A DYNAMIC MODEL OF ENVIRONMENTAL POLICIES

The case of innovation oriented voluntary agreements

International Workshop on "The Economics and Law of Voluntary Approaches in Environmental Policies", Venice, 18-19 November 1996

F.Aggeri and A.Hatchuel
CGS - Ecole des Mines de Paris
62, Bd St Michel, 75006 Paris, France.

Tel 33-40519109 fax 33-40460301

Abstract

Why do governments and industry contract voluntary agreements (VA) for the improvement of the environment? The number of agreements in this field is constantly increasing and an important one was recently signed in France on carwaste processing. This agreement aims to trigger the emergence of recycling as a new value for end-of-life vehicles (ELV) and for car design. It implies the expected commitment of all professionals of an industry in the concurrent development of new technologies, new markets and new firms without any state subsidies. The theoretical interpretation of this process challenges the classical approaches of regulation, particularly the regulatory capture theory and its agency-theory extensions. An explanation of the genesis of such agreements, their impacts and robustness requires us to root agency approaches in three theoretical and dynamic perspectives :

H1 : an "operational" theory of legal regulation ;
H2 : market transactions seen as "reciprocal prescriptions";
H3 : firm's strategy formulation as an organizational learning process.

Within this framework we can understand why, in specific contexts of uncertainty and complexity, voluntary agreements are both a result and an instrument of the regulatory process. They avoid the pitfalls of a law. They may also stimulate co-ordinated learning and exploratory actions in a competitive context even when there are no strong economic incentives or assessed technological solutions at the outset to bring about a collective improvement. The same theoretical perspectives can highlight the drawbacks that threaten such agreements and indicate a dynamic pattern of increasing interventionism. A general regulation strategy can thus be defined in three phases: 1) establishment of a VA; 2) if necessary, reinforcement through legal standards and policy monitoring; 3) if - and only if - environmental goals are not attained, taxes and regulation might be considered. The latter instruments are applied when enough knowledge is available to limit perverse effects.

This strategy is profoundly meaningful: public intervention requires knowledge, but also guides the production of knowledge. Hence, any intervention strategy has to be based on a specific and explicit pattern of collective learning.

The carwaste case, studied by the authors over the past four years with Renault, is used to illustrate these different points. A new model of state intervention is derived from this case and its validity is explored through a comparative study with other cases.

The end-of-life vehicle problem

Faced with growing interest in environmental problems and specifically those related to landfills, European governments plan to reduce waste disposal and are promoting all recycling methods including, in some cases, incineration with energy recovery. The car industry is directly concerned by this policy since plastics, tyres and glass, which account for approximately 25% of the car weight, end up in dumping sites.

In 1990, a regulatory process addressing carwaste disposal was begun at both national and European levels. The main issues under discussion were: *1) the nature and expected levels of landfilling and material recycling; 2) the principle of liability to adopt for determining these levels; 3) the adequacy of taxes and compensations for financing these additional operations*.

At first a German project for regulation was announced. It rather stringently defined high compulsory recycling ratios for scrapped vehicles and designated car manufacturers as entirely liable for such improvements. Three years after its first announcement this project had still not been adopted. Meanwhile, a different approach was taken in France and a voluntary agreement was signed in March 1993 between the French government and all representatives of the car sector; an agreement which may well inspire the forthcoming European carwaste regulations. This VA stipulates that all professionals concerned (parts and raw materials producers, manufacturers, dismantlers and shredders) will commit themselves to reaching lower levels of landfilling in 2002 (15% for old cars, 10% for new ones). It also emphasizes "*the principle of collective liability*" of all industrial actors, and that of a "free market" for carwaste and recycled materials (i.e. no subsidies)[1]. Similar agreements have been signed in other countries (Germany in 1996, Spain in 1995, and the Netherlands in 1994) and an EC directive with the same aims is being prepared for 1996.

These agreements have already been implemented and their first effects can be analyzed. An interpretation of their genesis and evolution challenges the classical approaches of regulation. We maintain here that it requires the combination of three theoretical perspectives that will be developed later in this paper.

In the first section of this paper we briefly summarize the main currents of the literature on regulation, and stress the paradoxical aspects of voluntary agreements seen as a weak form of co-operation. **In the second and third sections** we present the main aspects of the genesis of the French carwaste agreement. This empirical material will help us to introduce three theoretical perspectives. **In the fourth section** we analyse the spread of the French VA model in Europe. We then use these perspectives to outline the impact of these agreements and the shocks that could threaten their stability and lead governments to adopt a more interventionist attitude. **In the fifth section** we use a comparison with similar cases (domestic waste and electronic waste) to study the generality and limits of this new model of public intervention.

I. THE THEORY OF REGULATORY CAPTURE AND VOLUNTARY AGREEMENTS: CONTINUITY OR CONTRADICTION ?

Much has been done to understand or determine the regulatory process that could lead to "sustainable development" in modern economies, i.e. development which combines the advantages of economic

[1] The agreement foresees undifferentiated valorization objectives (recycling or incineration) of 85% of car weight for vehicles in 2002 (which is equivalent to an objective of 15% of maximum landfilling) and of 90% for new vehicles from 2002. In the end, valorization should reach 95%.

growth with the protection of environmental non renewable resources. To summarize, we can say that research has had two main orientations: the search for optimal incentives, and a political approach.

I.1. The search for optimal incentives

This first orientation is instrumentally-driven and is focused on the design and evaluation of different state incentives. Taxes, subsidies, standards or quasi markets (pollution rights) are compared in terms of their ability to maximize certain welfare criteria by correcting market failures or externalities. Since the early work of Pigou, two major assumptions in this approach have often been criticized: i) the hypothesis that governments are "benevolent maximizers" of social welfare, ii) the hypothesis that the State has perfect knowledge of the industrial costs of depollution, and hence that it is able to infer a function of depollution. In these conditions of substantive rationality the State can determine the type of incentive system and the most appropriate level for maximizing social welfare.

I .2. A political approach

This second orientation is more political. Research tries to identify the interest-groups concerned and to evaluate their ability to influence the regulatory process. Co-operation, collusion, or opportunistic behaviour are thus highlighted and discussed within a "political" framework. Following the seminal views of Stigler (1971), authors such as Peltzman (1976) or Becker (1983) emphasized the role of interest groups in the formulation of public policy. Based on the observation that state policies may either favour or threaten the interests of governments, public agencies, or industrial or consumer groups, regulation was viewed as the result of a "political" process where interest groups try to influence the design of the rules. Within the background of economic theory this approach led to an agency-theory framework (Laffont et Tirole 1991, Tirole, 1994). It stresses the influence of asymmetries of information between all groups intervening in the process and more specifically between politicians and regulatory agencies. It models several schemes of influence depending mainly on these asymmetries, on the costs needed to clear them, and on forms of collusion. Keeping this "political" perspective in mind, other authors have analysed the evolution of the different types of regulations used by governments to cope with the growing complexity of environmental issues and policies (Lascoumes 1990, Glachant 1993). They have found an increasing number of voluntary agreements between industries and governments. Yet, in spite of these empirical findings, VAs have received limited attention. We shall see that they challenge the regulatory capture approach and need a more dynamic perspective.

I.3. VA as a weak form of co-operation

VAs appear as co-operative relations between governments and firms. However, co-operation does not mean rejecting the "command and control" approach to regulation, as some firms may support the development of severe prescriptions (Leveque et Nadaï 1995). VA can therefore be called a **weak** form of co-operation which presents the following features:

** Environmental goals and prescriptions are accepted by the partners within a progressive plan of realization.;*
** A wide range of interest-groups participate to the agreement;*
** Sanctions against non-compliant partners are not considered in the agreement;*
** Partners announce co-operation and know-how transfers but no rule of risk-sharing is predefined.*

I.4. The paradoxes of VA: Why not a regulation with the same prescriptions?

The validity of such agreements is not easy to establish within an agency-theory approach. Asymmetries of information are permanent between governments and industries and governments may always suspect firms of opportunism. Therefore, a VA may also appear as the result of government capture by manufacturers. If this were true, however, manufacturers would have no reason to reject a regulation institutionalizing the same commitments they have actively supported (Leveque et Nadai 1995). On the other hand, if the content of the agreement were more or less imposed on the industries by the government, the latter would prefer an interventionist method in which sanctions could be taken in case of non-compliance. Hence, with a classical agency-theory approach, once an agreement is reached it seems that in all cases a regulation adopting the same rules would be preferred by both parties. The main reason for this paradox is that classical agency approaches do not focus on institutional aspects, and reduce learning processes to information acquisition costs when learning may result from the action process itself. Hence, to avoid this contradiction we have to adopt a more complex approach to the situation in order to highlight the following insights:

1. Using an operational theory of regulation (H1) we will show that establishing a regulation requires fairly comprehensive knowledge on pollution characteristics (who is the polluter? what are the consequences of the regulation for firms?) which is not necessarily available at the start of the process, especially in new technical domains such as recycling. In this context, owing to their less stringent formulation, VAs may appear to governments as a first step in a preventative strategy.

2. VA is a valuable strategy when there is no clear regulatory "capture" by any group[2]. This situation appears when all partners face strong "*shared uncertainties" and complex and evolving co-ordination* (see Aggeri, Hatchuel, Lefebvre 1993). Such co-ordination is a fundamental property of market relations between car manufacturers, suppliers, materials producers and dismantlers, that is to say, market relations built around "reciprocal prescriptions" (H2). In this case, industries will prefer the *flexible and reversible* aspects of VA, the most obvious advantage being the possibility to modify the content of an agreement more easily than that of a regulation. This means that a basic reason for accepting the agreement lies in some expected *inter-firm and intra-firm "organizational learning*" (H3). One could also say that each partner loses a weak ability to "capture" the regulatory process, but in return expects better knowledge and greater influence at the end of the planned period.

