reduce risk exposure and the cost of implementing environmental technology innovation. Rhône-Poulenc and Sita have acquired, through their jointly-owned subsidiary TERIS, the business of SCORI, a company specialising in the disposal of waste with cement makers. Elf Atochem has taken over several small CFC manufacturers in Greece and the United States in order to increase its capacity to conduct research into substitutes.

This sort of co-operation may be a significant factor in commercial globalisation. The process of strategic alliances leads, typically, either to more concentration or to the creation of network entities or networks of firms. These alliances and mergers by firms alter the balance of power, and in the process of organisational changes it is easy to foresee the disappearance of certain market participants. In certain instances, this leads to a loss of local control (or of national economic sovereignty), and can lead to more concentration within a sector or domain of activity.

4. The Social and Institutional Aspects of a Win-Win Strategy

Environmental technological innovations are not isolated processes having to do exclusively with the strategy of firms. There is a complex and significant interplay between environmental technological innovations and political, social and economic developments (Smeets and Weterings, 1996). Moreover, it cannot simply be assumed that the simultaneous adjustment of business practices and of regulations are going to provide adequately for long-term sustainable development (see e.g., discussion by Duchin, Lange and Kell, 1995). Business strategies that may see win-win from a firm's point of view in relation to specific environmental targets, may in the longer term be judged, from wider social points of view, as wrong-wrong.

Firms pursuing a win-win environmental strategy ought to reconcile business considerations with the requirements of social responsibility. That is,

1. On the one hand, business practices will reflect the need to earn a profit is reflected in costs, product prices and competitiveness considerations, as well as in market shares and positioning.
2. On the other hand, a problem of social legitimacy exists which has to do with a notion of public interest that ought to encompass current environmental problems along with the interest of future generations.

The European Commission, for example, frames this in its document *Towards Sustainable Development* (1993) as a three-way co-operation between the private sector, governance, and citizens. National and international political institutions, as well as the public at large, play roles complementary to that of business in choosing technological trajectories.

4.1. Social and environmental tensions within the new competitiveness

There is no particular reason to believe that approaches to meeting environmental performance obligations taken by private sector actors, based on their own ideas of what constitutes a competitive edge, will necessarily take into account these broader notions of public interest.

First, successful innovations may cause the economy to develop along locked-in technological trajectories that turn out to be sub-optimal environmentally. Worth citing here is the example of the development of catalytic converters as the exclusive technological solution to the problem of acid rain attributable to pollution caused by automobile exhaust fumes. The case of phosphate-free detergents is also interesting. In this case, the technological lock-in did not originate with an institution or regulation, but was linked to increasing returns from the products' popularity. Henkel based its strategy on an hypothesis of increased return from the popularity of phosphate-free laundry detergents, which caused the market penetration theory to be confirmed by their growing acceptance (with all brands gradually bringing out their own phosphate-free detergents). All manufacturers came out with phosphate-free laundry detergents not because it had been ascertained that they were safer than traditional products, but because every time one company brought out a phosphate-free detergent, the probability rose that another company would do likewise. Phosphate-free detergents took the lead from the start of the process and the fact that manufacturers earned increasing returns from their popularity caused a lock-in. The manufacturer Rhône-Poulenc, which found itself on the wrong technological track (as the world's leading producer of phosphates), tried to postpone the manufacturing of phosphate-free detergents for as long as possible by financing research into alternatives and by denouncing the unreliability of substitutes. The argument was that more time needed to be given for the "alternative" technology (in this case the traditional technology) to demonstrate its advantages (Moreau, 1994 ; Benhaïm and Schembri, 1995); this debate is still going on.

From these examples we can see the danger that successful innovations can cause the economy to take off in new directions which, while viable from a business point of view and satisfying for consumers in the short run, are in the longer run sub-optimal or even directly in conflict with objectives of a sustainable environment. There is also the problem of « green window-dressing ». There was a revealing case of Mobil Chemical Company. After the firm started marketing its biodegradable garbage bags, a company spokesman declared to the *Tallahassee Democrat* in 1991 (cited by Worldwatch and by *The New York Times*) that "degradability is just a marketing tool [...] We're talking out of both sides of our mouth because we want to sell bags. I don't think the average consumer knows what 'degradability' means. Customers don't care if it solves the solid waste problem. It makes them feel good...." (cited in Piasecki, 1995). Mention here might also be made of the well publicised replacement by McDonald's of a white polyethylene packaging sheet with polystyrene foam, which makes no significant difference from an environmental point of view -- it is a matter of air pollution versus water pollution (Duchin, Lange, Kell 1995).

