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Environmental policies and innovation
A knowledge-based perspective on cooperative approaches

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Abstract

The purpose of this article is to analyse the growing interest, in the field of the environment, for new cooperative approaches that make use of negotiated instruments such as voluntary agreements. Using an interpretation framework that puts the emphasis on collective learning and monitoring devices, we highlight the value of this type of approach in situations of great uncertainty where a coordinated process of innovation is required to achieve ambitious environmental targets. The implementation of this theoretical approach in the end-of-life vehicles (ELV) case, which has been the subject of several voluntary agreements in Europe, offers a fuller understanding of the characteristics and driving forces of the collective innovation process in action, as well as the obstacles that have still to be overcome. In particular, we explain why monitoring of innovation by the authorities, focusing on coordination mechanisms, is a crucial issue on which further research should be carried out.

Keywords: Environmental policies; Innovation; End-of-life vehicles (ELV); Voluntary agreements

1. Introduction

In the field of industrial environment, public intervention hovers between a command and control approach, through regulations, and a market-based approach that includes the use of economic instruments such as incentive taxes and tradeable permits. In the past few years, a third option has emerged (Dente, 1995), based on cooperation with firms and incorporating new criteria (prevention, the 'polluter pays' principle) and new instruments (voluntary agreements). This third way has now been adopted by the European authorities [1] in dealing with global environmental problems, such as the greenhouse effect, waste and ozone, for which innovative measures are necessary to achieve the goal of sustainable development.

Paradoxically, this new cooperative approach has received little attention from social science researchers. While an increasing number of theoretical and practical studies of economic instruments such as environment taxes and tradeable permits are being undertaken, there has been little work on the details of negotiated agreements [2], and those who have

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[1] See the 5th European Action Programme approved in 1992, or the Environmental Management Act signed in The Netherlands in 1993.

[2] The proceedings of a conference organised by the Enrico Mattei Foundation (Economics and Law of Voluntary Agreements, Venice, 1996) provide a fairly exhaustive overview of the work carried out on voluntary agreements.

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examined the subject often take a critical view: sometimes such measures are said to lead to a weakening of the initial targets due to pragmatic arguments (Godard, 1998), or even to regulatory capture; sometimes it is claimed that methods in use for some time are being brought to the forefront as evidence of rational management that has been extended to the administrative sphere (Lascoumes and Valluy, 1996).

How then can increasing interest from the authorities be explained? What are the first observable results of the approach? How effective is it compared to command and control or market-based approaches? What are its limitations?

The study of these new cooperative approaches means, in our opinion, extending the traditional framework for evaluating public policy, according to which regulatory processes are regarded as purely political in nature, the result of pressure and negotiations, between defined actors or interest groups with clearly defined strategies. We will argue that this restrictive viewpoint is unsuitable for evaluating situations of great uncertainty, involving long periods of time and involving the wide range of actors and controversial issues typical of contemporary environmental problems. We will attempt to show that in such circumstances, cooperation and collective learning are also at work at different levels (between companies, inside companies), and that they influence discussions and the content of public policy. In other words, in order to understand the nature and implications of the discussions taking place in the political arena, it is essential to evaluate what is going on elsewhere, in the construction of new knowledge, new organisations and new forms of economic relations.

This dynamic, interactive view of public policy has major repercussions on the role that the State can play in this type of process. In particular, once collective innovation is regarded as the chief means of achieving ambitious environmental targets, with the authorities forced to abandon their traditional role of unilaterally imposing a regulatory framework because they lack the necessary knowledge, we consider that the issue of public intervention is no longer one of defining, implementing and controlling measures, but rather one of coordinating innovation. It is an active form of coordination that takes account of technical and economic advances and seeks to identify obstacles that could threaten the innovation process. This fresh outlook calls for changes in the way public policy is viewed. In order to move forward, we will suggest an evaluation framework and concepts that are more suited to the study of current environmental policies, and we will examine how these may be implemented in a specific case that we have studied.

We shall organise these elements according to the following plan: after describing the new forms of cooperative approaches that may be observed nowadays and their rapid growth in Section 2, we shall look back over the theoretical debates that have arisen over this approach in Section 3. Then in Section 4, we shall put forward a theoretical framework and concepts that are appropriate for studying this approach. In Section 5, we will use this framework to evaluate the end-of-life vehicles (ELV) case study, before drawing conclusions in Section 6 about the value and limitations of this approach where environment problems are concerned.

2. New cooperative approaches: from implementation-oriented VAs to innovation-oriented VAs

Whether they call them voluntary agreements, branch contracts, conventions or charters [3], several authors (Glachant, 1994; Lascoumes and Valluy, 1996) underline the importance of the various forms of negotiated agreements introduced in industrialised countries. However, negotiation is not an appropriate term to qualify these forms of collective action since negotiation with stakeholders is a permanent feature of every public policy. What really characterises them is the preeminence of a horizontal cooperative process in which firms are partners, even if they are considered as polluters. This process includes an important step which is the signing of a contract (convention, charter, voluntary agreement, etc.) ratifying the agreement between the two parties and describing their reciprocal commitments. It is followed by a monitoring process involving various resources (norms, instruments, essays, reports, etc.).

[3] For a taxonomy of these agreements, see Lascoumes and Valluy (1996) or Lévèque (1996).

From a quantitative viewpoint, the European Environment Protection Agency lists in a recent report [4], over 300 agreements in force in the European Union (EU) in 1996, 40 of them signed during 1996 alone, compared to only about 10 in 1986, with a large number signed in two countries: The Netherlands (120) and Germany (100). These figures may be compared to the 180 economic instruments (taxes, tradeable permits, etc.) counted in the EU in 1997 (Sprenger, 1997).

2.1. First period: hygienism and compromise

Besides this quantitative growth, it is worth pointing out a qualitative change—rarely highlighted—which has occurred during the last 10 years and which concerns the legal status, legitimacy, content and problems treated in these agreements. As regards their legal status, the first voluntary agreements signed at the beginning of the seventies, at the time of the beginnings of environmental agencies, make sense in a context where this new institutional actor had to deal with a deficient legal framework, where sanctions were not dissuasive enough and where the means of control were limited (see Lascoumes, 1994). In such a context, where the definition, setting and control of regulation was too difficult, a cooperative approach made it possible to avoid obstruction by firms, by transforming them into partners of the regulatory process. Besides being more flexible, this approach was supposed to accelerate the signing of agreements, given that environmental agencies had an urgent need for concrete results to establish their credibility vis-à-vis other public agencies.

Finally, as regards the problems to be dealt with, we could say that most of them adhered to a 'hygienist perspective', which means that their aim was to combat acute and localised pollution and identifiable polluters, where urgent intervention was required. The first agreements signed in France during the seventies and eighties, concerning air pollution by cement and chemical plants, used waters from tanneries and sugar refineries, and asbestos, fell into this category.

With regards to their content, these agreements were mostly local, negotiated without transparency, with neither quantitative objectives nor clearly defined responsibilities. They were also collective, at a branch level, and did not contain burden-sharing mechanisms although it would have been possible to imagine, in principle, individual targets and sanctions since abatement technologies and costs were generally well known. The absence of individual targets may stem from the fact that public authorities did not have the means to impose a solution rejected by firms, and therefore preferred to negotiate an agreement which had a better chance of being implemented. [5] We suggest calling these agreements the 'implementation-oriented voluntary agreements', where pollution is localised, uncertainty is low and their degree of application the main goal pursued by public authorities.

In this context, voluntary agreements shall be considered as forming part of an 'accommodation strategy' (Padioleau, 1988) which tried to overcome the shortcomings of public action, even though they were considered as illegitimate compared to the 'command and control' model. This may explain why this cooperative approach was practised very discreetly for a long time (Lascoumes, 1994).