3. The VA is not, however, the regulatory process in itself but a step and an instrument of this process. If the process is globally interpreted as a collective learning and evolutionary process, VA is merely a device which stimulates differentiated learning by offering the minimal co-ordination needed in a complex design process.

Finally, voluntary agreements require a more complex framework of interpretation. We have to understand the process of collective negotiation and learning which lead to such agreements, and how VAs may initiate new learning processes at all levels of action. This also requires the elaboration of a more dynamic framework of knowledge distribution than the overly static concept of asymmetries of information. Voluntary agreements can be an interesting social phenomenon which helps us to unify classical agency theory, organizational learning, and evolutionary processes. For that purpose three complementary theoretical perspectives are required:

H1 : an operational theory of regulation;
H2 : market relations seen as reciprocal prescriptions;

[2] VAs are a response to the threat of a more authoritarian attitude by the government, but another paradox of VAs is that their existence reveals that this initial threat was limited.

H3 : Firm's strategy formulation as an organizational learning process.

Before discussing these three theoretical tools, we shall first introduce them through a discussion of the recent history and perspectives of the carwaste problem.

II. THE INITIAL PHASE OF THE REGULATORY PROCESS: THE GENESIS OF A VOLUNTARY AGREEMENT

II.1. The end-of-life vehicle economy: an old market of predation

The difference between the carwaste economy and other waste markets is the traditional activity of carwreck valorization. In all countries a kind of "predatory economy" has developed independently from car manufacturers. This usually consists of a large network of "dismantlers" (approximately 3,000 in France), who buy and collect second hand vehicles in order to repair them or to recover spare parts. The residual wrecks are then sold to shredders (about 40 in France), whose activity is far more capital intensive. Shredding is followed by a magnetic sorting operation in which the metallic content of the vehicles is separated from other materials. The scrap iron is sold to steelmakers and the non-ferrous materials to refiners, while the "shredder waste", composed of different materials (e.g. glass, rubber, plastics, liquids, heavy metals) ends up in dumping sites at the shredder's own cost. Thus, an end-of-life economy effectively exists for cars; it emerged "spontaneously", giving value to old and damaged cars. Cars are therefore already largely "recyclable" and "recycled", although almost 25% (approximately the non-metallic content of the vehicle) ends up in landfills.

The percentage of "non recyclable" materials in cars has, however, been growing in tandem with the increased use of plastic composites which help to reduce carweight and improve many other functionalities. At the same time, materials producers are pursuing policies of permanent innovation (material differentiation) as a factor of competitiveness, and cars tend to incorporate increasingly complex equipment (electronic devices, airbags, coolers, etc.). Furthermore, two fundamental contradictions may limit the growth of recycling:

1) Contradictory environmental regulations: In order to reduce CO2 emissions, car manufacturers tend to reduce carweight by increasing the use of plastics. As a result, they also reduce the car's recyclability.

2) Recycling and quality requirements: Recycled materials do not always comply with very stringent quality requirements in car design (problems of aspect, mechanical constraints, etc.).

Therefore, if recycling is to be a new economic value and design constraint, it will have to compete with other values such as weight reduction or quality improvement.

II.2. Authoritarian threat and collective learning response

During the first three years which followed the rise of the carwaste problem in Europe (1989-1992), strongly opposing points of views appeared. The German government first initiated the debate when in 1990 the minister of the environment announced a regulatory project with very ambitious goals and strong pressures on car manufacturers. Two types of waste recovery could be adopted by firms: the one gave priority to shredder waste incineration with energy recovery, while the other developed the recycling of materials. The German regulation aimed to limit energy recovery and to designate car manufacturers as responsible for meeting the new recycling goals. The German project received a very hostile response

from the car industry. In France, divergent opinions were starting to be voiced among public authorities: the minister of the environment adopted a standpoint very close to that of the Germans, while the minister of industry was more attentive to technical and economic debates about regulation policies. Car manufacturers (even the German ones) feared tough regulations which would penalize European cars in a context of economic crisis and stiff competition with the Japanese. Among the European partners, some countries supported the idea of cautious regulation (countries which have a car industry such as Great Britain or Italy), while others tended to favour the German project (e.g. Denmark and the Netherlands).

All industrialists in the sector were not against the idea of a regulation: shredders expected that increased recycling would create an opportunity for new markets; dismantlers' unions thought that a regulation might be a good opportunity to upgrade the profession; finally, newcomers such as waste treatment firms hoped for a regulation that would subsidize their entry into the car recycling market. Furthermore, car manufacturers could hardly oppose, in principle, the planned reduction of waste disposal. Consumers were starting to prefer "green" and "recyclable" products and some car manufacturers, claiming that they had already anticipated regulations, announced very high recyclability for their products in advertisement campaigns, even if these were promises rather than realities.

II.3. The emergence of new beliefs and new experts

For two years, the legal publication of the German decree was said to be imminent. However, as time passed it became clear that there were good reasons hindering the process. The numerous uncertainties about recycling were crucial in this strategic change, but how were such uncertainties formed and how did they begin to be shared? It is interesting to note the role played by the German announcement in accelerating the production of knowledge on recycling in automobile firms and professional organisations. At this point it is important to distinguish between the recycling of existing vehicles and the design of new ones as these two issues followed different organizational processes.

***II.3.1. The treatment of existing vehicles*:** The first investigations naturally focused on the first problem. Because they felt threatened by government intervention, car manufacturers launched several different R&D projects, most often in partnership with chemists, dismantlers or shredders. Together with such partners experimental plants for disassembly and depollution were built (e.g. BMW in Landfurth, Renault in Athis Mons, PSA in St Pierre de Chandieu). As shredder waste contains heavy metals (lead, zinc, chlorine, etc.) which do not always comply with emission norms for incineration, tests were launched to increase its acceptability and heat recovery levels. Chemists drew up several reports on the results of their recycling programmes (e.g. mechanical or chemical recycling techniques for plastics). The results of all these experiments were disseminated, discussed and analyzed in symposiums, congresses and visits. To sum up, we can say that this early phase was one of intense research and communication about new solutions for recycling.

This wave of R&D was also an intense process in which new actors' were created for until then experts in car recycling barely existed in the car industry! Firms began to specialize some engineers and managers in this field. Although their expertise and place in the organisation were often different from one firm to the next, they were usually to be found in R&D departments. To cope with the new recycling problems, they had to rely on the first R&D programmes implemented and on the emerging external literature, and to acquire basic knowledge on cars, materials and recycling. This learning process was not easy and they needed to filter many messages from partners and competitors, which were often strategic announcements rather than real results. Such new experts also had an interesting position. They were often in direct contact with top managers as their first mission was to contribute to the general policy of their firms in the ongoing discussions on regulation. In many cases, state agencies could easily identify and contact these

experts who had to gain recognition from their managers, from partners' experts and from State or European agencies.

These new experts contributed to the progressively shared belief that there were no easy technical and economic solutions for recycling that could be implemented immediately. Their main arguments were the following:

> 1) Technical limitations were numerous: variety and complexity of materials in cars, difficulties in dismantling some parts of the vehicles; limited possible re-incorporation of recycled materials into new ones without downgrading quality; heterogeneity of materials (composite materials, painted parts, etc.);
>
> 2) The economic viability of recycling was very precarious because :
>
> - experimental dismantling plants were often ad-hoc solutions, and may not even have accurately represented the problems that could be encountered on an industrial scale;
> - transportation costs of car wrecks and materials were high;
> - there were no market prices for recycled materials other than metals, and thus profitable and sustainable markets for recycled materials were uncertain and perhaps limited to a few cases[3].

Thus, it appeared clearly that any development in the field of recycling involved *continuous R&D efforts and complex co-operation between car manufacturers and other players*. In order to reduce investments and transportation costs, car manufacturers required the dismantlers' and shredders' co-operation in processing end-of-life vehicles. On the other hand, dismantlers needed dismantling standards to identify and sort recycled parts and materials in vehicles; chemists had to test some material changes to comply with manufacturers' prescriptions, and shredders could not develop a complex analysis of shredder waste pollution on their own.

***II.3.2. Design for recycling: a pending problem*:** Integrating carwaste criteria into the design process of cars is particularly challenging. Simple but significant actions were rapidly taken. The major one was the creation of an international code of materials which would allow for the labelling of all plastic parts of a new vehicle. This first action was also important because it allowed a better management of the repair and retailing network. Beyond this general measure, recycling was still a matter for R&D experts, distribution and top managers. The world of design, which means the world of the real car projects, was not yet directly concerned. This point had important consequences on the ongoing organizational process. *Without the involvement of designers, firms were unable to correctly evaluate the consequences of any regulation on recycling*. But such involvement was not easy at this stage of the process. Designers could not work without some functional and economic requisites and any recycling criteria had to be integrated into all other functional requisites of the cars. They also had to be shared with all the suppliers. Moreover, it could even be expected that recycling technologies might improve and finally absorb car design. Thus, throughout this phase, when design departments wanted to evaluate regulation impacts they first had to wait for clarification on the regulatory process.

II.4. Getting to the VA

[3] First, prices for recycled materials are limited by prices of pure materials and, secondly, the different costs (of depollution, dismantling and above all of transport) seem considerable and somehow incompressible.

When the complexity and uncertainties of the problem began to be "shared knowledge", some industries and countries considered favourably a tax on new vehicles to cover the costs generated by additional operations required by recycling. Car manufacturers were hostile to this idea because it would increase car prices and hence reduce sales, and also because it could stop innovation in the field of recycling. Some profitability of recycling, they argued, could be found in the future if learning processes were efficient and all partners co-operated. The new wave of R&D in recycling also provided detractors of the German project with arguments. State experts and firm's experts could easily agree on the fact that the goals of the German project were assessed neither on technical nor on economic grounds. The German approach appeared to be related to electoral contingencies rather than taking into account the potential of recycling end-of-life vehicles.