Further, there are concerns that commercially-driven environmental innovation can, in some cases, worsen social inequalities on an international level. The environmental-protection sector, which generated estimated revenues of 200 billion dollars in 1990 and is expected to grow by 50 percent during the coming ten years (OECD, 1993), operates primarily in OECD countries (90 percent of world production); the main exporting countries are Germany, the United States and Japan. Demand for products and services is expected to increase during the coming ten years in some developing countries, including the newly-industrialised countries of Southeast Asia, as well as in Eastern Europe. However, both the manufacturing and consumption of products and services will continue to take place chiefly in OECD countries.

The growth of the "ecology industry" could also have major repercussions on patterns of trade. If substantial raw material savings can be achieved, and substitutes are found for bulky raw materials, this will tend to lower demand for those goods and to increase that for recycled materials. Terms of trade can hence be expected to worsen for a number of developing countries where raw materials are produced but whose prospects of benefiting from recycling are limited. The situation is exemplified by

Western concerns with deforestation which have led to boycotts of wood products from some developing countries.

More generally, the fear is sometimes expressed that the movement in favour of deregulation within states and internationally, could mean that governments are playing a less clear part in environmental protection and handing the reins over to business. Indeed, a process by which industry seeks to self-regulate is emerging through an increase in so-called voluntary collective agreements (Aggieri and Hatchuel, 1996). In some instances, the trend is supported by developments within the governments themselves. An example is the adoption, at the European level, of an "eco-audit" regulation designed to incite industry to implement environmental policies on a voluntary basis.

It is interesting, in this respect, to note that far from slowing down the setting of standards, deregulation has actually coincided with more and more technical standards being adopted by trade and industry bodies. At the international level, a new generation of ISO standards on environmental management is being drafted. These ISO 14000 standards (especially 14020, 21, 22, 23 and 24; some are still being developed.), which contain provisions relating to environmental labelling, in some respects resemble the ISO 9000 standards on quality. Furthermore, national standards are being adopted, as illustrated by the French X 30-200 and the British BS77-50 standards. Environmental standards are also being developed for specific sectors at the initiative of industries. This was the case, for example, with the standard on the environmental properties of electrotechnical products created by the International Electrotechnical Commission (IEC).

So the question returns: what are the discernible trends of current processes of globalisation? The evolutionary systems view of economic and ecological change that underpins our analysis of competitiveness is exemplified in the work of Krupp (1992), who writes:

"Technologically, this century is characterised by an unprecedented rate of innovation triggered by and triggering a fast competitive race of economic and political entities [...] All production and feedback has become polarised towards profit generation" [...]

"Today's numerous incremental decisions by politicians and businessmen on energy, made wittingly and willingly or not, will accumulate to form fundamental constraints and contingencies shaping the lives of future generations. They determine whether, with all their growing wealth, they might have to cope with unfavourable climate changes, billions of tons of radioactive materials, millions of square kilometres of genetically-manipulated monoculture, including biomass for energy conversion, to name but a few examples, or, alternately, whether early resourceful self-restraint has avoided the related risks without impairment of the quality of future life on earth."

This economic dynamism is manifest, says Krupp, through technological innovation and the incessant release of new and "improved" products. The commodity economy and circuits of capital now become the main engines and beneficiaries of this dynamic of innovation, a positive-feedback loop driven by the quest for profits, and characterised by incessant liquidation and renewal. Yet, the intensification and extensification (through the growth of output and mass consumption levels) of this innovation process now threatens global resources and ecological conditions of life for hundreds of millions of people. Thus, as Krupp catalogues, fossil-fuel resources are being used up within a few generations in processes which endanger the earth with pollution and global warming.