2.2. Second period: the emergence of a new form of cooperative approach

New cooperative approaches are distinct from the previous ones on the following points.

2.2.1. The emergence of an environmental philosophy and law

While previous agreements were made on the fringes of a deficient legal framework, the most recent agreements exploit the resources offered by new stricter laws. Thus, national or European laws

[4] 'Environmental agreements—Environmental effectiveness', Environmental Issues series No. 3, Vol. 1, European Environmental Agency, 1997, Copenhagen.

[5] Padioleau analysed the first negotiations between the French Environmental Agency and the cement industry in 1971. The agency stimulated the negotiations because the anterior regulation was not applied. With the agreement of the firms, the negotiation ended with a legal formalisation: the decree of the 25 of August 1971 (Padioleau, 1988).

(European Act of 1986, Environmental Management Act in The Netherlands of 1993, the French Law on Waste of 1992, etc.) define the civil liability of polluters, tighten sanctions and introduce several fundamental notions such as: the polluter-pays principle, the prevention principle, the reduction at the source principle, the precaution principle, the proximity treatment principle for waste, the notion of ultimate waste, etc. This new vocabulary, which suggests a new philosophy of the general interest, allows for a harmonisation of the content of voluntary agreements. As regards the more coercive aspects of these laws, they help to reinforce alternative measures (credible threats) that might be taken by public authorities if the agreement is not respected by firms.

2.2.2. A progressive legitimation of practices

Although it was enforced in a clandestine manner, this new cooperative approach has now acquired the status of doctrine in several European countries. The Netherlands is probably the one that has gone farthest in this respect. [6] As part of the National Environmental Policy Plan of 1989, it is planned to systematically introduce negotiated agreements with manufacturers in 13 industrial branches, representing 12,000 companies. Bressers and Plettenburg (1997) reported that in 1997 9 out of 13 sectors had reached negotiated agreements. At European level, the 5th Action Plan drawn up by the DG XI (1992) provides for negotiations with civil sectors and manufacturers as well as the use of voluntary agreements as an alternative to more traditional instruments. A recent communication by the European Commission (1996) gives an account of the value of such agreements and of the conditions that should be fulfilled to improve their effectiveness. The report points to three main advantages: (i) agreements encourage a proactive attitude on the part of industry, (ii) they are conducive to the adoption of effective, tailor-made solutions, and (iii) they enable targets to be achieved more rapidly. Nonetheless, the report states that not all voluntary agreements have met with success in the past. Some points, in particular, may be regarded as critical: the determination of the authorities to pursue clear environmental targets, the extent to which it is possible to enforce the agreement, the existence of sanctions, and the ability to discourage temporary clandestine behaviour. In order to improve the effectiveness of the agreements, the report suggests that they should be drawn up as follows: they should be preceded by consultations; they should be the subject of a contract between the authorities and manufacturers; companies should set out their quantitative targets in accordance with a predefined schedule; the obligations of all those concerned should be laid down; the agreements should also specify how monitoring is to be carried out; and the outcome of the agreement should be published regularly and openly.

2.2.3. The influence of the doctrine on the forms of the agreement

Unlike the first agreements signed in the 1970s and 1980s, which were often local in scope and seldom set out quantitative targets or clear responsibilities, the most recent agreements signed in Europe [7] would appear to be more in keeping with the European Commission's wishes. The shift in negotiated regulation towards greater transparency and formality is clearly a consequence of the legitimacy it has managed to acquire with the authorities in recent years. It is interesting that this doctrine directly influences the practices of the member states as simultaneous processes are taking place at national and European levels. As we shall see further on, in the case of ELVs, this competition between national and European laws is a strong incentive for member states to propose solutions in line with the European Commission's wishes, in the hope of influencing the final content of the agreement or directive.

[6] In fact, the position of public authorities vis-à-vis cooperative approaches differs widely from one country to another, with more widespread use of voluntary agreements and a clearer doctrine in northern Europe (Denmark, Germany, The Netherlands, Sweden) than in southern Europe or Great Britain. In France, for instance, there are contradictory debates within the French Environmental Agency on the opportunity of this approach.

[7] These include the agreements signed by member countries over the recycling of waste packaging, ELV processing, and the reduction of carbon dioxide emissions.

2.2.4. A new class of environmental problem

Although the earliest agreements formed part of a 'hygienist' approach, a large number of new agreements [8] now deal with diffuse pollution, of which the scope and effects are controversial, which is seldom spotted directly, and is usually identified through a large number of intermediaries (experts, government bodies, professional organisations), and which represents risks that must be prevented. In particular, this is the case of VAs dealing with waste recovery, cross-border water pollution, CFC reduction and recycling. The consequences of this change are crucial: whereas in the former case the identification of polluters and of the Best Available Technologies and costs was quite easy, in the latter it requires an important process of innovation. In this context, setting individual targets makes no sense since the key issue is not to diffuse the BAT within an industrial sector, but rather to coordinate complementary efforts to invent new technologies and organisations. We suggest calling these agreements the 'innovation-oriented voluntary agreements', where pollution is diffuse, uncertainty is high, and innovation becomes the central feature. We shall revert to this point later.

3. Contradictory theoretical debates

Apart from a few recent studies [9], cooperative approaches and voluntary agreements have received very little attention. From a normative viewpoint, law or economic theories ignore this approach as an alternative solution to the 'command and control' or economic incentive approaches. From a positive viewpoint, various statements or even criticisms are directed at it, thus minimising its generality and efficiency.

3.1. Criticisms of cooperative approaches

3.1.1. Normative arguments

In the normative tradition of law and economics, environmental norms must be the expression of the general interest. They are produced and imposed by public authorities. In the first works of welfare economists, state intervention is legitimate for remedying market failures, negative externalities in the case of the environment. In a context of perfect information, these externalities can be corrected either by means of norms or taxes. Two assumptions in this approach have often been criticised: (i) the hypothesis that governments are 'benevolent maximizers of social welfare', (ii) the hypothesis that public authorities have perfect information on abatement costs.

Unlike these first works, the most recent ones reason in an imperfect information framework, in the situations of uncertainty which characterise the new environmental problems. In this context, they suggest the use of incentive taxes (Weitzman, 1974) or the introduction of tradeable permits (Baumol and Oates, 1988) which are supposed to be more flexible than norms. The argument for taxes is easy to understand: as soon as the problem becomes complicated (large number of polluters, uncertainty about costs and technical choices), it is better to reach agreement on a flexible rule which it is easy for all parties to observe, and which can easily be adjusted depending on the results achieved, rather than laying down a set of standards that are very difficult to impose and monitor. Moreover, it has been shown that taxes are more effective if they are accompanied by compensatory mechanisms (reductions in direct and indirect taxation to make up for the tax collected). Several authors, such as Hourcade (1998), maintain that a tax which is 'recycled' produces a 'double dividend': improving both the environment and employment if, for instance, recycling helps to reduce a company's social security contributions, enabling it to take on more staff. In this perspective, taxation appears also as the better solution for innovation because every

[8] However, we note that many voluntary agreements still deal with localised pollution. That is the case of most of the agreements relating to process industries' emissions (CO_2, NO_x or SO_2 emissions in the energy sector or chemical industries). In these situations, technical solutions are often known and the key issue is rather that of the diffusion of the Best Available Technologies (BAT) within an industrial sector.

[9] See, in particular, Glachant (1997), Van Dunné (1997), Aggeri and Hatchuel (1998).

firm will be incited to innovate since, for a given level of pollution, its abatement costs are higher than the tax it has to pay and since no technology is available on the market.

