THE ECOLOGICAL MODERNISATION OF INDUSTRY
Developing Multi-disciplinary Research on
Organisation & Environment

By

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A Thesis

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Acknowledgments

The journey that culminated in this thesis started much earlier than my formal enrolment as a PhD candidate, and so was the participation of people who made this endeavour possible. They are mostly listed here in order of appearance, and although a 'Dr' should precede the vast majority of the names, I am avoiding such formalisms here. The persons are listed to acknowledge their assistance in making this (long) *research journey*, as I prefer to call it, possible. The journey became not only a truly global experience but, more importantly, it made it possible to work with incredible people from around the world.

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Fortunately, my Dutch experience was not just limited at WIMM. Frank den Hond from the Institute of Environmental Studies (IVM), at the Free University of Amsterdam would become another central figure in my research journey. Simply, I gained a great friend in Frank. Throughout our lengthy conversations about the fate of cars at the end of their useful lives, we also discussed a wide range of environmental issues. These talks not only represented another intellectual input but also allowed me to know a great deal of Frank's personal values, which I greatly admire. I also appreciate and thank Frank for his efforts to make Amsterdam a true home for me.

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limited to the workshops, however. Over the next few years, our informal meetings during the GIN (Greening of Industry Network) conferences, and our permanent exchange of correspondence, assisted me in improving my knowledge on (cleaner) vehicles and transport technology. In particular, the feedback I received from Remco and Birguitta on articles and versions of the early thesis chapters were crucial in this regard.

Exchanging ideas with Peter Wells and Paul Nieuwenhuis, from the Centre for Automotive Industry Research (CAIR), Cardiff Business School, Cardiff, Wales (UK), was also instrumental for the development of my studies. In fact, I should say that I first learnt a great deal about ‘the automobile industry and the environment’ by reading Peter and Paul’s publications. Only after being inducted through their work did I gain sufficient confidence to be able to articulate the intricacies involved in this topic. Their constructive comments also encouraged me to continue to pursue answers, which eventually materialised in this thesis. Peter and Paul, thanks for your encouraging support. I only hope that I did justice to the high quality of your work in this field – obviously, any misinterpretations are entirely of my own accord.

While my overseas experiences grew, I was always supported here *down under* by the people at the School of Management, University of Technology, Sydney (UTS). The then Head of School Jenny Onyx, strongly supported ‘sustainability’ initiatives at the School, and, in particular, the design of the first environment-related MBA subject (Managing for Sustainability) made it possible to share some of my ideas with students. I am also grateful for the sponsorship of my various overseas trips to present papers in conferences, participate in workshops and collect data. Recognition is also due to Bob Robertson, the Faculty Dean, for awarding me ‘The 1998 Faculty of Business PhD scholarship’; to Gina Meibush and Stephen Teo, for our friendship and heated discussions at *Café Nine*; to Tania Tambiah for her support in the Research Office; to Cleo Lester, for her always friendly Brazilian-style support in Stewart Clegg’s office and, more recently, Professor Dexter Dunphy for the exchange of ideas on sustainability matters.

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methods. I learnt to admire the sharpness and precision of her comments – Thekla always aimed at the highest possible methodological rigour, although I must admit we did not always agree on the meaning of ‘rigour’. Nonetheless, at least in my opinion, the quality of my work was inexorably enhanced – even though I will never be sure whether Thekla agrees that I had gone far enough! All in all, I greatly admire Thekla’s work ethic and I extend my utmost *danke* to her.

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…And what it will have to deal with will be exactly what all myths have dealt with – the maturation of the individual, from dependency through adulthood, through maturity, and then to the exit; and then how to relate to this society and how to relate this society to the world of nature and the cosmos. That's what the myths have all talked about, and what this one's got to talk about. But the society that it's got to talk about is the society of the planet. And until that gets going, you don't have anything.

Joseph Campbell, *The Power of Myth*.

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Abstract

This thesis develops suitable approaches to conduct environment-related research in organisations, as well as systematic means for understanding the emergent phenomenon of ecological modernisation in industrialised societies. The study is organised in two distinct parts: While Part I deals with environment-related theories and practices in (and around) modern organisations, Part II situates such theories and practices in an analysis of the context of the European automobile industry.

The research problem is defined through several stages. The research questions driving Part I are premised on the exploratory nature of the study, developed in an unfolding interplay between the review of the literature, the collection of secondary and (exploratory) primary data, and the analysis and interpretation of the data. As the initial question is answered by reviewing the literature and interpreting the primary and secondary data, another question arises from the process, which then requires further research.

Part II of the study departs from a proposition based on ecological modernisation theory, that pro-active environmental practices in corporations are part of a broader emergent sociological phenomenon, typical of modern industrialised societies. It analyses a specific socio-technical context that, hypothetically, is undergoing such process – that of the European automobile industry. Hence, the development of Part II aims at answering the following principal research question: Why is the European automobile industry undergoing ecological modernisation? Analytically, the concept of *automobile field* is proposed to establish a link between the product (automobile) and the context embedding its systems of production and consumption (field). The exploratory character of the study implied that the most adequate research procedures were of a qualitative nature. A combination of grounded theory and reflexive methodology is used to orientate the overall research process, which introduces a novel approach for the triangulation of qualitative data.

Together, the chapters forming Part II of the thesis answer the principal research question. The fundamental technologies of the current technological regime of the automobile, as well as the economic and environmental implications of this regime are analysed. Then, an analysis of selected pilot programs to develop and commercialise electric vehicles, as well as schemes for the management of end-of-life vehicles in the Western European context is developed. Through the interplay between data collection and analysis, the thesis designs an analytical framework, built upon contingent factors, as well as circuits of political ecology, that foster or inhibit ecological modernisation in the automobile field.

The study showed that the auto industry has developed incremental technological innovations and practices that resemble the pre-requisites for ecological modernisation. Radical innovations, however, are more likely to be initiated by outsiders. The concepts inherited from the past and reproduced in the present practice of car design explains such a situation as one that imposes a specific set of technologies on car manufacturing that require high levels of investment in systems of production. Such design paradigm not only imposes high break-even points for most car models; they also result in vehicles with extremely low environmental performance and entail serious limitations for increasing recycling rates of non-metallic parts.

The characteristics of ecological modernisation in the European automobile industry are used to evaluate whether this phenomenon is conducive to sustainable industrial development. As an implication of this analysis, the concluding chapter presents suggestions for the enhancement of ecological modernisation theory. *Fallibility* is proposed as both a source of reflection about the appropriation of knowledge and a principle that can be used for the definition of eco-modernising strategies and actions. The acceptance of fallibility as an immanent characteristic of human action is critical for the approximation of the countervailing theories of ecological modernisation and risk society. Finally, if ecological modernisation is expected to facilitate sustainable industrial development, radical technological innovations may be necessary. Such radicalism in technology may need, however, an incremental institutional reform of modern societies. Together, radical technological innovations and incremental institutional reform constitute the concept of *radical reformism*, which is suggested for enhancement of the ecological modernisation theory, as well as for the development of its normative programmes.

1 Introduction: Prefiguring the Thesis

The ecological sustainability[1] of contemporary societies, among a myriad of endeavours, requires the transformation of current systems of production and consumption. While such a proposition has been endorsed by various sectors of the scientific community, *how* this transformation could be realised has become the core of debate in several applied disciplines (Fischer & Schot 1993; Egri & Pinfield 1996; Roome 1998). In the broad view of ecological economists, for instance, the economic system needs to be redefined as a sub-part of the planetary ecological system, requiring the modification of the fundamentals that have historically allowed agents of production to *externalise* environmental costs onto society (Constanza 1995; Daly 1977). On the demand side, behavioural change of consumers, privileging environmentally sound products and services, has also been indicated as a key ingredient for the development of more ecologically sustainable societies (Ropke 1999; Spargaaren 1997). Environmental sociologists and political scientists, in turn, have stressed the need for reforming the institutions that act as agents of modern industrial economies (Cohen 1997; Giddens 1990; Mol 1995). At the level of management in organisations, Shrivastava (1992; 1995) is among the pioneers addressing the need of organisational experts to identify mechanisms for firms to incorporate ecological principles into business strategies, and eliminate or *internalise* the environmental costs they generate.

The degree of complexity within each one of these levels – from the entire economic system and societal institutions, through industrial sectors and organisations, to the level of the individual – results in the specialisation of research in environment-related disciplines. Within the context of these specialised areas, research emerging from the broad field of *organisation studies* has questioned, since its inaugural steps, why organisations would pursue ecology-oriented strategies and practices (Starik & Marcus 2000). Researchers in this field have suggested the use of traditional areas within organisation studies, such as institutional theory (Jennings & Zanbergen 1995),

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1 This study adopts the well-known, indeed broad definition of ‘ecological sustainability’ or ‘ecological sustainable development’, proposed by the Brundtland Report (WCED 1987): “Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. A more elaborated definition of the concept, with which this study is aligned, can be found in Diesendorf (2000).

and resource-based theory (Hart 1995) as appropriate for such type of enquiry, and the empirical studies of Hoffman (1999), Howard *et al.* (1999), and King and Lenox (2000) constitute exemplars in this direction. The influence of environmental issues on the definition of corporate strategies (see: Reinhardt 1998; 1999a, for instance) is another growing area of enquiry, among many others, that focuses on the potential firms have to profit from environmental investments.

Understanding the interactions of human organisations with the natural environment has been advanced through the development of these specialised areas of investigation. Over time, specialised studies may address one of the main challenges faced by modern science: the identification of both the main causes of anthropogenic impacts in natural ecosystems[2], and possible solutions for their reduction, at levels that would eventually be conducive to ecological sustainable societies. Environment-related organisational studies certainly constitute an important contribution in this direction. Nonetheless, the independent treatment of the (ecological) problem by specialised areas of research has also resulted in some degree of segregation between the various scientific disciplines. Since ecological sustainability is an all-encompassing issue – indeed, more a vision to be pursued than a scientific concept (Dunphy & Benveniste 2000) – it requires reforms at all levels of human action, and the specialisation of research inevitably limits the integrative capacity of environment-related sciences (Capra 1997). Hence, establishing connections between distinct areas of investigation seems crucial for an enhanced understanding of the fundamental design faults of current systems of production and consumption, as well as for the elaboration of alternative configurations.

Research that considers such premises is irreducibly multi-disciplinary in character. The degree of complexity involved in this type of study is also considerable, not only because a wide range of disciplines and their corresponding theoretical perspectives need to be taken up by the researcher but because multi-disciplinary research also represents a challenge in methodological terms. This is why this thesis can be considered a quest for both: suitable approaches for developing environment-related research in

2 This study assumes that ‘men *is* nature’ and any distinction made between human organisation and the natural environment is, in essence, anthropocentric. Hence, it is for reasons of ease only that a distinction between human-made artificial systems, such as those embedded in industrial organisations, and natural ecosystems, such as native forests and coral reefs is made in this thesis.

organisations, and systematic means of understanding the emergent phenomenon of ecological modernisation in industrialised societies. As Section 1.1 will present, the various steps used in developing the research design represent the outcomes of such a search. The elaboration of successive research questions, which were followed up as answers to the previous ones were given, resulted in an extensive literature review. For this reason, the research design is presented in that section, together with the presentation of the study outline.

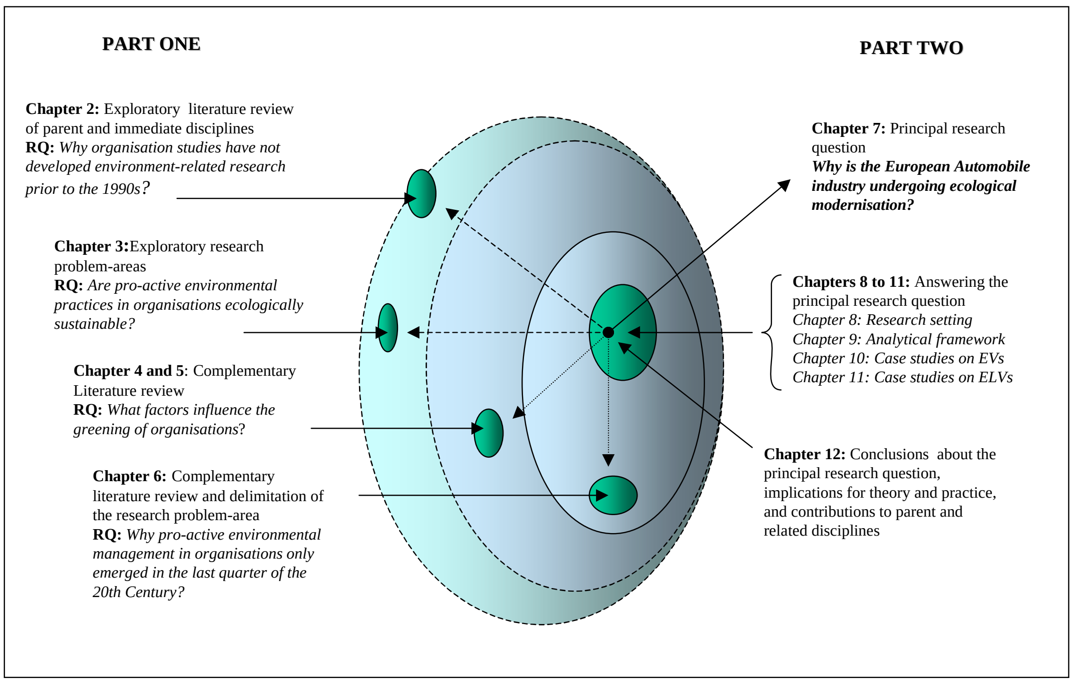
Section 1.2 presents theoretical and practical justifications for the development of the research. Rationales for the central role of the ecological modernisation theory, as well as the European automobile industry are elaborated in this section. The reason why this study enquired into novel ways of developing research in environment-related issues in organisations is presented in Section 1.3. This section introduces the methodology used in this study, which will be further explicated in Chapter 7. Finally, Section 1.4 describes the main limitations the design of the study imposed on its overall findings.

1.1 Research Design and Study Outline

This study is organised in two distinct parts. While Part I deals with both the context of theories and the practice of environmental management in modern (mostly industrial) organisations, Part II refers more specifically to such practices in the context of the European automobile industry. The definition of the research problem is made in several stages. The exploratory nature of the study requires that the research questions, which orient the chapters making up Part I of the study, are developed in an unfolding interplay between the review of the literature, the collection of secondary and (exploratory) primary data, and the analysis and interpretation of the data. As the initial question is answered by reviewing the literature – including parent and immediate disciplines in the field – and interpreting the primary and secondary data, another question arises from the process, which then requires further research.

Figure 1.1 stylises this process, illustrating the scope and relationships between the research problem and the questions orientating research, formalised in the various chapters of this thesis. The arrows in the left-hand side of the figure (corresponding to Part I of the study) depict the trajectory from the broad context of the exploratory literature review to the final delimitation of the research problem. The development of the various chapters are based on – but not limited to – the *research questions* (RQ) presented in the figure. Hence, the trajectory from larger to smaller circular areas in the figure represents a *journey* towards the specialisation of the research problem area and corresponding research questions. Such a process culminates in the core of the figure presenting the *principal research question* that launches Part II of the study. Finally, the arrows corresponding to Chapters 8 to 11 point (back) to the core of the figure because, together, those chapters are supposed to answer the principal research question. The final chapter presenting the conclusions of the study also has the arrow pointing to the core of the figure, since the results of the study are expected to summarise the answer for the principal research question. Finally, dashed arrows departing from the core of the figure and pointing back to the circular areas represent the potential contribution of the study to knowledge of parent and related disciplines.

Figure 1.1: The Research Design Process and Study Outline



The exploratory literature review begins from the problematic of what explains the slow pace of development of environment-oriented research in organisation studies: If the impact of organisations on the natural environment has long been recognised, why had the response of *organisation studies* been so slow to develop? Explanations for this *theoretical ‘gap’* require a review of environment-related studies in organisations, resulting in the development of Chapter 2. In contrast, Chapter 3 addresses the *practice* of environmental management in firms. More specifically, it focuses on pro-active (or beyond-compliance) environmental management practices adopted by firms. During the 1990s, several programs promoting these practices were created by private and public organisations. Such scenarios raised the question for researchers working in the emerging field of *organisation & environment* of whether these programs would result in ecologically sustainable organisational practices. This is why Chapter 3 reviews the most prominent initiatives, such as business codes of environmental practices, the standardisation of environmental management systems, and eco-labelling, which directly or indirectly advanced beyond-compliance environmental practices in organisations.

Although these initiatives were available to firms during the 1990s, the practice of pro-active environmental management was (and still is) confined to a relatively small number of organisations. An obvious question arising from this situation asks why only a limited number of corporations adopt such practices. Ultimately, what factors influence organisations to *'go green'*? This is the generic question orientating the development of Chapters 4 and 5. Initially, a complementary literature review is developed and presented in Chapter 4. The review recognises a central debate in environment-related studies in business. Academics and practitioners (in particular, Porter & van der Linde 1995; 1995b) have asserted that investment in environment-related technologies and practices could result in economic returns for firms, eventually enhancing their competitive position. Such scenarios would be more prone to occur in a context in which regulatory requirements were stringent, favouring those firms that adopted beyond-compliance practices. In other words, pro-active firms would benefit from strict regulations. In this perspective, competitiveness would be a central factor influencing corporations to adopt environmentally sound strategies and practices. But the observation of practices adopted by multinational corporations operating in Brazil made me speculate whether firms would adopt more environmentally benign technologies if they were capable of influencing the definition of the regulatory framework. This is the reason for Chapter 5 to explore political economy factors influencing the *greening*[3] of organisations.

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3 The term *'greening'* is used in this study to represent the broad range of practices that can potentially reduce the impact organisations cause to the natural environment.

Chapter 6 presents a complementary literature review and the (final) delimitation of the problem-area. It is argued in the chapter that the broad concept of pro-active environmental management practices in organisations constitutes an extension of the same historical continuum that ‘produced’ modernity. They are part of the phenomenon characterising the ‘emancipation’ of ecology from the economic and technological spheres. In this view, ecological modernisation relates to the process of institutional changes aiming at overcoming ecological crises happening in Western European countries. Rather than specific instances of corporate environmental management, ecological modernisation involves the institutionalisation of practices in the entire community of organisations (Spaargaren, 1997). For this reason, instead of questioning whether pro-active environmental practices in corporations are ecologically sustainable, the chapter focuses on the interpretation of these practices as an emergent, empirical, sociological phenomenon, happening in a specific industrial setting: the European[4] automobile industry. Hence, the development of Part II of this study aims at answering the following *principal research question*:

Why is the European automobile industry undergoing ecological modernisation?

The justification for adopting this question, as well as a detailed explanation of the research design and methods used for the collection, analysis and interpretation of primary and secondary data are presented in Chapter 7 (and introduced in Section 1.3). In order to answer this question, the following objectives were established for this research, which were addressed by the remaining chapters of Part II and taken up in the conclusion of the study:

1. Identify the fundamental technologies of the current *technological regime of the automobile*, as well as the economic and environmental implications of this regime (Chapter 8).
2. Elaborate the factors fostering or inhibiting ecological modernisation in the automobile industry, and design an analytical framework for the analysis of their dynamics (Chapter 9).
3. Analyse pilot programmes for the introduction of (battery) electric vehicles in Western European markets (Chapter 10).

4 The terms ‘Europe’ or ‘European’ are used in this thesis to designate exclusively ‘Western Europe or Western European countries’.

4. Analyse the end-of-life vehicle (ELV) schemes developed in Germany, Italy and France – the main automobile producers in Europe (Chapter 11).
5. Evaluate the limits of ecological modernisation in the automobile industry, and estimate whether this phenomenon is conducive to sustainable (industrial) development (Chapter 12).

1.2 Justification for the Research

Theoretically, there are at least three reasons justifying the relevance of this study. First, by the time this research was initiated in the mid-1990s, environment-related research in organisational studies was very scarce. Moreover, from the existing studies, a review of mainstream journals conducted by Kivisaari and Lovio (1996) identified a lack of political perspectives. They also found that a significant number of the environment-related studies had a tendency to analyse organisations as singular entities, focusing on internal factors. In particular, research focusing on industry levels was very scarce (Russo 1999).

By the end of the decade, the situation had improved substantially, with the natural environment gradually gaining ground in the study of organisations. Nonetheless, their number remained peripheral when compared to traditional areas of research. Overall, environment-related research in organisation studies has, thus far, produced a body of knowledge that could be considered to be in its *exploratory* stages (Roome 1998). If *organisation & environment*[5] is to become a new scientific field, advances in research are necessary (Starik & Marcus 2000). Generically, this study addresses such a need. In particular, it responds to the request for more research using political perspectives, developed mainly (but not limited to) at the industry level of analysis.

Environment-related research also presents methodological challenges. This is the second justification for developing this study. The examination of interactions between human organisations and natural ecosystems apparently demands a shift from a discipline-centred analysis to one focusing on the *relationships* among systems (Tibbs 1993). Such a perspective was considered in this study. By delving into areas ranging from environmental issues in organisation studies (Chapter 2), applied environmental management in organisations (Chapters 3 and 4), to political science (Chapter 5) and environmental sociology (Chapter 6), the study attempts to refine some *intersections* between these disciplines. In doing so, the thesis can be characterised as a *multi-disciplinary environment-related study*. Such effort is expected to represent a contribution not only to the field of *organisation & environment*; it also facilitates dialogue among researchers working in various environment-related disciplines.

The third theoretical justification for this study relates specifically to the development of ecological modernisation theory. According to environmental sociologists (for instance: Cohen 1997; Mol 1995; Spaargaren 1997), an ongoing phenomenon of *ecological modernisation* is occurring in some sectors of highly industrialised economies. Observing the circumstances in which car manufacturers[6], for instance, have responded to stricter regulation in Europe – by adopting cleaner manufacturing technologies and investing in environment-related research on fuel efficiency and car recycling – indicates that ecological modernisation is underway in this sector (Cohen, 1997). Only a few attempts, however, have been made to identify the dynamic forces involved in this phenomenon. This is exactly what this study attempts to reveal: the main factors influencing the ecological modernisation of one of the most important and controversial industries of modern times, which is the central issue framing the empirical work of the thesis.

Investigation of the ecological modernisation of the automobile industry also makes the study relevant on empirical grounds. According to Nieuwenhuis and Wells (1997:70): “the automotive sector is a key case study on whether international and collaborative action can create the mechanisms by which ecology can inform and underpin global restructuring”. In other words, the findings of environment-related studies of the automobile industry can be used to inform the process of restructuring not only in the auto industry but also in other sectors with which it has close

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5 The Academy of Management interest group uses the concept of *oganisations and the natural environment* (ONE), as to refer to this area of research. In order to avoid equalling this group of (mainly North American) researchers with the broad field of studies about environmental issues in organisations, this study adopts the concept of *organisation & environment* (OE)

6 There are, obviously, significant differences between the activities of *manufacturing* the components of an automobile and their subsequent *assembly* into a single unit (motorcar). However, because corporations in the automobile industry have different levels of (vertical) integration between manufacturing and assembling activities, the terms ‘car or auto manufacturers’, ‘carmakers’, ‘automakers’ and ‘car or auto assemblers’ are used interchangeably in this study.

interdependencies, such as the oil, petrochemical, and steel industries. Moreover, if novel paradigms of production and consumption emerge from the ecological modernisation of the car industry, the effects of such transformation could have widespread impact. Eventual spin-off effects of eco-modern principles and practices from the auto industry to other industrial sectors could even influence the way markets for industrial products are organised and managed nationally and internationally. Hence, revealing the factors fostering and inhibiting ecological modernisation can certainly have a crucial importance for management and policy-making.

1.3 Methodology

The research reported here is *exploratory* in its essence, since it principally asks ‘what are the variables involved’ (Perry 1994)? The exploratory character of the study implied that the most adequate research procedures were of a *qualitative nature*. Also, because exploratory qualitative research tends to be multi-method in focus, a combination of *grounded theory* (Glaser 1978; Strauss & Corbin 1994) and *reflexive methodology* (Alvesson & Sköldberg 2000) is used to orientate the overall research process. Essentially, the adoption of such perspective implied a constant reflexive consideration of alternative interpretations of the data, and its potential alternative meanings.

As it was mentioned in Section 1.1 (and described in detail in Chapter 7), the study is developed in two distinct phases. The first phase consists of a preliminary literature review, supplemented by the collection of primary data in *sensitising* (or exploratory) fieldwork, as well as the use of various sources of secondary data. The sensitising fieldwork comprehended the development of semi-structured interviews with representatives of organisations that were awarded ecological prizes for their outstanding environmental performance. During this phase, I also collected secondary data and complemented it by participating in workshops, academic conferences, and commercial fairs on environment-related technology. Combined, primary and secondary data collected in the first phase of the research are organised in the Data Group 1 (Section 7.1.2 in Chapter 7), and reported in selected sections of Chapters 3, 4 and 5.

The orientation of the research towards use of grounded theory and reflexive methodology implied that the incoming data was played against the theory, which was then reinterpreted. In Part I of the research, such a process resulted in the development of a complementary literature review, expressed in the frameworks of Chapters 4 (Figure 4.1) and 5 (Figure 5.1), culminating with Chapter 6 presenting and debating a specific theory in environmental sociology. A similar approach was used for the collection, analysis and interpretation of the data in Part II of the study. In other words, the processes of collecting and analysing data, rather than being developed separately, were both iterative and interactive. According to Eisenhardt (1989), a clear separation between the collection and analysis of qualitative data reflects a didactic representation of the research process rather more than its factual development. The data representing a specific reality comprehend not only its analysis but also the process that gathered such data (Clegg & Hardy 1996; Stablein 1996) and, for this reason, there is no clear separation between collection and analysis of data in this study.

The second part of the study focuses on environmental issues in the socio-technical context of the European automobile industry in which the iterative collection, analysis, and interpretation of primary and secondary data were organised in two additional groups. Data Group 2 comprises two case studies concerning (battery) *electric vehicles* (EVs) trials in France and Norway, while Data Group 3 encompasses case studies on *end-of-life vehicles* (ELVs) schemes, developed in Germany, France and Italy. Although primary data was used in the description and analysis of the cases, they relied principally on secondary accounts. Nonetheless, in order to enhance the quality of the analysis and interpretation of the data, a novel *triangulation* process was employed.

In qualitative research, triangulation refers to the use of multiple methods to reflect back upon each other in their various ways of illuminating the data, constituting an effort to secure an in-depth understanding of the phenomenon in question (Stake 1994). The use of such prerogatives for the particular case of this research resulted in the triangulation being obtained by interviewing the authors of the research reports and other sources of secondary data used in this study. Hence, some second order accounts by specialists in automobile and transport technologies were incorporated in my analysis, which synthesised them in a third order of accounting. That is, research reports on alternative vehicles and transportation systems became the ‘raw material’ for the work of theoretical development and construction that I conducted. The construction was done at the third level of theoretical synthesis. In this respect, one of the achievements of the thesis relates to the development of the ‘frame of reference’ – the ecological modernisation framework (Figure 9.1 in Chapter 9) – representing the construction of theory at this third level.

The research has mainly been developed at the industry level of analysis, or more specifically, at the level of the socio-technical context of the automobile – here denominated as the *automobile field*. Such definition is based on the concept of organisational field, proposed by DiMaggio and Powell (1983), and adapted to the specific case of the context of automobile industry. The concept of an organisational field is closely related to the traditional classification of an industrial sector but it also encompasses subjective elements such as cultural aspects and specific modes of rationality that guide organisational action in that locale. Therefore, an automobile field represents an application of the concept of organisational field to the specific context of the automobile, establishing a link between the product (the *automobile*) and the organisational *field* embedding its systems of production and consumption.

This study does not claim to have a *multi-level theory building* character, as those presented by Klein *et al.* (1999), but some overlapping between the organisational and the industry level of analysis does occur. This is mainly for empirical reasons. The significant size of operations – with business activities spread across the value chain of the car industry – and the consequent economic and political capacities of some car manufacturers, such as the *Fiat Group* in Italy, results in such firms being identified with the automobile industry itself. Moreover, as Chapter 11 will demonstrate, recycling schemes for end-of-life vehicles, established in some European countries, also blur the (theoretical) borders that delineate an industrial sector. In fact, this constitutes another reason for adopting the concept of *automobile field* in this study.

1.4 Limitations of the Study

The scope of this study is undoubtedly the source of its main limitations. The study is very broad in theoretical and empirical grounds. Theoretically, the multi-disciplinary character of the research imposes limitations *resembling* those of multilevel theory building (see: Kein *et al.* 1999). The study enquires into a considerable number of approaches and theorists drawn from (parent) disciplines, ranging from organisational theory, sociology, environmental engineering, to political science. The use of such a broad theoretical spectrum makes it difficult to satisfy experts in each of these disciplines. Because the study can only address the fundamentals of each theory or approach drawn from the specialised research areas, an expert audience may consider the review presented as one that, while broad, is overly simplified with respect to their specific field. Mirroring the limitations of multilevel theory building, where the audience may find ‘too little of the macro, or too much of the micro’ (level of analysis), multi-disciplinary research faces the problem of presenting ‘too little of the generic and too much of the specific’ (discipline). This is certainly a limitation faced by this study.

The multi-disciplinary character of the study also creates problems in determining the scope of the theory to be developed. In the context of this study, ecological modernisation theory was brought from the field of environmental sociology, whose theories normally have a societal scope. In this respect, even though a clear emphasis was put on the *automobile field* as the main scope of the theory, it was certainly challenging to ‘adapt’ the original theory to the theoretical range presented in this thesis. An appropriate middle ground – not too simple, yet not too complex; not too localised, yet not all-encompassing – was certainly difficult to find, and some readers may find some overlapping between the scope of the theory at the societal and the industry levels of analysis.

The extensive scope of the research also resulted in a challenging task of data collection, as well as analysis and interpretation. In simple terms, the vast array of environment-related issues involved in a complex product (the *automobile*) and its corresponding socio-technical context (*field*) required that the main source of data would have to be secondary in nature. There was simply no manner that an adequate primary data collection could have been encompassed within the frame of the thesis. To reduce the frame so that only primary methods of data collection were supported would have been both methodologically timid and theoretically constricted: hence, extensive use was made of secondary, besides primary data.

Although measures were taken to reduce the limitations associated with secondary data, as previously mentioned in Section 1.3 and detailed in Chapter 7, inescapable pitfalls remain in their use. It is certainly difficult to reduce the influence of the ‘filtration of knowledge’, embedded in research reports, scientific articles, and other sources of secondary data. Additionally, by collecting and interpreting data of a far-reaching research scope, a study may become too generic in its empirical grounds. Efforts were made to maintain certain levels of equity between the amount of data supporting different areas of enquiry (electric vehicles and recycling strategies, for instance) but the study might have unintentionally privileged some sources of data.

Even though the automobile industry is global in its main practices and strategies (Porter 1990), the findings of this research are limited to the Western European context. The geographical restriction is entirely explicable. In terms of environment-related initiatives taken by the auto industry, Western Europe has been the region in the world where the largest number of such initiatives have been developed more consistently than elsewhere (Rogers 1993). Although carmakers operating globally may use similar principles for environmental management during the manufacturing, use, and end-of-life phases of cars, there are strong contextual differences. Distinct regulatory frameworks, cultural preferences, resource availability, among many other variables, influence the developments of the auto industry in other regions in different ways, portrayed in this study for the European context (Atkin & Storey 1998). On the other end, what is described here as ‘European’ may not find resonance in localised instances of individual countries, or even regions within them. In other words, the tension between the global and the local certainly limits the findings of the study.

Although the empirical part of this thesis delves deeply into the context of the automobile industry, it should not be seen as a specialist study of this industrial sector. Rather, the automobile industry constituted the object for an environment-oriented analysis in which the findings are oriented primarily to an academic audience that is principally found in (but not limited to) the field of *organisation & environment*. For this reason, experts in current and alternative automobile technology, industry strategists and consultants, as well as specialists in transport systems may not find the arguments presented in Part II of this study significantly groundbreaking. Indeed, special effort was made to make the technical language used by industry experts accessible to a more universal audience. As a result, some of the arguments may over-simplify matters that are more thoroughly addressed by industry specialists. Hence, some of the ‘sophistication’ of the study resides not in the technology-specific arguments but rather in the ‘translation’ and articulation of these arguments to a broader, non-specialist audience.

Finally, as I articulated more thoroughly in Chapter 7, my research training, interests, values, and heuristics might have influenced the perceptions constituting the reality expressed in this document. Although I tried to discipline and reduce interference from personal idiosyncrasies in the development of the study, the results represent, ultimately, my personal interpretation of reality, with all the cognitive faults that others might detect therein.

1.5 Final Considerations

This chapter recounts the foundations for this thesis. The problem-areas of research and research questions, as well as and the overall research design used in the study were introduced in Section 1.1. Since the chapters of the thesis also reflect the various stages of the unfolding process of developing exploratory qualitative research, the presentation of the research questions was developed together with the description of the study outline. The main arguments justifying the research were presented in Section 1.2 and the methodology was briefly described and justified in Section 1.3. Finally, the main limitations of the study were given in Section 1.4. The next chapter launches the study by initially clarifying what constitutes the nature of the environmental impact caused by modern organisations.

PART ONE

Modern Organisations

and

Sustainable Industrial Development

2 The *Environment* of Modern Organisations and Theories

Environmental disruptions that have been caused by human action are not new phenomena. From the extinction of other species in particular pre-historical periods to today's pollution of water, air, and soil, human action has played a crucial role (Flannery 1996). Nevertheless, there is a key difference between the environmental impact of pre-industrial civilisations and those of modern industrial society. The construction of this society has made possible the development of technological means for transforming nature in an unprecedented manner and scale (Diamond 1998; Tibbs 2000). One consequence is that, as a result, the survival of species is now threatened by the continuous burdening of the sustenance base by human activities, a risk that has been increasing at an extraordinary pace (Brown 2000). Although a global threat has mainly been thought of in terms of a nuclear conflict, environmental catastrophes can actually develop over time, through climate and other changes provoked by unintended consequences of industrialism (Beck 1992a, 1992b; Giddens 1990). Systems of industrial production may also function as systems of ecological destruction (Beck 1997). The extension of activities performed by industrial organisations has reached a global scale and, for some observers, the exhaustion of the planetary ecological carrying capacity suggests that the current model of economic development may be reaching its limits (Constanza 1995; Daly 1992).

For most of us, the environmental challenge presents no novelty. The number of media reports on environmental disruptions caused by modern societies has flourished in the 1990s and there is an apparent awareness among scholars, business people, and lay citizens about the scale of the problem (Hoffman & Ehrenfeld 1998). Responsibility towards the natural environment seems to be on the rise, with some corporations showing signs of improved environmental performance. But these improvements are still confined to a very limited number of large sized corporations in specific industrial sectors (Roome 1998). In other words, environmental awareness does not seem to be reflected in widespread managerial action. Otherwise, how could the continuous environmental disruptions caused by modern organisations be explained? This chapter addresses this question first by identifying the main cause of the problem. The concept of environmental costs and the main reasons why organisations have been able to *externalise* them are explained in Section 2.1. The argument is developed through identifying a ‘gap’ between economic theory and management practices in modern organisations, as well as through investigating the complexities associated with the economic and political measures that try to correct this gap. If practical actions towards environmental improvements have taken a long time to be implemented by corporations, the situation is not substantially different in the academic context. Considering that the classic studies of Max Weber, developed almost a century ago, represented the foundational milestone of *organisation studies*[7], one could question why studies about organisation and the natural environment only started to emerge in the 1990s. After all, most lay citizens could easily perceive the environmental impact that industrial activities caused to natural ecosystems just by observing air emissions released by factories, and the littering of aquifers and soil, among many other ‘visible’ sources of pollution. By debating the role that social paradigm had in the treatment of the *environment* in organisation studies, Section 2.2 aims to answer why organisational scholars did not pay so much attention to this apparently obvious negative impact of organisations on nature. The evolution of theoretical approaches dealing with the interaction between organisation and the *external* environment is used to explain the slow pace of development of research about environmental issues in organisations.

Studies developed in the emerging field of *organisation & environment* in the 1990s, as well as the main approaches that compose alternative ‘social paradigms’ are explored in Section 2.3. The scope of the section is limited to a descriptive narrative of the context in which studies about organisations and the natural environment have developed. In this respect, the main contribution of this chapter relates to the contextualisation of the studies about organisations and the natural environment. Some of these studies have been developed from ‘hybrid’ disciplines, which emerged during the 1990s. Section 2.4 introduces a selected group of such interdisciplinary studies and debates the common elements influencing the surge of such approaches. Used in conjunction for the study of environmental issues in organisations and industries, they characterise multi-disciplinary studies, as Section 2.5 explains. A brief summary of the rationale for developing multi-disciplinary (environmental) studies closes the chapter.

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7 The concept of organisation studies used here encompasses more traditional categories such as organisation theory and organisation behaviour. The object of organisation studies focuses on both concrete organisations and the practice of organisation, as well as the processes of organising (see: Clegg, Hardy & Nord 1996).

2.1 Environmental Costs: The '*Gap*' Between Theory and Practice

Industrial organisations are the artefacts that allowed humans to reinvent nature and transform the original site of the species, imprinting our dominance on the world. Such dominance expresses itself globally, extending far beyond frontiers of political systems. Today at least one fifth of the world's population enjoys the comfort produced by industrialisation, even though almost everybody shares the burdens associated with this historical process (Brown 2000; Piel 1992). Environmental disruption rather than being confined by political systems consists of one of the legacies of industrialism that pervades both capitalist and socialist societies; both use organisations to exploit resources and to reinforce political systems (Giddens 1990).

If the effects of industrialisation are easily identifiable, why then are environmental problems so pervasive? Surprisingly, the answer to such a broad question is relatively simple: it relates to the treatment that economic systems have historically given to environmental costs. The system that assesses organisational performance in capitalist societies is a product of an incomplete theoretical representation of reality (Daly 1977). There is a 'gap' between the physical outcomes of organisational action and the economic representations of this action, materialised in the form of environmental pollution. The core of the problem for organisations that operate within the capitalist system is the difference between prices and costs – market prices do not always reflect total costs of products (Hawken 1993).

Where a corporation receives more monetary value for a product than the cost associated with the management of its value chain (see: Porter 1980), this organisation, theoretically, has achieved those economic conditions conducive to survival. Empirical examples of environmental costs include: the damage caused by the extraction of raw materials (eco-system disruption, landscape alterations, etc.); the pollution effects of production (such as noise, emissions, and industrial accidents); the damage caused during use by consumers, and the post-consumption effects of the product (costs of collecting, recycling, or depositing waste-products in landfills). Although these costs can be physically perceived, they are not considered in most companies' accounting systems (Bauer 1994; Gray 1993; Gray *et al.* 1995; McMahon 1995). In simple economic terms, most of today's physical pollution consists of environmental costs *externalised* from organisations onto other citizens and their organisations, in the state and civil society.

In socialist societies the reality can be even worse, since real economic costs (in capitalist terms) are rarely accounted by firms. More recent exposure to international scrutiny of centralised economies such as the ex-USSR, China, and North Korea have offered examples of the disastrous effects of political systems that limit social accountability. This happens mainly because of their over-development as states and under-development as civil societies. Apparently, few spaces for plural and countervailing pressure were allowed to flourish in those societies. Where such opposition did flourish it tended to be more focused on the economic and political system. While these political systems remained relatively closed, their environmental effects did not; artificial economies produced real environmental disruptions. As Chapter 6 will explore in detail, the environmental impact caused by modern organisations relate to the rules guiding the development of industrialism. The main root of current environmental disruptions caused by industries is the theoretical imperfection that allows them to externalise environmental costs onto society[8].

In theoretical terms, the solution is relatively simple: the elimination of these costs. But in most cases the total elimination of environmental costs demands the eradication of activities that generate them – something not feasible from the economic or social perspectives. A more pragmatic approach for the problem requires organisations to *internalise* some of these costs. However, if it is relatively simple to identify *what* needs to be done (the elimination or internalisations of environmental costs) controversies abound about *how* this change can be achieved. In fact, most theory and practice about environmental issues in business have developed around the search for solutions for this generic question, and the identification of mechanisms (economic, cultural, technological, etc.) for the elimination or internalisation of costs composes the foundation of environment-related disciplines. *Hybrid* disciplines, such as environmental law, environmental sociology, ecological economics, or industrial ecology (described in Section 2.4) normally depart from their primary expertise (law, sociology, economy, engineering, etc.) to propose alternatives to the current economic system. Regulatory measures, for instance, have historically been considered an

8 One might argue that the type of rationality guiding human action is the real cause of such problems. Kalberg (1980) for instance, employs such an argument by exploring further the studies of Weber (1968). In this section I do not deny these deeper roots guiding human action; rather I confine my studies to the intrinsic logic of economic action – itself a result of the predominant use of the (Weberian) use of *instrumental rationality*.

adequate instrument to correct market failures. Environmental law, on the other hand, is the area that specifically links legislation, among other legal instruments, to ecological issues. Similarly, the study of organisational changes that are necessary for the internalisation of environmental costs is the main contribution of organisation studies to the environmental debate. The reason why this contribution has so far been marginal is explored next.

2.2 The '*Silence*' of Organisation Studies

Organisation studies consist of one of the main areas of science dealing with business activity. For this reason, it would be logical to expect its practitioners to have made substantial contributions to the analysis of environmental disruptions caused by organisations; after all, such disruptions are core issues of what Beck (1992a) called *risk society* – a society in which the notion of unanticipated consequences of social action takes on dangerous proportions (see: Chapter 6). But until the beginning of the 1990s organisation studies have neglected this dimension[9]. Progress has been made in the past few years but environmental issues in organisations is still a relatively small area or research. One could say that, historically, organisation studies as a scientific field has failed to engage seriously in the environmental debate (Shrivastava 1995).

While organisation studies required time to develop as a scientific field, the effects of manufacturing activities on the natural environment appear concurrent with the industrial revolution. In the beginning of the 20th century Max Weber recognised the *Spirit of Capitalism* and already warned of its likely dominance until the extinction of 'the last ton of fossil fuel'. Weber (1968) explicitly linked the resource exploitation of an ever-expanding system of economic value to modern organisations. He identified these organisations as central causes of, and the only possible solutions to, contemporary societal and environmental problems. The societal level of analysis was used by Weber to analyse organisations and identify bureaucracies as specific types of social systems that resulted from the predominant use of formal rationality in the late 19th and early 20th century (Kalberg 1980). Ironically, his studies of social phenomena have been predominantly identified with the study of bureaucratic forms and, together

9 Gladwin *et al.* (1995) found that between 1990 and 1995, less than 0.003% of the abstracts of management articles of the ABI/Inform Database contained words such as biosphere, environmental quality, ecosystem and sustainable development.

with the work of Henry Fayol and Frederic Taylor, classified by many management experts in the *classical management* literature[10]. As a result, the early developments of organisation studies were strongly based on the notion of organisations as closed systems; entities dissociated from their environment.

When the environment finally ‘returned’ to the study of organisations as an organisational contingency (see, for instance: Lawrence & Lorsch 1967; Thompson 1967; Woodward 1965), it was defined as the *organisational environment* – something abstract and a-temporal, having little to do with the natural (or ecological) environment (Shrivastava 1994). The environment was interpreted from an organisational point of view and a capability for controlling it was pervasive in research and management practice. Most theories of organisations in the 1960s were oriented towards rationalistic managerial prerogatives in which machines, people, and the environment were equally considered contingencies that performed functions *for* organisational life. The organisation was not only the nucleus of an artificial form of life moulded by instrumental rationality but the majority of managerial theorists seemed to believe that every organisational variable could, and indeed should, be controlled by management.

The idea of being able to control the environment was questioned in the work of Hannan and Freeman (1977; 1989). Researchers of the *population ecology* perspective have imported theoretical concepts and sophisticated calculus techniques from biology to the world of formal organisations. They used birth and mortality rates as indicators of adaptation and survival of organisations to a specific niche (Baum, 1996). Also called *evolutionist theory*, what at first glimpse seemed to be an ecological theory of organisations, was actually a reification of the functionalistic paradigm. According to the classification of human nature by Burrell and Morgan (1979), the ‘natural selection’ of companies that fit within a specific population of organisations is a determinist perspective that minimises the importance of political dimensions of human organisation. Ironically, the application of biological models to the analysis of the ‘ecology of organisations’ has little to do with the natural environment (Young 1988).

The use of the concepts of ‘environment’ and ‘ecology’ by the perspectives of structural contingency and population ecology, meaning something different than the

10 Most textbooks on management use this classification for Weber’s study. For instance, see Robbins *et al.* (1997), Barney and Griffin (1992).

natural environment, should be seen more as a problem of the all-encompassing scope of the terms themselves than an intentional strategy of denying the importance of environmental issues in organisation studies. These perspectives successfully progressed as specialised scientific streams because they had their own research agendas focusing on a particular dimension of organisational reality. The organisational impact into natural environment simply was not part of their research agenda. Hence, these ground making perspectives, vulnerable to criticism, cannot be based on the 'appropriation' of the terms 'ecology' or 'environment'. There is nothing fundamentally wrong with their use as metaphors to express the 'organisational environment' or 'the ecology of organisations'. What makes these perspectives vulnerable, however, is the dominant epistemological positioning about research in organisation studies that they represent. The positivistic rigidity that dominated organisational studies until the late 1970s resulted in a scope of research that did not allow much space for its own reflexivity (see: Chapter 6). Indirectly, this might have influenced the interpretation of 'the environment' from a predominantly anthropocentric view, since it satisfied the prerequisites of 'good science'.

The emergence of critical and postmodernist theories in the late 1970s started questioning some of these *taken for granted* assumptions about research and organisation (Alvesson & Deetz 1996). It represented concerted attempts to break the historical isolation of organisation studies imposed by the functionalist thinking described by Burrell and Morgan (1979). New approaches emerged during the eighties and organisation studies gradually gave more space to dimensions such as emotions, aesthetics, and feminism (see: Clegg, Hardy & Nord 1996). These new approaches transformed organisation studies into a 'contested terrain' in which no hegemonic force controlled the proliferation of new images of organisation (Morgan 1986). Apart from a few voices reclaiming the return of a positivistic orthodoxy, such as Donaldson (1995) and Pfeffer (1993), the plurality of approaches and methodologies of current organisation studies represent the loss of the *credo* in a purist scientific field. The last quarter of the 20th century have resulted in a more heterodox scientific arena. Not only have organisations become targets of more ample public scrutiny, but also theorising about organisation became a less 'sacred' activity. Although more critical perspectives transformed organisation studies into an epistemologically contested ground, this disenchantment of organisation studies as a scientific province has failed to engage seriously with the environmental debate (Shrivastava 1995).

Considering that the importance of modern organisations as social constructs of contemporary life is unquestionable, what explains the marginal presence of organisation theory in the environmental debate? For Egri and Pinfield (1996), the explanation relates to the embeddedness of organisations and organisation theorists in what they call the *dominant social paradigm*[11]. In their view, an anthropocentric humanity stands apart from nature with a perspective that suggests that unlimited human progress results from the exploitation of infinite natural resources. This anthropocentrism pervades society, such that people's relationships with nature are based on exploitation and control. The natural environment must serve human needs, and organisations are the vehicle for their achievement. Seen as a technical apparatus, organisations would constitute instruments to reinvent nature and to build social reality. As products of humans, organisations extend human power over nature through institutional frameworks that reinforce theoretical concepts. The concept of organisation as tools has seen them less as devices that shape and reconstruct nature and more as tools with a human purpose. Characteristically, the concerns centre on the project guiding the tool and less on the impact of the tool on nature. Biology was hived off to the life sciences and, apart from people, social sciences became bereft of other natural or life forms. The consequences were a de-natured world of the social and a de-socialised world of nature. The assumptions of the dominant paradigm in both the social and the natural worlds opened a gap between each other, between society and nature, between organisations and natural environments.