In the end the French policy was based on three ideas: i) several years would be necessary to develop efficient recycling techniques and viable organizations[4]*, ii) regulation should not lock the end-of-life sector in a specific technological path; iii) the necessary partnerships for recycling would be endangered if powerful actors - i.e. car manufacturers - were considered as solely liable for all the costs of this development*. All these arguments convinced the French authorities and firms in the sector of the advantages of signing a voluntary agreement in March 1993. All the partners agreed to reduce the amount of waste, from every car, which ended up in a landfill and this without any state subsidies.

III. A THEORETICAL INTERPRETATION OF THE FRENCH AGREEMENT

After this brief history of the genesis of VAs, what are the specific theoretical concepts that are necessary to explain them? By specific we mean those concepts which are not normally considered in the regulatory capture theory.

III.1. An operational theory of regulation

By "operational" we mean that any State regulation requires the definition of at least four fundamental elements, and this is what is precisely avoided in the VA. These four elements are the following:

- *the nature of waste covered by the law;*
- *the liable actors and corresponding sanctions;*
- *the regulation targets and instruments;*
- *the definition of a perimeter of application.*

These elements can be derived from mere logic, but one can also infer them by examining all the other environmental regulations. What is of importance to our research is not to claim that this list is complete; it is sufficient to remark that available knowledge on recycling did not allow State agencies to get a clear perspective of two of these elements: the definition of a principle of liability, and the choice of operational targets.

III.1.1. A collective principle of liability is not an operational principle of liability. Any regulation has to state a principle of liability so that contraveners can be identified and sanctioned. For environmental policies things may seem simple, but in fact the *"polluter pays" principle* which is inscribed in the French law of 1975 and in the European Treaty of 1987 does little to solve the problem. Since pollution results

[4] In that sense, the situation was very different from that of car emissions for which a technical solution, however imperfect it may be, existed (catalytic converter).

from the activity of several agents (for instance household waste) this principle is particularly complex to apply. In our case, can we consider the car manufacturers as more liable than the chemists that sold non-recyclable plastic materials to them? What about the dismantlers and shredders, and the last owner who might have added additional equipment containing hazardous materials? The principle of liability was one of the major causes of conflict during negotiations. Because of their size and economic power, car manufacturers were more easily declared to be the "polluters"; in response they claimed that such an attitude would not stimulate their partners to innovate and to develop new R&D programmes. It would cause the entire economic and technical burden to be placed on the manufacturers, thereby creating a strong incentive for opportunistic behaviour among shredders and dismantlers, and even suppliers. What about a collective principle of liability? *The concept was interesting but had no operational value for a regulation*. Accepting collective liability meant accepting the VA model.

III.1.2. The targets and instruments of the regulation: What is meant by recycling? We call "targets", *the performance, procedures and processes* that regulation aims to change or create. The problem lies in the variety and controversial nature of these targets in environmental policies (Hourcade, Salles and Thery 1992). In the carwaste problem, the first type of target is very classical in environmental issues: limiting or prohibiting certain practices or resource utilization (materials, landfill, incineration norms, transfers of waste, etc.). A second type is more specific to the waste problem itself and concerns the creation of new channels of exchange: reuse and recycling. In both cases, taxes could be levied to pay for the additional costs related to these developments. However, in the carwaste problem the variety of materials involved and the complexity of dismantling problems led to endless speculations about the appropriate instrument. Each material would need a specific policy depending on its volume, its place in the car, the possibility of sorting it from the shredders' scrap, and so forth. It also appeared that there were two competing processes: materials (including parts) reuse, or energy recovery. What would be the optimal combination of these two processes? What would be the fairest tax system and what would it pay for[5]? With controversial and uncertain targets, how could one design the corresponding instruments? The only accepted fact was that on average 25% of the car weight was destined to landfills, and that landfills were the main limited resource in the long term. But landfill reduction has no "one best way", and technical or economic developments could at each moment modify the validity of a chosen policy. Consequently, regulation authorities and firms defined a general goal of landfill reduction but did not specify the best means to achieve it from either an economic or a technical viewpoint.

With no clear principle of liability, with targets limited to a general goal of landfill reduction and wide uncertainties on the economic viability of recycling, no "operational" regulation was easily definable for government intervention. Furthermore, no emergency or immediate political pressure could justify regulation in such conditions. *This explains the partnership of the State but not why all professionals accepted the VA. For that, we need another concept*.

III.2. A view of market transactions as reciprocal prescriptions : co-design and design parameters

Behind the principle of collective liability there is much more than a defensive attitude against regulation. If we were facing pure market relations and perfect competition in the car industry, this principle would

[5] Regulators should be very careful with such tax systems since certain experiments failed to prove their efficiency. For instance, many press reports have stressed the ineffectiveness of the German and French tax system for packaging which was only used to finance package collection, without stimulating innovation inr recycling. It thereby led to the increasing stockpiling of packaging and a lack of sustainable markets.

have no meaning; each firm would wait for signals from the market and respond to them independently. However, it is now well established in the literature that the car industry presents another reality:

- It is an international oligopoly where widespread co-operation exists between manufacturers and where each manufacturer has fairly stable relations with a limited number of important suppliers.

- This industry needs and has developed a large number of norms and design standards, some of which are already regulated by the State.

- The flow of innovations and the complexity of the product lead manufacturers and suppliers to practice *intensive co-design* of their products.

Hence, price signals are largely completed by a permanent exchange of knowledge and information allowing for a dynamic form of co-ordination on product quality, technological change and production requirements. In this context, the principle of collective liability makes sense. It recognizes the reality of this co-ordination and the existence in each transaction (between a manufacturer and a subcontractor) of "*reciprocal prescriptions"* (Hatchuel 1994): by this we mean that product design or services exchanged result from a negotiation in which each firm is aware of its specific expertise. Close attention has been given to co-design (and co-production) by the literature on the service economy (De Bandt and Gadrey, 1994). This type of exchange does not eliminate competition on prices but the criteria are mixed with many functional requirements. Bearing in mind the specific nature of such transactions, it is now possible to give a functional role to the VA goals and prescriptions. They appear as a **new design parameter** that all partners will consider in order to evaluate its consequences on their co-ordination mechanisms. The fact that this design parameter is a planned reduction of landfills for the year 2002, indicates that co-ordination also concerns expectations and anticipation.

The concept of a design parameter also appears in recent industrial economics (Milgrom and Roberts, 1992): in order to obtain temporal co-ordination between production units, a common schedule must be fixed ex-ante as a design parameter; then and only then can competition on prices start. This model supposes a central agency who decides the optimal schedule, and no other co-ordination is allowed. Clearly, this is not the case between firms in the car industry. Design parameters are common knowledge and are fixed ex-ante, but their impact is totally dependent of the co-ordination mechanisms existing between agents (Moisdon and Weil, 1992). The co-ordination model of the VA is not so far from internal contracting between different product designers in the same company (Hatchuel 1994, Nakhla et Soler 1994), if we exclude the central mechanism of budget allocation. Finally, establishing landfill ratios as a new design parameter with collective liability means allowing the development of co-ordinated R&D programmes on recycling in each firm in the car industry. *Partners accepted the VA and the collective liability principle because this kind of co-ordination was already in practice in the car economy. Hence, the VA reveals the nature of existing relations.*

If VA is also the result of an inter-firm process, it would not have been possible without corresponding internal agreements.

III.3. The formulation of firms' strategies as an organizational learning process: the shaping of internal agreements

Firms are organizational constructs. This means that their behaviour is the result of mechanisms of both differentiation and integration. The development of recycling policies in a firm implies a complex learning

process which has an impact on all internal actors and even stimulates the emergence of new ones. This process can be referred to as "organizational learning" if, rather than using this concept in its early holistic way (Argyris and Schon, 1978), we maintain an individualistic viewpoint on learning. Thus, "organizational learning" is the process in which there is interaction and influence, or no relationship at all, between the learning of different individuals (Hatchuel, 1994). This interplay is structured by the organizational and managerial techniques which regulate relations between different actors in the firm. Hence, "organizational learning" can be obtained through "reciprocal prescriptions" in market transactions or by integrating managerial procedures in firms.

Let us now take these concepts and revert to our case study. One could say that the VA was the result of intra-firm organizational learning: *top managers and new recycling experts reached a common perception of strategic, technical and economic uncertainties about recycling*. On the other hand, differences in firms' strategies could have appeared from differentiated organizational learning. Certain top managers could have been persuaded to ask for a tax system by other actors less inclined to innovate than the new recycling experts. Hence, the agency-theory approach of capture (Laffont et Tirole, 1991) could also be used to interpret intra-firm formulation of managers' strategies, in the same way that State agency can influence politicians. But the capture theory's limits are the same in an intra-firm context as they are between firms and regulators: facing a context of uncertainty and fearing more stringent regulations in case of non co-operation, managers favoured internal agreements, experimental approaches and general goals on recycling, thus allowing experts to continue their investigations and to establish new co-ordination with other departments of the firm. *Thus, we can analyse the voluntary agreement signed at the French level, as the image of previous internal agreements reached* between experts and top managers in each firm.

With these three theoretical approaches it is possible to obtain a comprehensive theory of the VA on car recycling viewed as the first step in a three-tiered learning process:

> *- the State level oriented by the operational requirements and hindrances of any legal regulation;*
>
> *- the inter-firm level where the complexity of market transactions in the car industry created the necessity to adopt a new common design parameter;*
>
> *- the corporate level where experts and top managers had to build internal agreements allowing the progressive and concurrent development of strategy and expertise.*

If this approach has any value for explaining the VA as the first phase of the regulation process, we are now going to use the same concepts to analyse the viability of the VA and the risks that could destabilize it in the future.