3.1.2. Positive arguments

Sociologists, political scientists and industrial economists have stated that the forms of public intervention are often far from theoretical models. The 'command and control' and incentive approaches conceal negotiation with firms, particularly in fields like the environment, security or labour, where regulations try to take into account a complex and changing reality, although the available knowledge is generally lacking. Whatever its form, negotiation is often considered with caution because it is supposed to lead to a suboptimal solution.

In this perspective, the following three explanations are usually put forward in social science literature to account for the growing interest in cooperative approaches expressed by public authorities.

3.1.2.1. The pragmatic explanation. The first is that it is justified on pragmatic grounds: the state does not have sufficient knowledge, means of control or sufficiently dissuasive sanctions to apply laws or regulations. Taking this view, negotiating should be regarded as striking a bargain: the state gives up its power of constraint in exchange for the commitment from industrialists to respect the objectives negotiated in common (Winter, 1985; Lascoumes, 1994).

3.1.2.2. The regulatory capture explanation. The second explanation denounces negotiation: this is the regulatory capture theory found among both economists (see Stigler, 1971; Laffont and Tirole, 1991) and sociologists (see Brénac, 1988). Their research suggests that negotiation serves private interests. As there is a high risk of collusion between government agents, elected representatives and firms, negotiated agreements would be distorted in favour of the most active interest groups. Regulatory capture can result in long, drawn-out negotiations that either lead to a weakening of the initial targets (Lévèque, 1996) or end in no agreement at all (the so-called 'smokescreen' strategy), in initial targets which do not provide sufficient incentives and which therefore guide the innovation process in a suboptimal trajectory (Godard, 1998; Serré, 1998) [10], or in measures that protect the interests of companies (subsidies, entry barriers, etc.).

3.1.2.3. The illusion of novelty. The third explanation questions whether this type of approach is really innovative (Lascoumes and Valluy, 1996). In this perspective, what is new is the growing interest of social science researchers in negotiated agreements, focusing more attention on them, as well as a large-scale trend for introducing management-style practices into the running of government bodies, stressing the principles of efficiency and cooperation to the detriment of traditional legal rationality, based on the rule of law. According to this viewpoint, the change would be mainly ideological: changing practices and values making it easier for public actors to claim that they are using these methods.

In all three cases, cooperative approaches lead at best to an agreement that is acceptable to industrialists, at worst to an agreement which serves private interests to the detriment of the general interest. In no instance can it be a credible or effective alternative to traditional forms of intervention (regulations, economic instruments).

3.2. Discussion: the consideration of the nature of problems and collective learning processes

The arguments put forward in these works cannot be ignored. It is impossible to deny either the pragmatic aspect, nor the managerial rationality that goes alongside the current fashion for cooperative ap-

[10] Thus, in the case of the French Packaging Agreement (Godard, 1998) and the French ELV Agreement (Serré, 1998), the authors question whether the initial targets contained in these voluntary agreements, signed in 1992 and 1993, respectively, offer real incentives. Their argument is that undifferentiated targets, without specific recycling targets, corresponding sanctions and ill-defined responsibilities, have drawn a suboptimal 'institutional trajectory' which explains the current results, regarded as limited, and the dominance of incineration with energy recovery over recycling. They express regret at the lack of stronger incentives in the agreements which might have made better results possible, although they do not specify what these incentives might be.

proaches, nor the risk of capture which threatens any negotiation process.

Nonetheless, we are also forced to observe that the arguments brought in to compare cooperative approaches on the one hand and legislative controls or economic instruments on the other are unbalanced. The presumed shortcomings of cooperative approaches are set against the theoretically proven benefits of legislative controls or economic instruments, while no mention is made of the fact that the way these are put into effect usually has little to do with theoretical forecasts; that negotiation is also used, that there are problems with control and enforcement, and that, more often than not, the results are disappointing (see the OECD, 1994 report).

It should also be emphasised that the politics of cooperative approaches are very controversial because they take a long time to show the expected results and because the first signs are difficult to spot and to interpret. Around these weak signals, it is mainly two representations of public policy which come into conflict. The traditional one, largely dominant in social sciences, consider the political process as mainly driven by power relations between public authorities and firms. [11] Beyond what differentiates works in economy, sociology or policy science (methodology, role of culture and social relationships, rationality of actors, etc.), at least four common assumptions can be identified: (1) the actors (the authorities, elected representatives, interest groups) are regarded as homogenous categories whose influence is in line with the size and homogeneity of the group (Olson, 1965); (2) each group of actors has information which they attempt to hide from the others (asymmetry of information); (3) the actors have a strategic overview of the process in which they are involved, i.e., they are presumed to have relevant information that enables them to establish preferences and pinpoint risks and opportunities; and (4) the analysis is focused on what is going on in the political arena, i.e., on the arguments traded and compromises reached between the authorities and company representatives.

[11] This representation refers, among other works, to the *institutional rational choice* models.

In our opinion, two main criticisms can be made of these interpretations [12]: (1) They tend to overestimate the cognitive and strategic capabilities of organisations, firms, in particular, while they are also crossed by contradictory debates and conflicts, and therefore the emergence of shared beliefs is never given for granted. (2) They focus on power relations between public authorities and firms, yet pay no attention to the subject matter of those relations or to the current state of knowledge, which we believe to be vital starting point. In fact, we believe that the forms of public intervention will be different, depending on the nature of the problems to be dealt with and the knowledge available at different points in the negotiation process.

3.2.1. The nature of problems and its effects on policy making

It is difficult to explicate the debates around cooperative approaches without taking into account the nature of the environmental problem (diffuse or localised pollution, level of uncertainty).

As long as environmental policies formed part of a 'hygienist' approach, the explanation in terms of power relations had a degree of relevance: it was a question of combating acute, localised pollution and identifiable polluters with existing technologies and costs that could be evaluated (oil slicks, dioxins, asbestos, illegal dumping, toxic smoke, etc.). When a crisis occurs and urgent intervention is necessary, legislation appears to be the most appropriate response if it is possible to enforce it. Indeed, it might be assumed that in such cases the information needed to lay down regulations (setting targets, measuring methods, sanctions) would be available. On the contrary, however, voluntary agreements are difficult to justify in these circumstances, except to make up for

[12] This point of view is in line with recent works which aim at developing a dynamic and interactive view of public policies. Among these works, the Advocacy Coalition Framework (Sabatier and Jenkins-Smith, 1993) proposes a very stimulating framework putting forward the cognitive limitations of actors and explaining the dynamics of public policies through the progressive construction of coalitions shaped by belief systems. However, as we will see it further, there are differences between this approach and the one we propose in this paper. In particular, we suggest to focus much more on monitoring devices and collective learning processes, paying also more attention to internal relationships within firms.

the shortcomings of the authorities that have neither the will nor the resources to enforce the law. There is no reason why such agreements, which we describe as 'implementation-oriented voluntary agreements' (see Table 1), should yield better results than those which could have been achieved through other means (taxes or standards).

Since the end of the 1980s, the state has been increasingly reluctant to intervene on matters of this nature. A new set of problems emerged as 'sustainable development' became the catch phrase for environment policies in industrialised countries. This philosophy may be summarised as follows: conservation of the environment should no longer be sacrificed to economic growth; rather, the two should be reconciled. In order to achieve this, short-sighted 'corrective' policies are no longer enough. Forward planning is also required, coupled with long-term preventive measures aimed at changing definitively the behaviour of economic actors. Whereas in the past, state intervention took place in a stable setting where uncertainty and controversy were limited, it increasingly occurs in 'controversial universes' (Hourcade et al., 1992) where, at the start of the process, there is enormous confusion about the nature and scope of pollution, the identity of the polluters, the validity of scientific knowledge and therefore about the solutions that should be implemented. The solution to these controversies cannot be envisaged without cooperation between various actors (scientists, manufacturers, representatives of civil society) [13] over long periods of time (often several decades), and at the cost of considerable effort regarding innovation.