The historic 'silence' of organisation studies regarding environmental issues has been challenged by a few voices in terms of the development of this scientific field. However, the dominant social paradigm has historically marginalized those pioneer studies that have addressed environmental problems associated with organisational action. Only in the 1990s did the emergence of responses give rise to a small body of literature in the area. The next section shows that these responses borrowed presuppositions from other disciplines, as well as traditional research areas of organisation studies.

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11 Distinct nomenclatures have been attributed to the *dominant social paradigm*. Colby (1990) employs the term *frontier economics*, while Gladwin *et al.* (1995) call it *technocentrism*. This study utilises Egri and Pinfield's (1996) terms, since it seems to best represent the theoretical approaches encompassed by the locution.

2.3 The Emergence of *Organisation & Environment*

During the 1990s, some organisational theorists started to direct more attention towards ecological issues (Kivisaari & Lovio 1996). Until the end of the decade, the number of publications remained marginal when compared with traditional areas of science, but the natural environment gradually gained ground in the study of organisations. Significant efforts have been made to understand why organisations might adopt environmental strategies. Evolutionary stages have been proposed that organisations should follow when pursuing environmental excellence (see: Haas 1996), and traditional research areas of organisation studies, such as institutional theory (Jennings & Zanbergen 1995), and resource-based theory (Hart 1995) have been suggested as appropriate for the study of organisations and the natural environment. The ample scope of environment related issues, and the possibilities of approaching them from distinct images of organisation (Morgan 1986) have, however, thus far produced a body of knowledge that is still in its exploratory stages. In a review of mainstream journals in the field of organisation studies Lovio *et al.* (1997:7) found that "comprehensive political analysis of both practical issues and research practices are lacking almost totally". They also found that a significant number of the studies have a tendency to analyse organisations as singular entities, focusing on internal determinants of environmental strategy. Russo (1999) emphasised that the majority of the studies on organisations and the environment tend to concentrate on the societal or organisational level of analysis with research focusing on industry levels being very scarce.

The early studies in *organisation & environment* (OE) were characterised by their appeal to ethical principles by which organisations *should* guide their ecological actions. Possibly, this was a reaction to the anthropocentricism that has historically dominated organisation theory and theorists (see: Commoner 1990). Approaches such as deep ecology, spiritual ecology, social ecology, and eco-feminism inspired the theoretical foundations of some pioneer OE works. These areas of study consider bio-species egalitarianism a pre-requisite for economic advancement in harmony with nature, encompassing what Egri and Pinfield (1996) called the 'radical environmentalism paradigm'. The lack of empirical evidence about ecologically sustainable organisational practices possibly explains why organisational scholars have often used ethical and moral philosophies, such as bio-species egalitarianism, to prescribe appropriate organisational behaviour towards the natural environment. Until the 1990s, empirical examples of pro-active environmental practices in firms were extremely scarce (Fisher & Schot 1993). As a result, theoretical and prescriptive approaches became common in the emerging field of *organisation & environment* (Lovio *et al.* 1997)[12].

Personal commitments by researchers towards environmentalism might also have influenced some of the rhetorical and voluntaristic assumptions in these studies (Newton & Harte 1997). In similar fashion to critical theorists, who defend the ideological goal of creating societies and workplaces that are free from domination (see: Alvesson & Deetz 1996; Reed 1996), theorists in *organisation & environment* normally promulgated the ecological rhetoric. Especially because organisational changes in the direction of ecological practices also depend on political struggles, most researchers made it explicit that the theoretical presuppositions of their work have a political, indeed environmental, agenda. A great number of OE researchers participate as active members in interest groups and networks[13], which have explicit agenda of influencing public and private policies towards more sustainable environmental practices in organisations.

Even though one can be sympathetic with ethically oriented ecological principles by which organisations *should* guide their action, there is no sufficient evidence that altruistic motives would guide organisational strategies toward the reduction of environmental disruptions (Brown 1998). In fact, if the history of labour relations can serve as a parameter, one can actually expect the opposite. The acceptance of more responsibilities towards the welfare of employees – from work safety to social benefits – did not occur without substantial disputes. The conquests of the workforce were possible not because managers were suddenly convinced that they *should* value human labour in a higher standard, but because a considerable number of (socio, political, economic and cultural) factors gradually influenced the positioning of firms towards

12 Early efforts to introduce the natural environment into organisation studies were made through special editions of academic journals. In special: *Journal of Organisational Change Management* (Number 7, Issue 4, 1994), *Academy of Management Review* (Number 20, Issue 4, 1995); and the *Scandinavian Journal of Management* (Number 12, Issue 3, 1996). The majority of the papers in these journals prescribed paradigmatic changes towards ecologically-centred organisational behaviour.

13 The *Organisation and Natural Environment* (ONE) interest group of the Academy of Management, the *Organisation & Environment* (OE) research group of the European Group of Organisational Studies (EGOS), and The *Greening of Industry Network* (GIN) are some examples of such groups. The collaboration between the editors of the Business Strategy & Environment Journal with GIN members is even more didactic in this regard.

renewed policies and practices for human resource management (HRM)[14]. Since environmental issues also involve these factors, one could argue that the generation of knowledge in the OE area requests the investigation of *why* modern organisations present specific behaviour towards environmentalism. Although one should never expect that science can be 'value-free' (Lincoln 1994; see also Chapter 7), if genuine scientific knowledge is expected to be generated in the OE field, prescription of organisational rectitude towards the natural environment needs to give way to rectitude in research principles and methods.

Less radical approaches stress the necessity of working *with* the rules that currently guide managerial action by incrementally incorporating bio-centric values into these rules, which, over time, would result in better environmental practices in organisations. These intermediate approaches compose the 'reformist environmental paradigm', and have been adopted by emerging disciplines dealing with environmental issues in organisations. The very basic idea of reformism is that organisations – and more specifically, business enterprises – are both the responsible agents for the promotion of environmental reform, and are sufficiently powerful to be able to do so (Hart 1997; Hawken 1993; Hawken *et al.* 1999).

The majority of the literature on corporate environmental management assumes reformism as the guiding principle for organisational change. *Incrementalism* is the basic principle of the standards of environmental management systems such as the ISO 14000 series (International Organisation for Standardisation) and the European EMAS (Eco-Management and Audit Scheme), as well as the business codes of environmental practice, described in Chapter 3. These programmes assume that through incremental improvements organisations would achieve organisational eco-efficiency and, eventually, ecological sustainability. It is precisely this prerogative of incrementalism that radical environmentalists attack. Colby (1990) stresses that the anthropocentric bias of reform environmentalism produces only minor adjustments to economic and technological systems rather than (the necessary) transformational changes in human society. For instance, the difficulty of finding a common definition of sustainability

14 The account of history of the Organisational Renewal Movement (ORM) in Australia, presented by Dunphy and Griffiths (1998) is an exemplar of such process.

made it possible for the business community to often co-opt the concept, using it in their own interest, as Srikantia and Bilimoria (1997:390) assert:

> The notion of sustainability has generally played itself out of in the business literature as sustainable competitive advantage, conforming to the values and interests of established business institutions in reinforcing individualistic, market-driven, competitive economic growth.

In analytical terms, some radical and reformist studies could be criticised in the grounds of their prescriptive nature. Ethics and moralities compose prescriptions for radical ecologists, while rational rules for eco-efficiency in corporations constitute the recipe of managerial-oriented reformist texts. While most of us – academics or otherwise – are able to recognise that ecological sustainability requires organisations to incorporate ecological principles into managerial rationality, it seems that too many answers have been given before enough questions have been asked. There is still a notable lack of understanding about how modern industries and societies can work towards ecological sustainability. If a bio-centric world is to be achieved, radical environmentalists have yet to develop a theory to satisfy this transition. Conversely, studies that can indicate whether incremental innovations are conducive to industrial sustainable development have not yet been developed.

Mainly because the field of OE focuses attention on the interface *between* organisations and the environment, rather than on organisations *per se*, its emergence represents a contribution to the search for models that could eventually lead to ecologically sustainable societies. The expertise that organisational theory has accumulated in the 20th century can certainly be used in conjunction with other disciplines, such as engineering, economics, and sociology to generate knowledge about current systems of production and consumption, and alternative models for their reorganisation. In the same fashion as OE originated from organisation studies, other *interdisciplinary* scientific streams evolved from their original scientific background, incorporating ecology and other disciplines for the study of environmental issues. The eventual intersection between these '*hybrid*' studies and OE might represent a significant contribution to the understanding of environmental issues in organisations, industries, and societies.

2.4 The Development of *Hybrid* Environment-related Disciplines

Beyond the 'frontiers' of organisation studies[15], research areas such as environmental accounting, industrial ecology, and ecological economics constitute alternative approaches that present guiding principles that businesses can use to incorporate the natural environment into decision-making processes. These disciplines fall under the 'reform environmentalism paradigm', proposed by Egri and Pinfield (1996). Rather than recommending a total rupture with the historical developments that culminated in these areas of science, they propose a *reform* of systems that guide organisational activities and control based on ecological principles. They constitute interdisciplinary or '*hybrid'* areas of research, which have been built, in this case, mainly upon the classic disciplines of accounting, engineering, and economics. In the same manner that Morgan (1986) suggested the use of distinct metaphors for the analysis of organisations, these studies represent attempts to incorporate environmental issues into organisational analysis. In this perspective, the interaction of the organisation with the natural environment becomes the focus of the analysis, in which ecological principles are used as metaphors guiding economics, accounting, and engineering.

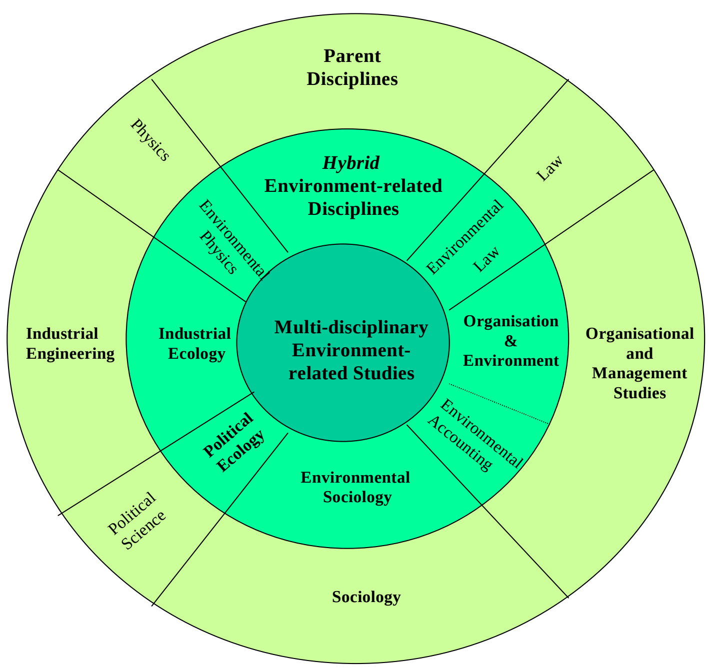
The hybrid disciplines presented here constitute selected environment-related subject areas that have been chosen for their immediacy to the new field of *organisation & environment*. They are neither exhaustive nor does their presentation on this occasion delve into specific research topics. Rather, by briefly introducing these scientific streams in this section the thesis intends to show that there was a concomitant 'emancipation' of ecological issues happening in distinct areas of research. In this respect, the emergence of critical perspectives in organisation studies in the late 1970s, questioning *taken-for-granted* assumptions concerning research and organisations (analysed in Section 2.2), should not be seen as an isolated event. In fact, the growth of ecologically oriented studies about systems of production and consumption should be seen as part of a broader revaluation of the capacity of traditional scientific disciplines to explain reality, as well as to present solutions for empirical problems faced by modern societies. There are several significant examples of work that critically addressed the limitations imposed by the paradigmatic assumptions of mainstream

15 This classification is essentially didactic, since there are no clear boundaries between these areas of study. Nonetheless, because these scientific streams have developed as quasi-independent areas of enquiry, I consider them as being 'outside' the borders of *organisation & environment*.

scientific disciplines. Among these are the foundation of ecological economics, established by Herman Daly's (1977) proposition of a steady-state economics, the approximation of concepts of modern physics with oriental philosophy by Capra (1981; 1986), and the more recent developments of chaos theory (see: Gleick 1987).

Therefore, it was through the inquisitive intellectual context developing in the last quarter of the 20th century that changes started to emerge in several areas of research, encompassing levels of analysis ranging from the individual, through organisations and industries, to the global economy and societies. In this regard, the selection of the hybrid or interdisciplinary studies presented in the next sections constitutes only a brief attempt to indicate the scope and levels of analysis used by environment-related areas of inquiry, rather than to present a thorough overview of their content. Hence, these disciplines should be seen as exemplars of a more intricate and broad spectrum of such disciplines. Figure 2.1 presents the hybrid disciplines and the respective (main) parent disciplines from which they have originated.

Figure 2.1: Selected Hybrid Disciplines



Developments that occurred in accounting – traditionally, one of the most conservative areas of management – is represented here, for instance, by environmental accounting or, as Bennett and James (1998) prefer to call it: *environment-related management accounting*. Although environmental accounting can be used to cover both national and firm level accounting activities, the next section emphasises the importance of environmental accounting at the firm level. Principles and techniques encompassing both the organisational and the industry level of analysis are introduced by industrial ecology. Finally, predominantly macro-scale analysis is addressed by research in ecological economics and environmental sociology.

2.4.1 Environment-related Management Accounting

The development of *environment-related management accounting* or *environmental accounting* can be seen as part of a broader attack on cost accounting systems, intensified in the early 1990s. Accounting has been criticised mainly for its limitations in representing *real* (internal and external) costs of manufacturing incurred by organisations. In the beginning of the decade, accounting became a target for professionals interested in more accurate systems for measuring factory productivity. Kaplan (1991) demonstrated that accounting techniques used by contemporary manufacturing companies were inadequate for the control of modern practices of operations management. According to him, there was a *relevant loss* of information about manufacturing processes as a result of the increasing complexity of systems of production. In essence, accounting cost differs greatly from technical costs mainly because the basic principles of financial accounting have practically not evolved over a century. While the general principles of financial accounting have become institutionalised practices in most industrialised countries, technological innovation significantly change the nature of management practices as well as the organisational structure and processes. Kaplan's critique generated new proposals for measuring the production and performance of companies such as the 'activity-based cost' (ABC) accounting, in which costs are broken out and assigned to the causative activities. The advent of ABC systems showed that traditional accounting systems were based on principles and concepts that do not reflect the real performance of organisations.

Contemporary accounting systems are also inadequate for the measurement of environmental costs that are externalised into society (Bauer 1994; Gray 1993; Gray *et al.* 1995). Both practitioners and researchers have acknowledged this deficiency but solutions about how to internalise environmental costs into accounting systems have not yet reached a common ground (Hibbitt & Blokdijk 1996). Concepts and techniques of environmental accounting evolved from this debate but there is significant disagreement about the criteria that should compose accounting systems (McMahon 1995). These limitations in quantifying environmental costs provoked the approximation of the areas of management auditing, accounting and reporting. What should be audited, accounted, and later published in an organisation's environmental report, is part of the same process that is expected to generate frameworks for the evaluation of the ecological accountability of organisations.

The extent to which the critique of traditional accounting systems influenced the development of environmental accounting is difficult to infer. Nonetheless, the use of ABC systems to better allocate costs according to distinct activities performed by an organisation could certainly be seen as a first step towards the identification of environmental costs, which have not traditionally been accounted for by organisations. The development of *Total Cost Assessment* (TCA) techniques, for instance, represents a step in this direction. Through the use of TCA methods, environmental costs are incorporated into (traditional) capital budgeting analysis[16]. Overall, during the 1990s, accounting for the natural environment, as well as social issues associated with the activities performed by firms have become increasingly important for both the practice of management and the corresponding formalisation in accounting systems.

2.4.2 The Ecology of Industrial Systems: Industrial Ecology

Another interdisciplinary scientific field with a broader scope than firm-level environmental accounting has emerged within the realms of industrial engineering. *Industrial ecology* studies environmental disruptions caused by industry mainly from a technological view[17]. From this perspective, individual manufacturing process should not be considered in isolation but rather as integrated parts of industrial systems and the natural environment. Industrial ecology systems should aim to maximise the use of resources at the same time that they minimise disruption to the environment. In this systemic view, the total cycle of materials – from virgin material, to component, to product, to waste product, and to ultimate disposal – is optimised in terms of resources, energy, environmental impact and capital (Frosh & Gallopoulus 1989). The ecological

16 For an overview of environmental accounting, including TCA principles and techniques, see: Bennett and James (1998; 1999).

17 A review of the main concepts and research areas of industrial ecology can be found in den Hond (2000).

metaphor is used to extend the biological principles that result in the *efficiency* of ecological systems to the industrial flow of energy and materials (Tibbs 1993).

The application of industrial ecology requires not just an interdependent flux of materials, processes and energy inside the cluster where firms are located but also new forms of collaboration between member firms (Tibbs 2000). The individual firm's behaviour – where manufacturing companies essentially relate to their (internal) value chain – gives space to a collective strategy that considers the flow of energy and resources in the overall industrial system. Collaborative projects, mainly in the USA and in the Netherlands, have sought to implement industrial ecology systems similar to the well-known eco-industrial park in the town of Kalundborg, Denmark (Kirshner 1995). In this Danish city, a coal-fired power plant, an oil refinery, a pharmaceutical company specialising in biotechnology, a gypsum plant, concrete producers, a producer of sulphuric acid, the municipal heating authority, a fish farm, some *green*houses, local farms, and other enterprises, all cooperate in order to optimise the user of energy and resources as well as to reduce the waste. The basic idea behind the system is that wastes and by-products of one company can become raw material for another. Without using any regulatory process or legislation, these organisations established an efficient flow of materials and energy. At the same time that they reduced their environmental impact, the internal costs of companies decreased as a function of the optimal use of resources.

The uniqueness of the Danish case – reported in almost every text of industrial ecology – raises doubts about the limits of the use of biological metaphors in the design of human enterprises. Considering the alleged economic and environmental benefits of ecological parks, one could ask why have they not occurred more frequently in countries such as the USA, where industrial districts are commonplace? According to Hileman (1995), governmental regulations constitute a major impediment to the diffusion of eco-parks because they indefinitely tie firms to their waste. Whenever companies manufacture products containing waste from another firm (secondary material) this firm could be held liable for health problems or damages caused by the waste used as raw material (see: Section 4.1 in Chapter 4). Another problem is that businesses usually have difficulty in securing funding for the environmental technologies that are essential for such parks.

These hurdles indicate that ecological principles have some limitations in their use for both the design and analysis of industrial systems; there are major differences between them and natural systems[18]. Industrial clusters are neither closed systems nor do they function exclusively based on mechanistic or organic principles. Political and economic variables play a significant role in defining a firm's willingness to incorporate ecological concepts in its strategies and to participate in industrial ecology schemes, such as the Kalundborg eco-park.

Although industrial ecologists, such as Laudise and Graedel (1998), recognise these imperfections they have focused the search for (predominantly technical) solutions through the analysis of interdependences in and between systems of production and consumption (Richards 1997). As a result, a multiplicity of techniques and tools that complement the principles of industrial ecology were developed during the 1990s[19]. Techniques of *design for the environment*, *design for disassembling*, and the concept of *product stewardship*, have increasingly been included into corporate environmental strategies (Roome 1998). Design for the environment, for instance, relates to design facilities, processes, products, and services with an awareness of both ecological and economic costs-benefits across the whole life-cycle of a product (Allenby 1993; Lowe, 1993). Design for disassembly can be considered a sub-division of design for environment by which companies improve recovery rates of materials and the overall efficiency of recycling processes. Product stewardship encompasses both techniques and focuses on minimising not only pollution from manufacturing but also all environmental impacts associated with the full life-cycle of a product (Hart 1997).

Although the early texts[20] in the area had a strong emphasis on technical analysis, more pluralistic approaches gradually became more common in the literature (see: Richards 1997; Richards & Pearson 1998). The increasing plurality of industrial ecology texts also reflects the amplification of research from systems of production to systems of consumption. Consumer behaviour is considered an important variable in the

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18 An overview of similarities and difference between natural and industrial systems can be found in Richards and Pearson (1998).

19 Industrial metabolism, for instance, has evolved from a sub-area of industrial ecology to a scientific field that focuses almost exclusively on the analysis of flow of materials in the economy (see: Ayres & Simonis 1994; Frosh 1994).

20 Frosh & Gallopoulus (1989;1992), Frosh (1992; 1994; 1995), Tibbs (1992; 2000), Allenby (1994); Allenby & Cooper (1994); Allemby & Richards (1994); Ehrenfeld (1994).

process of closing industrial cycles but industrial ecology studies tend to focus on the technical and economic analysis of post-consumer activities such as collection, processing, and recycling. For instance, reincorporating post-consumer waste in manufacturing processes depends on its economic value, since companies compare the costs of collecting and recycling materials with the cost of dumping them in the environment (Frosh, 1994). In the current industrial system, environmental costs are not considered in this analysis. As Section 2.1 has shown, this *externality* is neither included in a firm's book-keeping nor considered in the decision process about recyclability of materials. Thus, the lack of infrastructure and consequent higher costs of recycling could actually be understood as a consequence of the way current *accounting systems*, rather than *industrial systems* are defined. In other words, embedded economic principles in systems of production may be the fundamental cause of the problems tackled by industrial ecologists. At the macro level, these principles have been readdressed by another hybrid discipline.

2.4.3 'Ecologising' the Economy: Ecological Economics

Economic principles guiding the assessment of organisational performance impose serious constrains when seen from the macro-economic level. These constraints constitute the focus of another relatively new scientific field. *Ecological economics* addresses the relationship between eco-systems and economic systems in the broadest sense (Constanza 1995). The scope of ecological economics is enormous, since the economy is viewed as a sub-system of the planetary ecological order – rather than the traditional (opposite) view of neoclassic economics. This interdependence between natural and economic systems can be extended to human psychology but more instrumental approaches can be found in sub-areas of ecological economics, such as environmental impact assessment, ecological taxation, and the development of indicators of sustainability.

Work in ecological economics has developed mainly because researchers trained as economists and ecologists have been able to develop theories and frameworks that incorporate social and ecological variables into conventional frameworks so far ignored by classical economists. Principles of environmental equity and holistic management have been used for the development of analytical models for public and private administrators to determine pollution levels and economic compensation for the depletion and degradation of natural resources (Common 1995; Daily 1997). Ilinitch and Schaltegger (1993), for instance, quantify trade-offs between economic and environmental costs and benefits.

The development of models and analytical frameworks has certainly been an important achievement by the ecological economics community[21] but the necessary political bargaining processes that might eventually result in macro-economic changes are not as easy to achieve. Roodman (1998), for instance, demonstrated that cutting the estimated US$ 650 billion a year spent by governments worldwide to subsidise activities that harm the environment could actually benefit national economies. Such a policy would require the shift from income taxes to the taxation of natural resources and polluting industrial practices. Obviously, even if Roodman's proposal were technically perfect, it would not be easy to implement. The sensitivity of taxation policies is a well-known political variable in the election of governments, and changes of this magnitude cannot be expected to happen in the short term. Factors of political economy are certainly in play. In this respect, although the emergence of ecological economics as a scientific field certainly represents a contribution to a better understanding of current environmental issues, other hybrid disciplines may be needed to complement analysis.

2.5 Multi-disciplinary Environment-related Studies

As Section 2.1 previously addressed, environmental disruptions caused by modern organisations have their origins exactly on the consideration of them as entities dissociated from their physical or natural environment. The theoretical borders established between the artificial (or transformed) environment and the natural environment have long been indicated as a central cause of environmental disruptions (Daly 1977). Because of this, the design of research that does not oversimplify the interdependencies between natural and human systems and it is sufficiently focused to be feasible, represents a major challenge. Even though the definition of boundaries and focus for empirical research is problematic for research in social sciences in general, the broad interdependence of variables involved in environment-related issues in organisations certainly constitutes a renewed challenge for the design of empirical research.

21 Researches in this field have funded the *International Society for Ecological Economics* (ISEE), which organises bi-annual conferences and promotes informal networking between members.

The plurality of disciplines and research methods constitutes potential answer to such a challenge. The complexity of environment-related studies in organisations should not hinder efforts to design and develop research that can result in contributions to scientific knowledge. The special edition of the *Academy of Management Journal*[22], presenting empirical studies of environmental issues in organisations, constitutes an important contribution in this direction. Nonetheless, the understanding of the impact that systems of production and consumption cause to the natural environment, as well as their redesign based on ecologically-driven principles seems to require supplementary, indeed *multi-disciplinary* perspectives. According to Capra (1997), the study of interactions between human organisations and natural ecosystems apparently demands a shift from a discipline-centred analysis to one focusing on the *relationships* among systems.

This study pursued such perspectives. The following chapters present an overview of areas ranging from applied environmental management in organisations (Chapters 3 and 4) to political economy (Chapter 5) and environmental sociology (Chapter 6), as an attempt to refine some of the connections between these *hybrid* disciplines. Together, they characterise a *multi-disciplinary environment-related study*, depicted as the core of Figure 2.1. Such an effort is expected to represent a contribution to the field of *organisation & environment*, as well as to facilitate dialogue among researchers working in various environment-related disciplines.

2.6 Conclusion

The imperfection of the economic system used to assess organisational performance lies at the heart of the environmental disruptions caused by modern organisations. Companies can use natural resources and operate without being fully accountable for the damage they cause to natural eco-systems because they are not required to internalise most environmental costs. Although the poor record that organisations have shown in the field of corporate environmental responsibility has long been known, research only started to emerge in organisation studies during the late 1980s and early 1990s. The anthropocentric nature of organisation studies – with its substitution of the corporate body and the fiction of the organisation as a 'legal personality' for that of the

22 AMJ, Number 43, Issue 4, 2000.

corporeal individual – has been identified as one of the main reasons for the scarcity of research and publications on environmental issues. In the past, until relatively recently, researchers just did not address these issues.

By the end of the 1990s the number of publications on *organisation & environment* remained relatively small, compared with traditional areas of research, but the natural environment gradually gained ground in the study of organisations. Environmental issues entered research through traditional areas of organisational studies, such as institutional theory and resource-based theory. Organisational responses to environmental challenges as well as the identification of necessary changes for the creation of ecological sustainable organisations and societies currently encompass research on environmental issues in organisation studies. The literature adopts one or other, typically, of radical or reformist approaches (Egri & Pinfield 1996). *Radical* studies normally have their foundations in areas such as deep ecology, social ecology, and eco-feminism, which consider bio-species egalitarianism a pre-requisite for economic advancement in harmony with nature. In this view, radical changes in the values guiding organisational actions are required. Conversely, reformist approaches stress the necessity of working *within* the rules that currently guide managerial action. The studies assume that organisations – and more specifically, business enterprises – are both the responsible agents and the ones most likely to be sufficiently powerful to promote environmental reform (Hawken 1993).

Radical perspectives initially dominated studies about environmental issues in organisations. The lack of evidence that organisations will change their behaviour out of altruistic motives lead reformists to assume that *incrementalism* was the guiding principle of organisational change. The gradual incorporation of ecological values into corporate strategies and practices would happen over time, they argued. Incrementalism became the basic principle of technical approaches from the natural sciences to environmental management and most corporate responses to environmental challenges described in Section 2.4 are exemplars of this perspective. As a result, literature on environmental issues has grown during the 1990s not only inside the borders of organisation studies but also in new interdisciplinary scientific fields, such as environmental accounting, industrial ecology, and ecological economics.

The importance of political factors influencing environmental issues in modern industrial societies has gradually been recognised by more technical areas of research such as industrial ecology (see: Richards & Pearson 1998). This awareness, however, has not yet been reflected in substantial research. Comprehensive political analysis of both practical issues and research practices are almost totally lacking in the context of *organisation & environment* (Lovio *et al.* 1997). Additionally, a significant number of studies in this field tend to analyse organisations as singular entities, focusing on internal determinants of environmental strategy. Therefore, incorporating analytical perspectives that consider the chain of interdependencies between organisations and industries could, in theory, enhance the understanding of the process of *greening* in organisations. This is the main reason why Chapter 5 develops an analysis of the institutional-power context in which organisations are embedded, and presents an analytical framework for the analysis of business-environment relationships.

The expertise accumulated in organisational and management studies, used in conjunction with disciplines such as engineering, economics and sociology, can be expected to generate knowledge about current systems of production and consumption, as well as alternative models for their reorganisation. The mechanisms for the integration of ecological principles into business strategies and practices that foster or inhibit organisational learning and change need further research (Griffiths 2000; Roome 1998). Understanding structural and behavioural prerequisites that might increase the pace of environmental innovations and inter-firm collaboration is also crucial for the creation of more efficient industrial systems, and consequent *dematerialization* of the economy.

In conclusion, research about organisational strategies and practices that can lead to ecologically sustainable systems of production and consumption constitute the main environmental challenge for the emerging field of *organisation & environment*. The degree of complexity involved in this type of research is considerable. The majority of environmental issues in organisations seem to be irreducibly multi-disciplinary in character. Some questions related to the limits of environmental management practice in promoting ecological sustainability provide the best example of such complexity. Environmental management practices in corporations are expected to reduce the impact caused by industrial and commercial activity but one could question whether these practices are conducive to ecological sustainable development. Indeed, the business community seems to have a tendency to associate the concept of sustainable development with pro-active environmental practices in firms. The next chapter questions such association by presenting an overview of the schemes promoting pro-active environmental management in organisations and their potential to advance ecological sustainability.

3 Ecologically Sustainable Organisational Practices?

Studies of organisation and management present an impressive array of cases of companies that outperform their competitors in terms of market position, degree of innovation, or profitability. The identification of these *excellent* or *best-practice* companies can be done by traditional economic criteria, such as the financial indicators used to define technical share prices in stock exchange markets. The *Fortune 500* list, for instance, is based on economic criteria that position companies in terms of profitability, return on revenues, assets, or stockholders' equity. Management literature has developed, in part, as a search for factors that lead to organisational excellence and the consequent *economic sustainability* of business[23]. If organisational excellence can be sustained, business survival can potentially be secured. The literature is bountiful: strategic management, organisational change, leadership, and innovation are but a few examples where themes that seek to explain the path towards corporate excellence can be found[24]. Because best-practice companies can be easily identified, many of these management theories try to explain how empirical cases of organisational excellence were possible.

The issue is more complicated when one tries to evaluate corporate excellence in ecological terms. Chapter 2 has shown that research in the field of *organisation & environment* only emerged in the 1990s, and a common acceptance of indicators that could suggest levels of ecological sustainability of organisations has not yet been achieved (Bennett & James 1999). Although more recent attempts to define what would constitute a sustainable corporation have been proposed by Dunphy and Griffiths (1998), and Dunphy *et al.* (2000), in practice, the definition of what comprises an environmentally excellent business is still very controversial. This is due to the fact that, among other reasons, ecological excellence in organisations is a relational term; a firm may present excellent environmental practices relative to other firms but this excellence does not guarantee the ecological sustainability of the organisation (Tibbs 2000).

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23 The time frame of 'economic sustainability' can vary significantly, from short-term business profitability to long-term distribution of dividends. For the purpose of this study, however, what is important is the possibility of measuring this abstract notion of sustainability in economic terms.

24 For an overview of classic and more recent topics in organisation studies, see: Clegg, Hardy and Nord (1996).

This lack of scientific or theoretical certitude about what would constitute ecologically sustainable firms, industries, or societies, created both the opportunity and the need for the business community to promote its own vision about how corporations could work towards *ecological* sustainable development. From the mid-1980s onwards, industry associations, in partnership with governments and other interest groups, started voluntary programmes for the promotion of beyond-compliance or pro-active organisational practices. These initiatives represented a progression from the traditional compliance with minimal environmental performance required by law[25], to the standards defined by industry and/or interest groups. Environmental impacts caused by companies participating in these programmes have indeed been reduced but whether such practices are conducive to sustainable development remains an open question.

This chapter addresses this issue by evaluating private and public schemes promoting pro-active or beyond-compliance environmental management in firms, which have been implemented mainly during the 1990s. The initiatives presented here have been the most influential ones and, for this reason, the list is obviously selective. Although a vast array of business codes of environmental practices have been created, Section 3.1 presents the ones that have received the most considerable attention by both business and academic communities. The standardisation of environmental management systems (EMS) has emerged in the 1990s as a mechanism for the harmonisation of different approaches used by companies worldwide. Section 3.2 provides a brief description of the most influential standards for environmental management systems currently in place and reveals the basic assumptions used in their design. The main area of attention of environmental management systems is the monitoring of environmental impacts associated with manufacturing processes. By contrast, life-cycle assessment (LCA) and eco-labelling cover the impacts specifically associated with industrial products, and an analysis of their use is given in Section 3.3. The final section of the chapter questions whether industrial ecological sustainability is possible in the terms proposed by these initiatives.

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25 The compliance of a company to environmental regulations consists of an obvious indicator of environmental performance. However, because compliance relates to legalistic limits of environmental impacts that organisations can cause, companies that comply with local environmental regulations can still be heavy polluters. For this reason, compliance can only be used as an indicator of *minimum* levels of corporate environmental performance.

3.1 Business Codes of Environmental Management

In the 1980s, a series of environmental disasters influenced public opinion to demand industries to approach environmental issues from a different perspective. A new mode of addressing environmental regulation started to emerge, and a new phase of industry-governments relationship gradually gained terrain (Howes *et al.* 1997). Distinct sectors of the business community and non-profit organisations responded to the public demands for better corporate environmental performance with the release of a series of voluntary principles, in the form of codes of conduct, environmental guidelines, charters and programmes. Independent of their origin, these initiatives share the common objectives of assisting business to initiate and guide the implementation of environmental programmes, and to communicate this environmental commitment to the general public (Brophy 1998).

The Canadian Chemical Producers Association (CCPA) proposed one of the first industry environmental initiatives that gained international reputation. The *Responsible Care* initiative was created in 1983 as a voluntary programme for companies in the industry. In December 1984 public outrage at the disaster in the pesticide production plant of the *Union Carbide Co.* in Bophal, India[26], induced CCPA to make Responsible Care a condition for association membership. It was not until 1988, however, that the American Chemical Manufacturers Association (CMA) adopted the programme, which was later also embraced by the European Chemical Industry Council and other chemical associations around the world. Responsible Care is basically a voluntary initiative for health, safety and environmental (HSE) performance improvement. It is also the ethical framework around which member companies operate, representing their commitment to respond to public concerns about the safe management of chemicals.

Responsible Care encompasses management codes of conduct and practices but the codes do not prescribe standards of environmental performance, and firms can decide for themselves how they implement each requirement. In the United States, CMA developed specific codes of practice for the management of a firm’s manufacturing and distribution activities, and the interaction with community and customers. Every year, member-companies have to self-assess their environmental progress and submit a report

26 Approximately 2,500 people died, and 200,000 were injured as a consequence of the accident on December 3, 1984. For details see: Shrivastava (1992; 1995).

to CMA. Any company that does not comply with Responsible Care principles would theoretically lose its trade association membership. In practice, Nash and Ehrenfeld (1997: 500) asserted that:

> The chemical industry has resisted instituting disciplinary sanctions on the grounds that encouragement is superior to punishment. In Canada, the CCPA has taken the unusual step of expelling one member for 'not moving in the right direction'. In the United States, no CMA member has had its membership revoked (…) Only recently have CMA board members had access to the names of forms that are not implementing the codes on schedule.

The extension in which Responsible Care is implemented varies significantly from country to country. In Canada and Australia, third party verification has been instituted, but this is not the common practice for most countries – specially the ones where specific codes of environmental practice have not yet been developed. Apparently, the codes can become a useful instrument for the improvement of relationships between chemical companies and their main stakeholders. Nash and Ehrenfeld (1997:500) in their study of codes of environmental management practice, identify the interaction with community and relationships with distributors as the areas where Responsible Care has impacted most (see also: Howard *et al.* 1999). The combination of this conclusion with another study developed by King and Lenox (2000) suggests that Responsible Care has impacted more on the image of companies than on the overall improvement of their environmental performance.

Another environmental disaster was the determinant for a group of independent organisations to release another set of codes of environmental practice. The *Exxon Valdez* oil vessel accident in Alaska in 1989 prompted American institutional investors and environmental groups to launch the *Valdez Principles*, subsequently renamed *The Coalition for Environmental Responsible Economics*, or the *CERES Principles*[27]. In the early stages, companies that already had strong environmental reputation mainly adopted the CERES Principles, such as The *Body Shop* and *Ben & Jerry*, but in 1993 *Sun Oil* became the first Fortune 500 listed company to endorse the Principles. Today, several large organisations, including *General Motors* and *Polaroid*, have endorsed the principles and pledged to go voluntarily beyond the requirements of the law. By adopting these principles, corporations publicly affirm their responsibility for the environment, and commit themselves to release a standardised corporate environmental

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27 http://www.ceres.org/ (1999, November 2).

report every year. The CERES Principles can have a practical application, since they establish an environmental ethic with criteria by which investors and others can assess the environmental performance of companies. These Principles, however, are not intended to create legal liabilities, expand existing rights or obligations, waive legal defences, or otherwise affect the legal position of any endorsing company, and are not intended to be used against an endorser in any legal proceeding for any purpose (Brophy 1998).

A third environmental initiative that received a larger institutional acceptance is a coalition of international private companies that advocates economic growth and sustainable development as compatible achievements. The *World Business Council for Sustainable Development* (WBCSD)[28] was formed in January 1995 through a merger between the Business Council for Sustainable Development, in Geneva, and the World Industry Council for the Environment, an initiative of the International Chamber of Commerce (ICC), in Paris. Its members are drawn from thirty countries and more than twenty major industrial sectors. The WBCSD promotes the development of closer cooperation between business, government and organisations concerned with the environment and sustainable development. The group encourages high standards of environmental management in business through the promotion of business leadership in environmental management, the promotion of best practice demonstration programmes, participation in policy development, and global outreach through global networking.

The two private sector initiatives that eventually merged to form the WBCSD were developed mainly as an industry coalition for the 1992 United Nations (UN) Conference on Environment and Development held in Rio de Janeiro, Brazil (also known as *Earth Summit 92*). At that time, industry leaders were concerned with the possibility of the UN meeting to trigger more stringent governmental regulations (Nash & Eherenfeld 1997). The conference itself did not result in any major direct demand for better business environmental practices. However, most of today’s initiatives were consolidated after the UN meeting, and the lasting years of the decade were profuse in terms of business responses to the environmental challenge.

28 http://www.wbcsd.ch/aboutus.htm (1999, November 13).

The endorsement of these industry initiatives and programmes by corporations presumably results in better environmental performance[29]. It is reasonable to expect that the commitment to CERES principles, for instance, can trigger organisational innovation and generate some ‘double dividends’ – business profitability and environmental gains (the concept of double dividends will be explored in Chapter 4). The Responsible Care standards must be translated into a number of operational or practice areas, with measurable targets set for performance improvement. In this regard, it represents a significant step towards more ecologically sustainable practices at the industry level.

CERES and Responsible Care have been indicated as coherent and demanding guidelines for corporate environmental management (Krut & Gleckman 1998). Not surprisingly, the current number companies endorsing the CERES principles is significantly lower than the businesses that adopted the WBCSD as their environmental code of practice. In a review of several industry initiatives Brophy (1998:115-117) explains the context of this reality accurately:

> When examining environmental charters and guidelines it is relatively easy to become pessimistic. The degree of support given by industries to pro-active charters, as opposed to those that are mere ‘window dressing’, is on the whole disheartening. The more demanding environmental charters tend to originate from independent organisations, and are aimed at general audience. Those charters that have been developed by industrial associations, for specific industrial sectors, generally concentrate on issues of legal compliance and cost-cutting exercises.

This proliferation of general principles or guidelines, although resulting in better corporate practices in many instances, as a whole did not contribute to the achievement of a common criteria for the management of corporate environmental performance. Other initiatives tried to reach this common ground through the standardisation of environmental management systems; the theme of the next section.

3.2 Environmental Management Standards and Audit Schemes

The two main initiatives for the standardisation of environmental management practices that have been in the centre of the debate on sustainability are the Eco-Management and Audit Scheme (EMAS) and the International Organisation for Standardisation (ISO)

29 Several other private sector or government-sponsored initiatives have been developed. For a brief overview, see: Nash and Eherenfeld (1997).

14000 series[30]. Both initiatives are voluntary in principle and their character of environmental auditing is first and foremost intended as an *internal* management tool to monitor performance. Although they have similarities, there are significant differences in legal proceedings, assurance of regulatory compliance and performance, and the type of governance. The main difference, however, relates to the public participation during the process of designing EMAS and ISO standards for environmental management systems and subsequent scrutiny of their application (Gleckman & Krut 1997).

Legislating has historically been a central activity of governments and there is accumulated expertise in public consultation. This possibly explains the wide negotiation process that took place between the European Commission with industry representatives, environmental groups, and a wide array of stakeholders for the definition of the Eco-Management and Audit Scheme (EMAS) that was released in June 1993 (EEC 1836/93). The standard is an inter-governmental initiative that has been proposed for the regional level (European Union) and it is normally under consideration by environmental ministries of countries that might adopt the scheme. Additionally, once the standard has been adopted by one organisation, it requires compliance to the environmental laws of the country where the company operates, and third-party verification by an accredited EMAS auditor.

The ISO 14000 series followed a different route than EMAS mainly because it is basically a standard sponsored (and mainly defined) by the private sector. An international industry association and its participating membership – the national standard setting bodies – created the standards. The conception of ISO 14000 series had two other influences: the BS 7750 Environmental Management Systems of the British Standard Institution (BSI) and the ISO 9000 standards of quality series. BS 7750 was launched in April 1992 as the first formally adopted standard for environmental management systems, and in March 1995 it became operational for company certification. The experience with the development of BS 7750 served as the basis for negotiations for the definitions of the areas that should be covered by an environmental management system and its standardisation in the form of ISO 14001 (Blaza & Chambers 1997).

30 http://www.iso.ch/ (2000, February 15).

Although BS 7750 played an important role in the development of the three main areas of the ISO 14000 series – management systems standards, evaluation and auditing tools, and product-oriented support tools – the experience of ISO with quality management standards was more decisive. Before the release of ISO 9000 series, the main occupation of the International Organisation for Standardisation was the standardisation of technical specifications for the facilitation of international commerce. The release of ISO 9001 in 1987 represented the first move towards normative management, and the debut of ISO in the public policy arena. National standard setting bodies in over 70 countries worldwide have adopted ISO 9001, and it is by far the most successful ISO standard. Not surprisingly, during the task of writing an environmental management standard, several ideas were transplanted from the series of ISO 9000 into ISO 14000[31].

Although the correspondence between the two standards is facilitative to the administration of quality and environmental systems, it also limits the demand for excellent environmental performance of corporations. Basically, ISO 9001 and 14001 are *standards for the management system* rather than a standard of organisational performance – a common misinterpretation of the standard (Krut & Gleckman 1998). The certification of a company does not imply that the firm manufactures products with zero defects or emissions. In the words of Blaza and Chambers (1997: 200):

> The existence of a certification to the standard is not itself a guarantee of outstanding environmental performance. What it does indicate is the existence within the organisation of a process that can be geared to achieve stated, and preferably published, environmental improvement targets. It is the setting of those targets themselves that ultimately determines the environmental performance of the overall operation. If the targets are too low, little will be achieved, either for the business of for the environment, even though the organisation could now boast ISO 14001 on all its promotional literature.

In other words, the certification means only that an organisation has a formalised system in conformity with the ISO standards for environmental management. The certification of these systems are quite amusing: a company that makes lead balloons can be certified to ISO 9001, and a manufacturer of landmines can be certified to ISO 14001 (Krut & Gleckman 1998).

For export companies based in developing countries the new 14000 was seen as another trade barrier to overcome. This preoccupation was, for instance, the main reason

31 ISO makes this correspondence explicit in Annex B of ISO 14001, where links between ISO 14001 and ISO 9001 are explored.

for Brazilian industry associations to become involved in the elaboration of the ISO 14000 series through the working groups of the Technical Committee 207, as the words of Hortensius and Barthel (1997:35) indicated at the time of the elaboration of the standard:

> The newly industrialised and developing countries from South-East Asia, Africa and South America are concerned about possible trade restrictions arising from the use of the standards in contractual specifications. (…) Perhaps this explains why it is these very countries who are coming to the ISO/TC207 meetings in great numbers.

A group of thirty-four organisations, in cooperation with the Brazilian Association of Technical Standards (ABNT) sponsored the Supporting Group for Environmental Standardisation (GANA). According to representatives of this group, Brazilian industries did not want to repeat the same 'mistake' of not participating in the design of the standard, as it happened with ISO 9001. When this standard of quality was released, many Brazilian companies had a competitive disadvantage simply because it took longer for firms to develop the necessary expertise to comply with the new requirements. In some cases, this lead-time has proven to be crucial to suppliers of capital goods to European industries. Some companies imposed the certification to ISO 9001 as a pre-requisite for their suppliers, and many Brazilian exporters were not prepared in time lost their client firms[32].

The experience with the design and application of ISO 9001 strongly influenced the development of ISO 14001, resulting in a relatively undemanding environmental standard. Three main areas are crucial. First, internal disputes about trade barriers inside TC 207 eventually eliminated the certification of suppliers as a requirement of a company to be certified by ISO 14001. The diffusion effect of better corporate environmental performance across industries is limited by this measure, restraining the possibilities of a spin-off effect throughout industries. Secondly, the standard does not use objective performance indicators to evaluate the environmental management systems of a company. There is no real prerequisite in terms of sustainable practices; instead, what ISO 14001 requires is a 'bureaucratic practice'. Finally, the standard does not require a public environmental report of any type. Non-governmental organisations (NGOs) and other interest groups did not participate in the development of the standard,

32 Information obtained through interviews with GANA representatives in February 1996.

suggesting that this industry agreement lacks public and democratic legitimacy (Krut & Gleckman 1998).

Apart from the intrinsic weaknesses of ISO 14001, there is an apparent lack of interest and positive response of consumers, and this can reverberate in terms of a low pace of adoption of the standard by companies. Three main factors contributed to this reality: (i) superficial claims about companies' environmental programs and products – or *greenwashing* – made in the past; (ii) The lack of mechanisms to provide public access of companies' environmental performance, and; (iii) Failure of companies to communicate real achievements (Blaza & Chambers 1997). This general mismanagement of the communication between companies and consumers possibly contributed to a relative 'eco-apathy' on the part of the consumer. Ecological initiatives such as eco-labelling, directly targeting the consumer, have not enjoyed substantial responses. The standardisation of environmental management systems might suffer the consequences of previous experiences with product-oriented instruments for environmental management, described in the next section.

3.3 Product-Oriented Instruments for Environmental Management

In hierarchical terms, life-cycle assessment or analysis (LCA) and eco-labelling, such as the ISO 14040 sub-series on lifecycle assessment, and the ISO 14020 sub-series on environmental labelling, could actually be considered sub-systems or tools of a broad environmental management system. There are two main reasons why special consideration is given to these instruments in this section: complementary and interdependence. While the schemes presented in the previous sections focus attention on environmental impacts of manufacturing processes, LCA and eco-labelling deal more directly with final products. In this sense, they complement the auditing schemes of production processes analysed previously. Moreover, since the certification of an environmental label to a product depends on the assessment of its life-cycle, these tools are also interdependent. The following analysis of LCA and eco-labelling explains why 'objectivity' is a key word in the debate about the evaluation of corporate environmental performance.