IV. VA STRENGTHS AND WEAKNESSES: A DYNAMIC INTERVENTION STRATEGY

The French VA does not mean symmetrical obligations for firms and for Public Authorities. The latter have played (accepting the agreement and delaying any authoritarian regulation) and can now attempt to observe firm's actions and improvements. Firms have now to prove that they make the necessary efforts to reach the agreement's objectives. State agencies have to "monitor" the ongoing process since the VA states that continuous monitoring will be realized by a steering committee ("groupe de suivi") on which all partners in the agreement are represented.

Hence, the first impacts of the VA have to be analyzed at the corporate level. It is at that level that learning processes have begun and will continue. These processes will determine the new inter-firm co-operation that might emerge. Meanwhile, State agencies will try to derive new knowledge on recycling from firms' action; such expertise might well prove to be useful if the VA fails and if more authoritarian regulation becomes necessary.

IV. 1. The logic of product-process innovation

As stated above, reducing landfills can be achieved through two types of waste valorization. The first consists of dismantling certain parts of the vehicles before they are shredded in order to recycle the materials in those parts. We shall call this *the dismantling-recycling channel (I)*. The second way consists of incinerating the shredder waste, in what we shall call the *valorization with energy recovery channel (II)*[6]. "Pure" strategies (I or II exclusively) seem unlikely in the mid-term, while incineration (II) has technical limitations. Moreover, some governments (e.g. Germany) and populations are still very hostile to the creation of new incinerators. On the other hand, extensive dismantling is not realistic either: very few materials exist for which recycling processes are under control (only certain thermoplastics such as polypropylene and ABS, standard glass). Apart from this technical limitation on recycling - that could change with technological improvements - the dismantling activity is limited for a more fundamental reason: decreasing returns. In fact, dismantling can be described with a mining metaphor: whereas the external parts of a vehicle can easily be dismantled (bumpers, glasses, batteries, etc.), the same cannot be said for parts inside the vehicle. Once the good veins have been worked, the return of dismantling strongly decreases. This means that "mixed" end-of-life strategies, i.e. using both valorization channels, will be required.

The first results of experiments in the field confirmed this analysis. They showed that is was difficult to meet the regulatory objectives without additional costs. Experimental centres such as that of Renault at Athis Mons were perfectly capable of valorizing over 85% of a vehicle, but this required the company to subsidize certain dismantling and collection operations that were not economically viable.

In order to get round these economic constraints it was hoped that productivity gains would cut costs, but nothing guaranteed that intervention in the processing of scrapped vehicles alone would be enough to attain an economic equilibrium. Moreover, it was necessary to combat the tendency, observed on recent vehicles, of recyclability to deteriorate. At least the VA had established higher objectives for vehicles arriving on the market in 2002 (90% of valorization as opposed to 85% for existing ones). In these conditions, the major challenge facing manufacturers was to design more recyclable vehicles. Thus, *a cautious strategy consisted of acting simultaneously on the various sectors concerned and on car design, with a view to future processing of vehicles.*

This logic of simultaneous innovation in products and processes is fairly uncommon in industry (see Abernathy and Utterbach, 1975) and requires complex dynamic co-ordination between the two activities. The difficulty of the exercise can be seen in the fact that on average 15 years[7] separates the design of a vehicle from the time it is scrapped. Since the organization of the future recycling industry is unknown to designers, they have to develop design strategies based on assumptions. Similarly, since those who organize and develop the recycling industry progressively discover the

[6] These experiments involve most of the car network actors. Nevertheless, car manufacturers can be considered as the leaders of these actions. They were at the origin of end-of-life processing plants in co-operation with shredders and dismantlers, and are promoting recycling research with chemists.

[7] Roughly five years of research and a 10-year life-span.

materials used in future vehicles - and hence future sources of waste -, they constantly have to expand the sector.

We have seen that during the phase leading up to the VA, recycling concerned top managers and R&D experts. Since the French agreement was signed, many other actors have become involved in the process :

- recycling managers emerge to participate in the development of recycling procedures and methods, and to co-operate with dismantlers and shredders; they will play a major role in the evaluation of recycling costs and in assessing the economic viability of new co-operation for recycling existing cars;

- design managers are asked to use new design parameters and to increase expected recycling levels without creating extra costs and without any reduction of quality;

- purchasers are asked to introduce recycling as a new criterion of functionality for all the parts they have to buy; they therefore have to assess the efforts of suppliers towards the goals of the VA.

All these actors could not easily have joined the process without the clarification provided by the VA. By signing this VA, top managers have simultaneously changed the internal context of the problem. We can illustrate this point through the Renault example.

Creation of a recycling project: an organizational innovation promoting rapid learning

Once the French framework agreement had been signed, a general executive committee ratified, in July 1993, the creation of an ad hoc structure (a recycling project) for organizing recycling within Renault and beyond, and rapidly developing a strategy in this regard.

The choice of such a structure has several advantages in a situation of intense uncertainty where learning has to be rapid. First, it is an incentive structure in so far as its life-span is limited, which means that it constantly has to justify results in relation to initial goals if it is to survive. Second, the autonomy of the project and project leader enhances reactivity and enables the project leader to develop his or her own logic, free from the constraints and debates weighing on line managers. Finally, it facilitates indispensable co-ordination between diverse activities (e.g. internal and external relations; applied research on the recyclability of materials; assistance to and monitoring of the centres processing scrapped vehicles; involvement in vehicle projects; signing of co-operation agreements with the State or industries) which traditionally would have been compartmentalized into as many different occupations and services.

The project soon fell into shape and three main areas emerged: one section responsible for marketing and waste recovery; another responsible for organizing and leading work groups and research groups focused on the recycling sector and the valorization of materials; finally, a third section responsible for integrating recycling into the design process.

The first section, together with local and foreign partners (shredders, crushers, other manufacturers), sets up dismantling and depollution centres. The second section looks for possibilities for recycling various parts, including from the shredding residue, and doing R&D for those materials for which no recycling exists as yet. In short, this section is participating in the establishment of a recycling economy. Finally, the design section works on the integration of recycling into new vehicle projects. Its role is therefore to prescribe recycling requirements to the design teams and to ensure that these requirements are taken into account in designers' choices.

The contribution of these different sections enhances available knowledge on the future recycling economy, and this may largely influence firms' strategies. From that we can see that the creation of an economy is also rooted in the specific agenda of interactions that characterizes each organizational learning process.

Nevertheless, the most complex and progressive impact is on car design. This is not really surprising since many authors have stressed how car design was subjected to many, often contradictory constraints (quality, costs, delays, weight, security, etc.) and how decisions were the result of unstable compromises between all these constraints (Clark 1988[8], Moisdon and Weil 1992). Changes in materials are largely incremental (Willinger and Zuscovitch (1988) from one vehicle to another. Substituting non recyclable materials for recyclable ones is a very long and fairly unpredictable process since materials have different qualities. An improvement in recyclability may be offset by a deterioration of quality or price or anything else. Thus, no general law can be stated, and each part needs to be treated separately since the slightest modification can lead to multiple redesigns of contiguous parts, like in a domino game (Midler 1993, Moisdon et Weil 1992). The introduction of new recycling expertise in car design is largely underway at Renault (see Aggeri and Hatchuel, 1996), but it will take time since many actors are involved in the process (development services, manufacturing process, buyers, subcontractors, etc.). For these reasons, developments are not only dependent on R&D expenses in recycling (Nelson and Winter 1982). What matters most are the procedures and actors that will enhance or limit the collective learning process (see Aggeri, Hatchuel, 1996).

VI.2. Patterns of inter-firm co-operation : the future network of recycling organizations

Dismantling and depollution centres

The knowledge presently available suggests that the viability of a recycling economy meeting VA goals is somewhat difficult to achieve. This gives major importance to the organizational design of end-of-life structures. Will a variety of forms emerge? Until now, structures common to several car manufacturers have not been common. Does that mean that each car manufacturer will have to build its own dismantling and depollution network? This outcome seems very unlikely as co-operation presents important and sound advantages[9].

First, the car wreck field is geographically atomized and the added value of recycling will remain low if it exists at all. Hence, a key factor of recycling profitability is the cost of transporting wrecks. If these transport costs are to be minimized, the number of dismantling centres will have to be increased. Furthermore, in order to process a sufficient number of cars, these centres will need to accept cars from various manufacturers (multi-manufacturer centres). Besides transport costs, there is another reason for the small size of centres: it seems that economies of scale are very limited. In a dismantling centre the variety of models and the irregular quality of wrecks will be so significant that processes will be mainly labour-intensive, with limited tooling.

---

[8] We note, for instance, that knowledge about new composite materials is still embryonic in process manufacturing services where steel technologies have shpaed the profession.

[9] The Dutch researchers Groenewegen and Den Hond (1992) argue that there is already a variety in corporate technological strategies for recycling (Ford and Mercedes are even said to follow radical change strategies). For us, this variety concerns only R&D programmes and not operational strategies. When the authors interviewed car manufacturers, recycling was mainly an emergent problem and manufacturers were investigating various R&D solutions at the same time.

If small recycling centres are better adapted than large automated plants, the present large dismantlers' network which already controls the collection of wrecks may be the mainstay of the future system. Moreover, it seems unlikely that outsiders will invest in recycling centres which compete with existing dismantlers' plants. The potential profitability of these centres also seems limited: decreasing returns for dismantling, few sustainable markets, technical uncertainties, limited economies of scale. Consequently, what are the incentives for investing in recycling? At this stage more indirect incentives can be noted. Dismantlers may see in the recycling activity the opportunity for an important qualitative change in their profession: State qualifications, better relations with car manufacturers and dealers, larger and more regular flows of car wrecks. This may be a good strategy since processing a whole vehicle could still be a profitable operation if spare parts sales are considered.

The emergence of new branches of the recycling industry through the impetus given by manufacturers

Further downstream, branches of the valorization industry (recycling and energy recovery) are starting to be established for the main materials found in cars. By branches we mean here a succession of stages of transformation and economic exchange mobilizing various industrial actors. In the case of cars these branches concern: depollution, dismantling of parts by type of material, their shredding, shoring, transport and then valorization through recycling or energy recovery.