Two kinds of innovation may be at stake and it is important to distinguish them since they involve different dynamics and consequences for public policy. On the one hand, we have end-of-pipe innovations (new depollution techniques for plants, catalytic converters for cars, waste water plants, etc.) which aim to solve localised pollutions without changing the core process technology. On the other hand, we have 'innovations at the source' [14] (cleaner technologies, recycling channels, green products, etc.) which aim at reducing pollution by reengineering the whole technology or product. In the former case, the change is very limited and the key issue is that of diffusing the best available technologies throughout an industry, once they have been developed. In the latter, the change is much more important, and may concern a wide range of actors, organisations and technologies since many problems are tackled on an international scale and require an extensive cooperation between heterogeneous actors. In such circumstances, monitoring focusing on coordination is necessary to stimulate cooperation, and to prevent local actions from leading to incompatible choices, controversies from being continually rehashed, and opportunistic behaviour from threatening the whole process. [15]

Depending on the nature of the problem and innovation, the requirements of public intervention will change. For localised pollution, which mainly relates to end-of-pipe innovation, diffusion of new technologies will not require a coordination scheme as much as strong individual incentives and/or sanctions. In this respect, we witness an extensive use of economic instruments and regulations in process sectors where this problem is dominant (energy efficiency, plant emissions, waste incineration plants, etc.). In these cases, we can assume that once a voluntary agreement, which we will consider as implementation-oriented, is signed, there is always the idea that an economic instrument or regulation could have given better results.

By contrast, for diffuse pollution which mainly relates to innovation at the source, we may assume that the larger the number of actors involved and their heterogeneity, the larger the number of transfor-

[13] Callon and Rip (1991) have shown situations where there is extreme confusions over the facts and a large number of conflicting values (mad cow disease, the hole in the ozone layer, etc.), the best way to resolve the many controversies that may arise here is to involve as many parties concerned as possible in drawing up social and technical standards in what the author describes as 'hybrid forums'.

[14] Most of the normative economic works refer implicitly to end-of-pipe innovation, modeling situations in which innovation is seen as individual process in which each firm is setting its own strategy independently from the others.

[15] In some cases, both types of innovation may be required. Nevertheless, one type is often dominant.

Table 1
Innovation-oriented VAs vs. implementation-oriented VAs

	Implementation-oriented VAs	Innovation-oriented VAs
Nature of the environmental problem	localised pollution	diffuse pollution
Level of uncertainty	low	high
Key issue	diffusion of BAT	innovation at the source
Nature of monitoring	control	coordination

mation stages and the higher the level of uncertainty, the greater the need for a strong coordination scheme will be. Economic instruments, however, produce strong incentives but provide no indications on which technological paths should be explored. By contrast, voluntary agreements, at least innovation-oriented ones, which provide weaker incentives, mostly indirect incentives through regulatory threats, generally include a stronger coordination scheme (quantitative objectives, designation of responsibilities, know-how transfer rules, monitoring scheme) and they therefore seem a priori well adapted to this situation. Moreover, their implementation may be completed by economic instruments in the case of a lack of incentives.

3.2.2. Innovation-oriented VAs and collective learning processes

It is against this specific background that the gradual formalisation of a new cooperative approach should be interpreted, enabling to better stick to the requirements of cooperation and the uncertainties that inevitably arise from innovation. We shall highlight the effects of this new doctrine using the example of waste valorisation, which was regarded as a priority issue by the European Union at the start of the 1990s, one that could be broken down by sector into several areas (household waste, hospital waste, building industry waste, used vehicles, etc.). One of the first issues in any government intervention is to determine what is in the general interest, and therefore what kind of targets should be set, and at what level. In this case, pinpointing the general interest was not self-evident. Of course, there was general agreement on the fact that dumping had to be reduced, but the debate on waste valorisation suggested that not all methods are good ones: was it better to promote recycling or incineration with energy recovery? At what level should targets be set, and what form should they take? Was it advisable to set different targets for different materials? At the start of the 1990s, no one was in a position to reply to those questions because not enough information was available: there were no recycling networks, no organised waste sorting and collection, virulent arguments divided the supporters of incineration, dumping and recycling, and no expert was able to provide a satisfactory answer. In other words, finding out where the general interest lay meant conducting investigations, which gave rise to learning processes, thanks to which it would be possible to gradually reveal what was at stake, to put preferences in some sort of order and to set targets for dealing with waste.

Having said that uncertainty does not mean that it is impossible to set targets. Indeed, any proposed innovation requires the setting of joint targets, focal points around which the actors can coordinate. To put it simply, these targets, set in a conventional manner, must be identified as such by all parties, and they must accept the risk that an initial error of orientation may occur and agree to the principle that the agreement may be revised when new information comes to light. [16] In such circumstances, a flexible negotiated approach, such as a voluntary agreement, may be justified when they are devised from the start as schemes for learning and for monitoring innovation, and not as an inviolable contract. We will

[16] In a situation of strong uncertainties, it is easier to understand how it makes little sense whether or not incentives are tied in with the initial targets. An examination of the incentive content in recent research (Godard, 1998; Serré, 1998) on the French packaging and ELV examples show, in our opinion, an attempt to rationalise the situation after the event, whereas when the agreements were signed, no one was in a position to evaluate what the optimum level of dealing with pollution was. Other works on these two agreements (Glachant and Whiston, 1996; Aggeri and Hatchuel, 1998) lead to other conclusions. They highlight the number of experiments carried out which made it possible important collective learning.

describe as 'innovation-oriented voluntary agreements' those which take this dynamic perspective, with the agreement regarded not as an end in itself, but a means of acquiring new knowledge and organising the monitoring of a joint innovation process. The main differences between the two types of VAs are summarized in Table 1.

4. Theoretical framework and concepts

4.1. The theoretical framework

In order to analyse this new form of cooperative approach, we have adopted the methodological position of examining the innovation monitoring schemes introduced by the authorities and by companies, and studying how they were devised and subsequently altered. We shall return to the interest of this approach later, when presenting the case of recycling. At this point, we wish simply to recall two reasons for this choice which follows.

Firstly, the question of monitoring seems to us to fit in with the problems of coordination. Our theory is that without active and coordinated monitoring of the innovation process, it has every chance of never achieving its goals because it will be continually torn between incompatible world views.

Secondly, the decision reflects our view of joint action in a situation of innovation. In our opinion, collective learning is always threatened by the profusion of trajectories to be explored and by the existence of different representation frameworks from one actor to another. When the degree of uncertainty is significant, incentives are not enough to guide action, and learning is not merely the fruit of mutual contacts. In fact, collective learning works, more often than not, because of schemes that make it possible to pool knowledge, providing points of reference and enabling action to be oriented.

With this in mind, we shall define the monitoring schemes as a way of organising categories, rules, instruments and 'framing' (Callon, 1998) aimed at affecting action. A law, contract, standard or working group may be regarded as a monitoring device in the same way as a management tool or a norm. In our view, this very broad definition has one major advantage: it enables us to restore the symmetry between the state and firms in examining the relationships between them.

Although it is essential to define the parameters of the possible interactions and promote industrial cooperation, coordinating the various devices always poses problems because the variety of actors involved do not necessarily have any specific contacts outside the innovation process. Each device designed at local level is continually threatened with obsolescence as new information comes to light, the actors adjust their strategies accordingly and the strategies evolve into new schemes. In those circumstances, the coordination of different forms of action and of the innovation process generally can never be taken for granted, so increased vigilance is justified on the part of the authorities, and more generally on the part of all the actors, who are in a position to guide the behaviour of other actors either through their influence in a system of relationships or through respect for their expertise.