3.3.1 Life-cycle Assessment

Life-cycle assessment (LCA) is "a method for quantifying the environmental impact of an industrial process, activity or product" (Johnston 1997:225). The analysis comprehends the physical life-cycle impact of activities from the extraction of raw materials (or pre-manufacturing), manufacturing, use, and final disposal of a product or the recycling of its component materials. The concept of life-cycle assessment goes back to the early efforts at energy analysis in the 1960s but the complexities involved in the design of an LCA tool resulted in a very slow process of acceptance by business and government.

In general terms, distinct methodological assumptions are the main causes for the controversies between LCA systems. Different definitions of the system boundaries of a product or service can cause substantial distortions in the results. Accounting for the total environmental impact of a product as simple as a pencil, for instance, can become an all-encompassing and indeed extremely complex task. If a precise account of *most* environmental impact associated with the pencil is required – because it is practically impossible to consider *all* of them – the scope of the LCA can be overwhelming. An all-inclusive accounting of the environmental costs could be extended to the air emissions of the chainsaws used to extract the wood that will eventually become a raw material for the pencil. Similarly, if a restaurant limits the boundaries of an LCA to the dining room and in-house kitchen, it can be expected that the environmental impact of its activities will be lower than a similar restaurant that extends the boundaries to the production of food and disposal of waste.

Obviously, a sense of pragmatism suggests the demarcation of boundaries for such analysis, so empirical results can be achieved. By establishing (theoretical) boundaries between systems, it is certainly possible to use tools and techniques, such as LCAs for the practice of environmental management. Comparability between systems requires the use of similar scope and methodologies. However, this definition of scope is not free of political interests. As a representative of the Dutch Milieu Defence – an environmental non-governmental organisation (NGO) – asserted: “the outcome of the LCA is the result of the inputs. The inputs are a result of the preference of those who are paying for the study” (*The LCA Sourcebook* 1993:32).

Another problem with the use of LCA relates to the tendency to emphasise the *relative* hazard that products cause to the environment. For instance, in a classical study, Hunt & Welch (1974) have shown that, for the same number of bottles produced, polyvinylchloride (PVC) consumes much less total material and energy than glass; they are responsible for less atmospheric and waterborne emissions, generating less solid waste than the glass bottles they replaced. The dumping of plastics in landfills, in this perspective, can be technically justified for its relative lower damage for the environment – in comparison to other alternatives. In this case, although the non-biodegradability of plastic material (PVC) eliminates the possibility of its reintegration in the biological process, the recyclability of plastics will become a function of the energy necessary for their collection and reprocessing. In this case, even though LCA can serve as an important tool to help companies in the analysis of the environmental impact of products, the adoption of raw materials, processes, and products is based on some kind of *garbage can* decision-making (see: Cohen *et al*. 1978). LCA analysts tend to look for the 'best available solutions' within current systems of production. In other words, the decision about recyclability of wastes depends on available technologies; it does not depart from the ecological imperative of reintegrating of raw materials into the natural environment.

A more practical limiting factor for the diffusion of LCAs relates to the availability of information. Data required for the evaluation of environmental performance of products and processes across their life-cycle reside in many separate sectors of the economy, and any individual firm is unlikely to be able to generate all the necessary information. Because products are actually products of industrial systems, the chain of environmental impacts associated with pre-manufacturing activities (ex: activities of prospecting, extracting, transporting and refining oil that will become polypropylene for the manufacturing of car bumpers) may not be available for an LCA of an automobile. When the data are available, value judgments about the nature of data are always present. For instance, in a case where the information about the environmental impact of the production of polypropylene is available to the carmaker, one could question whether the impact includes the destruction of natural habitats, the risks associated with transport, or the costs of disposing oil platforms at the end of their lives. Obviously, such issues generate tremendous disputes between LCA designers and, apparently, can only be expected to be addressed with the extension of the debate from the context of technicians to the public arena.

There is already recognition among experts on life-cycle assessment that a complete evaluation of the impact of products or services demands the performance evaluation of a product in societal terms. According to the working group responsible for the development of *The LCA Sourcebook* (1993:29):

> As the environmental debate evolves, it would be a mistake to assume the need for a product or service you intend to focus on. As the environmental shadows thrown by particular materials or products are better defined and understood, so society may come to question the need for those materials or products.

Criticism of the limitations of current LCAs suggests that the evaluation of the fundamental function performed by products and services will be evaluated in terms of their societal impact and incorporated in this management tool sometime in the future. In this line of thought, a LCA expert, instead of comparing the environmental impacts of two different models of cars, would start from the need for travel and compare the use of cars versus public transport. At the end of the spectrum, an even more fundamental question would be asked: why is there a need for transport in the first place? Questions such as these could lead a manufacturer to see the function of its products from a different perspective and result in a radical shift of its core business (Section 8.3.3 in Chapter 8 readdresses the issue of rating the environmental impact of cars). Evidently, today it is practically impossible to imagine a society without cars but this line of thinking in terms of a LCA for industrial products would make even more clear the questionable societal need of products such as land mines Even though the available LCA systems do not incorporate such fundamental questioning, they have currently been used as practical tools for labelling the (standard) environmental performance of products. The next section demonstrates that it would be practically impossible to develop an ecological label without the support of a LCA.

3.3.2 Eco-Labelling

Another scheme used to indicate environmental performance of products is eco-labelling. According to Roy (1994: 373), eco-labelling programmes “aim to inform consumers which manufactures’ products meet certain criteria for environmental impacts during the various stages of a product’s life, from original manufacture to final disposal”. Originally, eco-labels have been thought of as having potential benefits for consumers as a way of limiting confusing, extravagant, or false claims of product environmental performance, acting as a leverage to improving industrial ecological efficiency. In theory, eco-labelling would foster industry rivalry and work as a reinforcing system for better environmental performance. Highly competitive industries would compete at the level of environmental attributes of their products in a similar way to the dynamics of Porter’s (1990) model of competitive advantage. Rivalry would be crucial for initiating an upgrading process of environmental competitiveness of corporations that would consequently be extended to the industry as a whole.

In practical terms eco-labelling schemes have proven to be less successful than might be expected. From the vast array of products currently marketed, the European washing machine industry is one of the few cases where eco-label has had a major positive impact on consumer behaviour (Roy 1994). Evidently, such labelling is far from representing contemporary practice for the majority of products and markets. Apart from some more recent and relatively successful experiences with eco-labels in Scandinavian countries, used by firms to differentiate their products (described in Chapter 4, Section 4.4.4); until mid 1990s, most European eco-labelling projects faced serious difficulties in achieving their main purpose of environmental marketing differentiation (Graham 1993). Yet, some market hurdles persist. Apparently, there is no direct relationship between certification to an eco-label and widespread market response. A fragmented consumer response to ecological appeals is typical, and most companies resist the idea of such a labelling process for this reason. For these companies, it is difficult to justify costs associated with certification by an independent (or third party) organisation because they already pay employees to test their products. Current eco-labelling practices in Europe also face the charge of 'bureaucratism'. It takes, on average, more than a year for some products to be certified, longer than the marketing life-cycle of many goods.

Another factor limiting the success of eco-labelling schemes is its dependency on reliable LCAs. This factor became clear in the development of the EU (European Union) Eco-label project, described by Smith (1997: 95-97):

> The development and acceptance of LCA has been crucial to the evolution of the EU Eco-label as a basis for the comparison of the quantitative environmental impacts of different commodities (…) However, information may be commercially sensitive, unreliable, or in an unusable form. There has been some consensus concerning the compilation of inventories, but considerable disagreement about techniques employed for comparing the impacts of different emissions. (…) The core methodology supporting LCA scheme is an evolving subject, and has been subject to criticism.

As the next chapter will demonstrate, eco-labels constitute important market driven instruments for the promotion of more sustainable patterns of production and consumption. Together with the other initiatives analysed in the chapter, they can certainly result in improved environmental performance in firms. However, as it has been signalled here, these programmes and their related principles and tools do not presuppose ecologically sustainable practices in corporations. At the most, they may be considered instruments to be used by ‘sustainability-promoting corporations’ (Diesendorf 2000). While the uncertainty about what constitute sustainable development remains, such concept would presume that certain practices are more desirable than others. But current practices, oriented by ISO 14000 series, CERES principles or Responsible Care, for instance, do not presuppose any level of ecological sustainability of organisations.

3.4 Conclusion

This chapter showed that, currently, there are many available initiatives promoting better environmental performance in companies. Apart from a relatively long history of compliance with environmental regulations based on ‘command and control’ the 1990s witnessed an upsurge of voluntary schemes and programmes, initiated by industry, governments, and interest groups promoting pro-active environmental management in organisations. As a whole, these programmes represent an advance towards an institutionalised system that can promote ecological modernisation of industries, as Chapter 6 will demonstrate. But, most of these programmes assume that ecological sustainability can be pursued – and perhaps achieved – without questioning the (ecological) need of some organisations and their products or services. In these terms, sustainable development could be pursued through the perpetuation of organisations that base their production systems on non-renewable sources of energy, such as nuclear power plants, petroleum companies, or firms for which the core business is the fabrication of warfare equipment. In other words, in the same fashion of the traditional business literature, most of these schemes consider the *economic* sustainability of business instead of the *ecological* sustainability of the natural environment (Srikantia & Bilimoria 1997).

Initiatives such as CERES and Responsible Care indeed carry the potential to transform current business practices. If companies are able extensively to adopt their guiding principles, one might expect that sustainable corporate practices could be achieved over time. The commitment towards incremental improvements in processes, materials, and the extension of environmental responsibility to all activities of a corporation can certainly result in environmental gains. However, the problem with the principles that guide these initiatives is their very nature: they are just principles. Industry codes of environmental practice require companies to go beyond their legal demands and adopt the so called ‘triple bottom line’ of financial, social, and environmental responsibilities but, at the present, deviation from the guiding principles does not result in any legal or financial penalty (Brophy 1998). Apart from being identified as a business that does not care for the natural environment, no serious penalties accrue in terms of trade or access to markets for those companies that do not follow the principles strictly.

Although it seems imperative to design systems that do not rely solely on regulatory rectitude for corporate ecological accountability, the self-regulatory nature of existing industry initiatives and general codes of management practice have shown their limitations in fostering better environmental practices (King and Lenox 2000). Basically, self-regulation tends to reflect self-interests. While environmental standards represent a positive step towards more environmentally responsible business, there are no clear indications that business will voluntarily question the real need for their current core competences in terms of processes, products and services, or the business as a whole. As the discussion of the development of the ISO 14001 pointed out in Section 2.2, the preoccupation with the self-preservation of the industry constitutes a clear limitation of the design and implementation of voluntary schemes.

The proliferation of industry principles, environmental programmes, schemes, standards, as well as academic prescriptions about how corporations can work towards sustainability, have also resulted in a confusing mix of solutions that do not seem to be useful for managers. In a review of the literature on corporate environmental strategy Hall and Roome (1996:9) found that:

> Although much has been written about how companies can improve their environmental performance and strive toward more sustainable practices, (…) we currently lack an integrated, holistic approach on which to found truly sustainable businesses. Although current thinking provides us with some valuable pointers, there still exists a vacuum surrounding what comprises ‘sustainable strategies’- in terms of both definition and process.

At the organisational level, it is not clear what type of strategy can be conducive to ecological sustainability. Although the basic principle of ‘reducing the harm to the natural environment’ is commonly addressed by most initiatives, the extension of the acceptable impact remains an open question. Reducing the impact during the refinement of oil by a chemical company possibly is in accordance with the Responsible Care programme, but is the transformation of oil into gasoline a sustainable business practice? Apparently, there is still a substantial difference between acceptable levels of corporate environmental performance and sustainable industrial practices. If sustainable industrial development is to be pursued, performance indicators cannot be limited to the existing activities of corporations but more fundamental questions need to be addressed. Overall, initiatives such as the ones presented in this chapter suggest the inadequacy of the use of the term 'sustainable development' when referring to pro-active or beyond-compliance environmental practices in organisations. Instead, Chapter 6 will suggest the use of the terms 'ecological modernisation' as a more appropriate term for representing such practices.

In conclusion, schemes and strategies that can lead to more environmentally benign organisational practices currently exist. By adopting such schemes, many corporations have improved their environmental records. In this regard, voluntary codes of environmental practices, environmental management systems, and eco-labelling programmes, for instance, are actually working as promoters of organisational *greening*. As one could expect, the next chapter will demonstrate that they are not the only ones. Several other factors could induce organisations to incorporate ecological prerogatives into their decision-making processes.

4 Influences on the *Greening* of Organisations

The previous chapter analysed initiatives promoting pro-active environmental management practices conducted by industrial organisations, government, and interest groups. Although the adoption of these initiatives by firms do not imply any level of ecological sustainability, they have the potential to influence organisations to adopt more ecologically sound practices. Schemes such as business codes of environmental practice, the standardisation of environmental management systems, and eco-labelling can undeniably work as promoters of better environmental practices in organisations. Overall, the alignment of these schemes with other external contingencies and internal organisational factors can result in incremental improvements in environmental management practices of firms. But if these initiatives consist of stimulus for the *greening* of organisations, what else can influence firms to develop more environmentally sound strategies and practices?

Bansal and Roth (2000) indicated four generic factors stimulating organisational *greening*: legislation, stakeholder pressure, economic opportunities, and ethical motives. The analytical review of these and other factors is the main aim of this chapter. Regulatory measures, for instance, have long been used as a mechanism to correct market failures, and have historically been used as a key determinant to stimulate corporate environmental responsibility. Section 4.1 explores the role environmental regulation played in distinct institutional contexts, showings its limitations as an apparatus that, theoretically, has the potential to correct market imperfections. Regulation is certainly a central factor influencing companies that present a reactive behaviour towards cleaner manufacturing processes but it does not explain the commitment of organisations to environmental strategies that go beyond compliance. Other determinants require analysis.

The anticipation of consumer demands, critically analysed in Section 4.2, is one of these factors, external to the organisation, influencing environmental strategies that go beyond compliance. The allegedly ‘power’ of consumers is analysed in the light of consumption patterns, with the intention to. Conversely, Section 4.3 explores some internal factors. For instance, the willingness of managers to incorporate ecological issues into decision-making is contrasted with structural and strategic dimensions of organisational life. Processes involved in the permanent structuring of organisations are also briefly analysed in this section.

More attention is devoted to analysing the influence that competitive forces exert on the *greening* of organisations. An analytical framework is proposed for the identification of logics of industrial competition in the *business & environment* front. Section 4.4 uses the framework to identify the circumstances in which the search for competitive advantage becomes a motivator of pro-active environmental management in corporations. The traditional types of competitive advantage – cost leadership and differentiation of products and services – are extended to organisational processes. Initially, the possibility of corporations to offset the costs of environmental investments in processes is analysed under the light of strategies based on resource productivity of industrial processes. As a consequence of this analysis, the debate about the 'double dividend' is presented as a possible scenario in which the eco-efficiency of systems of production influence not only manufacturing costs but also the costs of using products and their end-of-life. The section closes with the analysis of differentiation strategies for products and (organisational) process based on environmental attributes. Schemes such as the ISO 14001 standard, previously analysed in Chapter 3, are reinterpreted under the perspective of industrial competition, and an evaluation of their potential to become determinants of organisational *greening* is developed. Arguments about two questions regarding markets for environmentally oriented products close the session: Does competition influence the development of small market niches for ecologically oriented products? Can environmental prerogatives be transferred to any type of product, independently of the industrial segment?

Influences on organisational *greening* presented in this chapter cover a wide range of circumstances and are the ones requiring analysis for their importance in promoting industrial sustainable development. Nonetheless, it should be clear that the list is rather selective. The selection is a result of the interactive process of theory building in which empirical *sensitising* fieldwork (described in Chapter 7) was used to uncover areas of enquiry that were not sufficiently developed by the specialised literature. Detailed analysis of political, economic, technological, and historical influences on organisational *greening*, which have not been directly addressed in this chapter, receive special treatment in the remaining parts of the study. Hence, this chapter represents an introductory segment in the process of unveiling the factors fostering or inhibiting the development of ecologically sound practices in organisations.

4.1 Environmental Regulation

Regulation has been seen as one of the main forces inducing business to adopt better environmental practices (*Green et al.* 1994; Lévêque 1996). Until the 1980s, governments tended to respond to environmental degradation caused by industry by applying centralised regulatory measures that directed companies to control pollution – known as *command and control* regulation. In principle, this type of regulation should promote better corporate environmental performance. Regulatory measures would work as a device for correcting market imperfections, forcing corporations to internalise some of the environmental costs associated with their operations (see: Section 2.1 in Chapter 2). Historically, governments have used two main types of command and control regulation. The first is based on the definition of minimum standards of environmental performance by which governments *permit* companies to generate certain levels of pollution. Technology-based control is an example of the second type. To obtain an environmental permit, manufacturing plants should have the 'best-available technology', defined by law, for their industry (Nash & Ehrenfeld 1997). Since the costs of installing pollution control equipment would be common to all manufacturers that use similar technology in the industry, regulation itself would not represent a loss in competitiveness in national terms – although, of course, the international picture could be different.

In practical terms, command and control regulation has resulted mainly in the adoption of *end-of-pipe*[33] technologies and spread scepticism about the capacity of governments to correct market failures. The experience of the USA in establishing environmental legislation is an exemplar in this regard and shows that restrictive environmental laws may act as a disincentive to technological innovation. The *American Resource Conservation and Recovery Act*, for instance, has been cited by Weinberg *et al.* (1994) as an impediment to recycling efforts. The legislative intention, to limit further use of products classified as waste, also limits the possibility of developing new uses for them. This experience uncovers the main criticism of command and control regulation: fundamentally, it does not act as an incentive to innovation (Heaton 1997). By setting minimum standards of environmental

33 The term has been coined to represent the type of equipment used for pollution control at the end of production processes – normally, exhaustion pipes for gases or discharging pipes for liquids.

performance governments may cause some firms to focus their efforts on actively resisting change. Because compliance to the law is sufficient for firms to operate, there are no real incentives for companies to commit themselves to higher levels of environmental responsibility (Howard *et al.* 1999; Nash & Ehrenfeld 1997).

The comparison between the regulatory frameworks affecting the pulp-and-paper sector in the USA and Scandinavian countries also shows how command and control regulations can limit technological upgrading by companies. Strict regulations in the seventies forced American companies to adopt end-of-pipe technologies. More flexible regulation in Scandinavia, however, enabled manufactures to shift their focus from secondary treatment of wastes to the redesign of production processes. New pulping and bleaching technologies made it possible for Scandinavian organisations not only to meet emission standards but also to lower operation costs. This example is used by Porter and van der Linde (1995b:129) to emphasise that “the problem with regulation is not its strictness. It is the way in which standards are written and the sheer efficiency with which regulations are administered”. The analysis of the context in which regulations are written and the administrative structure that facilitates or impedes the act to be performed seems to be crucial for the comprehension of the limits of regulatory systems. Another example underscores this contextual facet of the regulating processes.

In the main mechanical engineering cluster of the State of *Santa Catarina*, in the south region of Brazil, where several world export companies locate, the regulatory system has generated an outcome that is common to many developing countries. Organisations in the industrial district have been polluting the region’s main river with all sorts of wastes for many years, practically causing its biological death. One might think that Brazilian organisations operate almost without any environmental constraints, without any regulation with which to comply. A closer look at articles of the Brazilian legislation demonstrates the opposite. The laws that companies should comply with are almost sixty years old and, according to the representative of a group of companies that recently joined forces to work towards cleaner technologies[34], “the Brazilian environmental legislation is good enough to ‘clean up’ most of the country”. The poor environmental performance of those companies cannot be explained by the non-

34 Interview with representatives of the ‘*Environmental Group’* of the Commercial and Industrial Association of Joinville, representing 23 largest export companies of Region.

existence of a regulatory framework. The problem is not the absence of regulation but its enforcement. Regulation in that context can be seen as a kind of ‘mock bureaucracy’ where the rules exist but no one takes them seriously (Gouldner 1954). In that scenario, regulations do not compound means through which members make sense of their context. They are not constituents of the *modes of rationality* that actors conventionally use in the definition of organisational strategies and structures (Clegg 1990; Orssatto 1994). Instead of representing a legal imperative for companies, the regulatory framework is seen as a negotiable device that can be used according to the localised organisational interests.

The limitations of the design and application of command and control regulatory mechanisms started to be debated in the 1980s when new types of environmental regulation emerged in two distinct directions. The first route pointed towards alternative approaches to the current statutory framework, such as information and market-based environmental regulations, and voluntary programmes instituted by governments, private sector, and interest groups. Chapter 3 explored some of the voluntary approaches, such as business codes of environmental practice, and the standardisation of environmental management systems – promoted mainly by the private sector. In this first route, voluntary programmes would reduce the degree of centrality that governments currently have in regulating organisational performance. In simple terms, it would represent less direct regulation.

The second route went in the opposite direction, since it actually expanded a company’s environmental responsibilities from manufacturing processes to the entire life-cycle of products – the *extended producer responsibility* approach (Lindhqvist 2000). This new type of legislation intended to integrate fragmented regulatory measures into a broader statutory framework by redefining the scope of environmental laws. Germany is the leading country of this new legislative form, having adopted the Closed Substance Cycle and Waste Management Act in July 1994: the implication of this principle for companies can be objectively seem in the Packaging Ordinance. In 1991, the packaging regulation set target percentages and dates by which industry would have to collect and recycle their packaging. Since December 1995, manufactures must collect and recycle eighty percent of the packaging actually handled by consumers. The law excludes incineration as a means of eliminating packaging and thus encourages recycling. These strict standards forced German and other international companies to create a new inter-organisational system, providing the foundation of the German Dual

System *(Duales System Deutchland - DSD)*. ‘Dual’, because the private sector now runs a parallel waste management system to the one conventionally administered by the government. With a payment that varies with the type and size of packaging, companies may place a *green* dot on their packaging, a symbolic indication to consumers to put this package in one of the millions of yellow recycling bins distributed throughout Germany by DSD. The waste is then transported to several licensed reprocessing companies in the country (Miller 1994; Reed 1992).

The complexities of ensuing coordination of the system have been enormous, and although Hawken (1993) considered the DSD an example of ‘good regulation’, Matten (1996; *personal communication*) asserts: “the only real achievement of the Dual System has been the creation of the second biggest monopoly in Germany”. The German experience reinforces the unexpected consequences of regulatory measures (see: Chapter 6). The numbers of variables that have to be considered in the design of regulatory mechanisms and the multiplicity of actors involved in its application, transforms environmental regulation in one of the least predictable and most debatable mechanisms for the correction of market failures. Regulatory measures certainly play an important role in influencing organisational *greening*, but it is clearly not a sufficient response to environmental problems caused by industry. As Chapter 5 demonstrates, it is necessary to consider the political dynamics influencing the design and application of the regulatory framework. This context is broadly shaped by the profile of the civil society; specifically, it is determined by the power citizens exert in influencing the *greening* of organisations.

4.2 Consumers: Collective Spirit and Individual Convenience

Some contemporary companies tie their generic strategies and eventual market success to the environmental positioning of their customers. Aware consumers can push companies to adopt environmentally friendly technologies and products (Simon 1992). A well-debated example of a business that tightly couples strategic decisions with the environmental preferences of its customers is the *Body Shop.* A *green* image has made the company a symbol of environmental correctness. The company has experienced exceptional growth in the last two decades and today has over 700 shops worldwide. This growth based itself on a series of claims. Products did not involve animal testing; use of largely ‘natural’ components rather than synthetic compounds, a widespread use of recycling and refilling policies, and aggressive eco-activism oriented marketing.

Even though criticism of the real environmental commitments and performance of *Body Shop* have lately grown substantially[35], the pioneer company's history shows the existence of consumers who willingly pay for what they think are *green* products.

There are specific cases suggesting that *green* consumerism may induce firms to be more responsible towards the natural environment. Especially when there is a clear option to boycott a product, consumers can indeed make a difference, as the case involving the oil company *Royal Dutch Shell* in 1995 suggests. *Shell* wanted to sink obsolete oilrigs in the North Sea but the subsequent outcry lead by the environmental organisation *Greenpeace* enticed consumers to boycott Shell petrol, resulting in a 60% downfall in sales in Germany alone. The pressure from consumers and the general public induced *Shell* to shift its strategy and the oil platform, *Brent Spar*, instead of being sunk in deep-sea waters, was dismantled on land (Dickson & McCulloch 1996). The Brent Spar case is a didactic example of how consumers can force corporations to modify their strategy. However, consumer pressure for better products is hardly as *clear-cut* an issue as this incident might suggest. Most of the time the choice about what to consume is influenced by a multiplicity of factors that are not so easy to isolate.

In trying to answer: (i) why productivity increases largely transformed into income increase instead of more leisure and (ii) why consumers tend to buy goods and services with high material intensity, rather than more environmentally friendly ones, Ropke (1999) listed three categories of explanations. The first one comprises the economic and socio-economic aspects related to the institutional set up of the economy. Accordingly, a simple explanation for the high levels of consumption of industrial products relates to the persistent fall of their prices, compared with products and services that cannot be provided industrially. Secondly, socio-psychological explanations focus on consumption from the perspective of human beings embedded in particular social relations. In this second category, the author explains that consumerism can be driven by variables ranging from envy to the necessity for people to make sense of their own lives and justify a personal self-image. "As goods are used as markers and classifiers, they make visible and stabilise the categories of culture – they, so to say, constitute the visible part of the culture as the tip of the iceberg which is the whole of the social

35 Journalist John Entine leads the attacks on BSI ethical and environmental commitments. He personally accuses the BSI co-founder and former Vice-President Anita Roddick of being hypocritical and untrue to the claims.

processes” (Ropke 1999:399). The third set of explanations comprises historical and socio-technological elements of different aspects of everyday life. Fundamentally, consumption is often discussed as a manner of choice but socio-technical frameworks actually bound most choices. In sum, Ropke provides an enlightening demonstration that shopping habits are embedded both inside consumer’s psychology and in the external organisation of society.

Green consumerism is just one part of the complexities of economic, social, and political interpellations constituting consuming subjects. While citizens may seek to relate practice to ideology, their political organisation, lifestyle, and consumption decisions always display tension. We shop and consume more typically as complex and embedded social individuals rather than as coherent and fully ideologically formed members of a party or a social movement. As a consumer, one does not find it difficult to recognise that ‘it is not easy being *green*’. The normal conditions of existence for most people involve uncertainty, equivocally, and a cacophony of competing interpellations. In part, that is the attraction of market pluralism. Many disparate signs jostle for our attention. The market is overwhelmingly an economy of significations that seeks to enlist subjectivities: as *green*; as fashionable; as dynamic; as caring; as feminine; as masculine. For most of us there is too much information to consider, too many problems to bother with, and too many self contradictions in the understanding of what is the ‘right thing’ to do.

The lack of objective economic constraints or rewards in regard to the purchase of *green* products also seems to reinforce their most direct convenience for the consumer. The intrinsic benefits of most goods and services position themselves according to conceptions of individual self-interests, rather than in terms of conceptions of environmental responsibility. As a result, environmental solidarity, as a socially preferred condition, is still absent from the shopping list of most consumers (Simith & Haugtvedt 1995). What people *say* about their willingness to buy *green* products normally differs substantially from what they *do* in their actual purchasing behaviour (Freeman 1995). According to Sagoff (1988:50) “individuals have incompatible beliefs, and do not rank them in a single hierarchy in the same manner of the ‘rational man’ of economic theory. Citizen preferences are judgments about what *we* should do, while consumer preferences are expressions of what *I* want” (italicised in the original).

Denying the role of the consumer as a potential determinant of organisational *greening* is to refuse the interdependence between systems of production and consumption. Consumers are undeniably important players in the process of incorporating ecological concerns into product design. After all, products are made available because there are consumers to buy them. However, pro-environmental behaviours have been a phenomenon closer to the academic debate than to the reality expressed in the shopping habits of consumers (Simith & Haugtvedt 1995). *Green* consumerism still remains a niche market possibly because of the complexities associated with the wide range of factors influencing decision-making. The growth of ecologically driven consumerism – which in practice constitutes the ‘objectivation’ of the *green* movement – demands the alignment of at least some of these factors. The problem is that the mechanisms of political organisation that are essential to its success are more easily available to firms than to ‘disorganised’ consumerism. As a result, consumers seem to rely on the willingness of corporations to present alternatives to the current range of products. The ‘external’ nature of the market, personalised in the behaviour of consumers, seems to wait for the next offer of its main provider. Industrial organisations, by their turn, have their own rationales that justify the pace of incorporation of ecology into organisational processes and products.

4.3 Organisational Factors

Are ecological strategies determined by the age of the organisation, its size, or the technology adopted by the firm? Does organisational design define the environmental choices of the firm? What is the importance of ethical or moral commitments of managers in the definition of environmental strategies? How important is the culture of the organisation in influencing the adoption of ecologically driven practices? These questions suggest that a variety of (intra) *organisational* characteristics can influence the adoption of *green* strategies. In fact, the debate about the interplay of contingent factors in shaping organisational structure has been in the core of organisation theory for decades, constituting a specific theoretical area of research called structural contingency theory[36]. After significant efforts to establish relations between contingent factors, the only clear conclusion that can be drawn from these studies is that “technology, environment, size and strategic choice are important and interactive

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36 See, for instance, the classic work of Woodward (1970), Thompson (1967), and Lawrence and Lorsh (1967). A more recent review of this perspective is presented by Donaldson (1996).

elements (...) and the most intelligent approach should combine these structural determinants" (Hall 1999:58). In sum, these factors are interdependent.

Similarly to the studies developed in structural contingency theory, cultural, political, and institutional aspects of the organisational reality have also become specialised research areas in organisation studies. More specifically, the management of *organisational change* – such as the ones required for the incorporation of ecological principles into business practices – has a long tradition in organisational theory. In this regard, it is not the aim of this section to review organisational factors limiting or facilitating changes in organisations, identified by these disciplines[37]. Neither is the intention to address determinants organisational *greening* identified by the normative environmental management literature. Many practitioners and environmental consultants have compiled their experience in books and articles in which they identify the reasons why companies *should* develop environmental strategies. Some of these studies – in particular, those in the traditional area of health, safety, and environmental management that have been extended to the context of corporate environmental strategy – can help one to identify determinants of organisational *greening*. But the prescriptive nature of this literature makes it inadequate for the purposes of this study. Therefore, below I use specific literature in the areas related to *organisation & environment* studies to address some of the key determinants of organisational *greening*.

4.3.1 Organisational Commitments to Ecological Preservation

The determination of some managers to *'go green'* may be more decisive than any other external factor. In companies that make a claim to moral characterisation by virtue of their ecologically substantive rationalities, decisions about products or processes do not seek justification simply through recourse to economic principles. Moral and ethical motives may assume more significance in shaping organisational culture and attitudes than market forces. Shrivastava (1996) used the example of *Ben and Jerry Homemade Ice Creams* to demonstrate how the values and vision of the founders can define the level of commitment of the organisation towards the natural environment. In that case, a powerful internal stakeholder was the main responsible for directing the organisation to

37 For an overview of the main theoretical approaches within organisation studies, see Clegg Hardy and Nord (1996). See also the section on Organisation and Management Studies of the *International Encyclopaedia of Social and Behavioural Sciences* (2001).

towards environmentally sound strategies. Reinforcing the importance of the role of the motives of a powerful player, Weaver *et al.* (1999) found that management commitment was the stronger determinant in the introduction of formal programmes to manage ethics in corporations.

The management commitment towards environmentalism has seemingly been the driving force of a company that became a symbol of responsible business in Brazil[38]. *Boticário*, one of the biggest Brazilian cosmetic companies[39], for years have been committed to using clean technologies, the development of recycling programmes, and the reduction of waste generated by its packaging. The company is also a leader in sponsoring social projects in local communities as well as conservation projects through its Foundation[40]. In many respects, one could imagine that *Boticário* follows a similar strategy to *Body Shop*: there is a close relationship between a *green* marketing strategy and consumer preferences for environmentally sound products. Curiously, this is not the case. Although both companies have a strong *green* image, there is a clear difference between the consumers of *Body Shop* and its Brazilian counterpart. As has been posed in Section 4.2, consumers of *Body Shop* seem to relate their shopping preferences to the environmental image of the company. On the other hand, according to the representatives of *Boticário*[41], there is little relation between what the company *does* and what it *sells*. Consumers are sympathetic to the company's *green* values but it is product convenience and fashion trends that drive the purchasing habits of consumers. The environmental commitment of the company is mainly a result of its organisational motives. Yet on this occasion it appears to have little to do with consumer behaviour. In this case, the company representatives affirm that the promotion and practice of *green* values actually serve to educate consumers into these values.

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38 Identified in the *sensitising fieldwork* (see Chapter 7).

39 In 1995, the *Boticário* had more than 1300 franchisees in Brazil, US$ 300 million in revenues. The company won several national and international ecological prizes.

40 The *Boticário Nature Protection Foundation* sponsors around $500,000 yearly in conservation projects. In February 1995, the foundation inaugurated a 17,000 hectares park of native forest in the State of Paraná, Brazil.

41The information presented here was obtained through interviews with the Vice-President of the *Boticário* and the director of the *Boticário Nature Protection Foundation*.

4.3.2 Perceived Organisational Competences and Risks

If ethical and moral commitments of stakeholders and managers can explain some cases of proactive corporate environmental management, this willingness needs to be considered together with other intra-organisational factors. For instance, a company might also develop environmentally oriented practices because the technology required to manufacture *green*er products is complementary to the system of production currently in use. Griffiths (2000) emphasised that organisational architectures that can facilitate or impede progress toward ecological sustainability, and research in this area is urgently required. Similarly, decisions about the functional areas such as marketing, finance, and human resources will need to accommodate the existing with the new in relation to ecological requirements. In the language of the resource-based perspective, the decision making process would revolve around the "fit between what a firm has the *ability* to do and what it has the *opportunity* to do" (Russo & Fouts 1997:536).

The match between abilities and opportunities constitute important element in the definition of corporate environmental strategies but the way in which managers perceive or consider the available resources or capabilities is equally important and, actually, prior to this match. Henriques and Sadorski (1999:87) found that "firms with more proactive profiles differ from less environmentally committed firms in their perceptions of the relative importance of different stakeholders". The perception of the *organisational environment* (see: Chapter 2) in decision-making processes constitutes a fundamental element in explaining the differences between strategies of corporations. For human capabilities to become a source of competitive advantage of a firm, they have to become an *issue* (see: Bachrach & Baratz 1970). In other words, a company might actually have physical and immaterial assets, or technology to manufacture environmentally sound products, but only when these resources are considered as such they will constitute a resource in literal sense (see also Sharma 2000).

The work of den Hond (1996) is an exemplar of perceptions influencing the management of intangible resources. Focusing on resources such as skills, knowledge, experiences, learning – the capabilities perspective of the firm – den Hond (1996) found that automobile companies developed distinct recycling strategies because they perceived the resources available to them differently. The difference in perception related to: (i) the degree of complementary of problem solving to the firm's core activities, (ii) the technological options to the firm, and (iii) the opportunities to profit from environmental innovation. Firms within the same industry, facing the same set of environmental constraints, developed distinct recycling strategies not just because they have different resources available to them but also because they interpreted the problem differently. The availability of the resource that eventually becomes a capability is, therefore, secondary to the decision (or non-decision) of incorporating ecology into the design of a production system[42].

The process of incorporating natural environment into business strategies and practices draws attention to the perceived nature of organisational reality. Levels of market saturation, for instance, can substantially influence the danger of market failure in the introduction of an environmentally friendly product. But it is not the danger itself that will be central in the definition of the marketing strategy. Rather, it is the risk evaluation of the danger. According to Giddens (1990:34):

> What risk presumes is exactly danger (not necessarily the awareness of danger)[…] Anyone who takes a calculated risk is aware of the threat or threats, which a specific course of action brings into play. But it is certainly possible to undertake actions or to be subject to situations, which are inherently risky without the individual involved being aware of how risky they are. In other words, they are unaware of the dangers they run.

Corporations might consider those investments sunk in machinery or the low profitability margins of more environmentally friendly products a sufficient justification for not developing proactive environmental strategies. The danger of losing current markets because of the growing ecological awareness of its consumers might not be considered a risk for the company. Similarly, firms may see competition differently and, as a result, the development of environmental strategies may be based in the search of different sources of competitive advantage.

4.4 Corporate Competitiveness and Environmental Strategies

Industrial competition has been considered an important factor inducing firms to incorporate *green* principles into business strategies. Authors such as Bonifant *et al.* (1995), and Berry and Rondinelli (1998), among others, argue that industry rivalry can encourage environmental initiatives within companies, inducing them to reach higher levels of environmental performance. The rivalry would be encouraged by the attempt of corporations to transform environmental initiatives into sources of competitive

42 A more extensive explanation of organisational imperatives has been developed elsewhere. See: Orssatto (1994), and Clegg (1990).

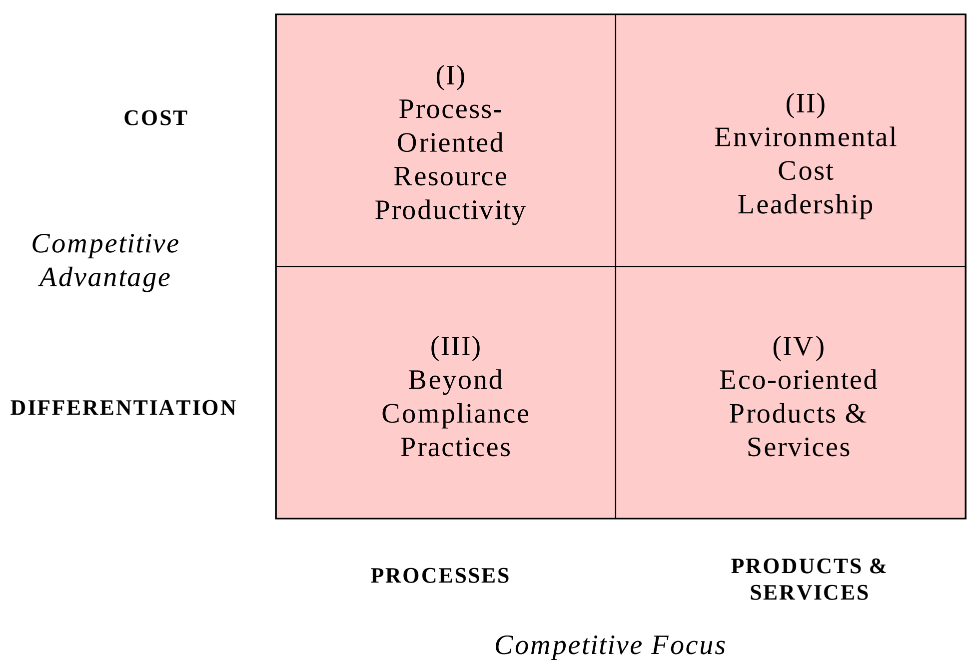
advantage. Eventual cost reductions resulting from environmental innovations would allow corporation to follow low-cost leadership strategies that eventually result in sources of competitive advantage. Likewise, by directing efforts to improving the environmental performance of products or processes, corporations would be able to differentiate themselves from their competitors. Empirical studies have shown that while such claims are grounded they cannot be used to generalise the findings to the overall economy (Walley & Whitehead 1994). This is the main reason why this section ventures into the magnitude of competition in promoting the *greening* of organisations.

In the classic work of Porter (1980; 1985) two basic types of competitive advantage that firms can posses were identified: low costs and differentiation. Cost advantage results from the capacity of a firm to produce with the lowest cost in its industry. Through the sheer efficiency of the use of labour and capital, firms can obtain competitive advantage by selling products with the lowest cost. On the other hand, the uniqueness of certain dimensions of the products or services valued by consumers allows a firm to explore differentiation strategies. Among these unique dimensions are the peculiarities of the product (for example, its aesthetics, technology, or performance), the services provided by the firm, such as the technology employed in performing certain activities, and customer support. The work of Porter became a milestone in the area of strategic management not only because these two basic types of competitive advantage were identified but also because, in later work, Porter (1990) proved that innovation is mainly driven by competition among companies in the industry in which they operate.

A spontaneous question arising from Porter's generic principles of competition relates to their applicability to environmental issues in organisations. Can the search for competitive advantage promote better environmental practices in corporations? Addressing this question requires one to recognise that the two traditional types of competitive advantage are associated with the products and services sold by a firm (See: Porter 1985). In simple terms, competitive advantage represents market advantage for the products and services commercialised by the corporation. The capacity of a firm to trade high volumes of low-cost products or to obtain price-premiums by selling differentiated products or services represents its competitive advantage. These two basic forms of competitive advantage can be used in broad or narrow ranges of industry segments, resulting in three basic types of strategies: cost leadership, differentiation, and focus. Although the scope of strategies can be significantly broad and encompass the administration of the entire value chain of companies, the positioning of products and services in the marketplace constitutes its core element.

Within the *business & environment* field, competitive advantage can apparently be obtained not only by corporations strategically positioning their products and services in the marketplace but also through the character of their organisational processes. Academics and practitioners have recently suggested that the industry self-regulatory programs such as Responsible Care (see: Section 3.2 in Chapter 3) and external certification of the environmental management system (EMS) of a company by independent bodies have the potential to become sources of competitive advantage (Reinhardt 1999b). Interestingly, environmental management systems or business codes of environmental management relate almost exclusively to organisational (mainly industrial) processes. They consist of specialised forms of management control, which do not have a direct relationship with the products and services sold by corporations in the marketplace. In this respect, how can environmental management systems become sources of competitive advantage? Are there special circumstances in which competitive advantage can be generated by the certification of EMS or the endorsement of codes of environmental practice?

Figure 4.1: Generic Types of Corporate Environmental Strategy



Addressing these questions requires one to establish a clear distinction between the traditional focus of competition on products and services with the (new) focus on organisational processes. A matrix combining these elements with the basic types of competitive advantage, with which a firm seeks to achieve, generates four possible strategies, represented in Figure 4.1 (in the previous page). This classification scheme represents an attempt to specify the circumstances in which the search for competitive advantage may motivate firms to pursue environmentally sound strategies and practices.

4.4.1 The Double Dividend Hypothesis: Process-Oriented Resource Productivity

A fundamental element in the debate about the potential for corporations to offset costs of environmental investments relates to the overall productivity of resource usage. Here, the influence of Michael Porter's work in the area of industrial competition was repeated in the business-environment front. A short essay in *Scientific American* (Porter 1991) introduced an argument that was later elaborated by Porter and van der Linde (1995a; 1995b) – that the environment-competitiveness debate has been incorrectly framed. One is at error to think of a trade-off between social benefits and private costs. According to the authors, this trade-off does not exist. Instead, environmental investments represent enhanced, rather than lessened, profit opportunities for business – a *double dividend* or a *win-win* scenario, in the business jargon. Central to their argument is the role that environmental regulations play in promoting resource productivity and innovation. Environmentally friendly regulation can act as an incentive for companies to use resources more efficiently, thus lowering costs and resulting in a gain in competitiveness (See: Section 4.1). According to Porter and van der Linde (1995a), companies should promote resource productivity in the form of materials savings, increases in process yields, and better utilisation of by-products because waste consists, fundamentally, of an inefficient use of resources.

In previous research, Porter (1990) demonstrated that productivity is the key element for companies to gain competitiveness, and that the way to achieve it is through more efficient management systems. Organisations should be able to transform environmental costs into profits by identifying concealed opportunities for innovation, leading to more efficient organisational systems. In Porter and van der Linde's (1995a) hypothesis, companies would need only to find hidden opportunities to profit from environmental investments. They support this argument through several case studies of companies that obtained significant outcomes as a result of innovative resource productivity programmes. Industries with improved environmental records that also obtained better competitive positioning include horticulture, white-goods, and pulp and paper (Porter & van der Linde 1995b).

From the technical and economic points of view, demonstration examples of win-win situations are very appealing for business. However, support has not been unanimous even inside the business community – many believe that what is good for the environment is normally costly for business. Corporate consultants Walley and Whitehead (1994) have lead those sceptical about the potential of win-win practices being extended indefinitely. They pointed to the limits on companies making profits from environmentally friendly technologies and strategies. Even though it is possible to improve substantially the performance of companies through better resource productivity, it is organisationally costly to respond to environmental challenges. After responding to simpler opportunities, companies face more complex environmental challenges, where costs continue to skyrocket and win-win solutions become increasingly scarce. Palmer *et al.* (1995:120) support this critique by questioning the validity of using case studies to generalise the double dividends hypothesis:

> With literally hundreds of thousands of firms subject to environmental regulation in the United States alone, it would be hard not to find instances where regulation has seemingly worked to a polluting firm's advantage. But collecting cases where this has happened in no way establishes a general presumption in favour of this outcome. It would be an easy matter for us to assemble a matching list where firms have found their costs increased and profits reduced as a result of environmental regulations, not to mention cases where regulation has pushed firms over the brink into bankruptcy.

In Porter and van der Linde's hypothesis, newly discovered technologies should offset the costs of pollution abatement or prevention. Palmer et al (1995) challenged this argument by analysing the data presented by the (American) *Bureau of Economic Analysis*. In 1992, companies in the USA had a net spending for environmental protection in excess of $100 billion. According to the authors, this figure undermines the thesis that environmental regulation results in diminished organisational costs. Additionally, when interviewing the Vice-Presidents or corporate directors for environmental protection at Dow Chemical, 3M, Ciba Geigy and Monsanto – all firms mentioned by Porter and van der Linde – Palmer et al (1995) found that, on the whole, environmental regulation amounted to a significant net cost to the companies.

Such attacks on the double dividend hypothesis, instead of demonising it, triggered a heated debate between critics and supporters of the '*free lunch thesis*' – as some have also called it[43]. This is not surprising, since corporate competitiveness has always been a controversial theme in the business management literature. What is interesting, however, is the use of case studies of corporate environmental practices to generalise the argument that '*it pays to be green*' by articles published in later issues of *Harvard Business Review* – indirectly ignoring Palmer *et al.* (1995) criticisms on the methodology used by Porter and van der Linde. In his award-winning article, Hart (1997) established a connection between corporate strategy and ecological sustainability in broad terms. The double dividend hypothesis was not central in the development of his arguments but cases of companies from various industries, such as *Xerox*, *Dow Chemical*, ABB, and *Sony* were used as benchmarks of corporate environmental practices that, in general, have been profitable. The adoption of strategies based on pollution prevention, cleaner technology, and sustainable vision was strongly supported by the potential of environmental investments to generate economic outcomes, independently of the industry in which the firm operates.

Lovins *et al.* (1999) addressed double dividend issues more directly. They thoughtfully demonstrated that the potential new set of business practices to enhance resource productivity is so considerable that a new economic system may emerge from its application. The *Natural Capitalism* is what capitalism might become if the natural capital of ecosystems service were properly valued and preserved by corporations. The authors substantiate their argument by presenting examples of corporations that are increasing the productivity of natural resources, shifting to biologically inspired productions models, moving to a solutions-based business model, and reinvesting in natural capital. *Interface*, a (former) producer of carpets, is thoroughly cited in the article as an example of business profiting from a new service-based strategy (see also: Anderson 1998). The pro-resource productivity arguments of Amory Lovins, Hunter Lovins, and Paul Hawken have been intensely articulated in Hawken *et al.* (1999), showing the immense potential of profiting from an 'ecologysed' economy (Chapter 6 further explores this concept). Nonetheless, similarly to the previous articles on the

43The early stages of the debate concerning this topic can be found in: 'The Challenge of Going *Green*'. *Harvard Business Review*, July-August, 1994, pp. 37-50.

same topic, published in the *Harvard Business Review*, demonstration cases of best environmental practices were widely used to justify the applicability of the proposed principles to the entire economy.