After several years a few branches for plastics, glass or fluids have started up. These did not emerge spontaneously, but rather through the impetus given by key actors, including manufacturers. The latter played a central role in the creation of these new industries by organizing interaction and co-ordination between the various industrial partners.

Today we are able to define more and more clearly the technologies and organization of these industries, as well as their economic balance. However, several problems are preventing them industries from effectively taking off: insufficient returns, sharing of the rent at the different stages, the opportunism of dismantlers, and so forth. We shall revert to these problems and ways of solving them at the end of this section.

IV.2. Diffusion of the framework agreement principle in Europe

After the signing of the framework agreement, several countries (Spain in 1995, the Netherlands in 1994 and Germany in 1996) following the French example by signing their own voluntary agreements.

IV.2.1. The European recommendation**:** In February 1994 the European think tank on end-of-life vehicles (ELV) submitted a document presenting its strategy to the European Union. This recommendation had no legal value vis-à-vis the Member States, but it was stated that it could serve as a basis for a future European directive. The document followed the main lines of the French framework agreement: quantitative objectives (85% valorization in the year 2002, 90% for new vehicles), the principle of collective responsibility or the assertion of the principle of a free market (no subsidies). Nevertheless, several differences need to be noted:

- Two objectives were added as compared to the French text: an objective of 95% for the year 2015 (the deadline was not specified in the French text) and a 5% limitation on the level of energy recovery (unspecified in the French text). Moreover, the group suggested several measures, including:
- establishment of a license of approval for dismantlers and other specialists in the dismantling and depollution of ELV. Approval was to be conditioned by the specialists' compliance with conditions for

protection of the environment, and on the existence of contractual relations with other licensed actors (so as to avoid pseudo-recycling and uncontrolled dumping);
- the establishment by the Member States of a compulsory certificate of destruction of the vehicle, issued to the last holder of the vehicle by approved operators (to avoid wrecks being abandoned). The text added that the implementation of this recommendation was to be monitored at national level where monitoring committees were to be set up before the end of 1995.

This recommendation calls for a number of comments in comparison with the framework agreement:

- First, the limit placed on the rate of energy recovery is clearly based on the concerns of Northern European countries who are hostile to this type of technology. However, the five percent threshold has particular significance: it the most robust technico-economic hypothesis to date. The valorization of shredding residue in cement factories is currently limited by the presence of heavy metals (e.g. lead, zinc) and chlorine in quantities exceeding the levels tolerated by cement factories (which are, in turn, also subjected to very strict norms for their emissions).

Several sorting techniques (e.g. flotation, sifting) have been tested by manufacturers in collaboration with shredders and cement factories to make shredding residue acceptable to the cement factories. Through this sorting a part of the undesirable substances can be removed, but not all since some of them remain trapped in certain absorbent materials (e.g. foam, cloth). As a result, only the "heavy" part of the shredding residue, composed of very dense materials (e.g. rubber, heavy plastics) is currently compatible with cement factories' norms. From an economic viewpoint, since they also have a high calorific value, these substances are the most useful fuel substitution. This "heavy" shredding residue accounts for around 20% of the total weight of the shredding residue, or roughly five percent of the vehicle's weight. Other experiments are underway to sort the light part of the shredding residue, but this additional sorting is expensive and the calorific value of the fuel thus obtained is low.

Finally, if the industrialists accepted the idea of introducing a limited rate of energy valorization, it is because experiments showed that this technology presented obvious limits. There again, the evolution of knowledge made it possible to change viewpoints and subsequently the content of agreements.

- The second comment concerns the recommended measures (licenses of approval for recycling centres, certificate of destruction). These measures were requested by the manufacturers, the shredders and even certain dismantlers (the trade unions) who considered that they were indispensable for combating the opportunism of some of their peers, for avoiding abuse, and for guaranteeing quality in the dismantling and depollution of ELV. While they were a powerful incentive for breakers, in so far as those who were not licensed would have difficulties obtaining wrecks, they were also to have a powerful restructuring effect on the breakers' profession. There was a chance of the latter being subjected to manufacturers who would have organized the materials recycling network upstream. The public authorities would probably agree to play the manufacturers' game, to the extent that they would hardly disapprove of the reorganization of an unlawful profession.

The most original point in the document is the conditional strategy which is defined in case the objectives are not met. In that event, the text proposes measures which could be taken in relation to predetermined risks. These measures range from the reinforcement of the manufacturers' responsibility to a tax on new vehicles. We shall revert to the theoretical interpretation of this conditional strategy in the following paragraph.

***IV.2.2. Evolution of the German position*:** At first, the framework agreement approach was developed in reaction to a draft regulation proposed by the German minister of the environment who was in favour of an authoritarian approach. It was based on the following lines: manufacturers' responsibility; very ambitious recycling objectives determined by type of material and excluding energy recovery; the obligation of manufacturers to take back wrecks; and the classification of carwaste as dangerous waste to be dumped in category 1 sites.

Not only was this very stringent project never approved, but it was finally a voluntary agreement, fairly similar to the spirit of the French framework agreement, that was signed in February 1996 in Germany.

There are, however, several differences compared to the French framework agreement and the European text:

- The text is less severe on one point: the objective of 90% valorization for new vehicles on the market has been dropped. In fact, it was probably the objective that was the most difficult to meet in so far as the trend in new vehicle design is difficult to inverse and that trend is currently for the recyclability of new vehicles to deteriorate.

- Apparently it is more severe on other points. In particular, liability is no longer collective; it lies on the shoulders of the manufacturers alone. They have to agree to organize the collection of end-of-life vehicles and to organize the valorization industry. Instead of the market principle, the text affirms that of the free return of ELV. Finally, it text includes the licensing measures proposed by the European think tank and that were not included in the French text (license of approval for processing centres and certificate of destruction of scrapped cars).

***IV.2.3. The German framework agreement*:** The German text seems to be a compromise between the position of the industrialists and the initial position of the minister of the environment. The latter dropped the objectives of recycling by type of material and was less demanding as regards new vehicles. On the other hand, the principles of manufacturers' liability and the taking back of wrecks at no charge were maintained.

While it is easy to understand the evolution of the German environment minister's position, since industrial experiments showed that the objectives of recycling by materials were unrealistic, it is more difficult to interpret a priori the evolution of the manufacturers' position. How can one explain that the manufacturers, at whom these measures were aimed, agreed to such clauses while they had always opposed them?

In the absolute, the principle of taking back wrecks at no charge seemed to penalize German manufacturers since in that country customers often pay around US$70 for their scrapped cars to be removed. However, a careful reading of the voluntary agreement shows that this clause is attended by highly restrictive conditions, i.e. it does not apply to vehicles less than 12 years old or to vehicles in a good condition (whole or mobile, containing no refuse or notable damages). Such conditions relativize the scope of the measure considerably.

With regard to the second clause, it is difficult to understand the evolution of the manufacturers' position vis-à-vis the principle of liability without a dynamic theory of the regulatory process. In fact, if their position has changed it is simply because the context has evolved. Between 1993 and 1996, manufacturers multiplied their research and their partnership agreements. They created dismantling and depollution centres, set up valorization industries, and so forth. Today, they are able to control and to assume

responsibility of the entire recycling economy. In fact, this is even in their interests for if they fail to do so the process may be too slow and they might finally be held responsible for not meeting regulatory objectives. The outcome might be the confirmation of their responsibility and the levying of a tax on new vehicles in order to finance the recycling of scrapped vehicles as in Sweden and the Netherlands. Hence, it is better to interpret this development not as a concession wrested from reluctant industrialists by the authorities, but rather as the logical result, owing to accumulated knowledge, of the evolution of the manufacturers' strategic position. What seemed to be very risky three years ago has today become acceptable.

In this light it is also easier to understand the nature of the licensing measures taken by the public authorities. These are the compensation for the manufacturers' commitment: they agree to the principle of liability in exchange for control of the sale of wrecks and of the networks of dismantling and depollution of ELV.

IV.3. Learning to reinforce the VA's : monitoring and standards setting

Two main shocks could destabilize the VA's signed in Europe: the development of new asymmetries of information during the learning phase, and differential compliance with the VA's.

* *New asymmetries:* The VA's open a new learning phase, but all firms will not learn the same things. For instance, dismantlers might disagree on the results of existing centres and some of them might decide not to co-operate in the creation of recycling centres. Similar observations could lead some materials suppliers to refuse the reuse of their dismantled parts. This kind of reaction is precisely the consequence of learning processes. Progressively, each firm will reduce its uncertainties about recycling and will form its own beliefs about technical and economic stakes in recycling.

* *Differential compliance to the VA's:* The simplest example of such differential compliance is the "free rider" strategy, e.g. a car manufacturer expecting that with reduced investment in recycling R&D, or limited effort in the setting up of dismantling and depollution centres, it could finally benefit from the other manufacturers' investments. Such strategies may also come from agency patterns, i.e. the difficulties for the State (as a principal) to observe and differentiate each firm's efforts.

These shocks would mean either that VA's goals are not reached, or that some partners (including public authorities) reject the VA's. To avoid such shocks without reaching the point of authoritarian regulation, the State could use this learning phase to prepare and establish standards. Economists (David, 1987) have stressed that standardization could efficiently combat opportunistic behaviour; quality standards would make it possible to reduce asymmetries of information and transaction costs (Foray, 1996) while compatibility standards would help to limit free-riding strategies and would favour network economies (Katz and Shapiro, 1985). Two types of standardization may be used in our case:

- Dismantling and depollution centres' agreement (compatibility standard): This would have an incentive effect on potential licensed dismantlers who should have privileged access to car wrecks. This measure could be linked to an obligation for the last owner to hand back the vehicle.