This viewpoint, bringing together monitoring devices and collective learning, is in line with current theories, putting the emphasis on phenomena of constructing knowledge in action (Blackler, 1995; Hatchuel and Weil, 1995; Moisdon, 1997). More precisely, we will define collective learning as the process by which actors influence one another, i.e., by which they share knowledge or construct it together, changing their own view of it in the process (see Hatchuel, 1994). We prefer to use the term collective learning rather than organisational learning, because the latter implies that the organisation is the relevant unit of evaluation, which we regard as questionable when examining such diffuse phenomena as innovation. We shall therefore evaluate the environmental innovation process as one that brings together different groups, different 'systems of action' (Crozier and Friedberg, 1977) which interact and help to construct one another.

With this in mind, we plan to distinguish three levels of evaluation (negotiation by the authorities, inter-company relations and relations within companies) by examining through which monitoring devices interactions between the three levels are constructed. For innovation is challenging established borders, knowledge and attitudes: what was yesterday regarded as an externality may no longer be seen in the same light tomorrow if in the meantime new

technical solutions to pollution have been found or if an agreement between polluters and victims of pollution is reached; asymmetries of information change at the same time as the relative learning speeds of economic actors, actors' strategies are constructed along the way, revealing a growing discrepancy between the behaviour of fast learners and free riders; technologies develop and change.

In our opinion, this continual movement of destructuring/restructuring can best be grasped through a dialectic which associates each of the traditional concepts derived from a static, political perspective with concepts that offer a more dynamic view of the process (see Table 2). It is not a question of substituting one perspective for another, but of bringing them together by showing how one can move gradually from a situation of great uncertainty, which can be described in a more relevant way using the concepts listed in the right-hand column, to a situation in which rather more is known and in which the concepts in the left-hand column are more relevant.

4.2. The main concepts suggested

4.2.1. The notion of shared uncertainties

The idea of asymmetries of information refers to the fact that the knowledge possessed by certain actors is not available to the others. In particular, industrialists are believed to have information about technologies and the costs of clearing pollution which the authorities could not know about. In our opinion, this theory, which is at the heart of agency theory, is unfounded in innovative situations where there is considerable uncertainty, asymmetries only exist where a field of action has already been explored, the range of technical and economic options is clearly understood, and all parties can evaluate their specific interests and come up with an appropriate strategy.

In the case of recycling, we described as 'shared uncertainties' (Aggeri and Hatchuel, 1997), the situation that prevailed at the start of the process and explained that when it was not possible to clearly identify opportunities and threats, each party took the risk of cooperating at first in order to find out a bit more. Indeed, the innovation process provided an opportunity to gradually lift those uncertainties. In the beginning, the actors have an interest in cooperating in order to discover new opportunities and to avoid intervention by the authorities. Later, as information emerges and leads to the development of technologies, new opportunities come to light. Naturally, manufacturers who have identified those new sources of income will tend to want to protect them by failing to reveal certain information. Thus, asymmetries of information will gradually be built up, not merely between manufacturers and the authorities, but also among manufacturers. From then on, the initial cooperation process will be reshaped and groups in competition with one another may emerge.

Table 2
The dialectics of environmental innovation

Political perspective	Innovation perspective
Competition	learning, cooperation
Free riders	fast learners
Information asymmetries	shared uncertainties
Best available technologies	technological progress
Implementation	innovation
Control	coordination
Static efficiency	procedural efficiency

4.2.2. The notion of fast learner

This differentiation process led us to distinguish two types of behaviour among the companies we studied: that of free riders and that of fast learners. Economic theory has for a long time incorporated the free rider into its models: this character sees danger everywhere and pretends to take action while trying to benefit from the actions of others. On the other hand, economists have not paid much attention to the 'fast learners', who have done a lot of experiments, found new opportunities and want to make the most of them. These two characters are necessary to make sense of strategies and the choice of alliances. They enable us to understand why the relative speed of learning is a central criterion in the innovation process. Fast learners can be incorporated into the model in three stages. Firstly, we have to highlight the activities of 'relay actors' (Crozier and Friedberg, 1977) who represent companies in negotiations with the authorities and take part in strategic monitoring concerning the environment. Through their mediation, these actors will play a key role in how the company acquires, more or less quickly, an

idea of the problem which will enable it to work out a strategy. Thus, depending on their standing in the company and their power of persuasion, companies will agree or refuse to be a leader in a new activity. In the second stage, companies have to focus on introducing experiments (investment, cooperation, R&D, etc.) in order to learn faster than their competitors. The final stage involves describing all the monitoring actions (indicators, management charts, contracts, etc.) which the companies have to undertake rapidly in order to channel and later adjust their innovation efforts

4.2.3. The notion of procedural efficiency

This dynamic perspective of environmental policy has significant drawbacks on the way environmental policies can be considered. In a context of radical uncertainties and controversies, there is growing consensus that the question is not a matter of determining optimal solutions but rather of a sequential process of decision-making to provide framing while avoiding irreversible options (Hourcade, 1998). Consequently, as soon as monitoring is considered a key issue, having a great influence on the trajectories that can be taken by firms and on further public decisions, procedural efficiency is considered most appropriate. That does not mean that the initial characteristics of the problem do not have any influence on the final result. On the contrary, depending on the initial level of uncertainty, on the existence of credible threats, on the nature of the relationships within an industrial sector, and on the ease with which polluters can be identified and sanctioned, we may assume that voluntary agreements will have greater or lesser chances of stimulating innovation and cooperation processes among firms. But this initial context is not sufficient to predict the success or failure of this kind of approach.

In this dynamic perspective, putting forward the differentiation of behaviours through relative speeds of learning, and thus the emergence of asymmetries of information, does not mean that we fall into a 'regulatory capture scenario'. Indeed, we assume that if an appropriate monitoring scheme has been built, public authorities will have learnt in the process and will therefore be in a better position to avoid capture and reorient the innovation process if necessary.

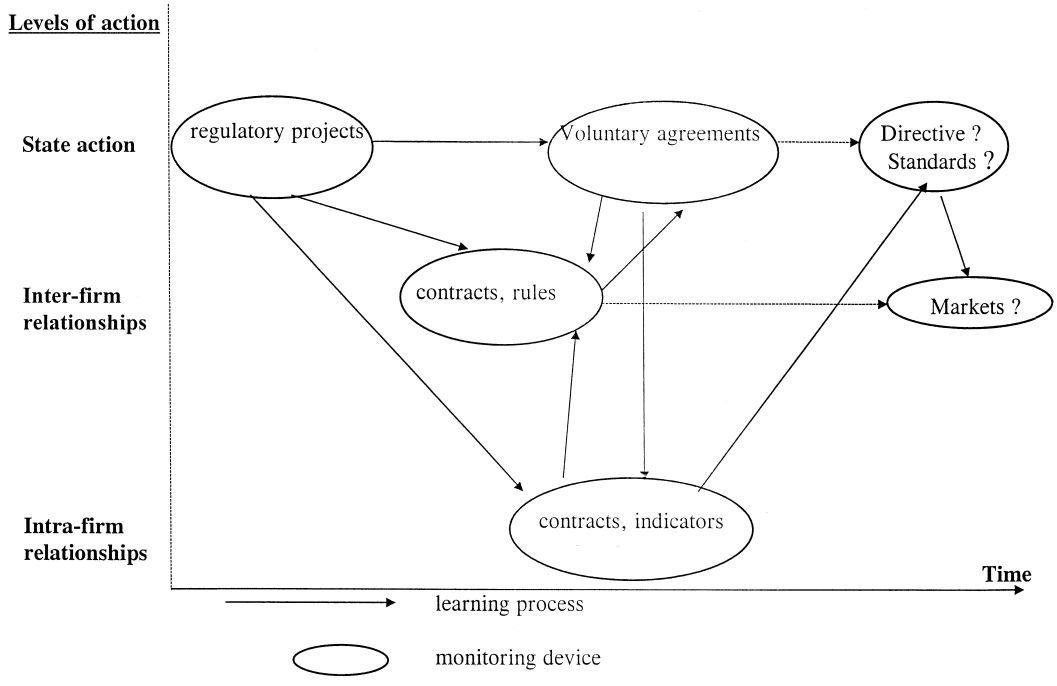

Fig. 1. An interactive model of innovation.