The social and environmental costs of this innovation process are unevenly distributed (Beckenbach 1994, who in turn draws on the cost-shifting notion of William Kapp). Under pressures of commercial survival, firms seek to off-load environmental and social performance burdens onto other social partners -- e.g., onto the state and taxpayers, onto workers (in terms of bad working conditions, commuting costs, etc.) onto future generations and non-human nature. According to the polluter-pays principle, business and consumers ought to take full account of the burdens they impose upon communities and ecosystems. But this is a responsibility which, considered an additional cost, is clearly in conflict with the profit motive.

Recently, in the context of observations about globalisation, increased attention has been given to instances of international externalities, cases of alleged cost-shifting by economic players separated by very large distances. Many of these involve multinational firms, such as the mining companies RTZ-CRA and Freeport-McMoRan, under attack in the courts and in the boardrooms for the adverse social and ecological impact of their gold and copper mining operations in Irian Jaya (Indonesia) (see "The Fun of Being a Multinational" in *The Economist*, July 20, 1996). These and other sorts of experiences are giving rise to a growing literature on "unequal ecological exchange" between the North and South countries. For example, conflicts over the control of the commercial exploitation and profits generated by agriculture and "wild" biodiversity have led to accusations of "biopiracy" against multinational firms. Analyses are increasingly being conducted of the "ecological footprints" left by production and consumption in rich countries, in terms of land area, water and photosynthesis requirements, compared with the availability of these resources in the producing and consuming countries (Rees and Wackernagel 1994; Rees 1996; Wackernagel and Rees 1995). The opportunity costs of forests and fisheries depletion are being discussed in terms of inter-society and intertemporal injustice (McEvoy 1986, McGarth 1993, O'Connor 1993).

Many commentators have raised concern about uneven social distribution of the benefits of economic globalisation (e.g., Gedicks, 1993; Balvin Diaz, 1995; Anderson, May and Balick, 1991). For example, the destruction of the communal fabric of economic infrastructures by large-scale dam and irrigation projects in India and China is well documented (Goldman, 1993), and much controversy surrounds the use of cost-benefit analyses to identify net social benefit in such circumstances.

Relatively more aluminium is imported into Japan today from countries such as Canada where hydroelectricity is very cheap than in the 1970s. Similarly, Japan is "developing hydroelectric power in countries such as Brazil and Indonesia" (Mukaibo, cited in Krupp 1992). For reasons such as these, as well as for reasons of technological innovations, within Japan itself "pollution will not seriously worsen" (ibid. p.17). A large part of the pollution and ecological damage associated with Japan's economic dynamism is currently being shifted offshore. Again, the fairness of distribution of the benefits of economic globalisation is being questioned.

Today market economies depend for their viability on the efficient and increasingly wide-ranging exploitation of the physical habitat through the appropriation of raw materials and the disposal of waste, as well as of publicly provided infrastructures (Krupp 1992; Altvater 1993; O'Connor 1993, 1994). Through international trade and the circuits of capital, this process of shifting costs over to natural systems and future generations can readily cross national borders, or even move from one side of the planet to the other.

This sort of vision emphasises the fact that "improved environmental performance", as measured for an individual firm or production process, has to be set against the backdrop of non-sustainable high levels of fish and forest harvesting, intensive agricultural and animal husbandry practices that are degrading the soil and water quality, in some cases irreversibly (e.g. aquifer and soil salinisation and soil structure breakdown).

A proposal for the North's response is provided by a recent study on the future of Japan, entitled "MITI's Centennial Vision of Global Environment and Technology and the Response to Global Warming: Concerning New Earth 21" (Okamatstu, in Krupp 1992). The report envisages, inter alia, the greening of deserts and space-based energy sources as solutions to global greenhouse problems. For the South, a parallel image might well be that of the urban or rural poor being obliged to walk long distances in order to obtain minimally drinkable water piped at considerable expense from distant sources, because of the contamination or exhaustion of local water supplies.