- Product quality standards: These standards could take the form of an ex-ante evaluation of the recyclability of each new car model (product approval by an expert). Such intervention could have two positive effects: reduce the risks of opportunism among dismantlers vis-à-vis the last owners of the vehicles, and also allow state regulators to differentiate car manufacturers' efforts towards recyclability.

All these norms could reinforce the VA's and increase their robustness, but such standards cannot be set without sufficient learning and assessment of recycling processes. This learning could come from the firms which have made the biggest efforts in establishing recycling procedures, while these firms would benefit from the general adoption of their specific standards. **Hence, we may have a self-reinforcing mechanism: standards can strengthen the VA's, but standard setting is impossible without new developments in recycling induced by the VA's.**

Finally, if standard setting fails, regulators will have to prescribe legal rules and subsidize recycling activities. *However, this situation will emerge after a substantial period of knowledge accumulation, technological assessment and organizational validation*. At that moment, strong asymmetries of information will have been established between all partners and strong attempts to capture the new regulation will exist; but by then regulators would have acquired sufficient knowledge to be in a better position to resist this capture.

It is interesting to note that this analysis was carried out by the public authorities. The February 1994 European text defines a strategy of conditional intervention in which it explicitly mentions the possibilities of revising the agreement in case of failure. A list of risks is defined and related measures, corresponding to those mentioned above, is suggested.

V. WHICH MODEL OF STATE ACTION FOR WHICH ENVIRONMENTAL PROBLEMS? SCOPE AND LIMITS OF THE FRAMEWORK AGREEMENT MODEL

V.1. Characterization of the framework agreement model

In the example developed above, the role of the State tends to evolve. It is not so much to restrict or to encourage industrialists-polluters, as to steer innovation within communities. In this perspective, the framework agreement seems to be an original tool which warrants being examined more closely, particularly as regards its scope of application and its limits.

The originality of the framework agreement lies not so much in its co-operative and voluntary nature, (voluntary agreements have existed for a long time) as in the complexity of the problem addressed from the outset, the formulation process, and the richness of content of the final agreement.

Innovation oriented VAs vs implementation oriented VAs **:** The sociologist P.Lascoumes (1990) studied about twenty voluntary agreements signed in France since the creation of the Ministry of the Environment in 1972, in different industrial sectors including cement, paper, asbestos, chemistry, metals and sugar. These agreements concerned very classical pollution problems (massive and localized pollution - e.g. water -, single polluters, often existing technologies) in which the constraint was mainly of an economic nature. The choice of that particular instrument (the VA) was justified mainly by a certain pragmatism (avoiding imposing ineffective laws) while the nature of the problems to solve warranted more authoritarian action. In our case, it was a question of solving a far more open problem: how to stimulate technological innovation and the emergence of a viable recycling economy compatible with environmental objectives. This type of problematic is a very recent development in Europe. As a report by the Ministry of the Environment on a sustainable transport policy recalls (1995), European environmental policy, oriented towards sustainable development, was only really formalized towards the end of the eighties.

A process of progressive construction*:* Rather than seeking a test of strength with the industrialists, the European Union privileged an approach based on consultation and co-operation from the outset. The

setting up at national and European level of working groups composed of all the industrialists and the public authorities unquestionably helped to stimulate reflection on the subject. This principle of consultation, first implemented at European level in 1990, is also relatively recent.

***An original content**:* Beyond any matter of principle, it was especially the content of these voluntary agreements that was original. Given that learning cannot take place without a framework to structure inter-firm co-ordination, six points are defined here: 1) quantitative objectives for valorization which do not stipulate the technology to be used, and which are defined according to a progressive schedule; 2) a principle of collective responsibility involving all the industrial actors in the sector; 3) rules of know-how transfer to facilitate the dissemination of knowledge within the industrial network; 4) the assertion of the principle of a free market without subsidies; 5) the setting up of national monitoring committees for steering the implementation of these agreements; 6) conditional measures in th event of commitments not being honoured by the industrialists.

The point which poses the most problems of acceptability for the industrialists is unquestionably the first one. Indeed, the level of objectives is always the object of intense negotiation between public authorities and firms, since the latter often strive for the lowest possible objectives. On the other hand, as M.Glachant (1996) points out, the means to attain these objectives (points 2,3,4,5 and 6) is less controversial in so far as it is in both parties' interests to find the most effective solutions to attain the objectives at the lowest cost.

Even if it is too early to take final stock of the implementation of the framework agreement (the first voluntary agreements reach their term in 2002 only), the intermediate evaluation can be considered as very positive. The principle has been generalized in all countries of the European Union and has, moreover, stimulated numerous actions in the industrial sector.

A co-operative approach such as that of the framework agreement is not altogether natural in environmental affairs since a priori nothing encourages the partners to agree: on the one hand the industrialists seldom have reason to accept an agreement which will increase their costs; on the other hand, the public authorities have every reason to mistrust the industrialists. What then, one might ask, are the conditions which in certain cases such as that of ELV, make this type of public action justified from both the point of view of the industrialists and that of the public authorities?

V.2. Conditions of effectiveness of the framework agreement model

From the analysis which we have just made of the example of recycling scrapped cars, four basic criteria seem to warrant the framework agreement solution:

1) The presence of shared uncertainties and the need for collective learning. We have shown how, at the start of the process, there was of radical uncertainty over the choice of technologies to use, the choice of organizations to involve and the cost of these solutions. Secondly, no industrialist could claim to be able to reduce this uncertainty alone, for know-how and ownership of the industrial network was in the hands of a series of actors. Finally, if the co-operative solution of the framework agreement was to be chosen, it was necessary for all the actors, and notably the public authorities, to be convinced that no one was concealing information. The combination of these three elements defined the situation that we have qualified as one of "shared uncertainties", as opposed to that in which asymmetries of information exist. Here, nobody can try to capture the regulation, and co-operation can be organized so that collective learning can take place. In this context of prevailing co-operation, voluntary agreements are far more appropriate than other types of instrument.

To illustrate the importance of this criterion, let us imagine the opposite, that is, a situation in which asymmetries of information existed from the start. If that were the case, some firms would have knowledge on technologies and on depollution costs. The State would have no reason to use voluntary agreements since co-operation would not be essential; rather, it would need to find incentive mechanisms to impel firms to divulge information. Once this information had been obtained, is would be possible to define an acceptable norm that were compatible with existing technologies and economic constraints. Such situations, with wide asymmetries of information, characterize many problems concerning emissions for which known depollution technologies exist at the outset (e.g. water purification or desulphurization of gas emissions). In this case, firms can themselves strive for the adoption of a standard if they think it might be to their competitive advantage. (We cite, for example, Bosch, a specialist in catalytic converters, who supported regulations on car emissions; or Du Pont de Nemours who defended regulations on CFCs because the firm had developed a substitute - HFC - before its competitors.)

2) Diffuse pollution and chain of polluters. In the case of carwaste, sources of pollution are diffuse and the public authorities are faced with a chain of polluters. This makes the implementation of the polluter-pays principle - and, by extension, the definition of a regulation - extremely difficult. By contrast, the flexibility of voluntary agreements makes it possible to define a principle of collective responsibility, which is more appropriate.

If the situation had been reversed and it had been easy to identify precisely both polluters and sources of pollution, there would hardly have been any reason for the regulator to implement voluntary agreements. A regulatory solution or economic instruments would, in that case, have been more suitable since it would have been easier for the authorities to control and sanction offenders. Here again, the case of emissions can be used to illustrate the argument.

A.Ikwue and J.Skea (1996) retrace the origins of the regulatory process concerning emissions from large combustion plants (electricity companies, refineries, etc.). The regulatory process was sparked off in the early eighties in Germany with the growing awareness of the damage to forests caused by acid rain. The major combustion plants were the first to be accused because acid rain was believed to be caused by the massive quantities of nitrogen and sulphur oxide emissions from these plants. The affair reached such proportions in Germany that the government of the time seemed to be threatened by the mounting pressure from ecologists. To please political opinion which was keenly aware of the issue, the government (despite resistance from industrialists) imposed a fairly severe regulation on the big combustion plants who had to reduce SO2 and NOX emissions. The cost of implementing this regulation in Germany was estimated at 21 billion DM[10]. In return, the industrialists requested that this regulatory constraint be exported to other European countries to preclude unfair competition. This was done five years later in 1988 when a European directive to that effect was issued. In this example, the choice of the instrument was never called into question. From the start, a classical approach of "direct regulation" was chosen by the government because on the one hand the technologies existed and, on the other hand, since the polluters and sources of pollution were well identified and easily controllable, there was no reason to do otherwise - especially in light of considerable public pressure.

Even in the case of diffuse pollution, the State can impose regulations if it is able to control the pollution at the source, by means of licenses of approval, for example. In the case of pesticides, CFC or exhaust fumes, the approval of products at the initial marketing stage is one of the main instruments of regulation.

[10] It was possible to evaluate this cost because at the time a desulfuration technique existed for reducing NOX and SO2 emissions.

ForELV this measure is insufficient because nothing guarantees that the vehicles will be recycled at the end of their life, as stipulated in the license of approval.

3) Credible threats and presence of large firms. If the industrialists agree to a solution of the voluntary agreement type, it is mainly because they want to avoid more severe and restrictive forms of public intervention. The public authorities must therefore be able to brandish credible threats. But what is a credible threat? It is a potential action by the public authorities which may, directly or indirectly, seriously affect the activity of firms. For example, in environmental affairs legal sanctions are not credible because they are too weak and are applied too sporadically to be dissuasive. By contrast other, more indirect, types of threat are far more effective, at least as far as major corporations are concerned. For small businesses the pressures are far too limited, for at least two reasons:

- 1) *Major corporations have a brand image to defend in the eyes of their customers and public opinion:* If they refuse to co-operate with the public authorities they leave themselves open to public criticism. To illustrate this point we need only recall the efforts made by chemical firms and detergent or car manufacturers, for example, to cultivate the "greenest" image possible. The controversy around the destruction of the Shell platform in the North Sea is ample reminder of the power of the environment lobbies in this type of situation. By contrast, small firms have less renown and are therefore difficult to reach in this respect.