Now let us look at how this interactive model (see Fig. 1) is being put into practice as part of a 5-year research project at Renault on the subject of recycling end-of-life vehicles (ELV). This case seems to us typical, insofar as innovative types of state intervention are combined with new forms of collective learning with a view to creating a new economic model for recycling.

5. The end-of-life vehicles recycling case study

5.1. Initial uncertainties and controversies

The issue of car waste, regarded as a priority at European level since 1990, is the subject of specific study in Brussels, where a working group, bringing together representatives of all the parties concerned (manufacturers from the car industry generally, ecologists, officials of member countries' environment ministries) has been formed. The authorities' aim was to encourage the reduction of car waste at source, promoting clearing and processing (by recycling and other methods) in order to avoid dumping car waste containing heavy or dangerous metals (lead, used oil, chlorine, etc.) which could pollute the soil. For although vehicles are partly recycled (spare parts are removed by car dismantlers, and metals are recovered from shredders for sale to the steel and metal industry), between 25 and 30% of the vehicles' weight, made up of plastic, glass, tires, various fluids and heavy metals, ends up being dumped.

The key issues discussed by the working group between representatives of governments and industry concern: (i) which types of valorisation techniques to encourage (recycling or incineration with energy recovery), (ii) the degree of dumping that should be tolerated, (iii) who should be made responsible for meeting those targets, (iv) how taxation can be used most effectively to finance car waste processing.

From the beginning, all Europe's car manufacturers came out strongly against a project of decree put forward by Germany which set very ambitious targets for different materials for ELVs and made manufacturers solely responsible for ensuring they were met. Meanwhile, a different approach, based on closer collaboration with manufacturers, was introduced in France, leading to the signing of a framework agreement which set out: (1) quantitative processing targets which did not specify the type of technology that should be used (85% for vehicles currently on the roads in 2002, 90% for vehicles sold after 2002), (2) a principle of shared responsibility involving all the actors in the sector, (3) rules for transferring know-how, making it easier to spread information within the network of manufacturers, (4) confirmation of the principle of a free market, without subsidies, (5) the introduction of follow-up committees to check that the agreements are enforced. In February 1996, in place of the initial decree, the German government itself signed a voluntary agreement very similar to the French Framework Agreement. A proposed directive is due to be examined by the European Parliament this autumn (1998).

How can we explain these series of reversals, the changing content of proposed legislative controls, as well as the length of the process? The initial clue to an answer lies in the complexity of the problem to be dealt with. For a start, vehicles are heterogenous in content and are made up of a wide variety of materials (metals, plastic, glass, rubber). Secondly, design developments make them harder to recycle because of new materials being introduced and more built-in parts used which are difficult to dismantle. Thirdly, recycling techniques, collection networks, and sorting and dismantling techniques used to be unknown or only emerging. Finally, responsibilities were difficult to determine because of the number of actors involved in how far a vehicle could be recycled (manufacturers, producers of accessories and materials, breakers, shredders, motorists).

A number of disputes emerged in this respect concerning the technical limits of recycling (was closed-loop recycling—i.e., as part of the same process—possible for plastics? was incineration with energy recovery acceptable from an environmental viewpoint?), how it should be organised (should processing be contracted out? what should the role of manufacturers be? what was the outlook for car dismantlers?), and the profitability of recycling (what extra costs were generated by recycling? should dismantling and recycling be subsidised? should a tax be introduced or should market forces be left to take their course?).

We realised that what was at stake in these various debates was not merely the costs and risks

connected with the development of new technologies, but also the radical change in the 'ELV economy', with the appearance alongside the traditional actors (dismantlers and shredders) of a whole series of new participants (recycling companies and experts, cement industry, haulage companies, manufacturers, the authorities) being called on to help streamline recycling activities through the introduction of new technologies, new working methods and new forms of organisation.

When great uncertainty exists, it is easier to understand why it was difficult for the authorities not only to settle disputes, but also to decide where to set standards that were both technically feasible and financially effective, to allocate responsibility effectively and especially to recommend specific technological solutions.

5.2. Voluntary agreements: devices for coordination and learning

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 have no meaning; each firm would wait for signals from the market and respond to them independently. If this principle has been actively defended, it is because it is entirely consistent with relations among manufacturers in the car industry, who are much closer to the image of a network than to that of a pure, perfect market.

The distinguishing characteristics of the sector are as follows:

– It is an international oligopoly where widespread cooperation exists between manufacturers and where each manufacturer has fairly stable relations with a limited number of major 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 practise intensive joint design of their products.

Hence, price signals are largely completed by a permanent exchange of knowledge and information allowing for a dynamic form of coordination on product quality, technological change and production requirements. In this context, the principle of collective liability makes sense. It recognises the reality of this coordination 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 are the result of negotiations in which each firm is aware of its specific expertise.

5.3. The dynamics of innovation between and within companies

To sum up, the French Framework Agreement prevented companies from undertaking irreversible investments, by setting general processing targets and not specifying which type of technology to use (recycling or energy production), and gave them time to look into each technico-economical solution in greater depth while at the same time sending a clear message to economic agents. Moreover, the principle of joint responsibility meant that opportunist behaviour was restricted, and all participants in the car industry were encouraged to feel that the problem concerned them. In this way, the signing of the framework agreement in companies was decisive in bringing the question of recycling into focus. Until an agreement was signed, recycling was a matter for the experts responsible for negotiating with the authorities, and for a few internal experts carrying out technological monitoring. After the signing, it was possible to involve staff from the design stage and to forge cooperation links with other companies. At Renault, we took part in the enforcement of recycling parameters in automobile development projects (Aggeri and Hatchuel, 1998). One key point was devising a 'recyclability indicator' and reporting procedures in order to measure the development performance, to compare it to VAs targets, to incite designers to take into account recyclability from the 'drawing board' and to facilitate monitoring at the project management level. This action resulted in the introduction of specific recycling targets in contracts with each team of designers and at a project level. Nevertheless, even if numerous actions have been carried out until now, meeting VAs targets (90% from 2002) still requires an important effort of innovation. Indeed, reducing the number of materials used in a vehicle, standardizing the attachments,

reducing the amount of pollutants (heavy metals, chlorine, etc.), developing modular equipments easy to remove, is a very long process which requires long-term partnerships and research in tandem with subcontractors.