The use of case studies to demonstrate the potential for gains in resource productivity does not present any methodological hindrance. The widespread use of cases in the literature indeed suggests that there is place for the double dividends in several areas of economic activity. Shrivastava (1996), for instance, is among many other authors who presented cases of companies profiting from *green* strategies in markedly distinct industries, such as chemicals, ice cream and automobiles. Lovins *et al.* (1999) used the demonstration cases mainly to indicate the potential of resource productivity strategies to promote *Natural Capitalism*. But mainly because the authors did not bracket industries in which such opportunities are minimal, their argument implied the potential for profiting from environmental investments being extensive to all firms, independently of the industry in which it operates, or factors of political economy (as it will be explored in Chapter 5). This characteristic approximates the work of Lovins *et al.* (1999), and Hawken *et al.* (1999) with the double dividend hypothesis of Porter and van der Linde's (1995a; 1995b).

In essence, the debate about double dividends became central in the *business & environment* literature mainly because some fundamentals of the economic theory of the firm were under assessment. If the defenders of the '*free lunch*' hypothesis were proven to be right, supplying social goods, such as clean water and air, via markets for private investments would, in theory, be applicable to most capitalist-based societies. In simple terms, the discussions have developed around the absolute question – does it pay to be *green*? The sceptics have argued that the proponents of the double dividends hypothesis cannot answer a common sense question: if opportunities for profiting from environmental investments are so readily available, why have companies not taken advantage of them? In later work, Esty and Porter (1998) addressed this question by indicating the organisational restrictions faced by managers, such as the lack of time and capacity to focus on the flow resources in and around the corporation, as the main reasons why corporations have missed such opportunities. More importantly, in this article Michael Porter also acknowledged that double dividend scenarios require specific conditions to be developed, and therefore cannot be indistinctively extended to all firms operating in capitalist economies.

More recently, Reinhardt (1998; 1999a; 1999b) moved the debate away from the grand topic of whether or not corporations can offset the costs of environmental investments to one questioning *when* it is possible to do so. In other words, the possibility for corporations to profit from environmental investments is now viewed as contingent to the competitive position of a firm in a specific industrial sector, among other factors. This conditional nature of economic investments in environment-related innovations justifies the attempt of this section to classify environmental strategies according to their potential to become sources of competitive advantage – as it has been presented in Figure 4.1. The use of the framework helps one to 'decouple' the elements involved in corporate environmental management that have not yet been treated as independent areas of strategic action, as this section proposes. This decoupling is fundamental for the identification of specific conditions in which strategies based on resource productivity might generate competitive advantage.

Reinhardt (1999a:18) asserts that the specific conditions in which environmental investments make business sense depend on "the economic fundamentals of the business, the structure of the industry in which the business operates, its position within that structure, and its organisational capabilities". Based on this view, environmental strategies based on *process-oriented resource productivity* would require a specific set of conditions to become successful. Directing a firm's efforts toward profit generation from investments in cleaner technologies might make business sense in certain circumstances but not in all. In the appropriate context, double dividends would eventually result from lowering the costs of operation as a result of innovation in manufacturing. In this case, the direct benefits result from radical or incremental improvements in systems of production, which are necessary for a firm to fabricate its products.

Focus on resource productivity can also reduce the costs of waste management activities, and generate business opportunities that go beyond the current core competences of corporations (Pauli 1998). Theoretically, strategies based on process-oriented resource productivity represent the commercial objectification of the concepts proposed by industrial ecologists (See: Section 2.4 in Chapter 2). In practical terms, the didactic example of the Danish industrial cluster of Kalundborg consists of evidence that the optimisation of by-products and waste can go beyond current practices used in the vast majority of industrial parks. Participant companies did not have to make substantial investments to achieve higher levels of resource productivity and reduce their costs with waste management. Although high levels of resource productivity have been achieved in this eco-industrial park, the *Zeri Systems* programme proposes to extend optimum levels of the utilisation of resources even further. According to Pauli (1998; *personal communication*), most industrial organisations could not only use raw materials and waste more efficiently but would also profit from their integration into new business activities. Demonstration cases of *Zeri* show that some breweries in Namibia, Sweden, Canada and Japan are able to convert the waste from the brewing process into commercial products[44]. In these cases, wastes are not considered as such, and new business opportunities are made possible through the reconfiguration of industrial systems.

The four strategies presented in Figure 4.1 represent a typology of specialised environmental strategies that corporations might adopt. As it has been stated, the structure of the industry in which a firm operates, its position within that industry, the types of markets the company serves, and its capabilities will determine the appropriate competitive focus (processes or products) and the potential source of competitive advantage (cost or differentiation) for a firm. Obviously, similarly to any other stylisation of reality, the boundaries between the four possible strategies are not rigid. Mainly because the very nature of industrial production implies interdependency between organisational processes and products, interdependences between the four generic strategies are prone to happen. As the next section will explore, efforts towards achieving resource productivity in industrial process can significantly help firms to develop strategies that can be classified as *environmental cost leadership*.

4.4.2 Extending Double Dividends: Environmental-Cost Leadership

In the traditional concept of cost leadership, competitive advantage is achieved when a firm is *the* lowest producer in its industry. Obtaining this cost advantage depends on a multitude of factors, such as cost of labour force, accessibility of raw materials, technology, and organisational capabilities, which have been explored in Chapter 3 of Porter (1985), and later extensively debated by the literature on competitive advantage. This is the main reason why a discussion about the conditions in which a firm might be encouraged to pursue strategies centred on cost leadership is not explored in detail here.

44 See: http://www.zeri.org/ (1999, October 13)

For the purposes of this study, it is necessary to analyse further the possibilities of corporations to use resource productivity strategies in order to reduce the costs of products.

Social and economic factors, among others, have influenced corporations to achieve a significant degree of labour and capital productivity, enabling them to substantially reduce manufacturing costs and consequent final price of products. Although gains in resource productivity have also been achieved, in comparative terms they lag behind these other two variables of the economic theory of the firm (Lovins *et al.* 1999). Some resources used in industrial activity have been relatively cheaper to obtain or are even free to be appropriated by organisations, such as water from public aquifers. In the words of Reinhardt (1999a:10) “in a world where environmental externalities were the only departure from the assumptions of perfect competition, and where no firm had preferential access to superior (low-cost) stocks of natural resources, firms that volunteered to internalise these costs could not survive”. Therefore, historical grounds (mainly economic) justify corporations concentrating their efforts to obtain greater levels of productivity of capital and labour, relatively to (natural) resources. Although these levels of productivity vary significantly among industrial sectors and individual firms, some areas of industrial activity present levels of waste generation that are remarkably high, such as in the production of coffee beams in which 99.8% of the resource (plant) lost as waste (Pauli 1998).

The possibility of substantially increasing the optimisation of the use of resources has already been widely recognised by authors such as Hawken *et al.* (1999), and Weizsäker *et al.* (1997), among others. Ryan (1998) asserts that design for environment can increase resource productivity by a factor of 20 (or a 95% reduction of the environmental impact of a product), at the same time reducing the cost of products, allowing corporations to develop cost leadership strategies. These cost reductions in production processes and utilisation of materials can certainly be transferred to products (Esty & Porter 1998), resulting in a zone of influence from strategies based on resource productivity to environmental cost leadership. In such a scenario it would be easier for a firm to explore the *double dividend* mainly because saving in process yields allow the company not only to cut the costs of its products but also to improve its competitiveness.

The potential of firms to explore resource productivity in processes for the development of strategies based on cost leadership (of products) is perhaps the clearest relationship between the generic strategies. Energy savings in production, for instance, might allow a firm to reduce the price of its products and pursue competitive advantages based on such strategies. Cost reductions resulting from the elimination of painting as an industrial process can be directly transferred to the final price of a product. This type of cost minimisation in production is the most obvious influence on environmental cost leadership strategies. However, other subtler possibilities of cost minimisation emerge when the scope of resource productivity is extended to other phases of the life-cycle of a product. Cost reductions might result form the relationship between the design of a product and its overall environmental performance during the use and end-of-life phases. For instance, design for disassembling (DfD) techniques applied to industrial products can represent significant savings for companies operating in industries subject regulation focusing on extended producer responsibility (Ryan 1998). Section 4.1 mentioned the possibilities of this type of regulation to become common in highly industrialised countries, and Chapter 11 demonstrates the relevance of design for dismantling techniques for the reduction of costs associated with end-of-life activities. Additional to the cost saving in dismantling, the recovery rate of materials is also dependent on the use of these techniques in the design phase.

Design that considers the entire life-cycle of a product has the potential to reduce its environmental impact during its use. Savings in materials or energy impact not only on the amount of work necessary during the manufacturing phase but also can reduce both economic and environmental costs of product use (Esty & Porter 1998). The consumer would benefit directly from resource efficiency simply because products cost less to operate. Porter (1985) classified this type of cost savings for the buyer as competitive advantage based on differentiation. The perspective presented here does not deny this possible classification. However, even though differentiation strategies might be possible for some lines of home appliances, for instance, a great number of them will still compete on the basis of cost simply because the consumer is not willing to pay for the ecological attributes of the product (Reinhardt 1998). In such cases, consumers might associate the economic gains of the product with its environmental qualities. This situation will force competitive advantage to be primarily based on the costs of the product. This is the main reason why the concept of *environmental cost leadership* (or simply *Ecost*) has been proposed here. By extending resource productivity efforts to the entire life-cycle of the product, corporations could explore cost leadership strategies on the basis of the relative low economic costs as well as the low environmental costs embedded in their products. In other words, competitive advantage could also be pursued on the basis of low environmental costs leadership.

4.4.3 Ecological Differentiation of Organisational Practices: Beyond-Compliance

An analysis of some voluntary environmental initiatives promoting organisational practices that go beyond compliance organisation in corporations was developed in Chapter 3. The potential of these initiatives to serve as indicators of corporate environmental performance and, consequently, indicate the degree of ecological sustainability of organisations, was the main area of inquiry of that chapter. In simple terms, the analysis indicated that there is substantial scepticism about the real potential of such schemes to promote ecologically sustainable industrial practices. The main reason for the scepticism relates to the fact that sustainability issues are left out of the implementation of such schemes. Whether or not the practices prescribed by the ISO 14000 series, for instance, are conducive to sustainable industrial development is an issue that is not required from organisations. Nonetheless, the analysis also acknowledged that initiatives such as CERES, Responsible Care, or the EMAS can act as catalysts of better corporate environmental practices. By adopting the guiding principles of these initiatives, improvements in incremental gains in process yields, materials and energy can be achieved, improving the overall environmental performance of corporations. The efforts the firms make to implement such schemes will eventually differentiate them from competitors and this ambition can also be interpreted as an influence on the *greening* of organisations.

Differentiation strategies based on organisational processes might produce some positive outcomes for the company. Corporate image, for instance, might be enhanced, influencing a positive public opinion about organisational practices (Kolk 2000). But can these types of strategies lead to first mover advantage? In traditional terms, *first mover advantage* is obtained when a particular action is taken by the organisation, which might result in direct or indirect gains. Consumer loyalty might be more easily achieved if the company is the first to launch a new product. Earlier returns of investments in research and development can reduce the financial costs of the corporation, representing a first mover advantage (Porter 1985). However, can organisational processes generate similar conditions for first mover advantage? By obtaining the ISO 14001 certification a firm might differentiate itself from its competitors but does this represent a first-mover advantage for the firm? Answers to these questions are still speculative. Nehrt (1998) is among the researchers who are trying to identify the conditions in which first mover advantages in the environmental front might be generated and sustained. Nonetheless, if conclusive answers need to wait for more empirical evidences, it is already clear that specific conditions for such advantage exist.

The need to establish a distinction between the types of consumers served by a company when developing strategies based on product environmental differentiation has been emphasised by Reinhardt (1998). The circumstances found in consumer markets normally differ substantially from those of industrial markets, and differentiation strategies developed for one context normally cannot be transplanted to the other. This distinction also seems to be useful for the case of process differentiation (see: Box III in Figure 4.1). Specific circumstances favouring the development of differentiation strategies based on organisational processes is expected to depend on the type of market served by the corporation. For companies supplying products or services to other corporations (industrial markets), the certification of their environmental management systems represents a source of competitive advantage when the company is selected as a supplier on the basis of its commitments towards environmental improvements in processes. Automakers *Ford*, *General Motors*, and *Toyota*, for instance, have made it virtually mandatory for their suppliers to be ISO 14001 certified by 2002[45]. In this case, the certification might not represent a first mover advantage for the suppliers but not having the certification will certainly represent a disadvantage. One can expect that competition in such markets will promote the diffusion of beyond compliance environmental practices.

In the traditional view of types of competitive advantage, low costs and differentiation strategies have a mutually exclusive character. Basically, the competitive advantage of a firm would result from from selling low cost products or obtaining higher margins from their differentiation, but rarely form both. Corporate environmental strategies, on the other hand, seem to allow a closer relationship between the two. The first-mover advantage is normally associated with the possibility of companies differentiating themselves from their competitors *by* profiting from their proactive environmental strategy (Nehrt 1998). In other words, competitive advantage can result

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from the firm's capacity to offset the costs of environmental investments. For instance, an industrial organisation might use its ISO 14001 certification for reasons of differentiation but the process of implementing an EMS might uncover potential areas in which an increase in resource productivity can be obtained (Roberts & Robinson 1998). Similarly, a company working towards improvements in resource productivity can facilitate the process of EMS development, reducing implementation costs. This interdependence between environmental strategies based on organisational processes generate a zone where resource productivity and beyond compliance practices mutually reinforce each other.

Companies that put effort toward achieving best environmental practices create the conditions – or, in broader terms, the organisational culture – favourable to the development of both strategies: resource productivity and beyond compliance. The potential for obtaining competitive advantage from the employment of such strategies depends on the business in which the firm operates. For suppliers of industries subject to high pressure to improve their environmental record and to reduce costs, efforts towards both resource productivity and beyond compliance practices might be the most sensible (hybrid) environmental strategy. Here again, suppliers in the auto industry represent didactic examples. Auto suppliers have faced not only the pressure to cut financial costs but they need to do so while committing themselves to improving the environmental performance of production processes. In this case, obtaining EMS certification simply makes business sense.

Would the same situation apply for firms selling their products to final consumers? The answer is a classic one: 'it depends'. Organisational processes that go beyond compliance might exert indirect influence on the image of a firm and eventually influence its market performance but this influence is apparently dependent on particular circumstances. Section 4.2 showed that when European consumers rejected the decision of *Shell* to dump oil rigs in the North Sea, there was a clear 'yes or no' situation, making it easier for consumers to boycott the products of the company. In that case, a slump in sales resulted from the rejection of the organisational practices that were not directly related to the products sold by the company. The Brent Spar case showed that the overall environmental performance of the company was becoming increasingly important to stakeholders. For many firms, environmental reporting is already an essential communication tool to address such considerations, and Shell actually leads the companies that have significantly improved their accountability (Kolk

2000). *Body Shop Inc.* (also mentioned in Section 4.2) is also a didactic example of how corporate environmental policy for production can be linked to products, and how consumers can respond to the corporate environmental image.

Yet, the Brent Spar case also showed that consumer response is more prone to happen when an 'issue' is created around a specific concern (see: Section 4.3). In order to respond to a particular environmental matter that relates to production processes, the public needs to be 'sensitised'. Among the multitude of variables influencing consumer behaviour, environmental concerns will eventually become important to consumers when an agency is able to mobilise the public opinion (see: Section 5.2 in Chapter 5). Hence, competitive advantage resulting from competitive focus on processes is subject to a particular set of circumstances, such as the type of consumers supplied by the company and the overall context in which the business operates. Competition is expected to influence the incorporation of environmental concerns into organisational practices but, as this section proposed, these conditions need to be analysed in detail.

4.4.4 Ecological Differentiation of Products and Services

Marketing differentiation based on environmental attributes of products constitutes the most straightforward strategy of the four possibilities presented in Figure 4.1. Today, ecologically oriented products represent a defined market niche explored by firms worldwide (Kotler 1999). The organically grown cotton shirts sold by the American sportswear company Patagonia has become a classic example of product environmental differentiation (see: Chouinard & Brown 1997; Reinhardt 1998). A more localised example of such strategy is presented by the Swedish KRAV (*Kontrollföreningen För Ecologisk Odling*) eco-label for organically grown food. In Sweden, more than 3,200 products use the KRAV label as a way to differentiate themselves from competitors. Corporations are able to charge between 10 to 100% higher prices than similar products that are not certified by KRAV.

In general terms (mainly in the European context), eco-labelling schemes cannot be considered a successful market initiative, as Section 3.3.2 (Chapter 3) has previously explained. Nonetheless, in the particular case of Scandinavian countries, the use of eco-labels by corporations as tools supporting marketing strategies based on product differentiation have been relatively more successful from mid 1990s onwards. The *änglamark* brand of ecologically oriented products sold by *Gröna Konsum*, a Swedish supermarket chain, constitutes an example of a successful ecological differentiation of products. Around 150 food and other domestic products, such as coffee filters and washing powder use the *änglamark* brand to communicate the image of environmentally responsible products (see: Heidenmark, 2000).

Although the scope for environmental improvements of the products and services currently supplied by organisations is significant, as the previous sections emphasised, only a fraction is expected to attain competitive advantage on the basis of environmental prerogatives. Justification for this assertion finds its roots in the conditions that satisfy the differentiation of any product, as well as the specific requirements for sustaining competitive advantage in the environmental front. In broad terms, "a firm differentiates itself from its competitors when it provides something unique that is valuable to buyers beyond simply offering a low price" (Porter 1985:120). Differentiation in these terms requires at least one strong motivation for buyers to acquire the product that does not relate to its price. In the specific case of ecological prerogatives, differentiation will occur when a product is able to provide greater environmental benefits, or imposes smaller environmental costs than similar products (Reinhardt 1998).

The satisfaction of these generic requirements for product differentiation cannot be extended to every product or service. In simple terms, differentiation implies distinctiveness, an attribute that by its very nature is only achieved by a minority. Once again, the conditions that satisfy the ecological differentiation of products depend on variables ranging from the structure of the industry, the regulatory framework, and the capabilities of the firm. These generic conditions provide the broad context in which a corporation might decide to explore environmental product differentiation strategies. But a propitious context for the development of such strategies does not guarantee successful marketing results. According to Reinhardt (1998), three specific conditions present in the relationship between the firm and its consumers need to be satisfied.

The willingness of consumers to pay for the ecological attributes of products is the first pre-requisite for environmental product differentiation. Fundamentally, most consumers need to perceive a clear benefit for their purchase. In the case of industrial markets, the benefits are normally translated into cost savings, better performance of the product (as an input for other industrial processes), and cost reduction of risk management. For instance, equipment and machinery that consume less energy and reprocess by-products might reduce the costs of operation for the client. Those ecological attributes (less environmental impact) that result in gains during product use can be commercially explored by the vendor. In case the company is not working in a price-sensitive market, a price-premium can be obtained. On the other hand, for consumer markets, as the example of the Swedish eco-label KRAV has shown, the attributes associated with organic food might allow companies to charge higher prices than competitors who lack such a label. However, in both cases – industrial and consumer markets – it is fundamental that the consumer is willing to pay for the ecological differentiation presented by the product.

Credible information is the second pre-requisite for environmental product differentiation. Public concern with the uncertainties associated with genetically modified organisms (GMO) is possibly a didactic example in which information played an important role in the failure of companies to communicate the (allegedly) environmental benefits of such technology. Mainly because there is a high degree of uncertainty not only about the potential danger associated with the production of genetically modified organisms but also with the unknown consequences of its consumption, differentiation in this case worked against the product. In other words, people want to know whether the food is genetically modified in order to have the choice of not buying it. A corporate environmental strategy based on genetically modified organisms that at first seemed to have a great chance to succeed (see: Magretta 1997), resulted in an unprecedented market failure. *Monsanto*, a former leader in agro-chemical industry, is still finding a way out of such strategy, which can cost its own survival in the business. As this case demonstrates, the lack of credible information about positive attributes of the product was the main reason for the failure of differentiating the GMOs.

The final requirement relates to barriers to imitation. If product environmental differentiation is to be successful in market terms, environmental innovation should not be easily replicated. Once other firms are able to reproduce the innovation, the focus of competition will tend to return to costs. Environmental product differentiation requires a high level of technological and managerial innovation to create products with environmental attributes that entail substantial organisational capabilities for their replication. In a similar fashion, barriers to imitation require substantial efforts to associate the corporate image of environmental responsibility with the products sold by the firm, as the classic case of the *Body Shop* best demonstrates (see: Section 4.2). Straightforwardly, a distinctive product trait that is easily replicable cannot become a source of competitive advantage.

The economic sustainability of differentiation strategies becomes important when one inquires into the ways in which competition can foster the development of ecologically oriented products, in particular, and ecologically sustainable organisational practices, in general. Without the understanding of the logic behind industrial competition, this issue loses ground. This section explored the four possible types of competitive advantage associated with environmental issues in organisations mainly to address this matter. Reinhardt (1998; 1999b) accurately emphasised the importance of evolving the debate from generic assumptions ‘whether it pays to be *green*’, to a more grounded analysis of the conditions in which environmental investments can become a source of competitive advantage. Although Reinhardt’s work represents a significant contribution to this debate, he does not establish a distinction between products and organisational processes. As it has been proposed in this section (summarised in Figure 4.1) this division is fundamental for the identification of appropriate conditions that might justify the development specialised corporate environmental strategies. Moreover, a detailed analysis of environmental competitiveness has the potential to reveal the elements explaining the current pace of environmental investments in corporations.

4.5 Conclusion

This chapter analysed factors influencing organisations to incorporate ecological prerogatives into their strategies and practices. Externally, environmental regulation champions the indication as the major promoter of better corporate environmental practices. Although this role of regulation was emphasised in the analysis, examples of different types of regulations and the results they can generate demonstrated the difficulties associated with the enforcement of the law. Moreover, the consequences of regulatory measures do not always correspond to the expectations of those who designed them. There is a great risk of regulation creating situations that inhibit organisational innovation. Among other factors, this unintended consequence of social supervision constituted an important motivation for governments to accept industry self-regulatory measures, as developed in the 1990s. Interestingly, voluntary schemes emerged almost simultaneously as legislation was going in the opposite direction. Regulation based on the concept of ‘extended product responsibility’ also emerged in the last decade as a possible solution for curbing the environmental impact of industries. The overall analysis has shown that the intricate character of design and enforcement of regulations has intrinsic limitations. Although regulations constitute important instruments for the control of organisational action, the motivation for corporations to develop more ecologically benign practices seem to depend on other factors.

Consumer satisfaction constitutes another important motivation for corporations to develop environmental practices beyond compliance. Section 4.2 demonstrated that there is some willingness to pay for more environmentally sound products and services and evidence of *green* consumerism is already available. However, it was also argued that social and psychological dimensions, intrinsic to the activity of shopping, have the potential to limit eco-centred behaviours. There is a hidden 'gap' between the attitudes of manifestly politically correct consumers and their real shopping behaviour. As was explored later in the chapter, there are specific conditions that need to be satisfied for consumers to be willing to pay for ecologically oriented products.

Dissemination of pro-nature attitudes inside organisations is also a matter of perception. As Section 4.3 posed, when influential managers perceive the natural environment as an organisational imperative, ethical motives can become a powerful influence on the development of ecologically driven strategies and practices. The commitment of an important organisational actor to environmentalism has the potential to trigger the necessary motivation inside the organisation for the promotion of more sustainable practices. Whether the motives for such commitment relate to the need for the reduction of organisational risks, or simply represent an attempt to demonstrate outstanding environmental performance to the public is still a matter under speculation by specialised research – one that might never reach consensus. For the purposes of this study, what is fundamental is the recognition that organisational motives and competences are not absolutes in themselves but depend on manager's perceptions of the nature of environmental problems, as well as the resources available to the firm to address them.

The relevance of competition in promoting better environmental performance in business was explored in Section 4.4. The main rationale guiding the section is based on the proposition of Reinhardt (1998; 1999b): this involves treating environmental issues with the same prerogatives as would be applied to traditional issues in business. In essence, the evaluation of industrial competition as a promoter of environmental innovation in corporations requires the understanding of the nature of competition from a business perspective. The section confirmed the perception that the search for competitive advantage plays an important role in the process of incorporating environmental requirements into business strategies. Advantages or pursuing environmentally centred strategies apparently exist, but the debate about its limitations does not allow one to conclude that companies will pursue such strategies based on those advantages. The search for competitive advantage might motivate corporations to develop beyond compliance strategies but to what extent competition can provoke the dissemination of such practices among industrial organisations remains an open question.

Contingent factors can work as both promoters and inhibitors of better environmental practices in organisations. For this reason, the use of the terms ‘factors’ and ‘determinant’ interchangeably in this chapter deserves a remark. As it has been shown during the chapter, the capacity ‘to determine’ outcomes is significantly limited by the contextual nature of the determinants themselves. A great number of studies in the *organisation & environment* field seem to overemphasise the capacity of environmental factors to foster innovation. In most cases, this happens simply because the focus of the study is located in explanations of cases of best practice, or prescription of proactive environmental management in organisations. The explanation of why the great majority of organisations are *not* developing this type of strategy is not central to these studies and, consequently, little attention is dedicated to the inhibiting feature of the factors. This chapter tried to avoid such limitations by not restricting its analysis only to the positive influences that these factors can exert on the *greening* of organisations.

The criterion used for selecting the factors also deserves a comment. Noticeably, several other influential factors could have been added to the list presented here. Shareholder rejection of environmental risks and public demand for environmental protection, for instance, compose what Berry and Rondinelli (1998) called ‘stakeholders forces’ triggering proactive environmental management in companies. Interest groups, non-governmental organisations, and other parties committed to politically oriented environmentalism constitute crucial influences that were not directly explored here. Together with other social, political, and cultural elements, they indeed constitute important forces motivating the *greening* of organisations. In this respect, the determinants presented in this chapter are the ones perceived as straightforward influences on the management of business organisations. The specialised literature indicates regulation, consumer preferences, organisational contingencies, and competition as crucial factors for the *greening* of firms but not in any way that is theoretically coherent or systematic. In this regard, the selection represents an orderly analysis of arguments presented by the specialised literature, complemented by insights gained from ‘sensitising’ fieldwork.

The analysis presented here also suggested that the determinants have the capacity to trigger proactive environmental management in companies but this capacity should not be over-simplified. The process of organisational *greening* depends not only on the ‘positive’ power of each determinant but also on the their alignment in order provoke the necessary changes in specific institutional contexts. In this chapter, the determinants were analysed separately for didactic reasons, but it should not be expected that the consumer alone, for instance, would be able to trigger substantial changes in the behaviour of an entire industrial sector. In the current industrial context, neither management armed with goodwill nor tough regulations seem to be sufficient forces to drive organisations towards ecological sustainability. As it will be explored in detail in Chapter 6, there are historical reasons justifying the current pace of environmental initiatives undertaken by organisations.

The absence of a specific section concerning technological and economic factors influencing the incorporation of ecology into environmental management strategies and practices also deserves justification. The way in which the determinants have been presented assumes that economic and technological factors are pervasive in all of them. Technology or economics cannot stand in isolation; rather, they relate to the context involving the determinants. In this chapter, economic elements were present in the choice of corporations to meet the regulatory demands and avoid the economic burdens associated with non-compliance penalties. Consumer choices are also strongly driven by the prices of products and corporations need to develop environmental strategies that are economically appropriate for this reality. Economic costs are not only a central element of strategies leading to competitive advantage but the double dividends debate also develops around questions concerning the economic limits to profiting from environmental investments. Hence, the pervasiveness of economic factors is what justifies the absence of a section dedicated to them.

Although environmental economics is in itself a very important area of research, excessive focus on the economics of environmental management would switch attention away from the context within which the search for double dividends, for instance, makes sense in the first place. The incorporation of ecological principles into systems of production and consumption demands economic viability in alignment with a new set of technological choices. These choices, however, do not comprise just a rational decision-making process but are embedded in far more complex context. Would organisations seek a 'double dividend' if they were able to persuade regulators to act in their interests? Would companies invest in radical technological innovations if they were able to dictate the pace of innovation in their industry? Answers for these questions require not only understanding of economics involved in environmental decision-making but also the consideration of social, cultural, and political dimensions encompassing technological preferences in industrial sectors. The incorporation of the natural environment into business rationality is an issue that does not seem be confined to the realms of focal organisations. There is interdependence among factors suggesting the need of extending analysis to the context in which the *greening* of organisations might occur. Chapter 5 provides further evidences of this interdependency and presents a framework for the analysis of fields of political influences under which organisations are constantly submitted.

5 The Political Ecology of Organisations

A central influence on the *greening* of organisations relates to industrial competition triggering the search for competitive advantage, as Chapter 4 demonstrated. Achieving such advantage is possible by enhancing resource productivity and hence the competitiveness of the firm – a *double dividends* scenario. The influential articles by Porter (1991), and Porter and van der Linde (1995a, 1995b) have received considerable attention in the academic arena, mainly because their argument debates the existence of a *trade-off* between economic and environmental gains. Finding hidden opportunities for organisations to profit from environmental strategies is an appealing theme for both business practice and academic communities. For the latter, finding profit in environmental strategies motivates studies about the economic limits of resource productivity – a central variable of the double dividend approach. The type of regulation that can promote adequate innovation comprises the second element of the debate. In a manner similar to Porter (1990), comparisons between the characteristics of the environmental regulatory framework are normally used to identify the roots of competitive advantage of specific industries or nations (Howes *et al.* 1997).

The search for scenarios, such as double dividends, for the development of business environmental strategies is crucial in the quest for more sustainable systems of production and consumption. However, this chapter inquires into the nature of resource productivity and regulation – the two central variables of the double dividend approach – by incorporating an institutional-power perspective into the debate. An institutional-power approach refers to the *structuration* of the relations between the state, organisations, other agencies, and the civil society (Giddens 1984; the concept of *structuration* will be further elaborated in Chapters 6 and 9). The broad context where factors of political economy can determine the willingness of companies to develop environmental strategies and, consequently, search for double dividends is explored in Section 5.1. The characteristics of the institutional-power framework, the mobility of capital, and the nature of competition, can all detract companies from the search for double dividends, as the case of new investments in car assembly in Brazil demonstrate[46].

Yet, the recognition that environmental issues are shaped by political economy factors is neither new nor sufficient in interpreting specific contexts in which the *greening* of organisations might occur. An *anatomy of power* is required. One needs to comprehend the ways that external political leverage drives and frames managerial rationalities and influences the ways that the ecological dimension may be integrated into organisational practices. This constitutes the main reason for presenting a theoretical framework for the analysis of organisational fields in Section 5.2. The main concepts derive from the studies of Clegg (1989), who proposed a framework for the analysis of relations of power mainly, but not exclusively, at the organisational level. Here, Clegg's framework is expanded and proposed for the analysis of the context in which environmental innovations are embedded – constituting *the political ecology of organisations*.

The proposition of the political ecology framework should be understood as a specific theoretical interpretation of power. More recent literature, such as Flyvberg (1998), Haugaard (1997), and Hindess (1996), review the classical works on power in similar fashion as Clegg did. In theory, they could also be used as the point of departure for the political ecology framework. However, Clegg's proposition of *circuits of power* not only encompasses the synthesis of classical interpretations of power but also focuses more directly on power in the context of organisations. Additionally, the elaboration of the political ecology framework happened through a process of theory building at a grounded theory, as well as reflexive methodology (see: Chapter 7). Consequently, the elaboration of the framework is a result of the interplay between theory and the analysis of the data collected for this study. This is the reason why the elements that compound the political ecology framework are presented in their theoretical essence in Section 5.2, and practical examples are introduced only in Part II of this study.

5.1 The Political Economy of Regulation

As it has been mentioned in Chapter 4 (Section 4.4), Reinhardt (1998) gave a new perspective to the debate about the limits of double dividend scenarios. Empirical and

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46 The examples have been drawn from of the sensitising fieldwork conducted in Brazil in 1996. For details, see

theoretical evidence also question the extent to which one can generalise from *win-win* situations (Howes *et al.* 1997; Jaffe *et al.* 1995; Reinhardt 1999a). Even Michael Porter – the main proponent of double dividends hypothesis – has recognised some of the limitations of his approach in later work (Esty & Porter 1998). Nonetheless, the most critical analysts also acknowledge that there is room for environmental improvements in companies that are cost effective, before reaching a trade-off between ecological and economic gains (Palmer *et al.* 1995; Walley & Whitehead, 1994). But to focus only on the economics of environmental management switches attention away from the context within which the search for double dividends made sense in the first place. Would organisations seek a double dividend if they were able to persuade regulators to act in their interests? Would companies invest in radical technological innovations if they were able to dictate the pace of innovation in their industry?

A partial answer to such questions involves three interdependent factors of political economy that constrain companies from committing themselves to the exploration of win-win situations: the characteristics of institutional-power contexts, the nature of competition, and capital mobility. From the perspective of institutional-power contexts, the major industrialised countries are sophisticated civil societies with a great density of community organisations. Some of these community organisations may have sufficient power resources to be able to influence state policies to constrain the organisation of private capital (McCarthy & Wolfson 1996; Pakulski 1991). Local legislation, as a restrictive framework, thus acts as a quasi-independent variable regulating business practices. In such contexts firms that go beyond mere compliance with environmental regulations may achieve competitive advantage (Porter & van der Linde 1995b; see also Section 4.4.3 in Chapter 4).

In other circumstances, such as those of developing nations, the capacities of the state to legislate may be considerably less. The nation's elite is likely to comprise substantial stakeholders in *comprador* investments. In these contexts, local state managers, mindful of their interest in and need for foreign capital, are less likely to legislate for environmental protection. Investments in new car plant in Brazil in the 1990s are a compelling example of this reality. Proposals from foreigner automakers to install new assembly plants received overwhelming support from the ruling Brazilian political parties. From the year 1995 onwards, State Premiers competed with each other to offer subsidies, trying to attract car manufacturers to their states (*Amanhã* 1995). Even though Roodman (1998) demonstrated that subsidising activities that harm the environment can also have a detrimental economic effect in the long term, the allegedly economic benefits of these investments were the leading factors in gaining wide public support.

Consider the context in which these assembling plants were introduced. In 1995, Brazil had about 150,000 km of paved roads (*Anfavea* 1995) – a relatively small amount for a country 8.5 million square kilometres in area. The annual production of cars, trucks and buses was projected to increase from 1.2 million in 1994 to 2.5 million by year 2000 (*Anfavea* 1995). However, similarly to other developing economies, Brazil has significant deficits in public transport and an extremely limited capacity to invest in road infrastructure. For these reasons, traffic congestion and pollution of Brazilian streets and roads could only be expected to worsen when these newly installed factories reach full capacity and double the size of the automotive market in the country. While the new investments in car manufacturing might be industrially feasible, they clearly underestimate economic and environmental costs of the necessary extension of urban development and road network.

When one considers the context in which these investments were defined it is not difficult to identify the capacity of global automobile companies to influence national environmental policies that would eventually affect their interests. The dependency of local governments on international investors simply diminishes their autonomy to regulate organisational action. In terms of national investments, oligopolistic situations emerge around industrial coalitions as a common strategy adopted by the main players in the industry. In such a context, competition is far from being ‘perfect’. Additionally, the nature of capitalistic transactions would also limit the search for double dividends. Flows of capital that eventually become factors of production for car manufacturing companies in Brazil create externalities – such as the pollution generated during the manufacturing, use, and disposal of cars – that are dissociated from the capital that made them possible (see Section 8.3 in Chapter 8). Because capitalists are physically separated from the capital that they control, capital can be redirected to more attractive contexts, while the externalities that it generates cannot.

In complex and sophisticated civil societies, organising and representing interests against the social costs that accompany capitalist reproduction of private profits is not always easy. In places where institutions that protect civil rights or the natural environment are less developed, and the state highly dependent on foreign investment, the situation can be even worse. Free to disassociate themselves from the actual functioning of their capital in various forms of property, capitalists roam the world of investment opportunities, in ways in which citizens and consumers, rooted in communities, cannot. Since global financial markets are largely beyond the control of national or international authorities, ecological threats, that are always experienced spatially, are not adequately dealt with (Soros 1998).

Political economy plays an important role in companies' strategic decisions to integrate environmental strategies into business practices. In specific contexts political economy factors justify the attitude of business organisations in trying to secure economic dividends first. Whether or not there is a 'second dividend' for the natural environment is something that companies will search for only when more traditional possibilities have been exhausted. Similar to the transference of basic manufacturing plants around the globe in search of cheaper labour forces, it can be expected that some businesses will tend to look for contexts where the responsibility for the internalisation of environmental costs can be avoided. In conditions of global competition, the allocation of capital may depend on localised political contracts embedded in particular institutional-power frameworks. The search for a second dividend is not a necessary moral or business imperative.

External pressure – or environment-contingent factors – such as legislation, public opinion, or industrial competition, can force companies to assume some environmental costs. But it is imperative that we make a realistic assessment of who the key actors are and the resource power available to them, as well as the conditions that allow for those resources to be effective (Callon 1980). It is necessary to consider how the determinants of organisational *greening* are embedded within a political economy of regulation that shapes the organisational field – the context in which technical, economic, social and political actions, and agents interact. One can infer that environmental responsibility is unlikely to flow from the assumptions centred on economic or managerial models. Instead, a more explicitly political perspective is necessary – a political ecology of organisations.

5.2 Framing the Political Ecology of Organisations

Environmental management can be seen as another form of organisational control, which is equally shaped intra- and inter-organisationally by power and knowledge (Foucault 1977). As a determinant of environmental strategies, regulatory systems are not just given to business, but they result from political disputations between governmental and private institutions (see: Chapter 11). Organisational actors, and other agencies, such as advocacy groups, often are able to alter existing circuits of power and influence the design of the regulatory framework and the selection of technological innovations (Clegg 1989).

Episodic power relations occur when agents get others to do something that they would not otherwise do. These episodes are what one can ordinarily think of as the result of resource dependency power – the exercise of abilities founded on resources whose possession creates dependencies for others lacking these resources but dependent on them (Pfeffer & Salancik 1978). However, it is necessary to add the concern with ‘issues’ and ‘non-issues’ raised by Bachrach and Baratz (1970) in political science to the resource dependency view. Sometimes power is not apparent in action, in stopping agents from doing things. Sometimes it simply does not have to be exercised. Social construction, either by implicit or explicit control of the tacit agenda of what is a legitimate issue, already constrains what can and will be considered in an organisational field. Issues only ever achieve definition within a specific organisational field. When issues that previously have not been taken seriously are championed and are thus forced on to the agenda, they may be capable of de-legitimating and transforming an existing field by raising new items, participants or locales for consideration. Bachrach and Baratz (1970) used the example of the Civil Rights Movement of Afro-Americans in US cities, mobilizing against segregation and for voter registration, in the 1950s and 1960s as a case in point. Similarly, business-environment relationships can be seen in terms of social issues being brought on to the agenda. When changes occur in these relations the underlying structures of episodic power are changed.

New actors, issues, participants and agendas can transform the legitimacy of circuits of power. Legitimisation occurs through the stabilisation of what Lockwood (1964) termed social and system integration. For Lockwood (1964:245) “the problem of social integration focuses attention upon the orderly or conflictful relationships between the *actors*, [while] the problem of system integration focuses on the orderly or conflictful relationships between the *parts* of a social system". While conflicts between actors may be visible in explicit power episodes, contradictions between parts of the overall system may not. However, out of such conflicts and contradictions new issues may emerge. Hence, it is through the transformation of both social and system integration that the institutionalisation of environmental practices in organisational fields will be secured. The former occurs through the impact of new actors, the latter through the management of new contradictions.

Through developing a framework for analysis of the transformation of system and social integration the dynamics of circuits of power enable one to see how constantly these have to be reconfigured if they are to remain the same. For this reason, this section extends the general *circuits of power* proposed by Clegg (1989) to the analysis of relationships between organisations and nature. Hence, *the political ecology of organisations* addresses ecological practices as a contingent, contested and indeterminate terrain of political and strategic actions, located both within and around organisations. The adoption of a political ecology perspective to the context of organisational studies borrows from sociology. According to Escobar (1996:325), "Political ecology studies the relationships between society and nature in contexts of power – particularly from the perspective of political economy." In its address of political ecology issues, the focus of this chapter draws from both (neo) institutional and power perspectives in organisation studies[47]. The proposition of a political ecology of organisations adopts an institutional-power approach to analyse organisational fields, embedded within the *structuration* of relations between the state, organisations, other agencies, and civil society (Clegg 1989; Giddens 1984). Figure 5.1 presents the basic components of the *circuits of political ecology* framework for the study of organisational fields.

Basically, the model works in terms of flows through system and social integration. For instance, the possibility of consumers influencing firms to make more environmentally friendly products will rarely be the result of a direct influence but more often will flow through the circuits of political ecology. Crucial product innovation, or a widespread acceptance of a new set of rules associated with a company's behaviour,

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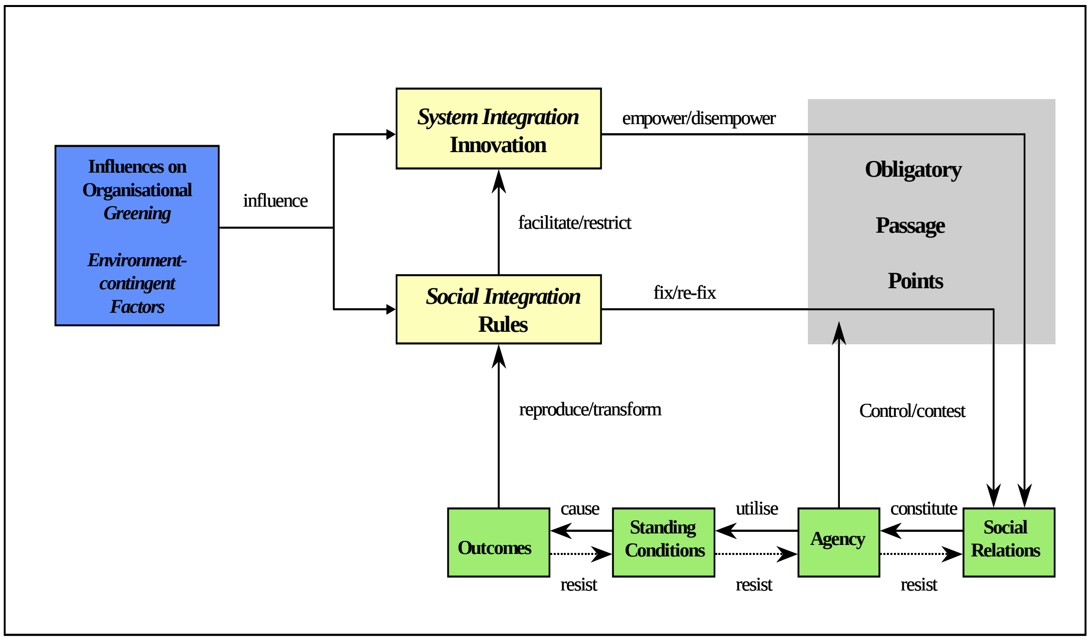
47 For a review of institutional theory, see: Tolbert and Zucker (1996). Hardy and Clegg (1996) provide a review of the main approaches concerning power perspectives in organisation studies.

may impact on the way obligatory passage points are defined, new actors empowered and the configuration of social relations re-fixed. As a result of this process, the relevance of different agencies – the people or organisations involved and interested – may change. The conditions sustaining their relevance may be transformed, reproducing and transforming the conditions of social and system integration.

Figure 5.1: Circuits of Political Ecology



Source: Adapted from Clegg (1989: 214)

Despite the fact that the main concepts are presented separately, the strength of the model is in the way that it allows systematic consideration of all the appropriate variables. Therefore, the reason for the adoption of the form of presentation through specific sub-sections and demonstration-cases is fundamentally didactic; the complexity of reality should not be confounded with the simplification of the framework for presentation purposes.

5.2.1 System Integration

System integration concerns “technological means of control over the physical environment, and the social environment and the skills associated with these means” (Lockwood 1964: 251). Thus, it refers to the ways in which innovations may empower or disempower the relative capacities of the different agents within the organisational field. Environmental innovation may derive from the pressure imposed by competition, consumers, or perhaps from new regulatory requirements. When changes in system integration occur they change not only technical tasks but also the relations between agents in organisational fields. That there exists a new technology alone is an insufficient criterion of changing system integration. Innovation in both social and technical relations is required. It is necessary to analyse how such innovations can empower or disempower existing social relations within the institutional-power context in which organisations are embedded

Revisiting one of the main variables of the double dividend approach, innovations that are conducive to resource productivity can be conceived as an element of system integration. For instance, the adoption of cleaner technologies in manufacturing depends on conceiving of production systems based on *design for the environment* (DfE) principles and techniques (see Section 2.4 in Chapter 2). Although the infrastructure comprises a crucial pre-requisite for adopting clean technologies, it is almost impossible to practice design for the environment without the widespread commitment of other companies, governmental agencies, universities, and research centres. That is, it requires labour skills, knowledge, and personal networks to function effectively. New skills and disciplines need to be introduced into the organisation, and into its management of the supplier relations. These techniques can greatly empower specialist members of the engineering profession, not only within those firms that employ them, but also in terms of the way they define and share the ways that this organisation will interact and transact with other companies in its context.

Therefore, it can be expected that organisations that are influenced by these determinants have to be able to manage a changed set of power and dependency relations, just as the engineers do within these firms. Given that DfE can be a technologically sophisticated strategy, it is likely to create many micro-power episodes organisationally, practitioners equipped with DfE techniques seek to enrol and translate members of other areas to its vision. Organisations thus, as Cohen *et al.* (1972) put it, do resemble sets of differentially powerful solutions, embedded in power/knowledge, seeking to define organisation problems as those they are especially equipped to handle.

The search for double dividends depends in many instances on the application of principles of design for the environment. By its turn, design for environment requires data for the evaluation of the environmental performance of products and processes across their life-cycles, technically denominated *life-cycle assessment* (LCA, previously analysed in Chapter 3, Section 3.3.1), which are costly to collect, and depend on high levels of training. The tools necessary for the implementation of resource productivity can sometimes be dependent on the integration of the parts of the system that can be significantly expensive for single organisations. Even though more easily identifiable gains in resource productivity can be achieved, an optimum level of environmental innovation might be located in other elements that compound system integration.

Unless the influences on organisational *greening*, such as the ones analysed in Chapter 4, actually make a difference to the ways in which agents in organisation fields constitute tasks and relations, they will not necessarily have the impact that some scholars normally assume. The existence of new technologies is insufficient in themselves to provoke radical changes. Clegg (1989) emphasises that innovations transform existing social relations within an organisational field. On whose terms the circuits of political ecology will be disciplined is always a political matter, dependent on the ways in which innovations transform existing power relations. Even though environmental factors may be facilitative of improved ecological practices in organisations, unless the innovations proposed are allied and enrolled either within existing circuits of political ecology, or can reconfigure them, they are unlikely to be effective.

5.2.2 Social Integration

Social integration deals with the symbolic sphere, with language and its relations of meaning, and the ways in which these define certain types of membership categories in relation to other categories within organisational fields. Existing relations of meaning and membership may facilitate or restrict the reception of innovation. Formal and informal rules fix relations of meaning and membership within and between organisations. These relations define who one is and what one does, through the ways they are embedded in rituals and routines. Through these, certain things get initiated and certain things get done. Actors in and around organisations use various means available to them to seek to control resources, so as to secure desired or favourable outcomes in terms of these rules. Such outcomes may either reproduce or transform those rules that presently fix current reality.