- *2) It is easier to impose norms and licenses of approval on large firms than on small ones:* For big corporations, the State can apply numerous forms of administrative harassment, norms or licenses of approval which are difficult to evade. For example, the security or emission norms for car manufacturers are very costly and restrictive, yet manufacturers have little choice in the matter since compliance with these norms conditions authorization to market cars. As regards ELV, the German draft regulation or the license of approval concerning the recyclability of vehicles were considered by manufacturers as very serious threats. One might even consider that these threats incontestably accelerated the search for a compromise with the public authorities. Furthermore, it may be relevant to question to what extent voluntary agreements need such stimuli if they are to materialize?

For many small firms these norms are less credible. On the one hand they require a large number of inspectors to monitor their application and, on the other hand, small firms often invoke the argument of employment or of terminating the business to justify their refusal. In this respect a British researcher explained in a conference that in Britain the implementation of regulations on forest enterprises had failed because pressures brought to bear on a large number of small firms were too weak. In the same order of ideas, it is public knowledge that most breakers have been contravening the law on graded (and other) equipment for years without any significant improvement in the situation.

Paradoxically, for exactly the opposite reasons, the presence of big corporations is a favourable factor for co-operative approaches. As noted above, these firms can, more easily than small businesses, form homogeneous interest groups capable of influencing the regulators (see M.Olson, 1965). In particular, their arguments are often favourably received by ministers of industry concerned about the effects of environmental policies on employment and on the industrial fabric. As we saw in the case of ELV, this objective alliance is often instrumental in bending the initially more radical position of the environment ministry.

4) Cohesion and homogeneity of the industrial system. The last favourable criterion for voluntary agreements is the existence of strong and durable links within the industrial system. We showed how the cohesion of the car industry system was perfectly consistent with the principle of collective responsibility

of the framework agreement, and more generally with a model of intervention grounded in the search for consensus, and aimed at building up lasting co-operation between industrial actors. By contrast, in situations in which relations are weak or even non-existent, co-operation is far more difficult to achieve.In the packaging industry this problem is acute because the plastic, glass, steel, aluminium and cardboard sectors have extremely different interests and concerns and never manage to find common ground.

When these three conditions are met, one can consider - as we have shown in the case of ELV - that the framework agreement model is both the most efficient and the easiest to implement.

The contrary is far less true since numerous voluntary agreements are implemented without all the above-mentioned conditions. For example, Lascoumes (1990) refers to instances where the regulator could just as well have implemented more authoritarian solutions or, alternatively, economic instruments. In these situations, the environment ministry opted for the negotiated approach in order to avoid a test of strength with the industrialists, in contexts in which its legitimacy and room for manoeuvre (notably in relation to the ministry of industry) were still uncertain.

V.3. The degree of generality of the framework agreement model

In the framework of the new problematics of sustainable development, more and more environmental problems are likely to correspond to the conditions mentioned above. Two examples offer an interesting parallel with the case of scrapped cars: the regulatory process governing packaging waste, studied by M.Glachant and G.Whiston (1996), and that of electronic and electric waste.

***V.3.1. The example of household packaging waste*:** As with cars, the question of packaging waste was first raised at the end of the eighties in Germany. Initially the collection and processing of this waste, derived from mass consumption products and comprising different types of material (iron, aluminium, plastic, cardboard, glass) was paid for by the municipalities. The problem was, indeed, very big. Household packaging waste amounted to 20 million tonnes per year in Germany (or 50% of domestic waste) and the volume has doubled since the sixties. Faced with this phenomenon, the German environment minister proposed a draft regulation in 1990 which included a set of very strict recycling objectives (80 to 90% in 1995, excluding energy valorization), a system of returnable packaging in certain cases (glass), and the obligation for certain retailers to take back such packaging (the distribution sector). The retailers and producers of consumer goods were to be responsible for collecting and recycling the packaging.

When the draft regulation was announced, reactions from industrialists were unanimously negative: retailers, because they would be considered de facto as the main party responsible for pollution; the packagers, because they were opposed to the deposit system which would force them to change their industrial and marketing strategies; and producers of packaging because they foresaw a drop in their production.

Retailers and packagers quickly organized a counter-proposal based on the argument that, given the pressure of public opinion on this issue, they could hardly call into question the principle of recycling. They therefore created a working group to formulate a counter-proposal issued in 1991. This document noted the same recycling objectives as the draft regulation, but differed from it on two points: 1) retailers were exempted from the responsibility to take back packaging; 2) a consortium (the DSD for Duales System Deutschland) was created by the industrialists to meet the recycling objectives. It was financed by

a system of dues paid by the industrialists[11]. In this proposal, the producers of materials played a marginal role. In fact, only the producers of glass supported the project. The producers of plastics accepted it only in its final version, while the cardboard industry remain opposed to it. In this project the latter had the responsibility of developing the recycling activity as such, which is probably very expensive for these materials while it is less so for aluminium, glass or iron. Although it had not been involved in the industrialists' process of reflection, the federal government reacted swiftly by transforming their proposal into a regulation which was adopted in 1991.

As in the case of motor cars, the regulatory process in France was strongly influenced by the process in Germany. France was opposed to German recycling objectives which it considered as over-ambitious. Shortly before the German project was announced, the French minister of the environment announced 75% recycling objectives for 2002 and asked A.Riboud (Chairman and MD of BSN) to set up a think tank to define a strategy for attaining these objectives. As M.Glachant and G.Whiston (1996) emphasized, co-operation between industrialists was more active in France than in Germany. Moreover, the public authorities were involved in the process of collective reflection, something that had not happened in Germany. The consumer goods industries and retailers took a leading position in the process. A proposition was issued and ratified by a decree in 1992. This decree set valorization objectives at 75% (with energy recovery being possible) in 2002 and created, along the same lines as the DSD, a consortium (Eco-emballages) responsible for meeting the objectives and operating according to the same principle of contributions.

At the end of the three-year negotiating process, a European directive was finally adopted in 1994. Valorization objectives ranged from 50 to 65% (of which 25 to 45% for recycling) depending on the materials and within a five-year time limit.

The consortium system

In France, like in Germany, the systems function according to three related principles:
1) the consortiums do not directly organize the collection and sorting of waste; they finance these operations through a series of contracts with private enterprises or municipalities; 2) downstream, the "guarantor firms" undertake to accept all waste from the consortium at a fixed price, and to promote recycling among recyclers and producers of materials; these "guarantors" guarantee the stability of prices of secondary raw materials so as to facilitate the recyclers investment plans. As M.Glachant and T.Whiston note (1996), the system of the private consortium is original, for this type of model is usually managed by public agencies.

First results

After four years it is possible to evaluate the first results of these regulations. In short, one could say that as far as the sorting and collection of waste is concerned, considerable progress has been made (notably in Germany owing to the selective sorting carried out by households), to the point where in Germany the initial objectives have been surpassed. The recycling capacities and technologies for certain materials (plastic in particular) have, however, not been able to follow suit and significant quantities of materials heap up, waiting to be sorted. The cost of the system has also been steadily increasing because the

[11] In fact, it is the consumers who indirectly finance the system because they pay a levy depending on the nature of the materials constituting the packaging, in exchange for the promise to recycle, shown by the "green point". The amount of the levy is then paid by the industrialists to the consortium DSD.

contributions on new packaging have been increased several times for certain materials. Despite these difficulties, co-operation continues to prevail in the industrial sector.

In the case of packaging, even if the legal form that was finally chosen is of the regulatory (and not voluntary) type, it is important to note that it was the result of a process of close co-operation between industrialists and public authorities, in which the latter drew directly upon the content of the industrialists' proposals. In fact the course of the process closely resembled that of the framework agreement model.

This resemblance is explained by the fact that the two contexts were largely similar. If we take our grid of four criteria, we note that in the packaging case most of the ingredients justifying a co-operative approach exist: 1) the presence of diffuse pollution and a chain of polluters; 2) the existence at the outset of shared uncertainties on techniques and the organization of sorting, collecting and recycling (at least of plastics); 3) the existence of credible threats (cf. the initial German regulatory proposal) and of large corporations to take charge of the issue.

There is, however, also a point of difference between the two contexts, to be found in the lack of homogeneity and cohesion of the industrial system compared to the automobile industry. In particular, whereas the car industry is dominated by the manufacturers, the packaging industry has a less hierarchical structure. Of course the consumer goods or retail industries are dominated by a few large groups who, moreover, initiated the regulatory projects that were finally adopted, but these firms do not have strong ties with the rest of the industrial chain. In particular, relations of reciprocal prescription and co-design are far less intense than in the automobile industry. Perhaps this basic difference explains the dissimilarity in the two cases considered here. For example, the solution of a consortium is based on the idea of a horizontal relations between firms.

A more fundamental difference lies with the economic mechanisms. Whereas in the case of carwaste the market principle was forcefully asserted, the consortium system is based on the distribution of subsidies to the various operators. It is likely that in the case of packaging - as M.Glachant and G.Whiston (1996) point out - the economic equilibrium of the system is more difficult to obtain due to sorting and collection costs combined with the low added value of the materials. But this does not explain everything. In effect, it seems that this solution was preferred because, in a sense, it "split" the risks and management of problems between the different industrialists. Without leaders capable of steering the innovation process, the industrialists preferred a solution based on horizontal co-operation and economic solidarity. However, this organization raised problems of effectiveness: is there not a risk that this system of subsidies might dampen incentives and create situation rents for certain operators? In the case of packaging, who is in a position to steer the innovation process? In particular, how is technical expertise distributed? How is it capitalized? Finally, who can co-ordinate collective learning within the system?