After the signing of the French Framework Agreement, followed by similar agreements in other European countries, cooperation between companies involving all the actors in the recycling chain (manufacturers, subcontractors, breakers, shredders, recycling firms) developed around the building of processing networks. Networks here means a series of stages involving transformation and financial exchanges involving various industrial actors. In the car industry, the main stages concerned: clearing, dismantling by type of material, grinding, sorting, transportation and finally processing by recycling or energy recovery. After a few years of expansion, during which joint standards were developed (specifications, recommendations on equipment, quality norms, etc.) on sorting, clearing and dismantling, a few networks for plastics, glass, fluids and energy production began to emerge. But contrary to the assumption implicit in the voluntary agreements, these networks did not emerge spontaneously. It transpired that the building of new markets for recycled products required much more subtle monitoring than was provided for in the framework agreement. As several authors have shown (Hatchuel, 1995; Karpik, 1996; Callon, 1998), in certain situations (great uncertainty, opportunism, specific assets), the exchange cannot be based solely on a merging of interests, and requires intervention by personal, institutional or immaterial delegates to facilitate the coordination of economic agents. In other words, if transactions are to take place on a regular basis, at as low a cost as possible, there has to be prior agreement between the partners on the goods to be exchanged, conditions of production, measuring systems, evaluation of costs and logistical organisation; in short, everything pertaining to the organisation of economic life. The drawing up of this framing, which includes a variety of arrangements (rules, technical standards, procedures, contracts, etc.) is done nowadays by inter-company networks coordinated by car manufacturers. The involvement of the manufacturers is not a sign of the market failing to function, rather a condition for it to emerge. It is possible to demonstrate that several obstacles to exchange (standardising the goods exchanged and vehicle processing methods, stabilising supply and outlets in order to reach a critical size) justify major coordination which those involved in making the exchanges (shredders, dismantlers, recycling companies) cannot carry out on their own because they are too small, lack the capability to carry out R&D and are dispersed all over the country. In the absence of institutional prescribers capable of taking on this coordination role, the manufacturers are well placed to do so, firstly, because they have acquired expertise in many areas concerning recycling (knowledge of dismantling procedures, manufacture of materials, and incineration with energy recovery), and secondly, because they are at both ends of the transformation chain through designing vehicles on the one hand, and incorporating recycled goods into their cars on the other.

5.4. The danger of destabilisation in the innovation process: low incentives and different behaviour patterns

Although the infrastructure of this economy (technology, organisation, outlets, rules) has now gained widespread acceptance in the world of industry, and costs have been more clearly identified, the number of vehicles processed by these networks still falls far short of what could be hoped for. The chief reason put forward by those involved is the networks' low profitability, which discourages certain actors (dismantlers in particular) from investing in recycling. Be that as it may, it is not the only obstacle threatening the innovation process.

The growing differentiation between manufacturers' strategies that may be observed nowadays is also a risk factor. Whereas the issue of recycling did not give rise to much discussion among manufacturers in the beginning, it is increasingly becoming a selling point and therefore a factor in competition. Companies like Volvo, Renault, Fiat, Mercedes and BMW, using increasingly aggressive advertising and investing large amounts of money, have stepped up their operations with subcontractors, the authorities and partners in order to assert their strategies and differentiate themselves from their competitors. Among these 'fast learners', we have paid special attention

to the case of Renault. We should emphasise the important role played by one 'relay actor', the company's former financial and sales director, who was put in charge of recycling issues in 1992. In 1993, he played a leading role in convincing the management to make a strong commitment to recycling by setting up a special recycling project backed by large financial resources. By way of contrast, his counterpart at PSA, who has a more technical background, was unable to convince his company to make such large resources available: the management preferred to adopt a 'wait and see' policy. On the other hand, some manufacturers appear willing to make some lesser efforts, as can be seen from the staff and investments allocated by each manufacturer. Growing differences in strategic planning may also be observed. Although inter-company working groups have been set up to reach agreement on joint action frameworks (deciding on standards, indicators and information systems), they have not always put forward a common viewpoint to the authorities. Meanwhile, the European directive is about to be published and agreement of this kind is vital to ensure that the steps taken by manufacturers are compatible as we move towards networks comprising several makes of car. Similar strategic differentiation can be seen among breakers, subcontractors, shredders and materials manufacturers. For example, the best organised dismantlers are tempted to gamble on cooperating with manufacturers to elbow out smaller firms and win a bigger share of wrecks. Materials manufacturers are also divided between those who fear that expansion of the recycled goods market may harm sales of new materials and those who have invested in such goods themselves as a way of winning new markets in the car industry.

Nowadays the growing differentiation in behaviour patterns and the lack of financial incentives are clearly working against the innovation process. Investments approved by some actors to devise the framing needed to make recycled goods benefit the group as a whole, but it is difficult to define who owns them. So although recycling companies which have developed new recycling methods or people who have perfected new dismantling equipment can apply for a patent, it is hard to see how manufacturers who have brought the various actors in a network into contact, helped to endorse recycled goods and defined specifications, worked out dismantling procedures or design indicators can be rewarded for their actions. This makes it easier to understand their reticence to make their findings available to all the actors in the sector, in particular, those who did not agree to make similar efforts, although this would clearly be in the interests of the sector as a whole because there is no rivalry over these findings. In other words, the risk is that positive externalities may be created that would benefit 'free riders' to the detriment of those making the innovations. The problem has been clearly highlighted by theorists of endogenous growth (Romer, 1990), who emphasise the importance of state intervention to provide back-up funding and the protection of R&D in this specific instance. In order to overcome the current deadlock and avoid discouraging fast learners, the authorities probably need to become involved—but in what way?

5.5. How should the authorities be involved in monitoring?

At this stage, we shall restrict ourselves to suggest a few tracks that might be explored. The transparency and definition of clear rules, understood by all, is a vital prerequisite for reducing the risk of capture, avoiding the possibility of misunderstandings and disputes. As new information has come to light on actors, technologies and costs, four types of measures may be envisaged: subsidies, taxes, institutional measures (standards, official approval, setting up of technical centres) and regulations. The granting of subsidies is widely used nowadays as a way of supporting innovation efforts. Nonetheless, this is a two-edged sword which should be handled carefully because it may distort competition by providing artificial support to certain activities. For example, several of the people we interviewed said that most of the financial results of recycling or waste incineration companies were distorted by the allocation of various more or less generous subsidies (from Europe, national governments or regions).

The subject of levying new taxes brings us back to the debate mentioned in Section 3 over the use of economic instruments. For instance, since technologies, costs and actors are better known, it would certainly be possible nowadays to simulate the ef-

fects of increasing the dumping tax and channelling the excess into supporting waste processing networks. This solution would have the advantage of creating greater financial incentives in a system that currently has too few. On the other hand, the idea of levying a tax on new vehicles to finance the collection and recycling of ELVs should on the face of it be ruled out because it does not provide an incentive to improve the economic efficiency of the system and would probably generate abusive rents.

As for institutional measures to improve coordination, such as the setting up of technical centres and the introduction of regulations or standards for compatibility, they become necessary when the range of possible technical options is too large or when those involved hold greatly conflicting viewpoints and cannot reach agreement on joint coordination. Several authors (Katz and Shapiro, 1985; Gabel, 1991) have shown how competition over standards could be a key issue for companies. As it happens, it could also be a way of rewarding the efforts made by fast learners and encourage other firms to innovate. Obviously, the problem is pinpointing the moment when this situation is reached, choosing rules and standards that do not favour some parties to an unwarranted extent and not excluding promising technological options too quickly.

More probably, it could be thought that a good policy would be to combine these various measures, whose advantages are complementary. In this perspective, regulation may be seen as a last resort which would mark an end to the logic of cooperation.

6. Conclusion

In this article, we have tried to highlight the interest and limits of a new form of cooperative approach shaped by instruments and doctrines to adapt to the new environmental problems that have emerged with the problematic of sustainable development. In this context, when the state does not have sufficient knowledge to lead the innovation process, it should be able to create conditions that encourage cooperation between firms. Thus we examined how, in the case of ELVs, the implementation of 'innovation-oriented voluntary agreements' made it possible to encourage the learning and innovation processes within and between companies. We have mentioned how both the authorities and manufacturers could have an interest in using this type of instrument in a situation of shared uncertainty, when polluters are hard to identify and there are credible threats to manufacturers, and when the industrial system works smoothly. We have also seen how such agreements have played the part of coordination mechanisms, encouraging coordinated learning and experimental action in companies. In addition, and this is more paradoxical, the introduction of these agreements could gradually increase the state's leeway owing to new knowledge gained by progressively synthesizing the action of the firms. Nonetheless, it may be thought that this capacity would only be used when the targets of voluntary agreements were not reached. On the other hand, there is nothing to prevent the companies that learned fastest from calling for a tightening up of the rules or the introduction of economic instruments as soon as they can foresee a competitive advantage and want to make the most of it. Through this case study, we can perceive the outlines of a dynamic, interactive model in which the strategies of the authorities on the one hand and companies on the other are built up in parallel and affect one another. This model enables us to infer why and how the content of public policy changes as companies' knowledge improves. Taking this dynamic view, the choice of a particular instrument (such as a voluntary agreement) is only significant when seen in relation to the overall innovation process of which it forms part.