4.2. Conclusions: From win-win firm strategies to sustainable development?

These considerations, both empirical examples and speculations, show the risks that environmental innovation may, in some cases, be like taking steps up an escalator (improved environmental performance) while the escalator itself (overall environmental quality) is sliding rapidly down. Business practices and regulatory standards evolve jointly. But it cannot simply be assumed that concurrent adjustments of business practices and political measures can meet the needs of a win-win environment-competitiveness strategy. In fact, worsening resource exhaustion and environmental problems can provide stimulus for innovation, and hence renewed competitiveness for some firms and sectors, while the overall situation worsens.

Our conclusion is that, in order to ensure that a win-win type of environmental strategy for whole nations and for the community of nations -- a vision of ecologically and economically sustainable development -- it seems indispensable to take into consideration other factors besides competitiveness alone.

These additional factors include the notion of "public interest" extended to future generations (and, more arguably, to ecosystems and other species as non-human living communities). It is, or would be, the task of governance to put out clear signals to orient all participants (including those in governance itself) towards the desired trajectory. To what extent will this be something that firms, government leaders and consumers want to make an investment in?

The outlook for a social partnership on win-win environmental strategies, and, more generally, on sustainable development strategies, can be examined in various manners, with social legitimacy being considered and challenged by various categories of participants from the environmental field. Many firms fear loss of competitiveness if they are forced to make major improvements to their environmental performance. This may often be true if end-of-pipe measures are having to be employed. In such situations, the marginal and total costs of abatement for any given pollutant can rise quite sharply as the abatement target is made more severe. Firms are also concerned about getting locked-in to expensive environmental protection measures that become obsolete if regulations or market conditions change. This is a problem of uncertainty. However, for several reasons, business outlooks may not be as bad.

- First, there are often significant gains in (for example) energy and raw materials use by improved efficiency practices within the production and transportation processes, at relatively low (or even negative) costs.
- Second, if a dynamic view of competitiveness is taken, then investments may be targeted on new generations of products and process technologies, through which substantial improvements in environmental performance may be obtained in the longer-run without prohibitive extra costs.
- Third, if clear signals are provided through public policy, including international conventions, that improved environmental performance is a basic « rule of the game », then firms can be reassured that all players are obliged to respond to the same standards.

These last two points represent possible starting points for building alliances between the public, private and communal sectors. Experiments conducted with large companies indicate that they are under two types of pressure to improve environmental performance, clearly indicative of the diversity of participants concerned whenever win-win environmental strategies are to be initiated:

1. vertical pressure (from outside of business) from public opinion and regulations imposed by governments and their agencies;
2. lateral pressure (from within the business) linked to the demands of principals, banks, insurance companies and shareholders; that pressure takes longer to bring about but it is also more productive as it is directly reflected on the order books of companies.

It is not necessary to convince SME managers and business executives of the scientific need to treat the environment in a strategic manner in order for them to agree to do so. It will suffice if they find it likely that their competitors, government institutions and consumers grant the environment such a status. At times when there are hesitations about future understandings, a key factor for economic co-ordination becomes the development of collective alliances of government (national and international institutions) the private sector (trade and industry associations) and the people (consumer associations, NGOs of all types) to promote a common understanding and vision of the world along with new standards of conduct giving legitimacy to a given orientation. It is interesting to note, for example, that almost 20 percent of all adults in the United States and Canada belong to consumer groups supporting the environment, such as True Blue or Greenback (Gallup International, 1992; Stisser, 1994). The commercial demand for environment-friendly products is estimated to be worth 120 million dollars and expected to reach 200 million dollars by the end of the century.

Under those circumstances, the negotiation of voluntary agreements can be given a new dimension in the crystallisation of common concepts. From a sociological viewpoint, the public interest is defined on the basis of a wide variety of ethical positions and of definitions of communities of reference. Those various definitions and reference points are not necessarily in harmony. For example, environmental principles based on the heritage from the past (such as canal or river systems), or the identification of a community within a small administrative area, may come into conflict with the "harmonisation" as understood by the WTO and European Directives. Protecting ecosystems and national biodiversity may conflict with economic trends (including mobility). These compromises must all be negotiated. Here, as the chairman of AKZO, a chemical corporation, recently commented (Schot 1996):

« History shows that no firm has ever outlived a permanent conflict with society. Dialogue, adjustments and co-operation are therefore not luxuries but rather necessities. »

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