***V.3.2. A case similar to that of the automobile: electric and electronic waste*:** Among the priorities defined by the European Union on environmental issues is waste generated by electric and electronic devices (computers, household appliances, hi-fi, video, batteries, etc.). In France the ministers of industry and of the environment entrusted J.P.Desgeorges, President of GEC-Alsthom, with the task of leading a working group comprised of representatives from all the industries in the sector, the public authorities and consumers' unions. The mission was to propose a valorization strategy for this waste which, in France, amounts to 1,3 million tonnes annually. A report was submitted to the government in November 1994. Noting that the situation prevailing in this industry is very similar to that of ELV, and after considering various types of strategy (economic internalization, distribution, cost of the process at the end-of-life stage, and the framework agreement) the report explained why the framework agreement model seemed, in this case, the most appropriate solution.

Five main arguments were put forth in the report and can be summarized as follows:

1) The initial problem is very similar to that of cars in so far as end-of-life electronic products follow the same route as ELV. These products are recovered by a network of "valorizers" who, after removing certain parts, resell the appliances to breakers. The latter valorize the metallic part (steel, aluminium, precious metals) and dump the rest (plastic, screens, various pollutants) at their own cost. In these conditions, it appears that certain materials common to cars and electronic appliances (e.g. PVC, PE, PP, ABS, electronic cards) may be processed by the same recycling industries.

2) As in the case of cars, there is not one polluter but a chain of polluters from the manufacturers and their network of sub-contractors, to retailers, customers, dismantlers and breakers. According to the report this organization, as in the case of cars, calls for a principle of collective responsibility.

3) The report notes the absence of recycling branches for certain materials (primarily plastics and glass) and the need for a collective co-ordinated approach to both stimulate technological innovation and set up new cost-effective industries. In particular, it emphasizes two sources of productivity: the organization of collection and sorting, and the responsibility of manufacturers in the design of more recyclable and more easily dismantled products.

4) On condition that these collective efforts are made, the report, with numerous economic simulations to support it, considers that it is possible to meet the recycling objectives without subsidies. It emphasizes the need to maintain competition and a free market system in order to guarantee the effectiveness of the economic system.

5) The report underscores the fact that the success of the framework agreement solution is conditioned by the existence of transparency. In this perspective, the responsibilities of each category of the industry are defined so as ensure the free flow of information.

In this brief analysis four criteria can be found to justify use of the framework agreement model: 1) shared uncertainties and the need for collective learning; 2) a chain of polluters and diffuse pollution; 3) credible threats (fear of regulation) and the presence of large corporations; 4) a fair degree of cohesion and uniformity in the industrial system.

As regards the latter point, even if these industries are strongly concentrated and dominated by a handful of large groups, unlike the automobile industry a considerable part of these markets is held by small Asian manufacturers. According to the report they would be difficult to control and to sanction in case of failure to comply. The report therefore suggests several measures to avoid a fracture in the principle of collective responsibility.

These two examples have enabled us to verify that the framework agreement model is not peculiar to the car industry context. Other examples could no doubt be found in other domains (e.g. water pollution, CO2 emissions since industrialists have themselves proposed a voluntary approach to avoid the use of economic instruments). Hence, the scope of the model still needs to be explored more fully.

CONCLUSION: TOWARDS A NEW MODEL OF STATE ACTION?

The aim of this paper was to show that the new character of environmental questions justifies a dynamic, flexible approach by the State. In particular, the objective of sustainable development makes innovation management the main objective of public action. Whenever the State does not have adequate knowledge to steer an innovation process, it must be able to create favourable conditions for co-operation between industrialists.

We were thus able to show that, in the case studied, the principle of a framework agreement was the most appropriate means for promoting learning and innovation in firms. We showed how this framework agreement was the best compromise for both the public authorities and the industrialists in a context of shared uncertainties where the polluters were difficult to identify, where the industrialists were faced with credible threats, and where the cohesion of the industrial system was sound. We also saw how this agreement acted as a co-ordination mechanism, promoting both co-ordinated learning and exploratory action in firms. Moreover, and more paradoxically, its implementation could gradually increase the State's leeway owing to new knowledge gained by progressively synthesizing the action of the firms. However, it seems likely that this capacity would only be used if the objectives of the framework agreement were not met. By contrast, there is no reason why the fast learners among firms should not demand tougher regulatory measures if they foresee therein the possibility of a competitive advantage and wish to exploit it.

Through this case we see the outline of an interactive and dynamic model in which the strategies of public authorities and of firms are formulated simultaneously and condition one another. This model helps to explain why and how the content of public policies evolves in tandem with the know-how of firms. In this dynamic perspective, the choice of an instrument (voluntary agreement for instance) has meaning only in relation to the regulatory context in which it is situated.

Apart from the case studied here, what would have happened without State intervention? Without this intervention, how can new value criteria emerge and which mechanisms guarantee co-ordination between the different learning processes? Although these questions are the focus of numerous research studies on the origins of innovation and new markets (the evolutionary current or the sociology of innovation, for example) they remain largely open. This type of study can help us to understand, apart from State intervention, the mechanisms which can be used to stimulate and co-ordinate collective learning. It can therefore also help us to interpret the more spontaneous processes of innovation and market creation.

REFERENCES

Abernathy W.J. and Utterback J.M. (1975), "A dynamic model of product and process innovation", *Omega*, vol.3, no 6.

Akerlof G.A. (1970), "The market for 'lemons': Qualitative uncertainty and the market mechanism", *Quaterly Journal of Economics*, 84; 488-500.

Aggeri F., Hatchuel A., Lefebvre P. (1994), "Shared uncertainties in the regulatory process", in Sorensen K.H. (ed.), *The car and its environment: the past, the present and the future of the motor car in Europe*, Brussels: European commission, Social sciences, pp.256-272.

Aggeri F. et Hatchuel A. (1996), "Managing creation and diffusion of new expertise in automobile development", *IRNOP Conference*.

Arthur W.B.(1988), "Competing technologies: an overview", in Dosi and Alii (eds.), *Technical change nd Economic Theory*, Pinter publishers.

Becker G. (1983), "A theory of competition among pressure groups for political influence", *Quaterly Journal of Economics*, XCVIII.

Clark K.B. (1985), "The interaction of Design Hierarchies and Market Concepts in technological evolution", *Research Policy*, Vol.14, 00.235-251.
David P.A. (1987), "Some New Standards for the Economics of Standardization in the Information Age", in Dasgupta and Stoneman (eds.), *The Handbook of Natural Resources and Energy Economics*, Cambridge University Press.
De Bandt J. and Gadrey J. eds. (1994), *Marchés de service, relations de service*, CNRS éditions Paris 1994.
Foray D. (1993), "Standardisation et concurrence: des relations ambivalentes", Mimeo, Ecole Centrale Paris.
Glachant M. (1993), *The setting of voluntary agreements: bargaining and efficiency*, CERNA/Ecole des Mines de Paris.
Glachant M. and Whiston T. (1996), "Voluntary agreements between industry and governments" in *Environmental policy in Europe - Industry, Competition and the Policy Process* -Edward Elgar.
Groenewegen P. and Den Hond F. (1993), "Waste in the automotive industry: technology and environmental management", *Business Strategy and the Environment*, n°1, 1993.
Hatchuel A. (1994), "Apprentissages collectifs et activités de conception", *Revue Française de Gestion*, juin-juillet-août 1994.
Hatchuel A. et Weil B. (1995), *Experts in Organizations,* Walter de Gruyter.
Hourcade J.C., Salles, Théry J.M. (1992),"Ecological economics and scientific controversies: lessons from recent policy making in the EEC", *Ecological Economics* Vol 6, pp.211-223.
Ikwue A. and Skea J. (1996), "The energy sector response to European combustion emission regulations" in *Environmental policy in Europe - Industry, Competition and the Policy Process* -Edward Elgar.
Katz M.L. and Shapiro C. (1985), "Network Externalities, Competition and Compatibility", *American Economic Review*, 3 (75).
Laffont J.J. and Tirole J.(1991), "The politics of government decision-making: a theory of regulatory capture", *Quarterly Journal of Economics*, vol. CVI., n°4, 1091-1127.
Lascoumes P. (1990), "Un droit de l'environnement négocié, volet discret d'une politique publique", Mimeo PIREN-CNRS.
Leveque F. (1996), in *Environmental policy in Europe - Industry, Competition and the Policy Process* - Edward Elgar.
Leveque F. and Nadai A. (1995), " A firm's involvment in the policy-making process", in H.Folmer, H.Opschoor and H.L.Gabel (Eds.)*, The principles of Environmental Economics : A guide for Students and Decision makers*, Aldershot: Edward Elgar.
Midler C. (1993), *L'auto qui n'existait pas*, Inter-éditions.
Milgrom P. and Roberts D. (1992), *Economics, Organization, and Management*, New Jersey, Prentice hall, Englewood Cliffs.
Moisdon J.C. et Weil B. (1992), " L'invention d'une voiture : un exercice de relations sociales", *Gérer et Comprendre*, Annales des Mines, septembre, pp. 30-41 et décembre, pp. 50-56.
Nakhla M. et Soler L.G. (1994), "Contrats internes, coordinations et pilotage économique de projet", *Cahiers de recherche* CGS, Ecole des Mines de Paris.
Nelson R. and Winter S.G. (1982), *An evolutionary theory of economic change*. Cambridge, Mass.: Harvard university press.
Peltzman S. (1976), "Toward a more general theory of regulation", *Journal of Law and Economics*, XIX.
Ponssard J.P., Tanguy H (1993)," Planning in firms as an interactive process", *Theory and Decision* 34, 139-159.
Stigler G. (1971), "The economic theory of regulation", *Bell Journal of Economics*.
Tirole J. (1994), "The internal organization of government", *Oxford Economic papers*, n°46, pp.1-29.
Willinger M. and Zuscovitch E. (1988), "Towards the economics of information-intensive production systems: the case of advanced materials", in *Technical change and economic theory*, Pinter Publishers.