There are several indications that this evaluation has a much wider field of application than simply the case of the car industry. An increasing number of legislative controls being introduced at European level have similar characteristics (the issue of which technologies should be used, degree of complexity, number of participants, various types of pollution) and cooperation between firms and the authorities is also tending to move forward, to the detriment of more authoritarian methods. More generally, we have put forward a number of assumptions regarding the circumstances in which voluntary agreements seem to be more effective and easier to put into practice than other instruments such as taxes or legislative controls.

Obviously, these assumptions should be tested in a larger number of case studies. Moreover, even when all the circumstances are right, they do not necessarily guarantee that public policy will be effective. We firmly believe that effectiveness is a dynamic quality which depends not only on the initial circumstances but also on the monitoring methods put into practice by all parties, and in particular by the authorities. In other words, even if this model, featuring a resourceful government which knows how to use its power and hide its weaknesses, may seem attractive, more effective forms of monitoring, focusing on cooperation mechanisms, by the authorities have yet to be explored.

References

Aggeri, F., Hatchuel, A., 1997. A dynamic model of environmental policy. The case of innovation oriented voluntary agreements. Nota di lavoro 24.97, Fondazione Enrico Mattei, Milan.

Aggeri, F., Hatchuel, A., 1998. Managing creation and learning of new expertise in automobile project development. In: Lundin, R.A., Midler, C. (Eds.), Projects as Arenas for Renewal and Learning Processes. Kluwer Academic Publishers, NY.

Baumol, W.J., Oates, W.E., 1988. The Theory of Environmental Policy, 2nd edn. Cambridge Univ. Press.

Blackler, F., 1995. Knowledge, Knowledge Work and Organizations: An Overview and Interpretation. Organization Studies, pp. 1021–1046.

Brénac, E., 1988. Corporatismes et politiques intersectorielles: la politique de l'environnement. In: L'Etat et les corporatismes. PUF, Paris, pp. 127–146.

Bressers, H., Plettenburg, L., 1997. National Environmental Policies: A Comparative Study of Capacity Building. Springer, Berlin, pp. 109–131.

Callon, M., 1998. An essay on framing and overflowing: economic externalities revisited by sociology. In: Callon (Ed.), The Laws of the Market. Blackwell, Oxford.

Callon, M., Rip, A., 1991. Forums hybrides et négociations des normes socio-techniques dans le domaine de l'environnement. In: Environnement, Science et Politique, ed. Collectif. 227–238, 13, Germes, Paris.

Crozier, M., Friedberg, E., 1977. L'acteur et le système. Editions du seuil.

Dente, B. (Ed.), 1995. Environmental Policy in Search of New Instruments. Kluwer Academic Publishers, Dordrecht.

European Commission, 1996. Communication from the Commission to the Council and the European Parliament on environmental agreements, COM (96) 561. Final, November 27.

European Environmental Agency, 1997. Environmental Agreements—Environmental Effectiveness, Vols. 1 and 2. Environmental Issues No. 3, Copenhagen.

Gabel, L., 1991. Competitive Strategies for Product Standards. McGraw-Hill, NY.

Glachant, M., 1994. The setting of voluntary agreements between industry and government: bargaining and efficiency. Business Strategy and the Environment 3, 2.

Glachant, M., 1997. The cost efficiency of voluntary agreements for regulating industrial pollution: a Coasean approach. Nota di Lavoro, 18.97, Fondazione Enrico Mattei, Milan.

Glachant, M., Whiston, G., 1996. Voluntary agreements between industry and government—the case of recycling regulations. In: Lévèque, F. (Ed.), Environmental Policy in Europe—Industry, Competition and the Policy Process. Edward Elgar.

Godard, O., 1998. Concertation et incitations efficaces, deux dispositifs incompatibles? Une analyse à partir du dispositif de gestion des déchets d'emballage en France. Journées de l'Association Française de Sciences Economiques (AFSE). Toulouse, France.

Hatchuel, A., 1994. Apprentissages collectifs et activités de conception. Revue Française de Gestion, juin–juillet–août.

Hatchuel, A., 1995. Les marchés à prescripteurs. Crises de l'échange et genèse sociale. In: L'inscription sociale du marché, L'harmattan, pp. 203–225.

Hatchuel, A., Weil, B., 1995. Experts in organization. A knowledge-based perspective on organizational change, Walter de Gruyter.

Hourcade, J.C., 1998. Analyse économique, modélisation prspective et développement durable ou comment faire remonter des informations du futur?. Economies et Sociétés, Série F 36, 175–198.

Hourcade, J.C., Salles, J.M., Théry, D., 1992. Ecological economics and scientifical controversies: lessons from some recent policy making in the EEC. Ecological Economics 6, 211–233.

Karpik, L., 1996. Dispositifs de confiance et engagements crédibles. Sociologie du travail 49/6, 527–548.

Katz, M.L., Shapiro, C., 1985. Network externalities, competition and compatibility. American Economic Review 3 (75).

Laffont, J.J., Tirole, J., 1991. The politics of government decision-making: a theory of regulatory capture. Quarterly Journal of Economics CVI (4), 1091–1127.

Lascoumes, P., 1994. L'éco-pouvoir - Environnements et décisions. Editions la Découverte, Paris.

Lascoumes, P., Valluy, J., 1996. Les activités publiques conventionnelles (APC): un nouvel instrument de politique publique? —L'exemple de la protection de l'environnement industriel. Sociologie du travail, 4/96.

Lévèque, F., 1996. Environmental policy in Europe. Industry, competition and the industry process. Edward Elgar.

Moisdon, J.C. (Ed.), 1997. Du mode d'existence des outils de gestion. Les instruments de gestion à l'épreuve de l'organisation. Editions Seli Arslan.

OECD, 1994. Applying economic instruments in OECD and dynamic non-member economies. Paris, OECD, 260 pp.

Olson, M., 1965. The Logic of Collective Action. Public Goods and the Theory of Groups, 4th edn. Harvard Univ. Press, Cambridge.

Padioleau, J.G., 1988. L'Etat et les entreprises: la lutte anti-pollu-

tion dans le secteur des cimenteries. In: L'Etat concret. PUF, Paris.
Romer, P., 1990. Endogenous technical growth. Journal of Political Economy 98, 5.
Sabatier, P., Jenkins-Smith, H. (Ed.), 1993. Policy Change and Learning. An Advocacy Coalition Framework. Westview Press, Boulder.
Serré, Y., 1998. Accords volontaires et dynamique de changement structurel. Eclairage de la relation à partir de la politique française de gestion des VHU. Revue d'économie iundustrielle, No. 83, 1er trim., pp. 225–238.
Sprenger, R.U., 1997. Market-based instruments for environmental management. In: Institutional aspects of economic instruments for environmental policy. International Workshop, CESAM, Copenhagen.
Stigler, G., 1971. The economic theory of regulation. Bell Journal of Economics.
Van Dunné, J.M., 1997. The use of environmental covenants and contracts in the case of river pollution in The Netherlands. In: The Law and Economics of Voluntary Approaches. Fondazione Enrico Mattei, Milan.
Weitzman, M., 1974. Prices vs. quantities. Review of Economic Studies 41 (4), 477–491.
Winter, G., 1985. Bartering rationality in regulation. Law and Society Review XIX, 2.