Existing relations of meaning and membership facilitate or restrict the reception of innovation. In this respect, one can expect that pre-existing and entrenched professional membership identities will resist the institutionalisation of environmental engineering techniques such as DfE. The existing disciplinary structure of power and knowledge will be inimical to the professional projects implied by the innovation: DfE solutions will devalue conventional engineering problems and their solution, much as the ‘garbage can’ model would predict (Cohen *et al.* 1972).

Actors use various means available to them to seek to control resources, so as to secure desired or favourable outcomes. Such outcomes may either reproduce or transform existing rules fixing the current organisational reality. These rules are crucial to power, because it is through the ways these are routinely embedded in the rituals and routines of organisations, that certain things get initiated, and certain things get done. What rules do, in the broadest sense of the term - encompassing both formal and informal rules in organisations - is to fix relations of meaning and membership within organisations. These relations define organisationally who one is and what one does.

Changes in both social and system integration can be endogenous or exogenous. Internally, an innovation in techniques of production such as *pollution prevention* can entail new forms of manufacturing, which are capable of transforming the way corporations consider environmental investments. For instance, an eventual confirmation and widespread acceptance of proactive environmental strategies based on the *double dividend* hypothesis would represent an endogenous transformation of circuit of system integration. Conversely, factors influencing organisational *greening*, previously analysed in Chapter 4, would represent external forces acting upon the circuit of political ecology. Draft regulations on product *take-back* (or extended producer responsibility) regulation, for instance, tend to trigger substantial political disputations in a specific organisational field, as Chapter 11 will demonstrate. The normal reaction of manufacturers is to avoid regulations that would, theoretically, represent more costs for the business. In simple terms, regulations will need to alter the circuit of social integration by refixing its obligatory passage points.

5.2.3 Obligatory Passage Points

Any innovation will flow through existent passage points, as existing interests secure what is obligatory and what is not, or they will create new ones. The ways in which power relations are constituted depends on the reproduction of certain obligatory ways of doing things. At the level of the organisation, formal and informal organisational routines constitute examples, such as the criteria used for choosing pollution control technology, and for the evaluation of corporate environmental performance.

At the level of the industry, obligatory passage points are associated with paradigms of production and consumption. The obligation, above all, is conceptual. Today the world's largest individual fortune belongs to an individual who was able to change the obligatory passage points of the computing industry. Bill Gates forced a breakthrough in this industry by re-conceptualising of what constitutes its core business – as a supplier of information technology. Instead of concentrating efforts on the manufacturing of a better machine – as Steven Jobs did with the *Macintosh* computer – he forced changes, literally, on the 'operational system' of the industry. Today there is a proliferation of computer manufacturers, but *Microsoft* (Gates' company) has practically reached a monopolistic market position in several countries. The current obligatory passage points of this industry are defined more by software creation than hardware engineering.

If a '*dematerialisation*' of products and industrial systems – i.e., the reduction of the material and energy content of products – is desired (as mentioned in Chapter 2), identifying the obligatory passage points of the industry is crucial. The obligatory passage points of most industrial products will need to have more in common with the ones of computers - a shift from material-based to a service-based performance economy (Braungart & Engelfried 1992; Stahel 1994). Additionally, for this transformation to happen, agency – another central component of the political ecology framework – will need to be transformed.

5.2.4 Agency

When people get others to do things that they would not otherwise have done, one can call this agency: the ability to make a difference. It makes a considerable difference whether this agency is embedded in work group structures, organisational routines or individual workers. Where knowledge is embedded in structures and routines rather than people it has potentially more power over a potentially longer duration. That is because it is less vulnerable to attrition or individual variability.

Power/knowledge relations are embedded as a repository within the culture of an organisational field (Schon 1983). Through such fields there weave complex patterns of "language, the words, phrases, vocabularies, and expressions which individual groups develop (...) artefacts, the material objects a group produces (…) in coordinated action routines" (Weick & Westley 1996: 442). The car as an artefact and the language games that traditionally developed around it has been the symbol of individual freedom in the 20th century. Schon (1983), and Weick and Westley (1996), characterise the organisational field surrounding the car as a learning system with a high degree of indeterminacy. Some of that indeterminacy attaches to the problematic effects of agents. When Ralph Nader[48] claimed that a certain automobile was 'unsafe at any speed' this intervention initiated a consumer revolution in the auto industry. It is through the exercise of agency that there exists a potential to learn by 'making a difference'; that this difference can be organisationally incorporated into repositories of action. That is what Nader did: he made a difference and the industry was obliged to learn. Weick and Westley (1996: 456) refer to such opportunities as 'learning moments':

> As organising becomes disorganised, the forgotten is remembered, the invisible becomes visible, the silenced becomes heard (…) when people can negotiate which portions of their continuing collective experience they will next forget, render invisible, and silence, and which discontinuous residuals they will treat as current meaningful artefacts of culture.

Whether any particular episode in which power is exercised makes a difference depends on the 'systematicity' of the organisational field. If it is too strong, "systems, routines, and order overwhelm capacities for unjustified variation" while, when it is too weak, "invention and disorder overwhelm capacities for retention and identity" (Weick & Westley 1996:456). This systematicity is captured in the model through the notion of 'standing conditions'. The causal power of agency can only be realised through the 'systematisation' of the organisational field. There is the need to organise the means of controlling the resources that might produce results for the scope of action of agents. Agencies need to mobilise the organisation of standing conditions.

5.2.5 Standing Conditions

Agency cannot be exercised independently of the context that maintains and stabilises the access of agents to resources. The term 'standing conditions' has, in fact, been borrowed from experimental natural science where it refers to the preconditions and controlled environment that are necessary to make an experiment work. Without the standing conditions being assured the experimental proof will not be forthcoming. Here, the 'standing' refers to the conditions that sustain the stable context within which

48 The popularity generated by of Ralph Nader's court case against American car manufacturers about the (lack of) security of automobiles in the 1960's might have facilitated his candidacy (through the *Green* Party) for the American Presidency in 2000.

resource dependence routinely functions as a means for producing particular outcomes. Access to certain resources is routinely required to make things happen, to have an effect. Thus, power normally has a degree of predictability about it – as long as the standing conditions are sustained.

At the level of the overall circuits, a high degree of system and social integration makes it difficult to innovate, but too loosely coupled organisational fields are also contexts where innovations cannot be sustained. As the analysis of the consumer behaviour in Chapter 4 demonstrated, *green* consumerism – as part of the broader environmental movement – could be characterised by the latter conditions while current systems of production could be characterised by the former. What is crucial is to achieve sufficient control of other agencies, fixing how things get done through fixing obligatory passage points, without achieving so much control that one creates a field that ceases to continue to learn. Thus, power concerns not only the exercise of capacities, but it also concerns the standing conditions within which these capacities are exercised.

5.3 Conclusion

This chapter aimed at showing that the incorporation of environmental practices in organisational strategies is not merely an issue of pure economics and competitiveness. The most influential debates have suggested, thus far, that this is the case. While progressive firms in highly developed economies and regulated states may seek for 'double dividends' there are contextual limits to conceptualising these strategies at the organisation level. Under these circumstances it is important to analyse the double dividend approach from a more political perspective. In the case of the new entrants to the auto-industry in Brazil it is evident that these companies are basing their strategies on guaranteeing their market share in an emerging market in which regulation and competition are compromised from the outset. In such circumstances, the double dividend might not be a high-order organisational strategy.

Understanding the process of *greening* of organisations and industries requires the consideration of the context of economic survival and competition, but this chapter stressed the importance of considering institutional-power frameworks. As specific instances of social design, organisations are embedded in waves of transformation, interactively influencing the social construction of reality (Meyer & Rowan 1977). For this reason, the surge of *greening* in organisations cannot be understood solely at an organisational level of analysis. For environmental practices of companies to become an institutionalised exemplar, episodic environmental gains of focal firms need to impact upon the organisational field through the transformation of those circuits of political ecology within which particular organisations are constituted.

The *anatomy of power* proposed in this chapter draws explicitly on the work of (Clegg 1989). In the *Frameworks of Power* Clegg stretches his analysis back to Machiavelli and Hobbes to present a critical review of power perspectives, such as the ones presented in the work of Lukes, Giddens, Foucault, among others classical works. In this regard, the *political ecology of organisations* suggested in this chapter conceives an organisational field as a dense and dynamic net of omnipresent relations in terms, where others, such as Porter and his associates, would simply see sovereign organisations embarking on *win-win* strategies in search of *double-dividends*. Yet, despite the differences with Porter, exemplified in the argument, implicit in the political ecology of organisations is the understanding that power can be ‘positive’, that it is not merely a matter of negation and negativity. Nor is it merely a matter of identifying who controls resource dependencies, locating where the centres of power are. It is not simply a matter of power centres, and of power being held by the powerful and not being held by the powerless. Nor is it a matter of the state as a locus of power. Power is not just something that the few possess and the majority are locked out of, or in which the many are so subjected to the hegemony of resources controlled by the few that they cannot pierce its workings. These are the errors and illusions of modern theorising (Clegg 1989) that the political ecology perspective tried to avoid.

Power has been studied here with a point of departure, empirically, that ranges over many locales, as a dense and dynamic set of relations. The political ecology of organisations assumes that it is impossible separating power from knowledge or rationality. Power flows through knowledge, precedes rationality and proceeds to saturate and imbue it with its rationality. And power is inextricably tied up with the capacity of agencies to make a difference. These agencies may be the car manufacturer *General Motors* planning its global strategy and seeking to enrol various Brazilian State Governors to its project as they think that they are enrolling the automaker to theirs. What is important is that analysis should seek to find its way through the circuits in which power moves. Thus, the analytical framework serves merely to unlock the pressure points that are capable of transforming industrial systems. The framework is a kind of mapping of the vital *anatomy of power*, unravelling the circuits through which it flows. By using the political ecology framework as a template, the analysis of organisational fields can help to identify whether episodic power gains can effectively influence other elements in the circuit and provoke the institutionalisation of environmentally sounder practices in organisations and industries.

The presentation of political ecology framework have also sought to demonstrate the insufficiency of restricting analysis purely to the voluntaristic level of an organisation's power to initiate distinct episodes of action in pursuit of its strategy. Other factors outside of the intentional strategy of the focal organisations that are not incorporated within current models of strategy also need be subjected to power analysis. As it will be demonstrated in Part II of this study (particularly in Chapter 11), the political ecology framework can be used to encompass relations of power and bridge levels of analysis from organisational strategy to the political economy.

In generic terms, this chapter, together with the previous ones, leads to the overall conclusion that research about environmental issues in organisations tends to be of interdisciplinary nature and often requires multi-level analysis. It seems necessary not only to consider the context in which organisations are embedded in order to evaluate not only economic, political, cultural, and social forces acting independently, but also the alignment of these forces as an historical continuum. Formal organisations constitute specific instance of the overall phenomenon that characterises modern societies. Industrial organisations, in special, represent the means by which the historical process of industrialisation has been possible. Consequently, an analysis of this process has the potential to uncover the fundamental forces shaping this phenomenon. This is the reason why Chapter 6 reviews the dimensions of modernity, and presents the rationale of the emerging theory of ecological modernisation.

6 The Ecological Modernisation of Organisational Fields

The interdisciplinary character of business-environment relationships was discussed extensively in previous chapters, culminating in the proposal in Chapter 5 of an analytical framework for analysis of the circuits of political ecology in organisational fields. Fundamentally, these chapters suggest that incorporation of ecological principles into organisational strategies and practices cannot be dissociated from the broader context in which organisations are embedded. Industrial organisations, particularly, are components of the extensive system of production and consumption, and the design, manufacture, and distribution of industrial products by corporations, among many other primary and support activities, happens in a flow of materials and energy embedded in a web of economic, political, social, and cultural influences. Hence, consideration of these interdependencies is fundamental in explaining how and why pro-active corporate environmental management is predominantly confined to select organisational fields located in highly industrialised countries.

In this chapter it will be argued that the (already sufficiently) complex context of the research concerning environmental issues in organisations needs also to consider the historical processes culminating in the current mode of production and consumption. Industrial organisations constitute one of the means by which the phenomenon of modernity was made possible. To attempt to interpret why organisations would develop pro-active environmental strategies requires consideration of how they are inserted in this historical process. Given that “modernity is itself deeply and intrinsically sociological” (Giddens 1990:43), the understanding of the *greening* of organisational fields requires a degree of ‘sociological sensitivity’. This is the main reason why this chapter attempts to bridge theory and research in the field of *organisation & environment* with developments in environmental sociology; to do so provides some contextualisation of the environmental strategies and practices developed by modern organisations.

In order to develop the main argument of the chapter, Section 6.1 presents a brief review of the evolution of corporate environmental strategies in the last quarter of the 20th century, when the natural environment emerged as an imperative in both theoretical and empirical contexts. Pro-active environmental strategies gradually became more common among large corporations at the same time that research about environmental issues in organisations started to gain momentum. Building upon this review of theory and practice in the field of corporate environmental management, this section summarises the context in which business-environment relationships are embedded. It then justifies why the incorporation of a specific theory, deriving from environmental sociology, is important for the analysis of environmental issues in organisations, as well as being imperative for the development of this study.

The practice of pro-active environmental management is more prominent in organisations that have their base in highly industrialised countries, such as Germany and Holland (Porter & van der Linde 1995). In these countries, the process of internalisation of environmental costs by organisations has been characterised as a part of the broader process of *hyper-industrialisation*. By this stage of development the industrialization process involves regulatory measures and the adoption of cleaner technologies, among other strategies (Simonis 1989). In order to explain the historical developments of this phenomenon, described as *ecological modernisation*, Section 6.2 provides the main dynamics that characterised modernity as a distinctive period of human history. The four dimensions characterising modernity are subsequently presented to argue that, instead of entering in a post-modern era, highly industrialised societies are actually intensifying their modern character (Giddens 1990; Beck 1997).

Finally, Section 6.3 provides both the historical origins and the main statements of ecological modernisation theory, developed to describe the ongoing process of ecological restructuring of industrial societies (Spaargaren 1997). The proponents of ecological modernisation theory consider the process of 'emancipation' of ecology from the economic and technological spheres to be an empirical reality. Also, they suggest it is a viable strategy for the solution of the ecological crisis – assumed here to be the ongoing destruction of the sustenance base of the planet. The *reflexive* character of the theory implies that ecological modernisation theory has explanatory and predictive capacities. The dual character of the theory, as well its all-embracing scope, makes it vulnerable to a vast array of criticisms. A review of the main attacks on ecological modernisation theory concludes the chapter.

6.1 Revisiting Pro-active Environmental Management Practices

Differentiating theory from empirical developments in the field of corporate environmental management can only serve a didactic purpose. In reality, in this area theory and practice have historically exerted a reciprocal influence; thus, they are inseparable and only comprehend different facets of reality (Jay 1996). The incorporation of ecological principles into corporate strategies and practices evolved almost in tandem with studies concerning ecological issues in organisations. Hence, the schematic distinction between the practice and theorisation of corporate environmental management serves only to summarise milestones in this area of management during the last quarter of the 20^{th} century, which have been addressed previously in other chapters.

The incorporation of the natural environment into organisational decision-making had a relatively slow start. Even though some companies in the chemical industry, for instance, started as early as the 1970s (Hoffman 1999), these practices were confined to a few large organisations. They tended to be seen as a burden that should be avoided, as a result of regulatory requirements to reduce levels of air emissions and contamination of soil and water. Most of the organisational efforts in this phase tended to be directed at fighting regulations. Firms typically resisted the *command and control* type of regulation because it did not generate incentives for them to assume higher levels of environmental responsibility or to innovate technologically (see Section 4.1 in Chapter 4). During 1970-1985, companies started to change their attitude by complying with centralised regulatory measures that commanded them to internalise environmental costs – normally achieved by installing pollution-control equipment (Schot & Fischer 1993).

From 1985 to the mid-1990s, dialogue between legislators and industry resulted in business accepting some responsibility for solving environmental problems, at the same time that new regulatory mechanisms were proposed as alternatives to the command and control approach. Industry associations, in partnership with governments and other interest groups, responded to consumer and public demand for environmental protection, as well as shareholder rejection of environmental risks by instituting voluntary business codes of environmental practice. The standardisation of environmental management systems, such as the *International Organisation for Standardisation* (ISO) 14000 environmental series, constituted another type of voluntary program developed in the 1990s. Pollution prevention was the basic principle guiding these initiatives, focused on minimising or eliminating waste before it was created by production processes.

The review in Chapter 3 of the leading voluntary initiatives reached two main conclusions. First, in practical terms, the schemes represented an important step towards better environmental practices in organisations – even though, as a whole, they still have not reduced the impact of industrial activities in the natural environment (Hart 1997). Second, mainly because the most widely adopted schemes are the ones defined by private organisations; such eco-efficient practices tend to be (erroneously) associated with the concept of ecological sustainability. An obvious question relates to whether these corporate environmental management practices are conducive to ecological sustainability. Can incremental improvements of focal organisations lead modern industrial societies to sustainable patterns of production and consumption? Or are radical changes imperative if we are to achieve ecologically sustainable societies? Such questions will be readdressed in the remaining sections of this chapter.

Increasing costs of pollution control, the development of new technologies for pollution-prevention, and cost-savings from waste reduction emerged as driving forces for pro-active corporate environmental management in the mid-1990s. Ecological requirements started to be seen as an integral part of quality management principles and as potential sources of competitive advantage. Chapters 4 and 5 explored this argument and emphasised the importance of considering the influence of political economy factors in shaping the positioning of corporations towards environmental regulation. The characteristics of the institutional-power context in which organisations operate were identified as central elements fostering or inhibiting pro-active environmental strategies in corporations and a framework was proposed for its analysis.

Economic incentives for the incorporation of ecological issues into business practices also became more evident in the environmental management literature during the second half of the 1990s (for instance, see: Lovins *et al.* 1999). Finding hidden opportunities for organisations to profit from environmental strategies became an appealing theme for both business and academic communities. Coincidentally, academic and managerial publications started to proliferate after economic incentives emerged as major driving forces for corporations to adopt pro-active environmental practices. Chapter 4 debated the *double dividends* approach, as well as other additional factors influencing the *greening* of organisations suggested by the specialist literatures. The analysis revealed the dual nature of these factors. Although regulations, consumers, and competition, for instance, may be considered key determinants for the *greening* of organisations, they can also act as inhibitors of better environmental practices.

Summarising, the review of the main issues dealing with pro-active environmental management and ecological sustainability has so far lead to four main conclusions: (i)

From the 1990s onwards, pro-active environmental practices in organisations have grown substantially in industrialised countries; (ii) Although there are multiple schemes for the promotion and evaluation of pro-active environmental practices in corporations, these do not evaluate the ecological sustainability of organisations *per se*. Consequently, the concepts of eco-efficiency or pro-active environmental management cannot be equated with the concept of ecological sustainability. (iii) Factors influencing organisational *greening* can work as both promoters and inhibitors of this process; (iv) Because political economic factors represent limitations within the rationale guiding business in the search for *double dividends*, research needs to consider the context in which business-environment relationships are embedded.

These four conclusions are the reason why it is appropriate for this study to ‘import’ a particular perspective (ecological modernisation theory) from environmental sociology. Fundamentally, the emergence of pro-active environmental management practices is not an isolated phenomenon but one that emerged in conjunction with other socio-cultural developments that need to be considered in the evolution of corporate environmental strategies. The ‘contextualisation’ of organisational practices will help to understand current *modes of rationality* guiding strategies and actions within a specific organisational field (see: Orssatto 1994). Following the footsteps of the classic work of Weber (1968) in trying to explain a particular sociological phenomenon in which modern organisations are embedded, the next section unfolds the main institutional dimensions of modernity.

6.2 The Phenomenon of Modernity

Different conceptions of modernity possibly have a ‘family resemblance’ to each other, in Wittgenstein’s terms (see: Haugaard 1997:2). Similarly to the way in which the extended members of a family may resemble each other but with no single core element that can tie them all together, the use of the concept of modernity tends to mean different things to different authors. The result is a vast literature debating, among many other themes, its meaning, social and technological consequences, and its historical development. Furthermore, the use of the terms ‘modernism’ or ‘modernist’, to refer to a specific aesthetic style or period in art and architecture, has often been associated with the broad concept of ‘modernity’. In organisation studies in particular, modernism has been associated with a certain epistemological positioning in research and theorising.

These pluralities of interpretations suggest that any venture to debate modernity needs to make its analytical scope very explicit.

The concept of *modernisation* normally refers to two broad areas of enquiry. The first area relates to the epistemological connotations of the term, or the nature of the theory. In the field of organisation studies, in particular, the modernist tradition of research and theorising relates to “the instrumentalisation of people and nature through the use of scientific-technical knowledge (…) to accomplish predictable results measured by productivity and technical problem-solving” (Alvesson & Deetz 1996:194). In epistemological terms, modernist organisational studies tend to adopt a positivistic attitude towards research, and rationalism and objectivism guide organisational analysis and practice[49]. Modernist scientific thinking is a legacy of the foundational claims of the Enlightenment in which the certainty of divine law was replaced by the certainty deriving from empirical observation (Giddens 1990). Although this sense of certainty has been challenged, mainly by critical and post-modernistic approaches in organisation studies, positivistic-oriented perspectives remain the main pillars forming the *dominant social paradigm* – explored in Section 2.2 of Chapter 2. In this study, the use of the term *modernisation* does not relate to epistemological assumptions about social theory. Even though there is no guarantee that the study will not fall into modern rationalistic thinking at times, it is not the intent of the study to be modernistic.

A second possible interpretation of the term *modernisation* – the one adopted in the context of this study – relates to the fundamental characteristics of the social reality in which people in western industrialised countries live today. In simple terms, normally this is what constitutes the debate about modernity and post-modernity. In organisational and management studies, for instance, an intense theoretical debate occurred about whether a post-modern order emerged in the late 1980s. The use of concepts such as post-industrial factory (Doll & Vonderembse, 1991; Jaikumar, 1986), post-modern organisation (Clegg 1990; Drucker 1990) and post-fordist system of production (Badham & Mathews 1989) suggested that the industrial model of mass-production was becoming exhausted. Although empirical studies raised doubts about the

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49 For an overview about the debate ‘modernism versus postmodernism’ in organisation studies, see: Reed and Hughes (1992), Hassard and Parker (1993), and Clegg (1990).

tendencies toward post-modern organisational forms, (such as: Orssatto 1994), the debate continued to trigger the imagination of scholars mainly because there was no agreement about what would constitute a post-modern organisational order. Fundamentally, debate around the *modern versus post-modern* requires clear definition of the dimensions under consideration. This is one of the main reasons why this study adopts one specific interpretation of what constitutes modernity, based on the work of Anthony Giddens.

In attempting to clarify what comprises modernity, there are two main reasons why the work of Giddens represents a unique contribution. First, there is a continuum between Giddens' (1984) theory of *structuration* and his later analysis of the consequences of modernity (Giddens 1990; 1991). The elaboration of arguments on power, trust, and individual autonomy, among others, used by the author to demonstrate 'the process of structuring of social structures' (or *structuration*) was later extended to his analysis of modernity (see also: Haugaard 1997, Chapter 4). Although in *The Consequences of Modernity* Giddens (1990) introduces novel analytical concepts, they are strongly based on the constitutive elements of societies, studies of which formed the pillars of Giddens' *structuration* theory, as well as serving to analyse modernity as one specific period in the historical development of societies. When one considers that the context in which political ecology dynamics occur is configured in a similar fashion to that described in the concept of *structuration* (see: Chapter 5) the relationship becomes relevant for this study. Second, mainly because Giddens' interpretation of modernity aligns with the theoretical foundations of ecological modernisation theory, (as explored in Section 6.3,) Spaargaren and Mol (1992) suggest that his work is the leading sociological theory supporting the ecological modernisation approach, which they have used to develop empirical research. For this reason, I briefly summarise the work of Giddens on modernity in order to proceed with the introduction of the main elements of ecological modernisation theory[50].

6.2.1 Sources of Dynamism Leading to Modernity

According to Giddens (1990:i): "Modernity refers to modes of social life or organisation which emerged in Europe from about the seventeenth century onwards and which subsequently became more or less world-wide in their influence”. This process happened due to three dominant sources of dynamism: (i) the separation of time and space; (ii) the development of ‘disembedding’ mechanisms through the widespread trust in symbolic tokens and expert systems, and (iii) the reflexive appropriation of knowledge. I shall explain each one of these dynamisms. First, it is fundamental to understand that physical presence in pre-modern societies was largely connected with time. The spatial dimensions of social life for the great majority of the population were intrinsically linked to localised activities. In the feudal context of Gothic Europe, for instance, the normal conditions of existence of most vassals were determined by the rules fixed by the local landlord. Time in such context was intrinsically associated with the localised relationship with the agent who could define the *obligatory passage points* of that institutional-power context (see: Chapter 5, Section 5.2). The advent of modernity changed this situation by ‘emptying’ these places of local meaning through standardised clocks, time-zones and, generically, a tendency towards the development of more secular cultures, culminating in the emergence of a specific rationalised form of social organisation (Weber 1978). Modern organisations made possible the connection of the local with the global in a way that was unthinkable in pre-modern societies. The emergence of bureaucracies helped to disconnect social activities from the locales they were embedded in, by establishing impersonal rules to guide personal action; in Giddens’ words, they became a ‘disembedding mechanism’.

Disembedding mechanisms in the form of symbolic tokens and expert systems constitute the second source of dynamism in modernity. By symbolic tokens Giddens (1990:22) means “the media of interchange which can be ‘passed around’ without regard to the specific characteristics of individuals or groups that handle them at any particular juncture”. The best example of a symbolic token is money. With the escalating influence of financial markets in modern times, money became largely dissociated from the physical asset that made it possible. Capitalists are physically separated from the capital they control; often capital takes the form of pure information on computer screens in financial institutions (Soros 1998). Expert systems constitute the second type of disembedding mechanisms. Possibly one of the most encompassing

50 A more extensive review on this topic can be found in the work of Spaargaren and Mol (1992), Mol (1995, Chapter 2), and Spaargaren (1997).

examples of an expert system is the automobile (further explored in Part II of this study). When people use cars, they tend to neither understand the technicalities involved in manufacturing automobiles nor do they question whether the infrastructure and supply systems will work properly. There is a *taken-for-granted* assumption that these expert systems will work appropriately, ‘disembedding’ any social relation from the immediate context of experiencing ‘the use’ of these expert systems (in the example, the experience of driving a car). Trust, therefore, instead of being vested in individuals – as it would predominantly be in a pre-modern condition – is intrinsic to the abstract capacities of these disembedding mechanisms.

The third source of dynamism of modernity relates to the reflexive nature of the appropriation of knowledge. Pre-modern agrarian societies tended to limit the questioning of knowledge to the reinterpretation and reproduction of traditional rules and rituals. Conversely, in modern lifestyles, social practices are permanently being evaluated, as incoming information about those practices induces the reformation of their previous character. Furthermore, the constantly reflexive character of social practices extends to knowledge about themselves, resulting in inquiry into the nature of reflection itself. As a result, social reality is strongly influenced by knowledge of its own conditions of existence. For example, Soros (1998, Part I) explains that due to the reflexive nature of financial markets, the shared knowledge of expectations among players about potential downfalls in future share prices will eventually *transform* that expectation into factual reality. In other words, the reflexive nature of knowledge about future prices will eventually *produce* the expected reality.

The reflexive character of modernity also implies that more knowledge about social life does not necessarily increase control over the fate of human condition. On the contrary, knowledge has a destabilising effect over the social world. As anticipated by Foucault (1977), knowledge cannot be dissociated from power. The appropriation of knowledge happens in a differential fashion, since the very possibility of obtaining knowledge indicates a privileged position to transform it into power resources (Chapter 5 explored the elements involved in the circuitry of power that can further explicate such situations). In this regard, the major consequence of differential power for this study, as Part II will demonstrate, is its influence in determining specific technological trajectories of industries.

Limitations on the control of social actions also result from the mutual influence between values and knowledge. Here the concept of *social integration*, introduced in

Chapter 5, is particularly well suited to demonstrate this relationship. The symbolic sphere of an organisational field is not fixed in time, but depends on its *fixing* and *refixing* through circuits of social integration (Clegg 1989). Neither empirical knowledge nor substantive values can entirely dominate an institutional-power context. Incoming knowledge will be reinterpreted not just in an instrumentally rational fashion but will simultaneously incorporate and transform the symbolic sphere in which it is embedded. Consequently, in many instances the introduction of new knowledge will have a destabilising effect, demanding that agents constantly work towards achieving stabilisation of the circuit of social integration.

Finally, rationality inescapably ‘filters’ knowledge. The classic work of Simon (1945) about the limits of rationality serves as a departure point to explain the potential impacts of unintended consequences of social action. The basic idea presented in Simon’s study is that decisions will always be satisfactory – rather than optimum – because of the impossibility of considering all possible alternatives that might solve a specific problem. This is particularly valid for knowledge about social life. Unexpected or unintended consequences of social action happen basically because knowledge cannot encompass all circumstances in which the implementation of rules might occur. The perennial social problems that constitute subjects for sociological studies constitute a didactic example of this facet of reflexive modernity. (The differing consequences of the application of environmental regulation presented in Section 4.1 of Chapter 4 is an example of this topic). This aspect of reflexivity has a special importance when the unintended consequence of human action is extended to technology. The work, of Ulrich Beck (1992a; 1992b) and the mainstream critique of the theory of ecological modernisation constitute the quintessential theoretical exploration of this direction. For this reason, Section 6.3 devotes special attention to this theoretical perspective.

The separation of time and space, the development of disembedding mechanisms, and the reflexivity of knowledge constitute facilitating conditions for the historical transition form pre-modernity to modern times. They were fundamental dynamics influencing the development of four main institutional clusters that would eventually characterise this specific period in the human history.

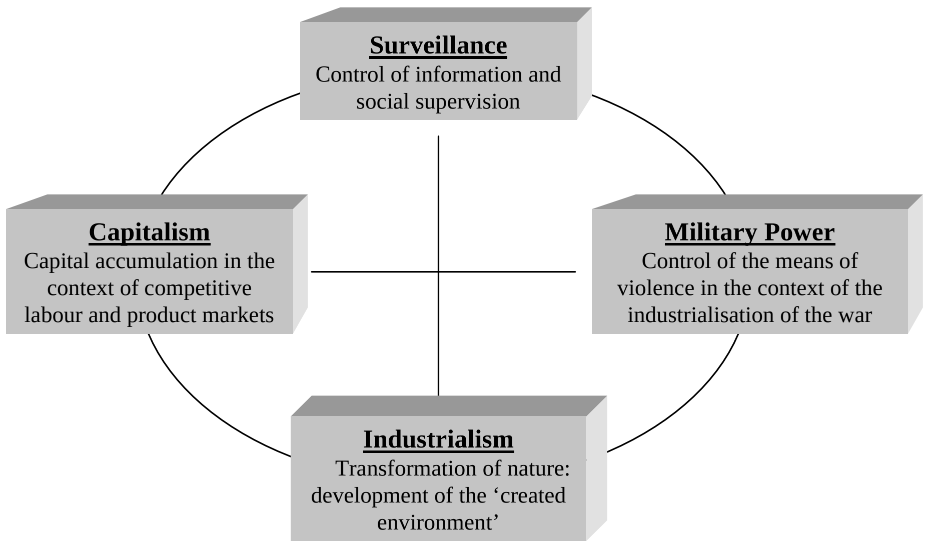
6.2.2 Institutional Dimensions of Modernity

Social theories have long debated capitalism and industrialism as the singular nexus of modern societies (Spaargaren 1997). Marx’s analysis of modernity is possibly the foremost example of a theory that explains modernity by focusing on capitalist relations; thus the Marxist legacy assumed modern institutions were essentially capitalistic ones. Industrial and post-industrial theories did not share this understanding but instead saw industrialism as the key feature of modern institutions (see: Badham 1984). In Giddens' (1990) opinion, this debate was deluded because both capitalism and industrialism could be analysed as distinct clusters that encompassed modernity. Even though capitalistic relations facilitated the emergence of industrial organisations, industrialism did not comprise a sub-type of capitalism. Rather, it was the fundamental technical feature of industrialism that defined it: "the use of inanimate sources of material power in the production of goods, coupled to the central role of machinery in the production process" (Giddens 1990:55-6). This view explains how industrialism could occur in political systems that were not based on capitalist principles, as industrialisation in the ex-USSR and China demonstrate.

Capitalism might relate to industrialisation processes required for the production of commodities but the relation between private ownership of capital and 'property-less' wage labour is a feature of capitalism that allows it to be exercised independently from industrialism. What makes industrialism attractive to capitalist enterprises is the sheer technical efficiency of manufacturing systems and the consequent cost reductions with their use. The expansionist nature of the capitalist enterprise and the constant search for lower costs of production has the ultimate capacity to foster technological innovation. The result of this interdependence is the creation of a self-reinforcing system between capitalism and industrialism. This interdependence, however, should not be confounded with the dominance of one over the other; as Giddens proposed, they constitute two distinct institutional dimensions of the broader phenomenon of modernity.

The evolution of capitalism and industrialism was accompanied by the development of a political form that became a central feature of modern times: the nation-state. The coordination of a delimited territorial cluster of organisations required new forms of surveillance that did not occur in pre-modern times. The capacities of states to indirectly supervise the activities of subject populations through the control of information – the third dimension of modernity in Figure 6.1 – represents a development well beyond the localised type of control exerted in traditional civilisations. Similarly, *military power* was also present in agrarian civilisations, such as the Aztec and Inca Empires on the American continent (see: Willianson 1992) or the city-states of medieval Europe – but permanent disputes of power among political centres produced constant struggles to secure the monopoly of military support[51]. The advent of nation-states fundamentally changed this situation by securing a monopoly over the legitimate means of political violence, making it possible for the emergence of an 'industrialisation of war' (the fourth dimension of modernity in Figure 6.1). The advent of the two World Wars in the 20th century represents the tragic expression of this interdependence between industrialism and the monopoly of military power.

Figure 6.1: The Institutional Dimensions of Modernity



Source: Giddens (1990:59)

The four dimensions of modernity are used by Giddens to deny the claims that western industrialised societies are currently entering a post-modern order. Instead, the inherently *globalising* tendency of modernity tends to propel these societies to times of *high* or *radicalised* modernity. The time-space distanciation of modern times – one of the three dynamics that facilitated the emergence of modernity, discussed previously – allows the intensification of social relations, linking distant regions of the world in such a way that local events are shaped by circumstances occurring in foreign locales. This phenomenon of globalisation has expanded the four dimensions of modernity from the

51 In the case of the Aztec and Inca civilisations, the success of the two 'conquerors' - Hernan Cortêz and Francisco Pizarro - was partially possible because they strategically explored the internal disputes for the monopoly of power in their favour (see: Skidmore & Smith 1992).

West to other parts of the world, intensifying the dominance of modern institutional clusters over other societies. In such an understanding, the emergence of Asian countries as powerful competitors in global markets does not represent the decline of Western institutions over the rest of the world but rather the opposite: it is a result of their success and consequent global spread (Giddens 1990).

The phenomenon of globalisation has profound social and environmental impacts. Today, the division of labour is not confined to tasks performed on shop floors of manufacturing facilities but extends itself to the regional specialisation of production, resulting in tremendous inequalities in income per-capita of different countries[52]. The competitive advantage of a nation is secured by the move from commodity-oriented to knowledge-intensive economies (Porter 1990) – an imperative difficult to accomplish by those ex-colonies that relatively recently emerged as nation-states. Environmental disruptions caused by the expansionist character of industrial organisations are even more conspicuous. Apart from the widely documented environmental impact on soil, air and water (see, for instance: Brown 2000), the diffusion of industrialism generated ecological risks such as ozone depletion and global warming that have the potential indiscriminately to affect people, independently of their economic or political status (Beck 1992b).

If current levels of environmental disruption are outcomes of historic dynamics, what are the possibilities of solving such crises? Is it necessary to transcend modernity to break this process? What possibility is there of transcending the institutional dimensions of modernity? In order to answer these questions, it is necessary first to make a clear distinction between history and historicity. History has no intrinsic form and no overall teleology and many 'histories' can be written about the same phenomenon[53]. Historicity, on the other hand, means the use of knowledge about the past as a means of breaking with it and envisioning the future. According to Giddens (1990), one of the greatest mistakes of the historical materialism of Marx was to associate one with the other, giving an incorrect unity to historical developments. Moreover, the reflexivity of knowledge was not recognised as a quality of modernity

52 Today, 20% of the world population owns approximately 83% of the total world Gross Domestic Product (UNDP 1992).

53 The (epistemologically post-modernistic) storytelling perspective in organisational studies consists of an example of this understanding (see: Boje 1991).

that could be used for its own reformation. The circularity of knowledge will never eliminate the ‘unintended consequences of modernity’ but elements of nature, for instance, via the technological components of expert systems, can be incorporated. Industrialism – as a specific modern organisational cluster – thus can be substantially reformed on the basis of the ‘emancipation’ of ecology.

6.3 Ecological Modernisation Theory

Industrialism is considered the central dimension to the restructuring of current systems of production and consumption by a theoretical approach that emerged from the debate (within environmental sociology) about the institutional changes necessary for overcoming ecological crises. Ecological modernisation theory assumes that the current destruction of natural ecosystems is a result of design faults in modernity that could be reformed by further extension of the use of that reflexive knowledge that characterises modern thinking. Many authors contributed to the development of the theory during the last two decades of the 20th century[54] but its foundations were established in Germany through the work of Joseph Huber. The personal experience of Huber as an active environmentalist strongly influenced his conviction that the pathway towards *hyper-modernity* and industrialisation is not only inevitable but *should* also be considered as a desirable strategy to overcome the current environmental crisis (Mol 1995).

The historical role of social movements, economic agents, and technology as promoters of change towards more ecologically sound societies is central in Huber’s proposal of ecological modernisation. In his understanding, the importance of social movements as collective actors promoting social changes has declined substantially in the last decades of the 20th century. Economic actors – especially business organisations – have become central for the promotion of environmental reforms. Limited economic feasibility and poor political support, among other factors, have significantly reduced the scope of *de-industrialisation* initiatives in restraining ecological deterioration (Mol 1995). Leading environmental groups have also shifted their strategies from ideological radicalism focusing on confrontation, to more solutions-oriented courses of action (Hajer 1996). A clear example of this shift is provided by the most widely well-known environmental organisation in the world, *Greenpeace*. After 25 years of radical activism

Greenpeace has moved from a strategy of pure confrontation to one of cooperation with business. In an interview for *Time Magazine* in 1996 (Jackson 1996:73), the newly hired International Executive Director Thilo Bode emphasised that:

> We must reaffirm *Greenpeace* as an important international environmental pressure group providing a counterbalance to purely commercial interests of society. We are not going to stop the industrialisation process, not should we. Our best hope is to guide it onto the tracks of hyper-efficiency and environmental friendliness so as not to repeat the mistakes of the West. In so doing, we may create an engine that can drive the rest of the world forward. Our challenge is to get this message across while inspiring people, not turning them off.

Over the last quarter of the 20th century, *Greenpeace* has been a central agency promoting public awareness and changes in organisational practice. Realignment of its course of action has the potential to influence changes in the circuits of political ecology involving other activist environmental organisations (see Chapter 5). The acceptance of incremental strategies for the incorporation of ecological principles into commercial activities – rather than their negation – by organisations such as *Greenpeace* endorses the role of industrialism as the motor for environmental restructuring. While environmental activism continues to be part of the mission of non-governmental organisations (NGOs) direct negotiation and collaboration have increasingly become ideologically acceptable and empirically practised organisation. The emergence of this new ideology guiding the political strategy of non-governmental environmental organisations was central to Huber's understanding of ecological modernisation. He saw it as a phenomenon driven by a new ideological positioning in times of *reflexive modernity* (see: Beck 1998) rather than a political program based purely on hypothetical assumptions.

In the 1990s, the work of the Dutch sociologists Geert Spaargaren and Arthur Mol substantiated Huber's propositions concerning ecological modernisation by connecting them with Giddens (1990; 1991) studies on modernity (see: Mol & Spaargaren 1993; Mol 1995; Spaargaren 1997; Spaargaren & Mol 1992). In their work the conjunction of these two theoretical perspectives represented an important contribution to the 'historicity' of ecological modernisation theory as well as to its refinement as a theory of social change. From this perspective, within the institutional dimensions of modernity, there are indications that current modes of production and consumption have

54 Martin Jänike, Volken von Prittwitz, Udo Simonis and Klaus Zimmermann (Germany), Geert Spaargaren, Maarten Hajer, and Arthur Mol (The Netherlands), and Albert Weale (Great Britain).

increasingly been redesigned according to ecological principles, redirecting the path of the modern industrial phenomenon; hence, ecological modernisation.

The proponents of this perspective believe that the sheer efficiency of modern systems of production could be significantly improved by using rational knowledge in a reflexive fashion. Weizsäcker *et al.* (1997), for instance, proposed that in many industrial sectors it was possible to double wealth at the same time that the use of resources could be halved – in mathematics terms, a factor of four. Because these achievements would be based on the incorporation of ecological principles, such as resource efficiency and de-materialisation, into current industrial practices, they would represent processes of ecological modernisation.

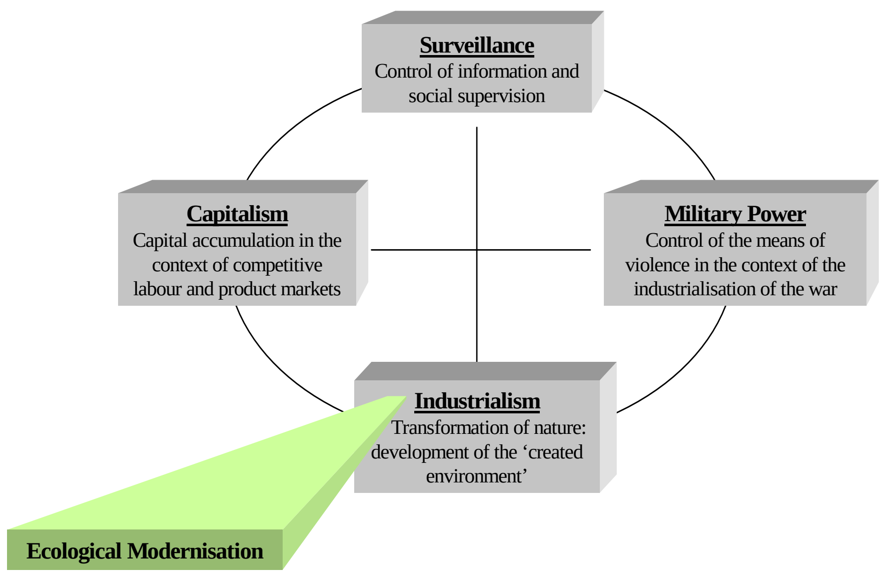
The main justification for focusing ecological modernisation on industrialism is due to the realisation that, in times of late modernity, even though nation states are the principal actors within the global political order, corporations are the dominant agents within the world economy. Today, many industrial organisations have bigger budgets than nations and substantial capacities to influence the policies of these nations (see Section 5.1 in Chapter 5). In physical terms, transforming nature (minerals, forests, etc.) into manufactured products is the very core of industrial activity, and industrial organisations constitute the means by which the development of the 'created environment' has been possible. Yet, consideration of industrialism as the focus of ecological modernisation theory does not deny the importance of powerful agencies operating outside the realms of industry. It is possible that industrial organisations do not retain the differential powers necessary for the *greening* of industry. But, whoever the main agencies are, industrial organisations constitute the *obligatory passage points* that transform nature into the artefacts characterising the lifestyles of affluent societies.

To say that industrialism is the main dimension of ecological modernisation theory does not negate the importance of the three other institutional clusters proposed by Giddens (1990). As has been stated, industrialism, capitalism, surveillance, and military power constitute institutional clusters that evolved in tandem, eventually characterising modernity. The interplay between global capitalism and industrialism has created intricate dependencies between the stability of financial markets, the depletion of natural resources and social equity, suggesting the limited importance of industrial organisations to solving environmental crisis.

Korten (1997) goes as far as to suggest that world power resides with global financial markets rather than corporations or nation states. Intrinsically agreeing with

Korten is the renowned funds manager and philanthropist, George Soros (1998), who points out the incapacity of current governments to harness the freedom of capitalist transactions and their unintended (or undesired) social and environmental consequences. In the light of such arguments, this study assumes industrialism to be the institutional dimension within which ecological modernisation theory concentrates its attention (See: Figure 1). But it also suggests the use of the political ecology framework for the identification of the rules defining *social integration* that may be more directly related to the other institutional clusters of modernity.

Figure 6.2: Modernity and Ecological Modernisation



The identification of the four institutional dimensions of modernity supplies ecological modernisation theory with broad building blocks for analytic-descriptive use. By employing these theoretical concepts, the historical developments that resulted in a specific social reality – such as modernity – can be described. Giddens' (1990) use of the four dimensions to explain why we are entering a period of radicalised modernity, instead of a post-modern order, is an exemplar in this respect. Adopted as analytical tools, the four dimensions become the foundational *analytic-descriptive* components of the ecological modernisation theory. Conversely, a *normative* perspective would emphasise the development of the theory of ecological modernisation as a mean for the achievement of chosen reality.

6.3.1 Ecological Modernisation as an Analytic-Descriptive Framework

The ideology influencing conservationist organisations and environmental activist groups during the 1970s and early 1980s was characterised by radical revision of some theoretical approaches, predominant in social sciences during that period. Perspectives such as those derived from the counter-culture, with its opposition to productivity, as well as neo-Marxist and post-industrial society theses, dominated the intellectual context of environmental sociology until the emergence of theories of ecological modernisation. Mol (1995) and Spaargaren (1997) present a comprehensive review of these perspectives. In doing so they explain why ecological modernisation, as a theory of social change, represented an important step towards the acceptance of incremental perspectives inducing social and environmental changes, rather than the radical ones proposed by existing approaches. More closely related to the emerging field of *organisation & environment*, Section 2.2 in Chapter 2 briefly described some of the approaches that have been inspired by the long tradition of radical ecological thinking in social sciences. These are encompassed within the 'radical environmental paradigm', such as deep ecology, eco-feminism and spiritual ecology. Although the fundamentals guiding most of these theories differ substantially from each other, they tend to negate the possibility of correcting the design faults of industrial systems without either partially or totally dismantling it. In other words, an historic revision – and reversion – had commonly been proposed previously as the only way out of ecological crisis.

The emergence of ecological modernisation theory represents a rupture with that radical line of thinking. By providing an explanation for the historic phenomenon of the 'emancipation of ecology' from the economic sphere, the ecological modernisation theory becomes a social theory that (claims to) provide a coherent set of concepts and ideas for analysing the way modern society reacts on and tries to cope with one of its most serious contemporary problems: the ecological crisis (Mol 1995). The 'emancipation of ecology' in this context refers to the process of incorporating ecological principles into the type of rationality that guides economic actions – called by Weber 'instrumental or practical' (see: Kalberg 1980). According to an ecological modernist analysis, this process is happening to such an extension that an ecologically oriented rationality would 'emancipate' itself from the economic sphere. In generic terms, the analysis of the process of emancipating ecology encompasses the analytical scope of ecological modernisation theory.

One of the first attempts to use ecological modernisation theory to guide the empirical analysis of a specific industrial sector was made by Mol (1995). Six *sensitising hypothesis* were used to summarise the processes of emancipation of the ecology in industrialised societies. Mol used the hypotheses to evaluate both the explanatory and predictive capacities of ecological modernisation theory[55]. The hypotheses were used to indicate the usefulness of ecological modernisation theory when confronted with other social theories, such as neo-Marxism and de-industrialisation theories. Thus, the hypotheses were not proposed as statements to be falsified or confirmed on the basis of empirical evidence but rather as sensitising theorems that inform one about phenomena occurring in modern industrialised societies[56]. In other words, the hypotheses 'sensitise' one to observed phenomena and trends that, allegedly, are best described by ecological modernisation theory. The considerable capacity of the sensitising hypotheses to summarise the phenomenon of ecological modernisation justifies their literal quotation here. According to Mol (1995:58):

> 1. The design, performance and evaluation of processes of production and consumption are increasingly based on ecological criteria;
> 2. Modern science and technology play a pivotal role in these ecology-induced transformations, which are no longer limited to the introduction of add-on technologies or process-integrated adaptation, but includes changes in product chains, technical systems and economic sectors/clusters;
> 3. Private economic actors and economic and market mechanisms play an increasingly important role in the process of ecological restructuring, while the role of the state agencies changes from bureaucratic, top-down *dirigism* to 'negotiated rulemaking' and the creation of favourable conditions for such transformation processes;
> 4. Environmental NGO's change their ideology, and expand their traditional strategy of keeping the environment on the public and political agendas towards participation in direct negotiations with economic agents and state representatives close to the centre of the decision-making process, and the development of concrete proposals for environmental reform;
> 5. This process of ecological restructuring is becoming increasingly interdependent with processes of globalisation in the political and economic dimension and will therefore not remain confined to one nation-state;
> 6. Alternative de-industrialisation initiatives for limiting ecological deterioration are applied only to a marginal extent due to limited economic feasibility and poor ideological and political support.

55 See Appendix 2 in Mol (1995) for an epistemological account of the use of *sensitising hypotheses*.

56 From a positivistic point of view, one could say that the *sensitising hypothesis* constitute assumptions about reality, since they do not state relationships between empirical variables.

In case researchers are able to transform these *sensitising hypotheses* into (positivistic-oriented) hypotheses that state relationships between empirical variables, they could potentially be tested empirically. Although the amount of data required for such task would be enormous, one can expect that, ‘technically’, it would be a feasible task. Nonetheless, considering the stage of development of the ecological modernisation theory, testing hypotheses does not seem to be as crucial as advancing studies (and hypotheses) that use the same ideas and concepts but focus on different industrial sectors or countries (Mol 1995). In its use as an analytic-descriptive framework, ecological modernisation theory requires additional ‘refinement’ before the identification of tendencies in specific societal contexts can be tested from a nomothetic methodological perspective (see: Burrell 1996). Thus, in order to research the phenomena of ecological modernisation one might (i) develop research questions or sensitising hypothesis similar to those developed in previous studies but directed to other contexts – in this case, industrial sectors – and (ii), design an analytical framework based on the collection of empirical data. Such a research frame could then serve as a guidepost for the future development of hypotheses and consequent test of the interdependencies between factors, as well as develop qualitative studies of the organisational field in which the factors are embedded (see: Chapter 5).

The general enquiry of research based on sensitising hypotheses also relates to the evaluation of the nature and degree of ecological modernisation phenomena in distinct industrial settings. Considering that the main purpose of the hypotheses is to ‘sensitise’ one to the occurrence of the phenomenon of ecological modernisation in a specific context they could be used as guideposts for elaborating research questions. For example, among the questions that be drawn from each one of the six sensitising hypothesis proposed by Mol (1995) are the following:

- What types of environmental innovations have competitors within an industry carried out?
- Are environmental innovations based on add-on technologies or are they based on the radical redesign of products and processes?
- Is an industry challenging its own paradigm of production and consumption through environmental strategies and practices?
- What types of regulatory measurers guide an industry? Are the ‘circuits of political ecology’ favouring environmental innovation in such a context?

- What role do interest groups, such as environmental NGO's (non-governmental organisations), consumers, employees, local communities, and various other stakeholders, play in the process of ecological modernisation of an industry?
- How does the globalisation of corporate activities affect ecological modernisation?

Empirical research addressing these questions should result in a crucial bridge being built between the organisational and societal levels of analysis, enhancing the chances of success of the use of theory as a practical political programme.

6.3.2 Ecological Modernisation as a Political and Ideological Programme

Ecological modernisation theory as a political and ideological programme starts from the proposition that the *emancipation of the ecology* – summarised by the sensitising hypotheses – not only reflects an historical phenomenon in industrialised societies but it is also a viable, indeed desirable, alternative for confronting ecological crisis. According to ecological modernists, a further modernisation of existing institutions of modern society is essential (Spaargaren 1997). Although substantial theoretical developments have been made in the last two decades, the interpretation that ecological modernisation is the only viable way out of ecological crises had its origins in the personal experiences of Joseph Huber in Germany. Interestingly, Huber's early work was ideologically aligned with counter-cultural anti-productivity or de-modernisation perspectives. During the 1970s, he worked with a network organisation stimulating and supporting small-scale projects (*Netzwerk Selbsthilfe Berlin*). Instead of creating a stronger adherence to radical ideological theories, Huber's experience with the programme was such that a 'paradigmatic shift' could be discerned in his subsequent work. The small-scale alternative type of organisations involved in the network tended to perform poorly in both economic and environmental spheres. In the context of 1970s West Berlin the organisations involved in the project lacked economic resources, resulting in the utilisation of outdated, polluting technologies. The desirable goals of environmentally sound firms differed greatly from the real outcomes generated by those organisations.

Obviously, the politico-ideological programme of ecological modernisation cannot be reduced to Huber's personal experience. Ecological modernisation as a socio-political programme broadly refers to the developments in the field of environmental policies and politics of some Western European countries in the 1970s and 1980s

(Spaargaren 1997). Nonetheless, Huber's experiences are useful in directing attention to the pragmatic difficulties of radical attempts to shift paradigms of production and consumption at the organisational level. 'Alternative' organisations, such as local cooperatives, need to deal with the rules that govern and eventually favour the entrenched position of other economic activities. Normally, newly established organisations also tend to lack the necessary managerial expertise and financial endurance required for their development[57], which are fundamental for their economic survival in the long term. More broadly, even though one might be sympathetic to the move towards an imaginary society based on ecological values, such as proposed by *deep ecologists* (see: Chapter 2), this transition would still require some sort of management. It would be necessary to find solutions to the eventual socio-economic effects of phasing out potential undesired industrial activities, such as those directly dependent on fossil fuels. This is the main reason why ecological modernists consider the inclusion of modern institutions an intrinsic, inevitable element in the solution of the current environmental crisis. This kind of strategy, by its very nature, is based on *incrementalism* – a central characteristic of ecological modernisation theory.

The incremental nature of ecological modernisation suggests a trajectory for industrialised societies based on current trends, such as the ones analysed in the previous section. The normative character of theory refers to the 'extrapolation' of the current movement towards the emancipation of the ecology from the economic and technological spheres. According to Cohen (1997), the design of four key strategies are suggested by ecological modernists for the intensification of this ongoing process: (i) organisational internalisation of ecological responsibility, (ii) the implementation of anticipatory planning practices – or the *precautionary principle*, (iii) the implementation of strict governmental regulation, and (iv) the switch to the use of cleaner technologies through the process of *hyper-industrialisation*. In fact, the concept of hyper-industrialisation encompasses an ecological modernisation trajectory substantiated by the other strategies. From an ecological modernist perspective, substantial efforts should be made to incorporate ecology into industrialism in order to achieve the highest possible levels of technical efficiency. Following the line of

57 In fact, this is the main logic driving governments worldwide to subsidise 'industrial incubators' and support new enterprises in the early stages of development.

proposals such as those of Weizsäcker *et al.* (1997) and Lovins *et al.* (1999), for instance, *dematerialisation* strategies would make it possible incrementally to ‘produce more with less’. The adoption of these strategies on a large scale would represent feasible processes of environmental reform that could reverse burdening the sustenance base of modern societies (Simonis 1989).

In essence, the underling assumption of ecological modernisation is that human ingenuity will be able to harmonise economic advancement with environmental improvement. There is an undeniably optimistic ‘faith’ in the possibility of moving towards hyper-industrialised societies by incorporating the natural environment into the re-design of modern institutions. Even though this might be a feasible strategy, at this stage it is impossible to know whether the unintended consequences of social design would countervail the achievements of an ecologically modern society (Beck 1997). Indeed, this is just one of many possible criticisms directed at ecological modernisation theory. Some fundamental issues about the nature of scientific rationality and the possibilities of controlling social and natural environmental still need to be addressed by this social theory.

6.3.3 Another Technocentric, Neo-Liberal, Conformist Ideology?

> Is ecological modernisation ‘mercantilism with a *green* twist’? Has it led to a new form of ‘state-managerialism’? Does ecological modernisation produce a break with previous discourses on technology and nature, or is it precisely the extension of the established technology-led social project? Or should the ‘ecological question’ be understood as the successor of the ‘social question’, and ecological modernisation as the new manifestation of progressive politics in the era of the ‘risk society’?

The questions posed by Hajer (1996:250) suggest the scope of criticisms directed at ecological modernisation theory. Primarily, the broad spectrum of the theory allows space for its interpretation as another neo-liberal ideology in the environmental front. Placing industrialism as the main dimension to be considered in the process of ecological restructuring implies that capitalistic transactions do not necessarily need to be overthrown to make more sustainable systems of production and consumption possible. *Win-win* situations or the *double dividend* discourse gains ground in such a perspective, since there is no direct threat to institutions that support political systems based on capitalist transactions. In this view, environmentalism is not a risk for capitalism. Not surprisingly, this assumption is in diametrical opposition with perspectives that consider capitalism the major cause of the current environmental crisis – the continuous burdening of the sustenance base of the planet.

The proposition of ecological modernisation theory as a viable solution to ecological crisis remains problematic for those who see the expansionist character of capitalism as the main cause of environmental degradation. Hajer (1996:255) points out that "eco-software will not save the planet if capitalist expansion remains the name of the game." Although this section does not intend to defend the ecological modernisation theory from such criticisms, which are more ideological than useful, the distinction between industrialism and capitalism made in previous sections can be used to question the understanding that environmental degradation is an immanent feature of capitalism. According to the main ideas presented in Section 6.3, rather than assuming the expansionist character of capitalist societies as the main cause of environmental degradation, ecological modernists locate the problem in the paradigm guiding the design of systems of production and consumption, independently of the political systems in which they are established. Nonetheless, this argument is still controversial and further analysis of the interdependencies between capitalism and industrialism is required. Furthermore, if ecological modernisation is to become a normative theory, it is crucial to use its analysis of these interdependencies to elaborate schemes that can attack the sources of environmental degradation generated in both capitalistic *and* socialist political systems.

Within the realms of environmental sociology, the three schools of thought that are in opposition to the line of thinking adopted by ecological modernisation theory are neo-Marxist theories, counter productivity and de-modernisation theories, and theories of post-industrial society. These social theories offer alternative explanations for environment-induced social change. Since comprehensive analyses of the main presuppositions of these theories and their explanatory power as alternatives social theories has been developed elsewhere (see, for instance: Badham 1984; Spaargaren 1993, 1997; Mol 1995), the critique presented in this section is based on a different assessment. By enquiring into the nature of reflexivity, the analysis concentrates on whether ecological modernisation theory represents a conformist, conservative movement or a new phase of progressive politics.

In the opinion of Mol (1995:394), "the theory of ecological modernisation seems to diverge somewhat from the notion of reflexivity (…) the theory seems to ignore the institutionalisation of doubt, the disenchantment of science and the endangering characteristics of modern science and technology". The strong reliance on rationality guiding the ever-increasing role of science and technology might persuade one to conclude that ecological modernisation theory is just another *conformist* strategy. The basic idea of the Enlightenment, that there is a steering role for a guiding science, might not seem sufficiently challenged. By proposing that environmental restoration be implemented by governments and corporations, ecological modernists implicitly seem to assume the possibility of controlling the environment in the same fashion of the positivist tradition in natural sciences, using this control to produce normative measures (see: Section 2.2 in Chapter 2). Yet, as discussed previously in this chapter, the reflexive nature of the appropriation of knowledge in modern times implies that more information does not necessarily bring more control over social systems. On the contrary, it can have a destabilising effect. The nature of the environmental debate is thus an expression of this dynamic character of modernity. Seen as 'cultural politics' (Hajer 1996), ecological modernisation implies that political discourses are hidden in the constructs that define what the environmental problem is. Moreover, limitations in the potential control of social systems can also be observed in the unintended consequences when regulatory measures are applied (see, for instance, Section 4.1 in Chapter 4). In sum, the degree to which the generic notions of environmental restoration are based on positivistic assumptions might undermine the potential of ecological modernisation theory to be recognised as a social theory with strong foundations.

The limited nature of *reflective* speculation on the reflexive character of ecological modernisation theory makes the work of Ulrich Beck (1992a) especially appropriate for its critical analysis. In simple terms, Beck sees societies in times of high or reflexive modernity as being organised around the negative process of distributing ecological risks; therefore, they are to be seen as a *risk society*. The secularisation and high degree of industrialisation achieved by countries such as Germany, Sweden, and Japan transforms insecurity about natural forces, such as epidemics or floods, to the fear of environmental catastrophes generated by human-made technological systems. Modernisation in these terms means the increase of unintended consequences generated by expert systems. In Beck's understanding, accidents such as Bhopal, Valdez (see: Chapter 3), and the disaster in the Russian nuclear power plant of Chernobyl, are expressions of the high consequence risks of industrial societies, causing a permanent (and justified) sense of insecurity in lay citizens. One of the very foundations of the emergence of modernity – trust in *expert systems* (see: Section 6.2) – is now placed in jeopardy by the confrontation of these systems with their side effects (Beck 1992a; 1992b).

The risk society perspective takes a sceptical view of the contribution of modern science and technology to bringing about the ecological switchover proposed by ecological modernists. In this respect, “the risk society perspective seems to contradict in a fundamental way the perspective of ecological modernisation” (Mol & Spaargaren 1993:439). Such a contradiction relates to the levels of questioning about the types of technology that translate into apparatuses powering industrial societies. It is not the knowledge about chemical elements or atomic physics that increases the chances of exposure to acid contamination or radioactivity. Rather, it is the use of this knowledge, based on a specific paradigm of production, which will generate the high consequence risks referred to by Beck (1992a). Nuclear technology, in itself, does not constitute a problem. Radiation can be used beneficially in the treatment of cancer. Therefore, the use of atomic energy to generate electricity is not a problem intrinsic to the rational scientific thinking but a political matter about sources of electricity generation. This example also illustrates that the degree to which the theories of risk society and ecological modernisation oppose each other depends on the nature of enquiry about the scientific and technological basis upon which industrialism is constructed.

The way in which reflexivity is envisioned also has the potential to transform risk society and ecological modernisation as complementary theories. Mol (1995:395) understands that there is an opportunity for some kind of ‘specialisation’ of the theories:

> The notion of reflexivity as articulated in risk society theory is especially fruitful for the analysis of high-consequence and low probability ecological risks, whereas the main frame of reference of ecological modernisation includes ‘normal’ environmental problems such as water pollution, chemical waste and acidification.

Indirectly, Ulrich Beck substantiates this proposition in more recent work. In *The Reinvention of Politics,* Beck (1997) assumes a normative approach similar to the political programme proposed by ecological modernists. By proposing a new model of politics for modern times, Beck goes beyond the identification of immanent problems of industrialism, recognising the need for theoretical frameworks that can help to promote social and environmental change. Beck emphasises that reflexive modernity is the period of the ‘*And’* – the time in which more criticism, more reflection, and more alternatives can be the key for more ecologically sound societies. Perhaps, the combination of concepts of ecological modernisation *and* risk society theories might be an appropriate strategy for tackling the environmental challenge faced in times of high modernity.

The possibility (and the need) of combining other theoretical perspectives is also what makes ecological modernisation theory an easy target for criticism. Ecological modernisation theory satisfies the definition of "a statement or a set of statements designed to explain a phenomenon or a class of phenomena" (*American Heritage Dictionary*). However, its all-encompassing set of definitions allows it to be identified with disciplines that do not always reflect the pre-requisites of ecological modernisation, such as, for instance, 'design for the environment' in manufacturing, and economic incentives that promote environmental innovation and eco-labelling, among other environmental-oriented practices (see: Chapter 3). These strategies are indeed part of the overall process of ecological modernisation. In isolation, however, they do not represent more than intrinsic constitutive techniques that might lead organisations to develop eco-efficient practices. They cannot be equated with ecological modernisation. Rather, eco-efficient tools and techniques can only be associated with ecological modernisation when a *sociological phenomenon* is identified. In fact, the evaluation of the extent to which this phenomenon is occurring in industrialised countries is exactly what justifies the need of more empirical research in this field. Consistent and programmatic research could help ecological modernists to sharpen the definitions of ecological modernisation processes at the three levels of organisations, industries, and national or supra-national societies. Through the identification of determinants and indicators of ecological modernisation of specific industrial sectors, the normative character of the theory can be 'refined', to include not only the analytical basis that supports the political programme, but also instruments for public debate and scrutiny. A more precise set of definitions and indicators would also avoid the theory being equated with isolated practices of environmental management that do not represent the complex character of the phenomenon of ecological modernisation.

Finally, one can question whether the political programme prescribed by ecological modernists is conducive to ecological sustainability. Mainly because 'sustainability' is an ill-defined concept, this is an issue that will remain open for some time. Conversely, if no claims can be made about the potential success of ecological modernisation programs, there is no fundamental principle or theoretical argument making the proposed strategies antithetical to ecological sustainability. While academic and political debate about the meaning of ecological sustainability or sustainable development proceeds, a more pragmatic set of issues related to the limited character or reflexivity need to be addressed by ecological modernists. How can the reflective awareness of the possibilities of ecological modernisation be increased? How can ecological modernisation become sufficiently open in order to examine the fundamental principles guiding its own the definition of problems and programmatic strategies? In other words, how can ecological modernisation question its own paradigmatic assumptions? What are the mechanisms for the realignment of relationships between nature, technology and society, the creation of alternative routes, and implementation of strategies based on *utopian realistic* visions of sustainable industrial development?

6.4 Conclusion

This chapter explored how the broad concept of ‘the *greening* of organisations’ constitutes an extension of the same historical continuum that ‘produced’ modernity and, consequently, cannot be dissociated from it. Within the domain of industrialism, pro-active environmental management practices in organisations are part of the phenomenon characterising the ‘emancipation’ of ecology from the economic and technological spheres. Section 6.1 showed that significant improvements have been achieved in corporate environmental management. Ecologically efficient practices have gradually became imperatives for a multitude of corporations in highly industrialised societies. Although some representatives of the business community (as well as in select areas of the specialist literature) have assumed that these eco-efficient organisational practices are conducive to ecological sustainable industries and societies, there is no scientific evidence supporting this postulate. The difficulties in assessing the ecological sustainability of organisations, previously explored in Chapter 3, suggest that it is not only methodological elements that limit the achievement of indicators of sustainability but also that the issues encompass fundamental philosophical concerns, such as human and animal rights. For this reason, rather than questioning whether pro-active environmental practices in corporations are ecologically sustainable, the chapter focused on the interpretation of these practices as an emergent, empirical, sociological phenomenon.

Section 6.2 showed that pro-active environmental practices in organisations constitute part of a broader phenomenon under which some sectors or industrial societies have been immersed in the last quarter of the 20th century: the move towards a *high* or *radicalised* modernity (Beck 1997; Giddens 1990). In order to understand the fundamentals of this movement, the dominant sources of dynamism of modernity were introduced. The separation of time and space, the development of ‘disembedding’ mechanisms, and the reflexive appropriation of knowledge were presented as the dynamics that facilitated the emergence of four main institutional clusters, eventually characterising modernity as a singular moment in history. The emergence of these four dimensions – capitalism, industrialism, the nation state, and the monopoly of military power – were introduced as an ongoing process that seems increasingly to influence the design of political systems around the globe. The *globalising* nature of modernity was used to explain why a tendency towards the radicalisation of modernity is the main phenomenon characterising contemporary industrialised societies. Globalisation, in these terms, can be seen as the continuous expansion of the modern institutional clusters – the separation of time and space, the use of disembedding mechanisms, and the reflexive appropriation of knowledge – to an ever-increasing number of societies around the globe.

The same dynamics that make the phenomenon of globalisation possible may explain recent developments in the area of environmental management in organisations. The increasing adoption of ecologically efficient practices by firms can be interpreted as a phenomenon that results from the extension of reflexive thinking to business-environment relationships. This is not to say that corporations are adopting pro-active environmental strategies simply because they realise they should re-examine their ethical behaviour towards the natural environment. As has been explored in previous chapters, a myriad of factors influence corporations to adopt environmentally sound technologies, and one cannot be so naive as to expect significant changes in organisational behaviour will be based solely on the realisation that corporations should reduce the impact they cause to natural ecosystems. Nonetheless, the very consideration of potential economic and social benefits resulting from environmental investments can be interpreted as an increasing tendency towards reflexive modernisation in the context of business-environment relationships.

The process of emancipating the ecology from the economic and technological spheres is a result, rather than a cause, of the reflexive appropriation of knowledge in the front of corporate environmental management. Future scenarios of *zero emissions* organisations (Pauli 1998) have substantially affected the definition of corporate environmental strategies. In this respect, pro-active environmental management can be seem as a response to stakeholders' future expectations of performance (even though this is an issue that is not easy to verify scientifically, since it depends on how business people make sense of their own decisions). This phenomenon has been more remarkable in the domains of industrialism; industrial practices of highly industrialised countries have increasingly been based on ecological principles. Section 6.3 presented the social theory that was developed around this sociological phenomenon: ecological modernisation.

The theory of ecological modernisation has two main distinctive uses. In its analytic-descriptive character, it is a social theory that aims to interpret the historical process of emancipation of ecology. *Modernisation*, in this situation, relates to the dominant characteristic of western industrialised societies. *Ecological* expands this recognition to the phenomenon of upgrading industrialism through the reformation of institutional clusters that have been increasingly based on ecological principles. The normative character of the ecological modernisation theory is expressed in the proposal of strategies be adopted by organisations and governments in order to harness the causes of the current ecological crisis. The ‘historicity’ of the theory emerges when the radicalisation of industrialisation processes is proposed as the next desirable stage of development of modern societies. In such a social design, where the institutional clusters of capitalism, nation-states, and military power would not necessarily change their modern characteristics, the design of systems of production and consumption would increasingly be based on ecological principles.

The theory of ecological modernisation has been criticised from several fronts. It has been seen as another neo-liberal ideology in the context of environmentalism, and a proposal based on technocentrism. The grounds of such criticism are based on the view that this perspective does not challenge capitalism and therefore it does not question the side effects of expansionism and consumerism. In a world where no other global system seems to be on offer, and in which the quality of the capitalism available, rather than the application of the category as such, seems most important, such ideological questions are easily bracketed.

Finally, the reflexive nature of ecological modernisation is also questioned in the light of the risk society theory. The role of science and technology becomes problematic if ecological modernists are not able to recognise the limitations in controlling social systems and the unintended consequences associated with the implementation of normative strategies. The prescriptive use of ecological modernisation theory suggests that the solution for current ecological crises and the eventual pathway towards sustainability may require not only the internalisation of environmental costs by manufacturing organisations but also the all-encompassing reformation of systems of production and consumption. The translation of this generic assumption into political programmes requires further development of the analytic character of the theory. In order to prescribe political programmes of industrial development, a better understanding of the way in which specific industrial sectors deal with environmental innovation is required. – What factors inhibit or foster ecological modernisation of specific industries? How do circuits of political ecology affect the process of ecological modernisation? What are the main paradigms defining the systems of production and consumption of particular organisational fields? Questions such as these ones, together with the issues raised by the risk society theory, should be addressed and overcome if ecological modernisation theory is to become useful as a framework for systematic, empirical research.

Studies dealing with environmental issues in organisations constitute evidences that the ongoing phenomenon of ecological modernisation is occurring in some sectors of highly industrialised economies. But only a few attempts have been made to identify the dynamic forces involved in this process at the industry level of analysis. The work of Mol (1995), in describing the process of *refinement of production* in the Dutch chemical industry, is an early venture in this direction. Mol analysed in detail three related industries (paint, plastics and pesticides), focusing mainly on the ecological modernisation of the systems of production in manufacturing processes. Due to the technical nature of the chemical industry, in which the main customers are other industries, the process of ecological modernisation of consumption is not central in Mol’s research. There is another industry that does deal with a product that has a closer relationship between manufacturing and consumer, and seems to be immersed in a process of ecological modernisation: the automobile sector. The next chapter introduces this industrial sector and the environmental problems associated with it, representing an initial investigation of one of the most important and controversial industries of modern times, which will frame the empirical work of the thesis.

PART TWO

The Ecological Modernisation

of the

Automobile Field

7 A Research Journey to the *Environment* of Automobiles

> The air seems so dense that every time I breathe I have the sensation that my lungs are becoming smaller, filled with the same dust that now limits my vision. I make an effort to keep my eyes on the road and the car on the track, but the only orientation I have is the space of my own car, literally confined by others. The traffic does not follow any rule. The fire expelled from giant chimneys cuts the darkness of the night, making clouds and rain look fragile attempts of nature to reduce the infernal summer temperature. The light from the fire exposes the immense and intricate series of pipes, buildings and smoking-towers in the surrounding area, scaring me and exposing myself to a world that I want to run away from. Maybe this can explain the anxiety I see in the faces inside other cars, disputing the next centimetre of the road in this frantic traffic jam, avoiding looking at the chaos in which we are embedded.
>
> Trying to cope with that 'environment', I concentrate my attention on the pipeline that climbs the hills. It's ironic, I think, that most of this paraphernalia exists to make cars, fuels, and roads possible – or is it the opposite? I remember some articles I read recently in the newspaper, in which business and government advocate the advantages of installing more automobile plants in the country. Their main argument is that the country's car-per-capita lags behind more industrialised nations. Besides – and more importantly – carmakers will provide important jobs and economic development that the country urgently needs. I try to imagine where more cars could be put and how this would improve the quality of life of the town I'm just passing through.
>
> Suddenly, as if in a mythological theatre, my thoughts are interrupted by human figures emerging from the smoky road. I rub my eyes and lean towards the windscreen in a desperate effort to clear my view and confirm to myself that I'm awake. As in a tribal ritual, their steps have a rhythm. Forwards and backwards, they seem to be dancing in the middle of the road, negotiating the space with the passing cars. In this *dance of death*, they are risking their lives to offer a special commodity to the travellers. In their hands are their market guns: water in plastic bottles. Men, women and children are literal *stakeholders* in a surrealist 21st century stock exchange – water for life. Scarcity, demand, price, costs... yes, it's the triumph of the market economy, I realise. Among high-tech internal combustion engine cars, the courage and boldness of these villagers does not seem to bother the drivers. They are just ignored.
>
> Twenty-seven kilometres travelled, two and half hours later I finally reach the major intersection and the road that will take me back to my city of 10 million neighbours. The intense traffic formed by heavy trucks, buses and the *racing* tourist cars that are ascending the hill, now ignoring any speed limit, helps me to forget the hell I have left behind. I start to feel better. I reframe my thoughts and think that, at least, the car transported my friends and I to wonderful beaches on the weekend. I try to relax and forget my feelings of guilt at not being able to do something to improve the situation. Maybe next time if I caught a bus… Well, we're already doing well by sharing the car, and I'm not sure if my friends would be happy to depend on buses on a Saturday night. I think about my own limitations as citizen and consumer. I try to move my thoughts away from the problems and benefits associated with the use of cars and convince myself that I'm not the only one guilty here.
>
> Cubatão, Brazil, February 1996.

The opening episode is not a piece of fiction. It is a personal experience that significantly influenced my choice in focusing this study on the automobile industry. Obviously, personal curiosity generated by isolated experiences, such as being in a traffic jam, does not in itself comprise a sufficient justification for the development of scientific research. A research problem should be justified from several theoretical and practical grounds (Perry 1994). Nonetheless, by questioning the correspondence between theory and perceived reality, everyday personal experiences have the potential to bring vital insights into the research process. As Marshall and Rossman (1986:22) stated, “qualitative research usually begins with observations in the real world that raise questions such as: Why do the everyday experiences I am hearing about not fit with extant theory? Why have policy and practice not led to predicted results? How do the existing theories, models and concepts apply to this new and different population or setting?”

In the experience described in the previous page, the theoretical assumptions about the benevolent prosperity brought by the automobile industry were confronted with the environmental disruptions caused by the industry, triggering important insights for the elaboration of research questions. The pristine and well-organised presentation of the stages of research in journal articles seldom reflects the nature of research in social sciences. In this scientific field, research involves a continuous and systematic interplay between theorisation and empirical observation, and the nature of this process normally follows a non-linear progression (Maxwell 1996; Glaser 1978). Theoretical prerogatives tend to be re-examined in the light of incoming information gained through personal experience, in a way that resembles cybernetic systems such as those described by Morgan (1986), among others.

One such interactive process of theory building culminated in this thesis. The *research journey* – as I prefer to call it, since it reflects the experience more accurately – a quest for both: suitable approaches for developing environment-related research in organisations, and systematic means of understanding the emergent phenomenon of ecological modernisation in industrialised societies. At the time that this study was initiated in 1995, research about environmental issues in organisations was still in its infancy (Egri & Pinfield 1996). In theoretical terms, a systematic body of knowledge that could orientate research was still lacking (Gladwin *et al.* 1995). The integration of environmental issues into corporate strategies and practices was also (and still is) a phenomenon limited only to a few large corporations, making it difficult to identify the appropriate approach for the study of such process. In this respect, the research reported in this dissertation is *exploratory* in its essence, since it principally asks ‘what are the variables involved’ (Perry 1994)?

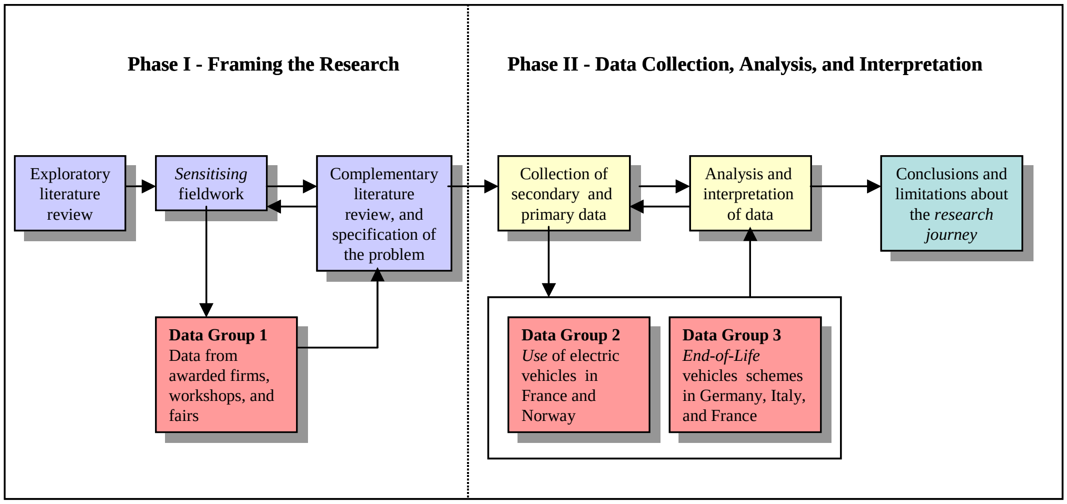
The character of exploratory research also implies that the most adequate research procedures tend to be of a *qualitative nature*, using research questions to guide the research process. In such cases, the development of a literature review will unearth research questions that will be answered in the research of later chapters. Such a research process is also influenced by the *reflexive* nature of the appropriation of knowledge, briefly discussed in Chapter 6, in which enquiry about the nature of reflection results in a constant reformulation of the subject matter. Maxwell (1996:2) asserts that in a qualitative study:

> Research design should be a reflexive process operating through every stage of a project The activities of collecting and analysing the data, developing and modifying theory, elaborating or refocusing the research questions and identifying and eliminating validity threats are usually going on more or less simultaneously, each influencing all the others.

Qualitative research is also, by its very nature, multi-method in focus. According to Denzin and Lincoln (1994:2), the qualitative researcher can be seen as “a *bricoleur* who uses the tools of his or her methodological trade, deploying whatever strategies, methods, or empirical materials are at hand”. When use is made of three or more multiple methods to reflect back upon each other in their various ways of illuminating the data, the process is known as *triangulation*, and constitutes an effort to secure an in-depth understanding of the phenomenon in question. For this reason, a combination of *grounded theory* and *reflexive methodology* oriented the research process. From these perspectives, the development of social research and generation of theory are seen as two parts of the same process (Glaser 1978). Theory may be generated initially from the data, or existing theories may be elaborated and modified as new data are played against them (Strauss & Corbin 1994). The research of Bouty (2000) constitutes an excellent example of the use of grounded theory in these terms. In the particular case of this study, the combination of grounded theory with reflexive methodology represents the adoption of less structured procedures, when compared with the work of Bouty (2000). Moreover, such perspective implied not only a more ample (and indeed construct-free) evaluation of the data generated, but also the constant (re)consideration of alternative interpretations of the data and its potential meanings (Alvesson & Sköldberg 2000). In particular, the development of the theoretical frameworks presented in Chapters 4, 5, and 9 adopted such perspective; collected primary and secondary data was used to modify further, and to elaborate the frameworks.

The research questions that orientated the development of Part I of this study emerged in tandem with the evolution of the research process. Figure 7.1 stylises this process. As this chapter will expose, once the initial research question was answered, additional questions emerged from the conclusions generated by the previous research (literature review or collection of primary and secondary data). Naturally, there is a great deal of overlap between the stages of the research process and the generic phases are presented in the figure for didactic purposes only. The scheme serves to highlight the distinct areas of interest and focus of analysis represented by each one of the research phases.

Figure 7.1: Research Phases



The sections of this chapter are also organised according to the above figure. Section 7.1 describes the process of *Framing the Research*, formed by an exploratory literature review, the preliminary gathering of primary and secondary data (called here the *sensitising* fieldwork), a complementary literature review, and the consequent specification of the problem. In their entirety, the chapters that form Part I of the study constitute the (traditional) chapter encompassing the review of the literature. However, in order to build the theoretical foundation and specify the problem that would be undertaken in Part II, the first stage of the study included not only the review of the literature of the immediate and parent disciplines (see: Perry 1994) but also preliminary (primary and secondary) gathering of data. Data collected in the *sensitising fieldwork* complemented the exploratory review of the literature and helped to identify theoretical approaches that could better explain the empirical reality (see Data Group 1 in Figure 7.1). The combination of theoretical approaches, such as power in organisations, industrial ecology, and environmental sociology, resulted in a study with a multi-disciplinary character.

The development of Part I was characterised by a tension between the attempt to reduce the scope of the research and the all-encompassing nature of environmental problems in organisations, something which kept pointing the research in the opposite direction. As it was explored in Chapter 2, the interdependence between systems is a crucial feature of environmental issues in organisations. In physical terms, the environmental impact of a product, for instance, starts with the extraction of raw materials, and substantial errors can be made when one limits the boundaries of the system to the borders of the organisation. When the perspective is socio-political, the interdependence between systems is even more pervasive. Such characteristics made it difficult to reduce the scope of the research, since the search for ecologically sustainable forms of organising required the consideration of the interdependence of socio-technical systems. Obviously, this approach challenged the operationalisation of the research. The organisational border was ‘exposed’ to a broader area of analysis that could not be confined to the realms of the specialised field of organisation studies. Methodologically, it was necessary to incorporate new research perspectives and methods, which could orientate the development of Part II of the study.

Section 7.2 shows that a *product life-cycle* perspective was used to research the context of one of the most complex industrial products of modern times: the automobile. Fundamentally, the study expanded its original scope from the organisational to the industry level of analysis (or organisational field, as Chapter 8 explains). Data was collected from multiple case studies dealing with market trials of electric vehicles – cases that represent the technology with the lowest levels of local air emissions during automobile use (Data Group 2). Finally, end-of-life vehicle (ELV) schemes developed in Germany, France, and Italy were also researched (Data Group 3). Although a significant amount of secondary data was used in the second part of the research, an original triangulation technique was used to reduce problems associated with the interpretation of the data.

The conclusions presented in Section 7.3 constitute reflections about the *research journey*. Doing research in the emerging field of *organisations & environment* engendered several lessons on the methodology front. This research represents not only a quest for the means of grasping the phenomenon of ecological modernisation in industries but also methodologies and tools that could guide the research journey. Considerations for future research journeys are presented in the final part of the chapter.

7.1 Framing the Research

The research questions that orientated the chapters making up Part I of this study were developed in an unfolding interplay between theory and practice. In other words, as the initial question was answered by reviewing the literature – including parent disciplines in the field – and interpreting the primary and secondary data collected, another question would arise from the process, which would then require further research. For instance, the exploratory literature review began from the problematic of what reasons explained the slow pace of development of ecologically oriented research in organisation studies: If the environmental impact or organisations has long been identified, why had the response of organisation studies have been so slow to develop? I tried to understand the reasons for the theoretical 'gap' in the study of *organisations & environment*, and the explanations for this situation required the research that eventually resulted in Chapter 2.

7.1.1 Exploratory Literature Review

Theoretically, there was little to be learned from organisation studies regarding the business-environment relationships. This lack of theoretical development in the field made me turn my attention to what other sources of empirical evidence of ecological sustainable organisational practices could be found, which were expressed in the second generic research question: are pro-active environmental management practices in organisations conducive to ecological sustainability? Chapter 3 demonstrated that today it is a practically impossible to reach a common ground concerning what constitute ecologically sustainable practices.

As Dunphy and Benveniste (2000:5) pose it, sustainability "is more a symbol than a scientific concept (…) it is a focus for a new value debate about the shape of the future". Moreover, scientific certitude about prerequisites for the ecological sustainability of societies is still lacking. For instance, there is no agreement even about the factor by which resource productivity should be increased in order to maintain the carrying capacity of the planet (see, for instance: Reijnders 1998; Ryan 1998). As Chapter 3 posed, there are no absolutes in the debate about the ecological sustainability of organisation and societies.

Nonetheless, when this study started in 1995, there were already indications that some corporations had improved environmental performance. Firms presenting ‘beyond-compliance’ practices were still a small minority but they certainly constituted evidences of changes in organisational behaviour that Porter and van der Linde (1995a) were not slow to consider. The research question that emerged from such observations was one related to the explanation of such phenomenon: What factors influenced differentially environmental-related behaviour among organisations? How could beyond-compliance practices be explained? An exploratory literature review indicated that regulatory measures, consumers, and interest groups represented important influences on organisations incorporating ecological issues into their strategies and practices. However, it was necessary to have an understanding of how such influences worked that was based on some empirical evidence. For this reason, a *sensitising fieldwork* complemented the exploratory literature review.

7.1.2 Data Group 1: Sensitising Fieldwork

Exploratory fieldwork was conducted in order to enhance the review of the literature, which tried to identify factors influencing organisations in their development of environmental strategies and practices. During the first quarter of 1996 I carried out semi-structured interviews with representatives of manufacturing companies and industry associations winners of an ecological prize in Brazil[58]. Prizes for outstanding environmental performance constitute basic schemes indicating companies that have excelled in their environmental management practices, compared with other organisations. By researching the organisations selected by this kind of initiative the main factors influencing their ‘environmental excellence’ could be identified. The companies were selected from the *Prêmio Expressão de Ecologia*, an environmental prize that, since 1993, has been awarded in the southern region of Brazil to companies operating in the region in recognition of their environmental achievements. The reputation of the organising agency – an independent publishing company – and the peer-reviewed character of the prize, confer legitimacy on the criteria used to choose these companies[59].

58 Mainly because Brazil is my home country, I initially intended to develop the empirical part of the study in that context.

59 From the ‘*Prêmio Expressão de Ecologia 95’*, I developed semi-structured interviews with representatives of the 23 largest export companies of Joinville Region (State of Santa Catarina); the *Boticário Co. and Fundação Boticário de Proteção à Natureza*; and *Equitel Co*. (São José dos Pinhais, State of Paraná).

The experience of developing these interviews during the exploratory fieldwork influenced choices concerning the level of analysis and the research scope, adopted in the next stages of the study. Two major limitations with the research methodology guiding these interviews were identified in that process. First, the *situated nature of people's accounts* seemed to play a fundamental role in the interviews with the winners of the *Prêmio Expressão de Ecologia*. Silverman (1993) emphasised the tendency that people have in seeking to make their behaviour conform to the rationality and moral appropriateness of particular contexts. This is the main reason why interviewers should avoid treating the actor's point of view as an explanation of the phenomenon when interpreting qualitative data. In that particular case, the interviewee's explanation for the environmental strategies and practices adopted by the company could be reflexively motivated by the very nature of the interview (see also: Section 6.2 in Chapter 6). In other words, when answering questions that sought to elaborate why the company excelled in their environmental practices, some interviewees' accounts were justified in terms of ethical motives being the main driving force (see: Section 4.3 in Chapter 4). In such cases there was no means of being certain whether the answer was a genuine one or simply one that represented a 'politically correct' response. The fear of regulatory measures or the minimisation of environmental business risk could have been the most important factors influencing beyond-compliance practices of the firm, and ethical and moral principles might only have been a part of the respondents' sensemaking.

Second, environmental improvements that were considered remarkable achievements by both corporate representatives and the agency awarding the ecological prize could be perceived differently by an outsider viewer. Describing this situation as *the paradox of proactive environmental strategy*, Howes *et al.* (1997:3-4) emphasised the importance of the point of view that one adopts when researching environmental issues in business:

> Sitting inside a major company looking outwards, an affirmative view of corporate environmental behaviour is now typical and, in many respects, justified (…) Some companies are publishing environmental reports containing quantitative performance indicators. When these activities are combined with target setting for waste and emissions, impressive environmental improvements can be achieved. Sitting outside the company and looking in from a public policy perspective, the picture can be less attractive. On a range of issues from local air and water pollution through acid rain and climate change, industry is seen by outsiders to be contributing to environmental damage and resisting policy measures, which would lead to environmental improvements. The internal perspective, which emphasises business processes, and the external perspective, which focuses more on environmental outcomes, conflict.

As the above paragraph suggests, an *outsider* perspective is clearly important when searching for determinants of corporate *greening*. Corroborating this view is the fact that the majority of the determinants of *greening* strategies of Brazilian companies that were mentioned by the interviewees were external to the companies, suggesting that the next step in the research should go beyond the organisational level of analysis. While corporate culture and other internal organisational elements have been identified as crucial factors in the adoption of environmental initiatives, external factors such as environmental regulation and international competitiveness seemed to play an equally important role (see: Chapter 4).

Data from the sensitising fieldwork[60] also indicated that the development of corporate environmental strategies and practices varied with the size of the organisation and the industry in which it operated, substantiating the studies of Howes *et al.* (1997). Since *global industries* work directly towards the definitions contained in international standards such as the ISO 14000 series, they tend to determine the pace of pro-active environmental management practices in organisations. Industries in this category encompass: (i) exporting companies that have to cope with non-tariff environmental trade barriers; (ii) companies that are dependent on loans from international banks who demand an evaluation of their environmental impact; (iii) multinational corporations that are susceptible to shareholder environmental pressure in their home country (*Gestão Ambiental* 1996). At the other end, most of what Porter (1990) calls *multi-domestic* industries – the ones that compete independently in each nation – tend to move in accordance only with local regulatory demands. Based on this basic classification, the chances of finding leaders of corporate environmental management were clearly higher in global industries than in multi-domestic ones. For instance, the main clients for the pollution control industry, cleaner technologies, and environmental consulting, tended to be large multinational companies[61]. Therefore, an obvious research strategy would involve the investigation of multinational corporations that operated in the same (global) industry.

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60 In addition to the interviews, secondary data was extensive collected during this phase of the research. Data was obtained from a variety of sources, such as visit to fairs of environmental technology (Eco-Brazil 96), the headquarters of the Brazilian Association of Vehicle Manufacturers (ANFAVEA), participation in public workshops about the developments of ISO 14001, and various local media releases.

61 This perception was reinforced during my visit to the biggest European environmental fair (*Pollutec 96*, Lyon, France). According to the information released by the organisations operating in the environmental management industry, the main clients are normally large international corporations.

In trying to identify a global industry in which the research could be focused, the automobile industry emerged as a ‘natural’ candidate. Besides the fact that the industry satisfies the four criteria described previously, both the economic and environmental impacts of the industry have been largely debated in the academic, business, and governmental contexts. In Brazil, automobile companies such as *General Motors*, *Ford*, and *Volkswagen* played a major role in the country’s import-substituting program from the late 1950s, and *Fiat* from the 1970s, onwards (Ferro 1995). Today, automobile manufacturing in Brazil is a mature and competitive economic activity that follows international standards of quality. Hence, one could expect that investments with the potential to reduce the environmental impact of cars during the phases of manufacturing, use, and end-of-life would also follow the standards adopted in factories located in highly industrialised economies, such as the USA and Western European countries. As Section 5.1 in Chapter 5 has explored, this was not the case in 1996.

The importance of variables of political economy in the definition of corporate environmental strategies, in particular, and the technological choices of industries, in the broad spectrum, encompassed the general conclusion of the sensitising fieldwork. In this study, Chapter 5 consists of an exemplar of data collection and theory building as part of the same process, as mentioned previously. The observation of the relatively lower environmental performance of Brazilian branches of car manufacturers, when compared to their parent companies, induced me to reframe the previous understanding of influences on the *greening* of organisations and industries (see: Chapter 4). Mainly because automakers face more restrictive environmental regulation in their home countries, their main environment-related projects were not in place in Brazil[62], at the time that the sensitising fieldwork was conducted. Finally, the need to review theories dealing with power *in and around* organisations (Mintzberg 1983), as well as political sciences disciplines, became clear. Chapter 5 presents this review and the reasons why a minimum understanding of *the political ecology of organisations* is necessary for answering why corporations might not adopt environmentally sound technologies that are available to them.

62 Although the ‘Pro-Alcohol’ program was an internationally renowned environmental initiative, it was the military government that initiated the program in the 1970s and early 1980s. Therefore, the project cannot be considered an auto industry initiative (Michael & Oliveira 1995).

7.1.3 Complementary Literature Review

Reaching the conclusion that the *greening* of organisations would be contingent on political ecology factors also influenced the direction taken in the review of the complementary literature, as well as the final definition of the problem. Fundamentally, the overall message expressed by Chapters 4 and 5 is that the nature of the *'greening'* of organisations is a phenomenon that transcends the organisational level of analysis – even though it is echoed in management practices of firms. This was the main justification for the development of Chapter 6: It was necessary to understand why ecological concerns (only) entered into organisational decision-making in the last decades of the 20th century. What could explain this timing? What is the nature of such practices? Is pro-active environment management another business fashion or an irrevocable historical phenomenon? Partial answers to these questions are presented in Chapter 6 but instead of closing the analysis, the contents of the chapter posed more challenging questions that Part II of this study aimed to answer.

7.1.4 Specification of the Problem

If the *greening* of organisations in its essence represents the phenomenon of *ecological modernisation* in highly industrialised societies, as Chapter 6 suggests, then what changes could be expected to happen in modern organisations and industrial sectors in consequence? Does this phenomenon lead to the complete redesign of industrial systems? Such questions could not be answered without empirical references. This is the main reason why Part II of this dissertation is dedicated to the study of the European automobile industry[63]. Environment-related developments in this economic sector suggest that a process of ecological modernisation is underway (see, for instance: Nieuwenhuis & Wells 1997). Such a perception, however, has not yet been researched in the light of ecological modernisation theory. Hence the second part of this study aimed to answer the following *principal research question*:

Why is the European automobile industry undergoing ecological modernisation?

63 In the context of this study, the European automobile industry refers mainly, but is not limited to, the car manufacturers that have assembling plants in Western European countries.

In order to answer this question, the following five objectives were established for this research, which are addressed by the remaining chapters of Part II and taken up in the conclusion of the study:

1. Identify the fundamental technologies of the current *technological regime of the automobile*, as well as the economic and environmental implications of this regime (Chapter 8).
2. Identify the factors fostering or inhibiting ecological modernisation in the automobile industry, and design an analytical framework for the analysis of their dynamics (Chapter 9).
3. Analyse pilot programmes for the introduction of (battery) electric vehicles in Western European markets (Chapter 10).
4. Analyse the end-of-life vehicle (ELV) schemes developed in Germany, Italy and France – the main automobile producers in Europe (Chapter 11).
5. Evaluate the limits of ecological modernisation in the automobile industry, and estimate whether this phenomenon is conducive to sustainable industrial development (Chapter 12).

Hence, identifying the extent to which the automobile industry is engaged in a process of ecological modernisation was the reason for initiating the analysis contained in Part II of this study. However, the research has implications that are by no means limited to such investigation. A scientific study needs to satisfy requirements that go beyond the verification of an empirical phenomenon, generating some implications for theory and practice (Perry 1994; Stablein 1996). For this reason, the study intended to contribute to the further elaboration of a *general or formal theory,* rather than generate a substantive theory based on the particular aspects of case studies. Hence, 'grounded', in the context of this study, does not refer to a research process grounded in the research context as might characterise the classical definition of grounded theory (see: Glaser & Strauss 1967). Instead, 'grounded' in this study refers more specifically to the (*research*) *process* of building theory out of a permanent dialectic between the theories guiding the research and data collection and analysis. According to Strauss and Corbin (1994:227):

> Researchers carry into their research the *sensitising* possibilities of their training, reading, and research experience, as well as explicit theories that might be useful if played against systematically gathered data, in conjunction with theories emerging from analysis of these data.

As was stated in Chapter 6, the phenomenon of ecological modernisation is based on broad theorems, summarised by Mol (1995) as six *sensitising hypotheses*. The characterisation of the phenomenon of ecological modernisation is still not definitive; it requires further analysis and refinement. Thus, the hypotheses serve more as guideposts for further development of the foundations of the theory, rather than as propositions to be tested according to a positivistic epistemological foundation and a nomothetic methodological orientation (see: Burrell 1996; Burrell & Morgan 1979). In this respect, this study differs in its main objective from the one presented by Mol (1995). In his work, Mol mainly intended to prove the superiority of ecological modernisation theory – when compared to other social theories – in explaining and predicting a specific social reality: the environment-induced transformations in society. Conversely, this study does not attempt to prove the explanatory and predictive powers of the theory. Rather, it intends to explain why a specific social setting (the automobile industry) is undergoing a particular phenomenon (ecological modernisation).

7.2 Data Collection, Analysis, and Interpretation

Part II of the research process was dedicated to the collection, analysis, and interpretation of data specifically related to the European automobile industry. As Figure 7.1 suggests, the processes of collecting and analysing data, rather than being developed separately, were both iterative and interactive. Theoretical and practical reasons justified this procedure. In theoretical terms, this study is aligned with Stablein's (1996:551) understanding that "all data are representations (…) and the 'thing' that our data represent is not a concrete object or experience. Instead, it is a human conception, constituted by the sensemaking of scientists" (see also: Clegg & Hardy 1996). In the light of such understanding – that science is primarily a sensemaking activity based on assumptions about what constitute reality (Kuhn 1962) – a clear separation between the collection and analysis of data reflects more a didactic representation of the research process than its factual development actually allows. This is the reason why there is no clear separation between collection and analysis of data in this study. The data representing a specific reality comprehend not only its analysis but also the process that gathered such data. Eisenhardt (1989:539) supports such approach for building theories from case study research, asserting that:

> Overlapping data analysis with data collection not only gives the researcher a head start in the analysis but, more importantly, allows the researchers to take advantage of flexible data

> collection (…) Adjustments can be made to data collection instruments, such as the addition of questions to an interview protocol or questions to a questionnaire.

In practical terms, the research scope encompassed by the research questions and objectives required the collection of a vast assortment of data. For this reason, although primary data was collected in this phase, the research relied mostly on secondary sources. Nonetheless, in order to enhance the quality of secondary data, I developed some data *triangulation*. It is important to emphasise that this triangulation does not refer to a traditional positivistic method of triangulation but should be rather understood as an *alternative* approach, developed in the context of qualitative research. In this situation "triangulation is not a tool or a strategy of validation, but an alternative to validation" (Denzin & Lincoln 1994:2). This statement is better understood in terms of Stake's (1994:241) suggestion that, in the context of qualitative research:

> Triangulation is a process of using multiple perceptions to clarify meaning, verifying the repeatability of an observation or interpretation. But acknowledging that no observations or interpretations are perfectly repeatable, triangulation serves also to clarify meaning by identifying different ways the phenomenon is being seen.

Empirically, the triangulation involved the development of interviews with the authors of the main sources of secondary data used in the research. After the initial review of the literature on the *automobile industry and the environment*, I visited research centres[64] and interviewed the authors of the main reports, articles, and books that formed that background material for the preliminary phase of the study. Through these interviews it was also possible to identify additional sources of data and obtain expert assessment of my interpretation of such material. Such a process of iterative interaction allowed me to cover a wide range of issues in the specialised field of the automobile industry and the environment, in a relatively short time, as well as providing me with directions to pursue in the next phases of the research. As the following

64 USA: Technology, Business & Environment Program, Massachusetts Institute of Technology (MIT). England: Centre for Automotive Industry Research, University of Wales College of Cardiff. The Netherlands: Institute for Environmental Studies, Free University, Amsterdam, and Centre for Studies of Science, Technology and Society, University of Twente.

sections describe, this process also helped me to identify areas where the collection of additional (primary and secondary) data was necessary[65].

Specifically related to the object of analysis – the automobile industry – the research adopted a *product life-cycle perspective*. The main justification for the adoption of this approach, which is explained more extensively in Chapter 8, refers to the environmental impact of cars during their entire life-cycle. With over 80% of the lifetime pollution of a car generated during its operation – the remaining being divided between its production and final disposal (Rogers 1993) – a clear sense of proportion justified focusing the research on alternatives that aim to reduce their environmental impact during the use phase. Almost all vehicles marketed today are based on principles that consider the internal combustion engines (ICE) and all-steel car bodies as design pre-requisites. Because of this, fundamental questions can be raised about the overall environmental performance of these vehicles. What is the significance of resource productivity in car manufacturing (see: Chapter 4), if the final product is one that relies on technologies that prioritise the use of non-renewable sources of energy? Environmental improvements in painting processes, for instance, although they constitute important steps towards more environmentally sound industrial practices, become less influential when compared with the 80% environmental disruption caused by the car *after* it leaves the factory (Graedel & Allenby 1998). Such figures suggested that the entire life-cycle proportion of environmental impact should be considered in the research design but more attention given to potential improvements in environmental performance during vehicle use and disposal, relative to the manufacturing phase[66].

Regarding the study of environmental issues during the *manufacturing phase*, a pragmatic reason justified the use of environmental data released to the public by automakers. Considering that a central motive for car manufacturers to release environmental reports is to inform the public about the organisations' environmental

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65 Although I focused my attention on business-environment issues, I also studied the competitive dynamics inside the industry as well as the main technological and economic developments, and challenges faced by the automobile industry. I read industry-specific journals such as *FT Automotive World, Automotive International, Automotive News Europe*, newsletter and reports of the European Automobile Manufacturers Association (ACEA), special reports about automobile markets, related industries, or materials, published by *the Economist Intelligence Unit* (ex. Europe's Automotive Components Business), and *Financial Times* (ex: Automotive Materials), among other sources.

commitment and performance, one could expect that it is in their own interest to announce the *highest* environmental achievements by their companies. Hence, the self-proclaimed environmental milestones achieved by the industry, presented in environmental reports, served to evaluate *how far* the industry would be willing to fundamentally realign auto manufacturing on ecological principles. Improvements in waste reduction, energy efficiency, and emission levels in factories that have been presented in environmental reports were used to indicate both the tendency and the limitations of environmental strategies and practices adopted in car manufacturing[67].

The evaluation of environmental improvements during the phases of *use* and *end-of-life* of vehicles (ELV) was made through the collection and analysis of primary and secondary data generated from several case studies. Stake (1994:237) classifies such approach as *collective case studies* in which:

> Researchers study a number of cases jointly in order to enquire into the phenomenon, population, or general condition (…) Individual cases in the collection may or may not be know in advance to manifest the common characteristic. They may be similar or dissimilar, redundancy and variety each having voice. They are chosen because it is believed that understanding them will lead to better understanding, perhaps better theorising, about a still larger collection of cases.

As the next section explains in more detail, the study of the collective cases indicates whether or not the phenomenon of ecological modernisation had become a reality in the European automobile industry. The second data group made it possible the analysis of an automobile technology that significantly reduces local air emissions during the *use phase*: electric traction. Such analysis had the potential to unveil the barriers faced by players *in and around* the automobile industry in transforming such technology into a market success.

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66 Even though the pre-assembly stage can be clearly distinguished from the assembling activities performed by automakers, this study does not analyse the environmental impact associated with this phase of the life-cycle of automobiles (see: Chapter 8). Also, in this study, the words manufacturing and assembling are used interchangeably.

67 Although environmental reports published by automakers provided the (secondary) data used in this part of the research, the observation of manufacturing practices in the engine plant of *Mercedes-Benz* in Stuttgart (Nov 1996), and the assembling plant of *Fiat Auto* in Turin (Oct 1996) provided an informative overview of the main environmental issues faced by automakers during the manufacturing phase.

7.2.1 Data Group 2: Electric Vehicle Experiments in Western Europe

Under certain conditions[68], the cleanest commercially available source of traction for cars is provided by electric powertrains (Cronk 1995). A move away from today's internal combustion engine technology would represent a fundamental shift not only for the system of production guiding the automobile industry but also a significant transformation in current transport patterns (Nieuwenhuis & Wells 1997). The basic technology that would allow such transformation has been available to the automobile industry since its early days (Yergin 1992). Hence, one could question why electric vehicles have not yet succeeded in market terms? What can explain the market disadvantage of electric traction in relation to one based on internal combustion technology? What can explain the seemingly permanent failure of this technological alternative?

These questions find a wide range of explanations in the specialised literature. Justifications vary from the more 'purist' superiority of internal combustion engines, to the ones based on political interests and cultural values associated with the dominant technological regime (Kemp 1994). According to Schot *et al.* (1994) the (relative) market failure of electric vehicles is a typical socio-technical problem. The authors supported this perception with extensive research about the *automobile system*, developed in five of the most highly industrialised countries in the world[69]. Through this research, pivotal factors limiting the diffusion of emerging technologies were identified, making it possible to develop a theoretical approach to the management of technological niches. Kemp *et al.* (1998) present the foundations of the *Strategic Niche Management* (SNM) approach, which was evaluated through the analysis of multiple cases studies about alternative cars and transport systems.

The *Strategic Niche Management* research project[70] aimed at understanding the diffusion of technologies, which have been ready for use for a long time. The SNM project did not limit experiments sponsored by the auto industry. Looking beyond the

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68 Electricity generated from hydroelectric or other renewable sources of energy (Michaelis & Davidson, in Simon & Hoogma 1998).

69 France: Hoogma (1995), Sweden: Hoogma and Schot (1995), Germany: Hoogma, Bruheze and Schot (1995), Japan: Elzen (1995a), USA: Elzen (1995b).

70 The Strategic Niche Management as a tool for a Transition to a Sustainable Transport System project. The European Commission, DG XII, area of Human Dimensions of Environmental Change, RTD Programme in Environment and Change.

frontiers was a strategy required to identify alternatives to the conventional car. For this reason, initiatives conducted by potential new entrants, such as small manufacturers of lightweight electric vehicles were also included in the SNM cases studies. This criterion for the choice of the case studies made the SNM project particularly adequate for the purposes of my study. Generically, if economic and technical barriers to the diffusion of electric vehicles were shown to be possible to overcome, the unwillingness of the auto industry to move beyond the ICE technology would be under question. The eventual market success of an industry 'outsider' would represent an indisposition of the auto industry to work towards ecological modernisation.

The selection of the case studies is in accordance with the criteria proposed by Glaser and Straus (1967) for research based on grounded theory. When building theory from case study research, random selection is neither necessary nor preferable and cases should be chosen for theoretical, not statistical reasons (Eisenhardt 1989). This is the main reason why the data generated by some of the SNM cases were appropriate for the purposes of this research. The empirical evaluation of ecological modernisation theory in the context of the automobile industry required the analysis of potential environmental innovations in the domain of product use, which were not limited to the market leaders in that sector. As expressed previously, the industry, historically, had capabilities for undertaking innovation, such as those based on electric traction but, for reasons the research will unveil, these innovations were carried out by industry 'outsiders'. In practical terms, the cases involving these outsiders, selected from the SNM project, represented excellent sources of data in the field of alternative vehicles, satisfying a central aim of this analysis, being related to environmentally related innovations in product use. The experiments analysed in the SNM project constituted the 'state of the art' in EV technology in Europe, as well as the most fertile environment for this type of market trial anywhere in the world.

Two EV experiments were selected from a total of 16 case studies analysed in the SNM project. The main reason for the choice related to the involvement of the automobile industry in these case studies. In *La Rochelle* (France) the French PSA Group was the leading organisation promoting pilot programs for the use of (converted conventional internal combustion engine cars into) EVs. The case of the *Pivco* venture (Norway) analyses the efforts made by a new entrant in the automobile field, which used an innovative design for both the lightweight electric vehicle and its system of production. Chapter 10 presents background information on, and the analysis of, the efforts to develop EV for the urban market niches. Together they represent experiments that emerged at both the core (La Rochelle) and the 'periphery' (*Pivco*) of the auto industry, and have the potential to become embryos for a fundamental change in the industry.

Although the SNM case studies have been treated as secondary data for this research, as an invited commentator on the project I had the opportunity to observe the process of data analysis, interpretation, and reporting. Preliminary research reports of each case study were made available to the participants in working group meetings. During these meetings, the theoretical background of the research, corrections of the research strategy, and the findings of each case study were debated among the participants. On two of these occasions[71] I had the opportunity to discuss extensively the research findings, documented in preliminary reports, with the persons responsible for the development of each case study. Eisenhardt (1989:538) strongly recommends such scenarios for building theories from case study research. According to her, case study research conducted by multiple investigators present two key advantages:

> First, they enhance the creative potential of the study. Team members often have complementary insights, which add to the richness of data, and their different perspectives increases the likelihood of capitalising on any novel insight, which may be in the data. Second, the convergence of observations from multiple investigators enhances confidence in the findings. Convergent perceptions add to the empirical grounding of the hypothesis, while conflicting perceptions keep the group from premature closure. Thus, the use of more investigators builds confidence in the findings and increases the likelihood of surprising findings.

As the development of the cases progressed, I maintained regular communication with the SNM team; conflicting perceptions on my part concerning the case studies were debated with members of the team on various occasions[72]. During this period I also directed specific questions to the SNM participants about the interpretation of findings presented in their reports, suggested possible alternative interpretations of the results, and considered some of the implications of these for the conclusions of the collective case studies. This process characterised the *triangulation* of qualitative data, mentioned previously. The confrontation of my interpretation of the results with those presented in

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71 Group meetings at the University of Twente (October 10-13, 1996), and Maastricht (May 23-25, 1997), both in The Netherlands.

72 Information with the coordinator of the project and the authors of the case studies was exchanged in a regular basis during Oct 1996-1998. Special sections about the SNM project and electric vehicles during the *Greening of Industry Network* (GIN) conferences in Heidelberg, Germany (November 24-27, 1996), and Santa Barbara, CA, USA (November 16-20, 1997) were also used to debate the case studies.

the publications of the working group reduced the problems of knowledge transfer in case study reporting, mentioned by Stake (1994). The conceptual structures of both the writer and the reader can make hazardous the transfer of experience generated in the case studies. Although it is not possible to completely eliminate such limitations, the interaction with the writers of the SNM reports certainly reduced the misinterpretations normally present in this type of knowledge transfer. The content of secondary data, embodied in the reports, was not taken for granted but instead was submitted to a long process of scrutiny of their contents[73].

The *treatment of data* generated by the SNM cases followed a specific approach suggested by Eisenhardt (1989) for finding patterns in cross-case analysis. In fact, the criteria for the organisation of the data followed the theoretical principles guiding the SNM approach. A 'template' was used for the development of the cases studies, as well as to report: (i) the situation before the experiment; (ii) the aims, main players, the network formation, etc., in each experiment; (iii) the formation and development of the niche, and, (iv) the evaluation of the experiment. By using the same template to guide the collection and the analysis of the data, the researchers focused their attention on the elements composing these four topics. They made it possible, for instance, to compare the case studies in terms of the characteristics of network formation, and the strategies used to 'protect' the niche from competition of rival technologies. In this respect, the criteria used for the treatment of the data also satisfied the demands of this research. The standardised organisation of the data, describing the evolution of each experiment, facilitated the identification of actors and networks fostering or inhibiting the success of a more environmentally benign automobile technology. The detailed analysis of these processes is presented in Chapter 10.

Informal participation in the analysis of the case studies also allowed me to build a personal interpretation of the conclusions of each individual case, as well as the collective case studies. Although the theoretical foundations and empirical research related to the SNM approach were familiar to me, I did not follow the same theoretical trajectory in my research. In fact, the data collected in the SNM project certainly allowed for multiple interpretations, depending on the theoretical approach employed by

73 The researchers involved in the experiments in La Rochelle (Remco Hoogma and Benoît Simon) and Pivco (Birguitta Schwartz and Kanehira Maruo), as well as a representative of *Th!ink Nordic* (the ex-*Pivco*) commented and suggested revisions in Chapter 10.

the researcher. The analysis of factors influencing the success of more environmentally sound automotive technologies served various research objectives but, as demonstrated in Chapter 10, the focus of analysis and the results of the study presented here substantially differ from those of the SNM perspective. In sum, my research draws on and uses the materials generated by the SNM project but it does not simply reproduce them: they are the documentary data for my own theoretical and synthetic work. With a slightly different emphasis, such perspective was also used in the research on the last stage of the life-cycle of automobiles.

7.2.2 Data Group 3: ELV Schemes in Germany, France, and Italy

The analysis of environmental issues associated with the end-of-life vehicles (ELV) constitutes the last area of investigation of this dissertation. Manufacturers have increasingly accepted car recycling as an imperative for the industry, but they have contested their sole responsibility for bearing all the costs of recycling activities (Wright *et al.* 1998). Although draft legislation on ELVs was proposed in Germany as early as 1990, disputes between carmakers and regulatory agencies delayed the implementation of direct regulation by more than 10 years. Voluntary agreements in France and Italy, and later at the European Union level, were tried during the 1990s but the results of such schemes did not convince policy-makes about the seriousness of the auto industry in addressing the ELV problem. As a whole, the sector adopted a controversial attitude. At the same time that ELV strategies and practices were developed by individual automakers, the main representative organisation of the industry – European Automobile Manufacturers Association (ACEA) – was instrumental in repudiating ELV legislation. Such actions needed to be explained if he objectives of this research were to be satisfied. What shaped the interests of automobile companies in developing ELV schemes? Were the recycling schemes proposed by automakers serious attempts to address the problems associated with ELVs or were they only ‘window-dressing’ and image maintenance strategies? In other words, were organisational and industry-related actions regarding the ELV issue in Europe conducive to ecological modernisation?

The answer to these questions required analysis of the main recycling initiatives developed in the European auto industry context. This is the main rationale for conducting an analysis of the evolution of ELV strategies in Germany, France, and Italy – the three biggest car producers in Europe. Initially, the work of Matsyak (1992), and Kincaid *et al.* (1992), among others, introduced the main ELV issues faced by the industry in the early nineties. By the middle of 1996, however, the research of den Hond (1996) presented the most comprehensive overview of ELV strategies developed in Europe. In particular, his work explored the political processes involving governmental agencies, automakers, car dismantlers, and other key players in the development of ELV strategies in Germany and France[74]. For this reason, after having studied this secondary data, I debated the findings of den Hond's work extensively with the author[75]. Explanations for the different recycling strategies developed by car manufacturers, and the role of the governmental agencies in Germany and France, among other areas of enquiry, were part of this extensive examination. This procedure represented a *triangulation* of qualitative data, similar to the one used in the analysis of the strategic niche management cases, described in the previous section.

This process also helped me to identify areas where further empirical research was necessary. The collection of primary data on the *Fiat Auto Recycling* (FARE) programme reflects the identification of such a need. The data aimed to complement existing research on distinct environmental policies and programmes adopted by EU countries concerning the ELV issue. *Fiat*, the most influential industrial group in Italy, was by the middle 1990s claiming the success of its FARE programme. Indeed, the pragmatic approach taken by *Fiat*, from the very early stages of ELV developments in Europe, seemed to be unique among automakers. Reliable data about the FARE case was, however, scarce. Most available data consisted of marketing material released by *Fiat* and very little was known about the other partners in the FARE programme. Therefore, in the second half of 1996 I developed semi-structured interviews not only with the persons responsible for the scheme at *Fiat Auto* but also with other FARE member organisations, such as car dismantlers, recyclers of polypropylene, glass, car seats, among other materials[76].

The framework developed in Chapter 9 guided the analysis of the data concerning the Italian case, which, together with the studies of ELV strategies in Germany and

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74 Publications Frank den Hond were used as the main secondary data for the analysis of the ELV issue in Germany and France (see: den Hond 1998a; 1998b; den Hond & Groenewegen 1993, Groenewegen & den Hond, 1992).

75 Interviews with Frank den Hond were conducted in October 1996, and March and September 1997.

76 Interviews with: (1) Personnel of the Project Management and Industrial Development, Central Laboratory of *Fiat Auto*, (2) Directorate of Environmental Affairs of *Fiat*, Torino, Italy, (3) Vice-president of the Italian Association of Auto Demolition Companies (ADA), (4) representative of *Montel Polyolefins*, Italy and, (5) Representative of the *Rhône-Poulenc* Group, Italy.

France[77], is presented in Chapter 11. However, the identification of factors triggering innovation, as well as the main technical and economic challenges faced by the industry to increase recyclability rates of vehicles in each particular context, did not follow a linear progression. The analysis of the ELV cases also allowed a refinement of the framework, since the 'incoming data' was played against the theoretical background represented by the framework. As has been mentioned in the previous section, this interplay between theory and data is the normal practice in developing grounded theory – and differs considerably from positivist-oriented research in their proposition of models to be tested. The framework used to describe the evolution of ELV development in Europe represents both the process of understanding the context under investigation, as well as being a product of the analysis.

7.2.3 Research Sample and Population

Finally, a few words need to be said about the overall definition of the *research population* in this study. The choice of the research population followed principles similar to those adopted in the study by Hoffman (1999:554), in which the "membership and bounds were not externally imposed by the experimenter but emerged from the data". In particular, when defining the scope of an organisational field, Hoffman (1999:351) suggests that:

> The notion of that an organisational field forms around a central issue – such as the protection of the natural environment – rather than a central technology or market introduces the idea that fields become centres of debate in which competing interests negotiate over issue interpretation.

By addressing the problem-areas involved in the current *automotive system*, the scope of influences on the ecological modernisation of the European automobile industry – and consequent research population – could be identified. For instance, the research population included traditional organisations that have relationships with car manufacturers, such as suppliers of car components and sub-assembled parts, retailers, advertising companies, etc. However, through the analysis of the case studies it was possible to identify less intuitive organisational forms promoting the adoption of more environmentally benign practices, such as research institutes and inter-firm

77 Complementary information about the ELV issue in France was obtained through informal conversations with representatives of CFF - the main French shredding company - during the *Pollutec 96* (the largest European environmental fair) in Lyon, France.

collaborative programs. The remaining chapters of this study show that ‘marginal’ businesses, such as car dismantling were identified as fundamental players in helping the industry to increase recycling rates of cars. They consist of another factor that expanded the scope of the research population. In sum, the definition of the population to be researched was defined through the patterns of social interaction, which resulted from the research process. Such a procedure represents one of the key characteristics of qualitative research based on non-positivistic paradigmatic assumptions. The main advantages and limitations of such perspective, which orientated this research, compose the final part of this chapter.

7.3 Conclusions and Limitations

This chapter aimed at exposing the *research journey* – the personal experience of conducting research in the emerging field of *organisation & environment* – to the scrutiny of the reader. From the point of view of validating research findings, this is by no means a distinctive initiative. Verification procedures that confer validity to the process of developing research have historically been the bastions of the positivistic tradition in scientific investigation. Nonetheless, methodological assumptions in positivism and post-positivism have historically assumed the possibility of proving that research findings are *true* or *false*. Such claims do not find resonance in the paradigmatic approach adopted in this research. In the words of Mol (1995:58): “Positivistic verification and critical rationalistic falsification procedures are unsuitable evaluation strategies both for social theories in general and for the ecological modernisation theory in particular”. The main justification for such positioning finds its roots on the broad notion of paradigms guiding human action. According to Guba and Lincoln (1994), paradigms are belief systems based on ontological, epistemological, and methodological assumptions (see also, Burrell & Morgan 1979), and the *truth* about ‘reality’ will always be inter-subjective for those who share the same paradigmatic assumptions. Given that paradigms are human constructions, “advocates of any particular construction must rely on *persuasiveness* and *utility* rather than proof in arguing their position” (Guba & Lincoln 1994:108).

According to this view, this chapter merely tried to *persuade* the reader to accept the degree of complexity involved in developing research in the area of environmental issues in organisations and the consequent appropriateness of using methodological paradigms and research techniques that differ from those based on positivism and post-positivism. Such positioning encompasses empirical and theoretical justifications. Empirically, the complexity of the phenomenon under investigation required “a set of practices that is multi-method in focus, involving an interpretive, naturalistic approach to its subject matter” (Denzin & Lincoln 1994:2). These characteristics constitute one of the (many) definitions of qualitative research and, for this reason, this was the generic perspective adopted by this research. In practical terms, qualitative research requires social researchers to be not only *connoisseurs* of a wide variety of research methods but also inventive scientists who apply appropriate techniques and develop new approaches according to the circumstances they face as they develop their research.

In theoretical terms, the main reason for adopting a qualitative perspective relies on the view that objective reality can never be captured but only created. Ontologically, this view is aligned with the perception of reality suggested by Guba and Lincoln (1994:110), in which:

> Reality is assumed to be apprehendable that was once plastic, but that was, over time, shaped by a congeries of social, political, cultural, economic, ethnic, and gender factions, and then crystallised (reified) into a series of structures that are now (inappropriately) taken as ‘real’, that is, natural and immutable. For all practical purposes the structures are ‘real’, a virtual or historical reality”.

Such an understanding about what constitutes reality has direct implications for both the research practices and consequent findings of this study. Fundamentally, the attempts to persuade the reader to accept the *utility* of this research do not carry any (naive) claim of objectivity. The embedded values carried by the researcher transform research in social science into an irremediably political arena (Punch 1994). Although efforts were made to minimise the interference of idiosyncrasies and political preferences, the research was carried out with the awareness that personal values were embedded in the interpretation (and creation) of ‘reality’. When working as a *bricoleur*, interviewing people, triangulating data and methods, and deploying whatever strategies, methods, and empirical materials at hand, I considered Denzin and Lincoln’s (1994:3) perception that:

> The *bricoleur* understands that research is an interactive process shaped by his or her personal history, biography, gender, social class, race, and ethnicity, and those of the people in the setting. The *bricoleur* knows that science is power, for all research findings have political implications. There is no value-free science.

In alignment with this ontological position is the epistemological (the nature of the theory) understanding that research findings are value-*mediated* entities: “What can be known is inextricably intertwined with the interaction between a *particular* investigator and a *particular* object or group" (Guba & Lincoln 1994:110, italicised in the original). The historical hegemony exerted by positivistic and post-positivistic paradigms suggests that this mediation will only occur in the realms of paradigms characterising critical theory and constructivism (for a detailed explanation of the paradigms, see: Guba & Lincoln 1994). This study is aligned with Richardson (1994) argument that the present moment is defined by a new sensibility in which that any discourse has a privileged place, and any method or theory a universal and general claim of authoritative knowledge. But such positioning might not be sympathetic to those who claim the superiority of scientific investigation based on positivism. After all, this dispute is itself an evidence of the politics involved in the making of social sciences.

The ontological and epistemological assumptions of this research also presuppose the limitations of the knowledge generated from its development. In Chapter 6, Section 6.2.1 discussed the reflexive nature of the accumulation of knowledge in social sciences – or the classic problem of *double hermeneutics* (see also: Giddens 1984). Fundamentally, reflexivity in social sciences relates to the pre-interpreted nature of the reality under investigation. As was mentioned in section 7.1 of this chapter, the *situated nature of peoples' accounts* (Silverman 1993) can be seen to constitute an example of the limitations faced by social scientists when they are collecting and interpreting data. Sociological data that supposedly explains 'reality' contains in itself the frames of meaning for its interpretation. Mainly because it is not possible to separate the object of analysis (social actors) from the observer (social scientist), there is a component of *self-fulfilling* and *self-denyin*g in any social theory that attempts to explain causal relations and predict future events (Mol 1995). Hence, there is certainly a good degree of *circular logic* in social theories in general. Such characteristics are inevitably present in the logic expressed in the overall development of this study.

The identification of limitations associated with the accumulation of knowledge in social sciences also unfolds the differences between paradigms guiding research practices. In fact, this recognition represents the first area of *utility* of this study regarding methodology. By calling attention to the reflexive nature of knowledge in social sciences, this chapter debated the degree in which reality is socially constructed. Independently of the approach researchers may use to develop research in the same field, such insights have the potential to trigger more critical view of both their role as researchers as well as the overall activity of developing research. This increased awareness leads to the second area of utility of this study, which concerns the learning outcomes associated with the process of conducting social research. Along the *research journey*, the attempts to design the research, to collect, analyse, and interpret data increased awareness of the limitations of both grasping reality, and the methodologies associated with such attempts. Novice analysts in the field of *organisation & environment* can benefit from the experiences described in this chapter and eventually incorporate the lessons provided by the perspective used in this study in their future work.

Finally, the contribution to the development of formal theory constitutes the last area of justification of the approaches adopted in the *research journey*. As has been stated in Chapter 6, if the ecological modernisation theory is expected to help social scientist to analyse (and eventually predict) social phenomena, further development of the theory is necessary (Mol 1995). For Strauss and Corbin (1994), the challenge of developing formal theory is one of the biggest challenges for those who believe that theory should be grounded. They quote Vaughan (in Strauss & Corbin 1994:282) to advocate the elaboration of formal theory, which:

> Consists of taking off from extant theories and developing them further in conjunction with qualitative case analysis. By *theory* she means theoretical tools in general, including formulated theory, models, and concepts. By *elaboration* she means the process of refining the theory, model, or concept in order to specify more carefully the circumstances in which it does not offer potential for explanation (italicised in the original).

By confronting the above suggestions with the approach taken by this research, one can perceive that by developing the theoretical tools, models, and concepts, this research addresses the requisites for theory elaboration. The subsequent chapters of this study formalise such effort, presenting theoretical tools for the analysis of a particular industrial setting. The description of the *automobile field* in the next chapter introduces the outcomes of the ‘research journey to the environment of automobiles’.

8 The *Automobile Field* and the Environment

The economic significance of the automobile industry is remarkable. The commercial value of new vehicles sold is estimated at around €1.1 trillion[78] a year (Maxton & Wormald 1995). Car manufacturing is *the* motor of the industrialisation policies and strategies of those countries (particularly Korea, Japan, Germany, USA, Italy, and France) that have a multitude of related economic sectors directly or indirectly dependent on this industrial activity. Automotive technology as a system involves not only the industrial production of cars but also the infrastructure and super-structure associated with their use, maintenance, and partial recycling. Its economic importance is most directly felt in the capacity of the sector to generate wealth through the creation of jobs. In political terms, job creation represents the differential power that the industry has when bargaining concessions for new factories to be established, as discussed in Chapter 5. Likewise, the outcry of employees facing the imminent closure of the factory of carmaker Rover in the UK (then owned by the German BMW) during the European spring of 2000 also illustrates the significant economic and political implications that would be attendant upon withdrawal from the activity of car manufacturing.

The tremendous economic importance of the industry also generates an ecological counterpart. Significant environmental impacts are associated with all phases of the life-cycle of cars, as well as with related systems, such as road and supply infrastructures. Taken together, this complex system suggests that cars are among the most environmentally damaging of industrial products. Public pressure and concern in relation to them is on the rise. Since the last quarter of the 20th century, automakers have increasingly been under pressure to improve their overall environmental performance. Undeniably, progress has been made. Today there is a better utilisation of materials during production cycles through in-process reusing and recycling, and the general productivity of manufacturing systems has increased substantially (Graedel & Allenby 1998). Emissions of particulates and gases during car use have decreased significantly

78 All values presented in this and subsequent chapters have been converted from United States Dollars ($) and *British Pounds* (£) to *Euro* (€), based on the average currency rates for July 2000, according to: http://www.x-rates.com (2000, July 30). The values do not consider inflation between 1996 and 2000. Since the numbers intend to give an idea of magnitude, precision is not a key element. Therefore, they represent an approximate value of the original currency.

since the 1970s, and schemes for dealing with the non-ferrous content of end-of-life vehicles have been developed in Europe (see: Chapter 11). Carmakers *Fiat Auto, Ford, General Motors* (GM), *Nissan* (now owned by *Renault*), *Toyota,* and *Volkswagen*, all endorse the principles of the World Business Council for Sustainable Development (WBCSD)[79]. *Ford* and GM also support the CERES principles[80] (for an overview of these schemes, see Chapter 3). In late 1999, Sustainable Asset Management listed *Volkswagen* as a ‘sustainability leader’ on the Dow Jones stock exchange. Such practices suggest that ecological issues have grown in importance for automakers.

To assess the extent to which the industry is exploring the potential for reducing the overall impact that cars have on the natural environment, a basic understanding of the nature of the initiatives undertaken by automakers, as well as the overall context in which they have been developed is required. Thus, the contours of the complex systems in which the automobile is embedded require development, which this chapter will provide. By identifying the main technological, economic, and environmental challenges faced by the automobile industry, the chapter embodies the *research setting* of the study, satisfying the first objective of Part II of this study, described in Section 7.1.4 in Chapter 7. In this respect, the information presented here depicts the socio-technical context of the car industry – the *automobile field* – and the key problem-areas associated with that context.

Section 8.1 introduces the fundamental technologies that support the technological regime of the modern automobile. The main conceptual framework used in car design, as well as associated materials and systems of production, are analysed in this section. The economic fundamentals that orientate today’s car assembly and marketing are presented in Section 8.2. Practices currently adopted by automakers that aim at the rationalisation of systems of production, such as platform consolidation and modular assembly, are briefly discussed in this part of the chapter. In this section the thesis also inquires into the main reasons for the high pace of consolidation that characterised the automobile assembly and supplier sectors during the 1990s.

The environmental impact of automobiles is the theme of Section 8.3. Controversial environmental issues, such as disputes between the steel and aluminium industries over

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79 WBCSD: http://www.wbcsd.ch/ (1999, September 20)

80 Coalition for Environmentally Responsible Economics: http://www.ceres.org/ (1999, September 18).

CO_2 emissions during car manufacturing and use, form the core of the analysis. Finally, by questioning the levels of efficiency of current automobiles and identifying the core competences of automakers, Section 8.4 explains why the concept of an *automobile field* is appropriate for the study of the ecological modernisation of the auto industry.

8.1 The *Technological Regime* of the Modern Automobile

An automobile is not just a physical product of technology. It also has economic, social, cultural, and political dimensions. The dominance of automobiles as a specific means of transportation refers to a technological system that encompasses more than auto manufacturing, use, recycling, and disposal. The *automotive technology system* also involves infrastructure-related technologies such as the built environment (e.g. road, highways, bridges, and tunnels) and the supply infrastructure, best represented by one of the most influential economic sectors of the 20^{th} century: the petroleum industry (Graedel & Allenby 1998). When the entire implications of the automotive technology system associated with the internal combustion engine (ICE) are considered, one can think of it in terms of a *technological regime*. Such a regime extends its influence across the whole social structure, through its effects on the geographical patterns of population distribution. According to Weber *et al.* (1999:16), this regime may be defined as "the whole complex of scientific knowledge, engineering practices, production process technologies, product characteristics, skills and procedures, and institutions and infrastructures that make up a totality of a technology".

This chapter – and the thesis in general – cannot be so ambitious as to consider dealing with such an all-encompassing system in its entirety. Nonetheless, a basic understanding of the European automobile industry – the principal *research setting* of this study – requires the identification of the main technological interdependencies between the systems with which automobiles interact. Most economic and environmental challenges faced by the automobile industry have close relationships with the development of other industrial sectors, such as the steel, aluminium, and petroleum industries. The roots of these interdependencies will be unearthed in this chapter.

Although it has become almost a reflex to acknowledge the economic power of the automotive and related industries, there is still a lack of understanding of the fundamentals of such dominance. For instance, what influenced the design options and related technologies of the modern automobile? What can explain the dominance of the gasoline-powered car? The answers to these questions must refer to three central characteristics that are at the core of the technological regime of the modern automobile: all-steel car bodies, internal combustion engines, and multi-purpose vehicles. The following sections summarise these three elements, and provide a brief explanation of the economic and the environmental implications associated with them.

8.1.1 The All-Steel Car Body

The use of steel as a specific design premise for the modern automobile has been so influential in car manufacturing that it has been regarded as a specialised technological paradigm of production. In an excellent account, Nieuwenhuis and Wells (1997) provide a detailed explanation of the 'all steel-body paradigm' and, for this reason, this section limits itself to summarising the central elements of such technology. Fundamentally, this requires one to recognise that the body-chassis technology introduced by Edward Budd was what defined the technological paradigm embedded in the modern automobile. In simple terms, by engineering a solution for the substitution of steel for wood, in order to integrate the chassis and the car body in one piece – the steel *monocoque* or *unibody*, Budd determined the scale and pace of contemporary car manufacturing. This innovation resulted in an impressive change of materials used in cars. In 1920, 85% of the car bodies were made out of wood. Six years later, steel represented 70% of the total (Lovins & Lovins 1995). The overall result of such innovation was the reduction of manufacturing and assembling costs and, once economies of scale were reached, more affordable cars could be made available to consumers.

Nieuwenhuis and Wells (1997) go as far as to assert that the mass production of cars as we know it today was only possible because of this innovation, and that the system of production characterised in the popular term '*Fordism*' should more accurately be called '*Buddism*'. Although Henry Ford introduced innovative shop floor techniques in automobile manufacturing, it was Edward Budd's technology that made possible the production of high volumes and facilitated automation in manufacturing of the modern automobile. Ford essentially streamlined the machining of key mechanical components and their assembly into a chassis, resulting also in the high levels of differentiation among tasks executed by the workforce. A wide array of researchers in management and organisational studies, as well as historians and sociologists of organisations have associated the human resource management (HRM) practices, introduced by Henry Ford as the key element for the mass production of automobiles[81]. According to Nieuwenhuis and Wells (1997), these researches have erroneously equalled the *techniques of production* introduced by Ford, with the *technology of production* embedded in the *design* of modern automobiles. In other words, the core technology embedded in car design and manufacturing developed by Edward Budd has erroneously been attributed to Henry Ford. Hence, it was the *Buddist* – rather than the *Fordist* – technology embedded in the design of (all-steel) car bodies that come to dominate automobile manufacturing from the 1930s onwards.

The *Buddist* paradigm of production and consequent dominance of steel in car manufacturing also resulted in vital consequences for the future of the auto industry. Essentially, the 'steel revolution' represented an impediment for future innovations in production processes, as well as the use of alternative materials. One of the main reasons for such a situation relates to the high investment in manufacturing technology required for the production of all-steel car bodies. According to Nieuwenhuis (1996:6):

> The *Buddist* paradigm involves high investments in the press shop (where steel sheet is pressed into shaped panel), body shop (where the pressed panels are welded together into subassemblies and thence into a monocoque body-chassis unit) and paint shop before any products have been developed. The minimum investment in a press shop would be around €160 million. Body shop investment depends on automation levels, but can be between €80 million and €160 million. Joining the Budd paradigm therefore involves an entry cost of at least between €560 million and € 800 million, without the dedicated tooling for a particular car or model.

Such entry costs may explain the fact that between 1996 and 1998 *Samsung*, a Korean *chaebol*[82], spent approximately €2.7 billion just to build and equip its car plant in Pusan, a city in the Southern part of the country (Gadacz 1996). Before producing a single car, rumours about the viability of *Samsung's* auto business started to emerge. The ambitions of the company were high but a combination of the aftermath of the Asian economic crisis of 1997, the over-capacity of internal markets and, quite possibly, unrealistic management objectives meant a dramatic entry was rapidly followed by an early exit in the volume automotive industry. In its first year of operations in 1998, *Samsung* reached fourth position in the Korean market, selling 41,593 of its SM5 car – an adapted version of the Japanese *Nissan Maxima*. But these sales represented less than

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81 For an overview of systems of production based on *fordism* and *post-fordism*, see: Badham and Matthews 1989; Clegg 1990; Orssatto 1994)

82 *Chaebols* are Korean industrial groups normally controlled by family clans, which tend to be vertically and horizontally integrated. See: Clegg (1990).

16% of its production capacity of 250,000 units per year. After having spent an estimated €5,5 billion to enter the auto business, *Samsung Motors* was liquidated in 1999. In 2000 the French Automaker *Renault* stepped in and acquired 36,8% from the creditors. *Renault* intends to 'resuscitate' the business, now renamed *Renault Samsung Motors*, and resume car manufacturing in the Pusan plant by the end of 2000 (Boley 1999).

The *Samsung* case is a didactic example of how the definition of systems of production imposes economies of scale in automobile manufacturing. *Samsung's* investments in its manufacturing facilities imposed a high *break-even point*[83] on its cars, a scenario that 'imprisons' most automakers within steel-related system of production for several years. *Renault*, in turn, after the investment of a significant amount of money in the *Samsung* plant, will certainly try to optimise the use of the 221 robots and other equipment in the body shop, which have been mainly designed for the production of all-steel car bodies. The new models that *Renault-Samsung* eventually manufactures in the future will require new tooling and their break-even point will almost certainly be close to 100,000 units per year. Added together, such economies of scale constitute significant imperatives in how auto-making should be done.

System and social integration play a very important role in maintaining the circuits of political ecology favouring the steel industry, as explored in Chapter 5. The dominance of a technological regime favouring the use of steel is hardly due to the technical advantages of the material. As Nieuwenhuis and Wells (1997:94) pointed out:

> Despite continuous improvement in steel-making technology and in design and manufacturing processes to transform steel into vehicle bodies, and despite the significant cost per unit advantage for steel in high volumes, all-steel car bodies are too heavy and the production technology too capital intensive and inflexible.

Ironically, the two apparent disadvantages of the steel industry – of being capital intensive and inflexible – seem to favour the continuing dominance of its privileged position in the auto business. The industry benefits from the historical development of sophisticated interdependencies between activities that favour a technological regime in which the all-steel car body is a core element (Section 8.3 further explores this topic).

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83 A *break-even point*, as a generic economic concept, represents the quantity where the contribution to fixed costs equals fixed costs. In the auto industry, the concept is used in a vague manner. Usually, a *break-even point* expresses the absolute number of cars produced per year (per plant or model), or the proportion of installed capacity for a particular plant. For the purposes of this study, the *break-even point* for car manufacturing, can also be understood as the amount of car production necessary to cover the fixed costs of production.

Such technological interdependencies obviously have an economic component. A self-reinforcing momentum connects economies of scale in the production of raw materials, their price, and their final use as car components. Higher volumes of primary production of steel (from iron ore) reduce the price of raw materials. As well as the fact that the levels of primary production make the material highly available, the well established infrastructure for the collection and recycling of the steel content of cars reinforces such material availability. While such scenarios favour steel as the core material in the modern automobile, the interdependencies between two of the most powerful industries in the 20th century determined the use of a specify technology to power cars.

8.1.2 Powertrains based on Internal Combustion Engines

There are several explanations for the selection and diffusion of cars based on the internal combustion engine (ICE) as a key technology in modern societies[84]. Because these theoretical approaches are well-established, this section does not intend to develop a particular account of the dominance of such know-how. Rather, it concentrates on some key characteristics of the ICE expertise that have influenced its dominance in 20th century societies. Obviously, the analysis also represents a particular interpretation of the phenomenon of the *age of oil* (Fleay 1995) or the *hydrocarbon society* (Yergin 1992). As elaborated in Chapter 7, many ‘stories’ can be told about the same phenomenon, since how ‘reality’ is registered as such fundamentally depends on the perspective adopted by the theoretical observer. As a particular socio-technical phenomenon, the explanation for the dominance of the ICE is, in this respect, another ‘story’. By revisiting the early developments in the oil industry, the section emphasises the close interdependence between the technologies that were central for the success of a specific concept of automobile. Additionally, by comparing the technical advantages and disadvantages of the ICE technology with other forms of car traction, the core elements of this technology are exposed.

A basic understanding of the success of the internal combustion engine requires a journey to the early days of the most influential economic sector of modern times: the oil industry. A combination of innovations and product substitution in the second half of

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84 Some of these explanations are based on (i) evolutionary economics, (ii) constructivist sociology and (iii) technological trajectories and quasi-evolutionary processes. For an overview of these perspectives, see: Schot (1992), Schot *et al.* (1994).

the 19th century made the ICE not only a viable technology for power generation but also a technological option that could maintain the dominance of the wealthiest American monopoly of that time. In his remarkable study of the oil industry, Yergin (1992:14) summarises the main elements of this historical period in the following:

> In the first decades, the oil business provided an industrializing world with a product called by the made-up name of 'kerosene' and known as the 'new light', which pushed back the night and extended the working day. At the end of the nineteenth century, John D. Rockefeller had become the richest man in the United States, mostly from the sale of kerosene. Gasoline was sold as much as two cent a gallon, and, when it could not be sold at all, was run into rivers at night. But just as the invention of the incandescent light bulb seemed to signal the obsolescence of the oil industry, a new era opened with the development of the internal combustion engine powered by gasoline. The oil industry had a new market, and a new civilization was born.

Hence, Rockefeller's company, *Standard Oil*, transformed its eventual loss of the kerosene market in the illumination business into an even more lucrative commerce. The substitution of oil for coal as the main fuel for locomotives, as well as other applications in the early days of the internal combustion engine, allowed *Standard Oil* to continually increase profits from the exploration of oil fields and the subsequent refining and commercialisation of their derivative products. Such an advantageous position was further reinforced by another invention. The automobile – although the butt of jokes, because of its early unreliability – became a remarkably successful product during the period of the early 20th century. In the United States of America (USA), internal combustion engines powered only 22% of the cars sold in 1900: 38% were electric and 40% were powered by steam engines (Shacket in Nieuwenhuis & Wells 1997). The situation changed rapidly: by 1905 gasoline-powered automobiles had defeated their competitors. The number of car registrations in the USA grew from 8,000 in 1900 to 902,000 in 1912 (Yergin 1992). Considering that gasoline engines powered the vast majority of these cars, by any standard, it represented a remarkable success for ICE technology.

The strategic importance of the automobile industry for oil producers was certainly a crucial influence in the success of the gasoline-powered car. The petroleum industry had an underlying economic justification to encourage automakers to continue adapting the internal combustion engine to hydrocarbon fuels. The widespread use of this technology to power automobiles would represent, as history has shown, a crucial market for the producers of oil. Those early developments would influence the petroleum and car industries to become interdependent for the remaining part of the 20th century. While such interdependence was fundamental for the success of the gasoline car, the intrinsic characteristics of ICE-vehicles, as well as the advantages resulting from their use, cannot be ignored. The rapid spread of automobiles in rural areas revealed the source of such advantage. In contrast with electric vehicles, the gasoline car did not depend on an infrastructure of electric supply and, consequently, could be used in regions in which electricity was not yet available. Although this does not explain the absence of electric cars in cities – constituting the main theme of Chapter 10 – the comparative higher flexibility and degree of independence of ICE cars certainly influenced their success. The high-energy content of gasoline and other hydrocarbon fuels resulted in relatively higher levels of drive autonomy, compared to cars powered by electric batteries. As one can envisage, in the early days of the 20th century, such advantages were even more crucial than today.

The use of ICEs in automobile powertrains manufactured by the former chief engineer of the *Edison Illuminating Co.*, (the company of Thomas Edison), became another key element in the dissemination of a specific car concept. Henry Ford's capabilities in mass-producing gasoline-powered cars significantly influenced the institution of powertrains based on ICEs. The corporations that competed against Ford from the second quarter of the 20th century onwards all utilised similar technologies. The race had been set around ICE-cars as the dominant and determinate auto-form. For most automobile manufacturers, the combination of an all-steel car body and the internal combustion engine represented an emergent and convergent core competence. Subsequent efforts have since been directed to reinforcing the competitive position of such expertise (Nieuwenhuis & Wells 1997).

The high production volume of all-steel car bodies was coincidently matched by the economies of scale required in engine manufacturing. According to Rhys (1999) the optimum scale of casting blocks and other engine parts is estimated to be around 1 million units. The production of such high volumes requires automakers to have considerable economic strength. They need to invest in resources, development and manufacturing infrastructure, as well as managerial capabilities to coordinate the development of engine components within a network of suppliers. Put simply, engine manufacturing is a large-scale business. The magnitude of production and the relative independence of engines from issues of style result in engine families remaining in production for longer periods of time than individual car models (Wells 1998). As a consequence, any changes in material specification are dependent on even longer cycles than in car-body applications. Historians of technology describe the overall result of such practices as ‘lock-in’ situations (Schot *et al.* 1994). Understandably, for most automakers, abandoning the ICE-powered car is simply an anti-economic choice, once ‘they are locked out of by being effectively locked in to the ICE’.

Further improvements in the efficiency of the internal combustion technology are still feasible (Nieuwenhuis 1998). Nonetheless, the pressure to improve the environmental performance of ICEs is expected to escalate in the first decades of the new millennium. Gasoline/diesel-powered cars will be required to achieve increasingly restrictively regulated levels of emission for cleaner air (Knibb *et al.* 1998). Alternative forms of automobile traction are expected to become more attractive from both an economic and environmental perspective. As a consequence, the early paradigmatic interdependence established between the oil and automobile industries may be due for a profound shift that would see consumption of petroleum change from fuelling engines to more durable applications, such as advanced plastics, composites, and elastomers. Demand for change will not be confined to ICE powertrains and all-steel car bodies, but to the very nature of what we think of as the essential car design.

8.1.3 Multi-Purpose Automobiles

The basic characteristics of the modern automobile – the all-steel car body and ICE-based powertrain – influenced the definition of a third central feature of the car design. Today, three market segments, denominated *core segments*, account for approximately 70% of total sales of automobiles in Europe[85]. Although the other 30% comprise *niche market vehicles*, such as four-wheel drive, luxury and sports vehicles, most of these cars can be classified as *multi-purpose vehicles*[86]. Basically, these cars can carry one to five passengers, reach speeds of more than 160km/h (although the legal limit is 110km/h and the average traffic speed is approximately 70 km/h), and have sufficient fuel capacity for approximately 400km. Most trips do not demand such performance but the vast majority of motorcars currently available in the market present these

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85 According to *Automotive News Europe*, the core segments and respective best sellers of the first quarter of 2000 were: Supermini (Fiat Punto), Lower Medium (VW Golf), and Upper Medium (VW Passat). The best sellers in the niche market vehicles were: Mini (Renault Twingo), Full Size (GM Omega), Lower Luxury (BMW 3 Series), Medium Luxury (Mercedes Benz E-Class), Upper Luxury (Mercedes Benz S-Class), Supper Luxury (All Ferrari models), Coupe/Roadster, Specialty (Mercedes Benz SLK), Minivan full-size (Renault Espace) Minivan compact (Renault Scenic), Sport Utility (Land Rover Freelander).

86 The concept used here differs from the one referring to *multi-purpose vehicles* (MPV) eventually used in classifications of market segmentation to denominate a specific market niche.

characteristics. The average drive in cities – the place where most cars spend the largest part of their time – requires less than 20% of such performance, and the average occupancy is also much lower than the capacity of these cars to comfortably accommodate five people (Gibbs 1997). Thus, one could question the reasons for consumers to keep buying over-dimensioned and over-specified cars. Simply, what could explain the success of the multi-purpose vehicle? If a smaller car with substantially reduced performance (presumably costing less than a multi-purpose car) could potentially satisfy the needs of most motorists, why do they pay relatively more for larger cars?

There are three apparent reasons for the ubiquity of this large car as a multi-purpose vehicle concept. The first relates to the supply side of the equation. As was emphasised in the first sections of this chapter, technological options in systems of production impose high *break-even points* for car manufacturing and, consequently, denote that there are large economies of scale to be achieved in the auto business in general. As the next section will explain in more detail, having cars with similar dimensions increases the chances of an automaker being able to achieve economies of scale. For instance, manufacturing cars to fit only two people, although apparently simple, requires a substantially new approach to car design and material use. Lightweight vehicles entail a shift from the all-steel car body to materials that may require a new set of safety technologies, which would inevitably incur additional costs for carmakers (see Chapter 10). Significantly smaller ICE engines, or other sources of propulsion, could power smaller cars. Developing such powertrains, besides representing increased costs, may constitute a risky strategy for carmakers: the consumer must be willing to buy such cars. Hence, for most carmakers, manufacturing multi-purpose cars simple makes better business sense than ecologically preferable alternatives.

The other two reasons people buy multi-purpose automobiles refer to elements embedded in the demand side. Fundamentally, for most consumers the conceptual image of an automobile resembles the multi-purpose vehicle (Freund & Martin 1993). Although the technology embedded in conventional steel-bodied cars powered by internal combustion engines is under-utilised, this concept became synonymous with what a car should be.

Traditionally, sport cars have been the only area of market success for two-passenger cars. Roadsters, such as the BMW *Z3*, Mercedes-Benz *SLK 230*, Porsche *Boxster*, and Mazda *Miata* suggest that preferences for two-seater cars have little to do with environmental concerns. These market successes represent a specialised niche preference associated with velocity and freedom. The case of the *Smart* car – a two-seater launched by Mercedes in 1997 – demonstrates that consumers have not responded so well to cars whose appeal is premixed on their environmental friendliness (Ostle 1999a). In the case of *Smart*, it was only when the marketing strategy refocused on its appeal as 'fun-to-drive', and its high-tech equipment, such as formula one soft-tip gearshifts and the design of interior parts, that consumers started to respond. In fact, the continued survival of the *Smart* car seems to depend on the launch of a roadster that will compete with other sports cars (Ostle 1999b). In this case, the *Smart* will move from being a two-passenger car in the 'mini segment', in which it was originally created to compete on the basis of its environmental prerogatives, to become a sports car competing on the basis of its emotional appeal as something that is 'fun-to-drive'.

The structure of the after-sales market constitutes the last factor influencing people's choices in buying multi-purpose cars. For most consumers, the relatively high economic value of vehicles transforms them into major sources of investment. Generically, average cars are easier to commercialise than those designed for specific market niches. In these circumstances, a car presenting the characteristics of the *Smart* (two seats) can expect to find only a very select number of consumers willing to buy it as a second-hand vehicle. By contrast, cars such as the *Volkswagen Beetle* (a multi-purpose car, according to the prerogatives presented here) became a product of high commercial value in many countries mainly because of its potential to be further traded. In fact, the characteristics of the automobile market, which currently reinforce consumer preferences, are not limited to the demand side. The current *technological regime of the automobile* impose development strategies and forms of rivalry that, in many respects, are specific to the auto industry. They are explored next.

8.2 Economies and Strategies of Rivalry in the Automobile Industry

Auto manufacturers have historically considered the all-steel car body and the internal combustion engine as their core competences (Nieuwenhuis & Wells 1997). They mastered the technologies assisting these core competences and, in this respect, the automobile sector has achieved a great degree of maturity. Internal combustion engines have achieved an amazing degree of sophistication and efficiency (Nieuwenhuis 1998) and the technology associated with the production of all-steel car bodies has been the main driving force in the development of robots in factories (Porter 1990). Not only have an impressive array of technological developments been achieved during the history of the automobile but the sector has also served as a benchmark for new management strategies and skills, such as total quality management (TQM) and lean production (Womack *et al.* 1990). Terms such as *Fordism* and *Toyotaism* became associated with specific management techniques, widely adopted by organisations in other industrial sectors (see, for instance: Badham & Mathews 1989). Either from an economic, technological, cultural, or political perspective, the auto industry has been a successful enterprise.

Nonetheless, there are many reasons to believe that the foundations for this historic success are fading away. Remaining profitable or exiting from the auto industry without substantial losses is becoming increasingly difficult, as the case of Samsung demonstrates. To become a volume producer is extremely expensive; however, leaving the industry can also result in significant losses. Thus, for most enterprises associated with the production and commercialisation of automobiles, fighting for their survival within the industry is the only viable strategy. As a whole, such positioning has caused significant changes in the structure of the auto industry. The imperatives of cost reduction have been imposed on component suppliers and automakers have imposed a rationalisation of systems of production that extended far beyond the frontiers of the focal car corporations. Economic pressure has driven the automobile industry towards a profound process of restructuring and redefinition of its competitive strategies. The main roots and consequences of such transformations will be summarised next

8.2.1 Economies of Scale, Low Profitability, and Market Saturation

Manufacturing automobiles has increasingly become a risky enterprise. Observe the demise of the (former) Japanese automaker *Nissan*. During the 1980s, Nissan was among the Japanese corporations that served as a benchmark of efficiency and quality for western firms. In 1989 the company obtained a 2.1% net return on sales of 2.81 million vehicles. However, during the period 1992-98, *Nissan* sold an average of 2.72 million automobiles per year and the only year in which the company had net positive returns on sales was 1996 (Hunston 1999). What explains such performance? How can a company sell volumes that are comparatively higher than the combined production of cars and trucks of all Latin America[87] and still not be profitable?

The bubble burst of the Japanese economy in the early 1990s is certainly one of the factors influencing *Nissan's* performance. But it does not explain the continuous success of *Nissan's* rivals, such as *Toyota* and *Honda*. As one might expect, poor management practices were part of the equation. The nature of the decision-making within the vertical *Keiretsu* system, which bound Nissan to its suppliers, was one, among many other management practices that resulted in the accumulation of debts totalling €7.72 billion . In 1998, the French automaker *Renault* bought 38.6% of the company and became *Nissan's* largest shareholder. The new management imposed a drastic 'rescue plan', including the closure of five factories and the consequent loss of 21,000 jobs worldwide, as well as the reduction of annual capacity from 2.4 to 1.5 million cars from the year 2000 onwards[88].

A more stable Japanese economy and the new French-oriented management team will be central for the future success of the renewed Renault-Nissan. For the purposes of this study, however, the importance of Nissan's case is not to demonstrate the potential consequences of market fluctuations or practices of crisis management. Rather, the case reveals a central characteristic of the auto business: the slim margins between profit and loss faced by most automakers. Two interconnected factors explain such reality. The first is the imperative of economies of scale that automakers imposed on themselves over the years. A break-even point of 250,000 units for the Fiat *Bravo/Brava* (lower-medium segment), for instance, is considered normal practice in the industry (Bremner 1999), for reasons that were explored in Section 8.1. The next section will show that carmakers are implementing rationalisation measures, which have the potential to reduce production costs and lower the break-even point for most models. Nonetheless, these practices do not change the fundamental imperative of economies of scale for most automakers. Although *Nissan* intends to reduce its production capacity, from 2.4

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87 In 1999, 2,236,389 units were produced in Latin America. Source: *Automotive News Europe*, 1999 Global Market Data Book, p. 5.

88 *Automotive World*, November 1999, p. 18-19, and December 1999, p. 43-37.

to 1.5 million vehicles per year, such volume is still larger than the total number of cars and trucks produced in Brazil[89] in 1999 – the eighth biggest producer in the world.

The second factor explaining automakers' slim margin between profit and loss is the low level of profitability of the car assembling business. A close look at the profit pool involving car manufacturing, retailing, leasing, and car parts, among other businesses, shows that carmakers take a meagre 1% of the total (Golding 1999). In terms of operating margins, car assemblers and component suppliers together have average returns on revenue of 3.5%. Not surprisingly, the combination of such margins with high break-even points for most car models makes carmakers particularly vulnerable to slight market fluctuations (Golding 1999). The saturation of mature markets in highly industrialised countries transforms this vulnerability into a cycle of profit and loss in the industry (see Table 8.1.). A close look on the table will show that only three volume manufacturers – BMW, *Toyota*, and *Honda* – did not experience any year of losses during the period of 1990-1998. In 1992, *General Motors* reported a loss of €26 billion on a turnover of €131 billion. Although around €22 billion was due to changes in accounting practices related to pension liabilities, there is no doubt that the company incurred a massive loss in that fiscal year.

The figures presented in Table 1 and the sales records in mature markets around the globe during the past decade are strong indications of market saturation. During the 1990s, the number of automobile registrations remained around 12 million cars per year[90] in Western Europe, with Japan and North America presenting similar, quasi-horizontal curves. Such a scenario certainly favoured the consumer. Higher levels of rivalry among automakers put pressure on prices and favoured consumer demand on a wider variety of models.

In competing for an increasingly fragmented market share, automakers also faced pressure to invest in product development. Simultaneously, the low profitability of the industry put pressure on them to cut costs. Recognisably, such a situation is far from ideal from the producer's point of view. The combination of the imperatives of

89 Total: 1,347,766 units (253,766 trucks and 1,094,000 cars). Source: *Automotive News Europe,* 1999 Global Market Data Book, p. 5.

90 *Automotive News Europe*, 1999 Global Market Data Book, p. 7.

economies of scale, market saturation, high consumer demand for a wider range of models, and low profitability margins, is not exactly a good basis to enter business.

Table 8.1: Net Profit/Revenue in Assembly Firms 1990-1998 (%)

Company	High	Low
BMW	2.6	1.5
Daewoo	4.3	-9.1
Daimler Chrysler	4.0	-5.5
Fiat Auto	1.5	-7.1
Ford	3.7	-10.2
General Motors	4.4	-18.3
Honda	4.2	0.6
Hyundai	1.5	-0.1
Mazda	1.0	-2.2
Mitsubishi	0.9	-2.5
Nissan	2.1	-2.8
PSA Peugeot-Citroen	5.8	-1.0
Renault	3.1	-2.9
Toyota	4.8	1.6
Volkswagen	1.6	-2.5

Source: *Automotive World*, September 1999

If there is agreement about the saturation of markets, the picture is not so clear about where to locate the overcapacity of the industry. According to Wells (1998), in 1996 the global excess capacity of the auto industry was equivalent to 40 average assembly plants. Four years later, industry experts seemed to agree that overcapacity was around 18-20 million cars per year – or 30% of the total capacity of 60-65 million units per year (Keller 2000). Many automakers saw the emerging markets of developing countries as a way of relocating their overcapacity. Section 5.1 of Chapter 5 briefly described the process of expansion of auto manufacturing in Brazil during the 1990s. At that time, the markets of Latin American, Easter Europe, India, and China were considered to be the likely salvation for the industry's ills. By installing factories in these countries, carmakers would be better able to exploit financial returns in local markets while at the same time optimising their economies of scale at a global level.

High expectations in respect of emerging markets encountered a tough reality. Problems common to most developing countries, such as a lack of infrastructure, high currency fluctuations and consequent price instabilities, and structural problems resulting from inequalities in income distribution, considerably limited the potential for projections to become reality. For instance, during the second half of the 1990s the projection of sales of motor vehicles in Brazil for the year 1999 was 2.5 million units. Such a prognosis was one of the reasons for the massive influx of automakers' investments during this period, which transformed Brazil into the country with the highest number of local market vehicle producers. However, the sales of motor vehicles achieved in Brazil in 1999 was 1,298,696 units[91], or only 52% of the forecast. Currency devaluation was indicated as the major factor responsible for the economic recession and the slump in car sales during that period. Today, the estimate of overcapacity in the *Mercosur*[92] is even higher than in mature markets: around 50% of the production capacity in the region (Calmon 1999). In many respects, the potential of Brazil to become major markets for car manufacturers remains unaltered, as is also the case in other developing economies. While carmakers wait for these emerging markets to alleviate the problems faced in mature markets they have to work on areas where they have more control. Production and distribution costs are some of these areas.

8.2.2 Rationalisation of Systems of Production

The auto business is faced both by the saturation of mature markets and by low levels of profitability. The rationalisation of systems of production and commercialisation has been one of the main responses by firms in the industry. Fundamentally, automakers have to explore every cost saving opportunity to maintain their competitive edge and profitability margins. Although the peculiarities and capabilities of each producer determine how they implement their cost cutting measures, the main areas of common action that have emerged in the last decade include platform consolidation and modular assembly.

a) Platform Consolidation

Although there is no common concept of what constitutes a 'platform', in its essence a platform is the 'floor' or the foundation of a vehicle. When car models use different platforms, they require dedicated engineering, general tooling, and assembly elements. The idea of sharing platforms is, therefore, a simple one: a lower number of platforms for a vehicle manufacturer across their range means lower costs. Harbour (2000) asserts that platform consolidation can represents savings of between €55 million and €110 million in body welding alone in a car plant but savings can also be achieved in engineering, testing and tooling. Fundamentally, this is the main rationale fostering

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91 *Automotive News Europe*, 2000 Global Market Data Book, p. 23.

92 The Southern Common Market (*Mercosur*) members are Brazil, Argentina, Uruguay, and Paraguay. See: http://www.mercosur.org/english/default.htm (2000, September 7)

platform consolidation, which the auto industry has pursued vigorously from the second half of the 1990s onwards. Sharing platforms not only saves money; there is an apparent consensus in the industry that it also reduces development time and improves quality. These are the main reasons why the vast majority of carmakers have put substantial efforts into reducing the total number of platforms[93].

Platform consolidation should be understood as a management strategy, rather than an innovative design for production systems. In fact, the concept of a common platform is as old as the automobile. By the 1920s, carmakers were using similar techniques aimed at economies of scale (Chapman 1999). However, increasing consumer demand and rivalry within the industry resulted in a substantial growth in car models for several decades. Satisfying consumer demand for new models was relatively more important than the rationalisation of platforms. In the 1990s, the situation reversed. Many markets became saturated and the investment costs of new platforms simply could not be maintained by automakers. Rationalisation of systems of production became an imperative ‘correction’ of manufacturing strategies that could only be maintained in the ‘old times’ of substantially higher demand for cars and less pressure on cost reduction. Automakers have pursued platform-sharing strategies to such an extent that in 1999 *Automotive World* – a leading publication in the industry – started to rank the ‘top 100 platforms’. There is an unequivocal race for the best performance, measured by the total number of cars of different models produced with a single platform. *Volkswagen*, for instance, topped the list in 1999. The German company used a single platform for the production of eight different models whose combined sales totalled 1.9 million units (Bremner 2000).

There is a risk associated with extreme platform rationalization: cars may end up looking too similar. Some experts in the industry believe that consumers of relatively more expensive car brands may not appreciate the fact that the automaker uses the same platform to manufacture lower-ranked cars (Wells 1999). For instance, this is the case with the *Audi* A3 and *Audi* TT, which share the same platform as the VW *Golf* and *Skoda Octavia*. This leads to the conclusion that, while there is room for cost cuttings in

93 Japanese carmakers *Toyota, Honda,* and *Nissan* currently have 61 platforms across their model ranges. In the next few years, they plan to reduce these to twenty-eight only in the next few years. The American car manufacturers GM and *Ford,* and the German-American *DaimlerChrysler* plan a reduction from a total of 53 to 41 platforms (see: Harbour 2000).

platform consolidation, there is also a clear limit to the implementation of such practices. Further cost savings need to be pursued in other aspects of car manufacturing, such as modular assembly.

b) Modular Assembly

Suppliers of vehicle components have played progressively important roles in cost savings strategies in auto manufacturing. The search for hidden opportunities for cost cutting moved from the components themselves to the management of the interface between components and car assembly. In other words, the suppliers become actively involved not only in the design of components but also participate in the assembly process. With this method, known as *modular assembly*, firms supplied not only components but also entire sub-assemblies, fitting them in the assembly lines.

An example of *modular assembly* can be found in the city of Resende, in the state of Rio de Janeiro, Brazil. There, seven suppliers collaborated with *Volkswagen* to build a truck plant. The component suppliers employed three quarters of the factory workers that participated directly in the trucks final assembly. Similar practices were adopted in ‘Smart Ville’, the industrial facility where the Smart car is assembled in Hambach, France. Rather than assembling the entire *Smart*; the *Micro Compact Car* company (MMC) sub-contracted large sections of the assembly plant to suppliers, whom they designated as ‘system partners’. The partners occupy buildings located in the area surrounding the (mathematically shaped) ‘plus’ building, where the core activities of MCC are performed. Instead of supplying single components, the system partners are responsible for the delivery of entire modules, such as seats and dashboards. Fundamentally, such practices imply that quality assurance is no longer located in the individual components companies. Suppliers are responsible not only for the quality of the modules but also need to provide assurance concerning the quality of the processes that relate to the installation of the modules in the vehicle.

The direct participation of suppliers in investments in new plants reduces the need for capital directly invested in the factory. However, such attempts to integrate the supply chain seem to have a more managerial rationale. The management of a more integrated system is certainly less costly for automakers. By dealing with a smaller number of suppliers, long-term relationships can be better established, and cost-cutting strategies can be based on a more collaborative character. A long-term commitment to be involved directly in the core business of the automaker becomes a central motive for the supplier to explore cost-savings opportunities not only in the manufacturing of components but also in the activities associated with the delivery and final assembly of modules into the vehicle. Such an approach is expected to result in the reduction of manufacturing costs and assembly time.

The pressure to become a ‘system partner’ or a ‘module assembler’ has become considerable since the early 1990s. Basically, the capability to supply modules requires firms to do one or other of a number of things: acquire expertise to manufacture the entire range of components, or else merge with, or buy, other companies. Although there are several options, one organisational characteristic became imperative for systems suppliers: size. Aligned with the need for rationalising systems of production in car manufacturing, developments in the auto-assembly business have forced consolidation in the industry even further. The next section exposes the driving forces embedded in this phenomenon.

8.2.3 Industry Consolidation: Mergers and Acquisitions

In terms of ownership, the automobile industry in the first quarter of 1998 was to differ significantly from the situation just two years later. The intercontinental merger of the American *Chrysler Corporation* with *Daimler-Benz* of Germany in May 1998 represented a milestone in the history of the auto industry. Since then, the pace of mergers and acquisitions has been so remarkable that the ownership situation has become confusing, even for industry experts. Only a well-informed consumer would know who is the actual owner of the plant in which the car she or he is buying was made. Although the names of traditional car brands and companies still remain in the market, today *Volvo* ‘*is*’ *Ford,* while *Bentley* ‘*is*’ *Volkswagen*. Observe the amusing summary of the consolidations that occurred in the period 1998-2000, as they are presented by Feast (2000:34):

> Ford snapped up Volvo Cars and now Land Rover, Volkswagen bought Bentley, BMW will own Rolls-Royce from 2003, Audi acquired Lamborghini and Hyundai Motor won control of the bankrupt Kia Motors. Rover was put down. Renault raced to the rescue of troubled Nissan and Dacia and now wants to take over the bankrupt Samsung Motors. Daewoo Motor won the battle for Ssang Yong Motor, only for the whole Daewoo group to collapse. Now Daewoo Motor itself is on the block, with Fiat, GM, Ford and DaimlerChrysler eager to pick up the pieces. DaimlerChrysler itself appears close to a merger with heavily indebted Mitsubishi Motors. Whatever next?

What can explain such pace of change? Why has such large-scale consolidation practically became a business imperative in the auto industry? Although the root explanations of answers to these questions reside in factors already explored in the previous sections, practically, they converge into a single concept: that of economies of scale. Experts in the industry seem to agree on the size imperative. That is, in order to compete in this *brutal busines*s (Keller 2000), car manufacturers need to have global reach. In the view of O'Brian (1999:56):

> Mergers and takeovers among assemblers are designed to achieve economies of scale and scope; strengthen positions in certain markets, including though brand reinforcement; and, in some cases, to provide access to a better mix of labour than was previously available to the stronger firm.

Globalisation has supposedly become the key word behind the trend of mergers and acquisitions. Indeed, many industry analysts believe that this is the only strategy for survival in the auto business. If current trends of consolidation are maintained, by the year 2020 only six automakers, each one producing around 15million units per year, will remain in the industry (Feast 2000).

The formation of corporations with such global reach makes business sense but, in practice, the majority of mergers fail to deliver their promise. *DaimlerChrysler* is the most well-known of the recent mergers. On November 17 1998, the first day of stock trading of *DaimlerChrysler*, the co-chairmen of the newly formed corporation Jürgen Schrempp, stated: "seventy percent of mergers fail because they forget the customer". Indeed, satisfactory sales of car brands, such as *Mercedes Benz* and *Jeep* during the 1999 suggest that *DaimlerChrysler* kept customers satisfied. However, shareholders seemed more capricious. During the same period the shares of the company lost a third of their value. Lack of synergy between the two organisations resulted in poor communication with shareholders and consequent discrediting of business performance. From the perspective of shareholder value, the amalgamation did not bring sufficient value. However, the institutional mould has been made: for American and German counterparts, globalisation seems to be the only strategy to be followed − Indeed, two years after the merger, *DaimlerChrysler* would acquire 38% of the Japanese automaker *Mitsubishi*.

Despite the enthusiasm of auto industrialists for adding former rivals to their business portfolio, not everyone agrees with the frantic pace of mergers in the industry. Rhys (1999) considers opportunistic takeovers a risky business. He emphasises that the high number of failures in mergers is a result of acquisitions that had not considered the fundamentals of the businesses purchased. Wells and Nieuwenhuis (2000) suggest that the problem does not lie in the fundamentals of the businesses but the overall assumption that bigger corporations will have a better chance of surviving in the industry. Indeed, concentration of capital and ownership reduces the risks of exposure to localised market fluctuations, and increases the capacity of carmakers to invest in research and development as well as marketing. However, the authors stress that economic, social, environmental and new enabling technologies are making a new structural configuration of the industry possible. Escalating environmental pressure has the potential to accentuate the economic constraints faced by the auto industry to such an extent that, eventually, a new technological regime for the automobile may emerge. The next section explores the main problem-areas that might lead to such radical changes.

8.3 Environmental Issues in the Context of the Automobile Industry

The scope of environmental harm caused by cars is vast. According to the German Environment and Forecasting Institute, before an average car is put into use, it has already produced 26.6 tonnes of waste and 922m^3 of polluted air (Whitelegg 1993). Although this is a significant figure, it represents less than 10% of the total environmental impact of an automobile during its life-cycle. About 80% of its impact results from air emissions during car use, the remaining 10% being due to the pollution associated with the final disposal of its constituent parts (Rogers 1993). Overall, the automobile constitutes an example of a product with an extensive environmental footprint in all phases of its life-cycle. Table 2 provides a simplified overview of the environmental impacts caused by automobiles during their complete life-cycle.

Technical information about the impact of automobiles on the natural environment, described in Table 2, is readily available[94]. Graedel and Allenby (1998), for instance, produced a remarkable account of the environmental impact of the entire automotive system. The authors provide detailed information not only about its impact in all phases of its life-cycle, such as energy consumption during car manufacturing as well as details of in-service phases, infrastructure needs, and recycling techniques, but they also suggest alternatives for improving the current system. Hence, it is because of the

94 See, for instance: OICA (1995); the research reports of *The Economist Intelligence Unit* on ‘the automobile industry and the environment’, such as Rogers (1993); The series of environmental reports of *FT Automotive* (for instance, Knibb *et al.* 1998); Substantial information is also available on the *Internet*. The Environmental Defence, an American NGO, for instance, presents a basic life-cycle analysis of the impact of automobiles: http://www.edf.org/programs/ppa/vlc/index.html (2000, August 15).

availability of this material that this section focuses more on specific issues, rather than exploring all areas in which the automobile impacts on the natural environment.

Table 8.2: Simplified Car Life-cycle Environmental Impact

1	**Pre-Assembly**
	Mineral extraction for raw material (iron ore, bauxite, oil, etc.); transport of raw materials Production of secondary material (steel, aluminium, plastics, etc) Transport of these materials to assemblers and suppliers Production of components and subassemblies Transport of components and subassemblies
2	**Assembly**
	Energy used in assembly plant Pollutions caused in assembly process, particularly in paintshop emissions Release of waste materials into ground and water and into the recycling system Transport of finished vehicles to customer
3	**Use**
	Energy used for driving Pollutions caused by emissions and waste materials from disposables (batteries, tyres, oil, etc.) Land-use requirements (roads, fuel stations, parking facilities, etc) Accident damage to people and environment
4	**Post-Use**
	Transport to dismantling site/scrapyard Energy use in dismantling/scrapping processes Pollution caused by dismantling/scrapping processes Transport of recyclates

Source: Nieuwenhuis & Wells(1997:140)

The topics presented in the next sections deal with environmental impacts occurring in more than one phase of the life-cycle of cars and, for this reason, they focus on controversies and disputes between several interested parties. Technical information is combined with (mainly political) disputes associated with technological innovations in design and manufacturing, and questions concerning the adoption of materials and fuels, to address the main environmental issues related to automobile manufacture, use, and recycling. The remaining chapters present more detailed information about some of the topics discussed in this section, as well as problem-areas that are not covered in detail here. Environmental regulation and research & development (R&D) programmes, for instance, are explored in Chapter 9; the environmental impact of end-of-life vehicles, and coverage of the schemes developed in Western Europe to tackle them, will be the theme of Chapter 11. Although these topics are at the centre of industry debate, several other disputes currently add to the broad theme of the ‘environmental impact of automobiles’.

8.3.1 Environmental impacts: Interdependencies and Trade-offs in the Life-cycle of Cars

If at all possible, a study concerning the environmental impact of automobiles should follow the recommendations of Graedel and Allenby (1998:78):

> One should consider the extraction from their reservoirs of the materials that are used, what happens to them (and the environment) during product manufacture, how the use of the product or systems affects the world within which the use occurs, and, finally, what happens to the product or system and its materials once it is obsolete or the consumer disposed of it.

Clearly, such a study requires an analysis of environmental impacts happening in all phases of the product's life-cycle. Although this remark is of critical importance, there are two other central reasons for using a *product life-cycle* approach when analysing the environmental impact of automobiles. They both relate to the interactions that occur between phases, rather than the impact associated with each stage of a car's life-cycle. First, there are interdependencies between the various phases of the product lifecycle, and technical innovations in one phase have the potential to either reduce or increase environmental impacts occurring in other phases. For instance, the specification of extruded-coloured plastic for the body parts of the electric vehicle *Th!nk*, resulted in the elimination of painting from the manufacturing processes (see: Section 10.4 in Chapter 10). The elimination of this harmful production process through product redesign significantly offset any environmental gains achievable through incremental innovation in painting. In this case, analysis focusing only on environmental innovation during manufacturing would be misleading, since the most significant gains would have been 'hidden' in the design phase of the product.

Another reason for considering the entire life-cycle of a product in environment-related research relates to the potential *trade-offs* between distinct phases. In simple terms, environmental gains in one phase can represent a loss in another. As Chapter 11 will explore in more detail, the substitution of plastics for steel can result in the reduction of weight and consequent fuel consumption during the use of a car, but higher rates of non-recyclable car parts can negate the environmental gains in fuel economy (Frosh & Gallopoulus 1992). Trade-offs between the use and disposal phases are not exclusive to this example. Consider the amounts of energy and materials required for car manufacturing. In this context it is not clear whether taking relatively old cars (older than ten years, for instance) off the roads through legislation that compulsorily scraps them would mitigate the environmental impact of air emissions during the extended use of these cars. Should the industry seek to extend the life-cycle of automobiles or substitute for them new ones with better fuel performance? As the question suggests, if the analysis of vehicle environmental performance is not based on a life-cycle perspective, ecological improvements in car design can be misleading.

These fundamental examples highlight the complexity of environment-related issues in the context of the automobile and the need to adopt a product life-cycle perspective when tackling such issues. Using this approach, the overall design of cars and associated industrial processes resulting from their production will be under scrutiny. The present study does not develop a technical *life-cycle assessment* (LCA) of cars (according to the requisites discussed in Chapter 3, Section 3.3) but a *life-cycle perspective* guides the overall analysis of various parts of the study. (For details about the perspective adopted in data collection, analysis, and interpretation, see Section 7.2 in Chapter 7.) Issues related to the consumption of fuel, for instance, are normally associated with – and treated independently from – the phases of car use. As the section below shows, a life-cycle perspective is essential in comparing the environmental impact of steel and aluminium with the emission of CO_2 during the production and use of cars. The possibility of substituting aluminium for steel in structural functions, as well as in car bodies, has to be seen in the context of an important battle between suppliers of raw materials to the automobile industry. The dispute between aluminium and steel-makers has accentuated in recent years – at issue is the reduction of the weight of vehicles.

8.3.2 Air Emissions: Disputes Between Steel and Aluminium Industries

Central to the issue of vehicle fuel consumption – and consequent air emissions – is the weight of automobiles. It is here that the dominance of steel in car manufacturing suffers its biggest potential threat. The greater density of steel, when compared with aluminium or plastic composites used in similar applications, results in relatively higher energy requirements during car use. In simple terms, heavier vehicles consume more fuel. Associated with the burning of fuels by internal combustion engines are harmful emissions, such as oxides of nitrogen (NO_x), and carbon dioxide (CO_2). Mainly because of the lower density of aluminium, it can reduce the total weight of the vehicle, making this material a likely substitute for steel in several automotive applications.

Seventy years or so of investments in all-steel car body technology work against a move away from steel. Although the automobile sector represents only 16% of the steel market in OECD countries (Organisation for Economic Cooperation and Development), any market loss would accentuate the problems the steel industry has with its current overcapacity (Wells 1998). For this reason, during the 1990s, the sector put substantial efforts into overcoming the main weaknesses perceived to attach to the use of steel in automobiles: its relatively heavy weight when compared with alternative materials, such as aluminium and carbon fibre. In 1994, a consortium of world leaders in steel production launched the *Ultra Light Steel Auto Body* (ULSAB) project. In its first phase, the project successfully demonstrated the (theoretical) technological possibility of reducing the mass of steel by 20% without compromising safety or performance. Phase two, which started in 1996, expected to achieve a reduction of approximately 200kg in the average weight of vehicles. Phase three intends to transform the €23 million investment in the first two phases into volume vehicle production.

The steel industry has used the ULSAB project to respond to criticisms about the relative high environmental impact of the all-steel car body during the phase of car use. The loss of a significant market share in automotive applications would not have a great impact on the *aggregate* sales of the steel industry but, given the present state of overcapacity in steel production, the sector is fighting for every fractional share of the overall market. Moreover, when a distinction between the two main groups forming the steel industry is made, for many producers, the dependence of the auto industry becomes much higher. The integrated blast mills, for instance, are strongly oriented towards the high value of some wide-strips of steel they supply to the auto industry. For many mills, the auto industry represents more than 30% of their turnover, and an eventual reduction the market in this sector would certainly have disastrous economic consequences for these firms.

In the aluminium sector the base percentages of the market fractions are smaller. Producers of aluminium have succeeded in increasing the content of the metal used in cars from around 3% in the 1970s to 8% in the 1990s, mainly in non-structural applications (Weernink 1998). Engine castings represent half of the total consumption of aluminium while wheels count for around one quarter (Wells 1998). While this represents a steady increase in the use of aluminium in cars, there exist exponential opportunities for growth in the use of the material for structural applications.

In the battle between aluminium and steel what, increasingly, has been at issue has been the trade-off between the environmental impact of material inputs in *production* compared with their impact *in-use*. Aluminium producers argue that the substitution of one tonne of aluminium for steel in automotive applications would reduce CO_2 emissions by 20 tonnes over the life-cycle of an average vehicle. The steel industry argues that producing one tonne of virgin aluminium (primary production) generates 10-15 times more CO_2 emissions than producing one tonne of steel.

The dispute between the aluminium and steel industries on this matter can be simplified by identifying an ‘energy break-even point’, which represents the energy consumption of steel or aluminium through the entire life-cycle of a car. The steel industry has used the results of research conducted by the Materials Systems Laboratory at the Massachusetts Institute of Technology (MIT) to argue that, because the primary production of aluminium results in higher emissions of CO_2, cars with high aluminium content also have a high break-even point. The MIT study compared the total CO_2 emissions associated with the production and fuel use of both materials for: (i) a typical vehicle, (ii) a vehicle with an aluminium body, (iii) and the ULSAB (Ultra Light Steel Auto Body) vehicle. The results show that, when compared with a contemporary all-steel car body, the break-even point for the car with aluminium body is 10 years of usage, and 12 years for the ULSAB vehicle[95]. In simple terms, according to this study, the environmental impact that occurs during the production of aluminium can be mitigated through the useful life of the car. The lower environmental impact that is sustained during the production phase, compared with the primary production of aluminium, seems to represent a competitive advantage for the steel industry.

Nonetheless, the results of the MIT study would change dramatically if one considered aluminium produced from post consumer materials or scrap alloys. The secondary production of aluminium (recycling) requires only 5% of the energy needed to produce primary aluminium from raw materials (Thomas & Wirtz 1994). But current material availability limits the levels of secondary production. In the USA there is a well-established infrastructure for collection and recycling of aluminium beverage cans, which are used to manufacture vehicles cabs, among other products. However, the separation of specific alloy types suitable for extrusion and/or pressing still represents a problem. In most countries, systems for collection and recycling of aluminium are not as developed as those established for steel during the decades of its dominance of in car

95 Calculated for an average life-cycle of 12,5 years, a total drive of 224,015Km, corresponding to 17,921Km/year. See: http://www.autosteel.org/co2/default.htm (2000, September 23)

making. Additionally, low levels of recovery and consequent fluctuations in price impose serious limitations in the availability of material for secondary production (Picton 1999).

Simply, the structure of both the steel and the aluminium industry favours the former. The interdependency between the structure of the industry and the prices of its key input commodities is highly significant. Especially, this is true of the infrastructure for material recovery and recycling. The quality of this infrastructure can either foster or inhibit the *greening* of industrial sectors. Similar interdependencies are also present in another area of environmental dispute in the automobile industry: the central role of oil and petrol pricing strategies.

8.3.3 Oil Availability and Prices and the Future of ICE technology

Internal combustion engines are vulnerable to the availability of oil. Although the finitude of oil reserves is unquestionable, the time frame for its exhaustion is very controversial. The fundamental disagreement resides in: (i) the estimation of existing and undiscovered petroleum reserves, (ii) the rate of oil consumption, (iii) and the costs of extracting the final deposits of oil from wells (Campbell & Laherrère 1998). First, the estimation of oil reserves is vulnerable to political manoeuvres. Around the world, the numbers of reserves published by oil-producing countries and corporations are not subject to public scrutiny. By inflating reports of reserves, members of OPEC (Organisation of Petroleum Exporting Countries), for instance, can increase their exports of oil. Estimates of reserves can also raise the value of a corporation working in oil exploration, increasing the chances of speculation around the real amount of oil deposits.

Second, there are controversies about the rate at which oil will be consumed in the next decades. Although statistical data indicate demand tendencies, speculations about changes in patterns of consumption make it difficult to extrapolate past trends. Disputes among political parties and other interest groups make estimates of probable consumption even more vulnerable to political speculation than is the case with oil reserves. Finally, the cost of optimising extraction rates from oil wells is also controversial. In simple terms, the costs of extracting oil increases with the depletion of the well. Apart from the geological differences between wells, as petroleum is extracted, the costs of pumping the remaining portion tend to escalate. For this reason, pumping

100% from a well might be technically feasible but in most cases is economically unattractive.

Campbell and Laherrère (1998) considered all the above to estimate that 1,000 billion barrels of petroleum remain underground – 850 billion in oil reserves, and 150 billion in undiscovered oilfields. At current rates of 2% growth in consumption per year, the authors predict that this amount of oil will be able to 'fuel' societies for approximately 40 more years. Contrary to popular concern, for Campbell and Laherrère, working from an economic perspective, identifying the exact date when the world runs out of petrol is irrelevant. Instead, what is of consequence is when world production will start to decline. If their calculations are correct, oil production should peak in 2010 and, unless technological and social factors significantly reduce demand for oil, prices will rise considerably. With less oil to be marketed it means that oil will be sold at higher prices.

The availability of petroleum and its consequent fluctuation in price will certainly remain subject to dispute. Wells (1998:171), for instance, asserts that: "the mainstream view of the short to medium future for petroleum is that supply will easily meet demand – there will be no fundamental economic or physical resource constraints". Until actual demand numbers start to top predictions, such as those of Campbell and Laherrère, the debate will be open to speculation. Despite these disputes, a common ground seems to be that environmental concerns are the most important reason for avoiding oil dependency (Wells 1998; Yergin 1992; Hörmandinger 1997). Extracting oil from sand (oil shale), for instance, could become economically profitable in the next few years (George 1998) but public concerns about the environmental impact of such activities pose tremendous pressure on governments and corporations engaged in this type of project. Moreover, even if oil can be extracted with a minimum local environmental impact, the need to curb CO_2 emissions from the burning of fossil fuels will possibly affect the willingness of governments continuing to endorse oil-mining activities. In sum, whether or not oil prices will rise in the next decade as a result of resource depletion is an open issue. Environmental concerns, on the other hand, already exert concrete pressure on corporations to reduce their dependence on fossil fuels.

The debate about oil availability and price is central to the technological regime of the automobile for a simple reason: fundamentally, internal combustion engines (ICE) depend on oil. There are certainly alternative fuels to power ICEs. Methanol – an alcohol derived from the destructive distillation of wood or fossil sources, such as coal, from natural gas, or by synthesis from carbon monoxide in catalytic process – can certainly be used. Other non-renewable fuels, such as LPG (liquefied petroleum gas), natural gas, and oil extracted from sand (oil-shale) can also be explored (Rogers 1993). Although the use of such fuels can certainly extend the life-cycle of ICE technology, they face the same challenges as petrol because their finitude is certain. Finally, vegetable-based fuels, such as rapeseed oil and ethanol, have proven to be economically viable in powering ICEs. Brazil has been a showcase country in the use of ethanol to power its car fleet.

In the 1980s, around 90% of Brazilian vehicles were powered by ethanol (Michael & Oliveira 1995). Today, ethanol is used only by 3.7% of the total number of cars and trucks in the country. The main reason for such a rapid decline relates to the withdrawal of state subsidies, which made the production of alcohol an economically viable activity. Apart from the tremendous environmental impact associated with the production of ethanol, the use of land to produce fuel would make it unavailable for food production. With a current world production of 60 million cars per year, projected to grow to 103 million by the year 2020 (Feast 2000), the use of land to grow 'fuel' is simply not a viable alternative[96]. If environmentally sustainable sound solutions for automobile traction are to be found, a move away from ICE technology seems imperative. Moreover, the astonishing number of cars that are expected to populate roads in the near future raises serious questions about the overall ecological sustainability of an increasing number of vehicles.

8.3.4 Vehicle Population

Although the use of alternative technologies to power automobiles can reduce the environmental impact per unit, the exponential growth in the car population imposes a continuous growth in the *ecological footprint*[97] of the industry. From the 1950s to the year 2000, the world population of cars has grown from about 40 million to 550 million

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96 Although methanol extracted from wood and ethanol from sugar cane, wood, or corn are actually renewable fuels, they could not be produced in sufficient quantity to substitute fossil fuels without compromising the amount of land required to produce other traditional grazing crops. Moreover, "the world's corn production, if used solely for motor vehicle fuel, would satisfy less than 10% of the need" (Graedel & Allenby 1998:116).

97 An *ecological footprint* is defined as "the amount of land required to meet a typical consumer's needs" (Hart 1997:68). This concept is used here only as a metaphor, referring to the amount of land necessary for each car produced by the automobile industry.

vehicles (Graedel & Allenby 1998). As pointed out in the previous section, one can expect maintenance of this exponential growth in the world car population, reaching production volumes of 100 million units per year. Accompanying such growth is the general requirement for infrastructure and land used by automobiles. Roads, bridges, and tunnels, among other elements forming the infrastructure of the automotive system, account for an even higher environmental impact than that directly associated with the production, use, and disposal of automobiles. Hence, even if more environmentally sound vehicles eventually replace existing automobiles, the required infrastructure will maintain the high ecological footprint of the industry as a whole.

Numerous authors (see, for instance: Freund & Martin 1993; Lowe 1989; Renner 1988; Whitelegg 1993;) have emphasised that a cultural shift is necessary in order to reduce the dependency of transport based on private ownership and individual use of cars. Such changes, however, are extremely difficult to achieve. As Chapter 9 will explore, politically correct consumer behaviour is unlikely when product performance and the overall convenience of the transport system do not support its requirements. If a reduction in car use and consequent stabilisation or decrease of vehicle populations is expected to become a reality, it seems that more emphasis should be given to the production side of the equation. Closer inspection of what 'the business of the automobile business' consists of seems imperative. As has been pointed out in this and in the previous sections, the tremendous economic and environmental challenges faced by the industry are indicative of the flaws embedded in the automotive system.

8.4 The Socio-Technical Context of the Car Industry

The signs of stress and potential sources of structural change for the automobile industry have roots in many locales that do not encompass the traditional concept of an 'industry'. A new understanding of what constitutes the 'context of automobiles', or the *automobile field*, as it will be explored in this section, seems necessary. During the history of the automobile industry, examples are broadly available of how the sector, when faced with the task of overcoming its own structural inertia, was able to do so. Organisational size, type of structure, strategy, sunk investments in systems of production, and the imperatives of scale, can work as impediments to radical changes[98]. The loss of market share by American car companies to their Japanese counterparts during the 1980s is possibly the most debated topic in this respect. The lack of openness towards other ‘ways of doing things’ was very costly for the American automotive industry. It was only after significant expenditures in research, re-training of workforce, and redesign of production systems, that the industry partially regained its former market positions in the 1990s (see: Ruigrock & van Tulder 1995). For the purposes of this study, there are important lessons to be learnt from the loss of competitiveness by American automakers in the 1980s as well as from the problems faced by some Japanese carmakers, such as Nissan and Mitsubishi, during the 1990s (see Section 8.2). These emphasise the importance of questioning *taken-for-granted* management concepts adopted by the industry. Further, one should recognise the extent to which market leaders have been inhibited in their innovation. Such experiences emphasise the potential risk for new entrants who would become central players in the sector.

8.4.1 The Automobile Field

The complexities involved in the behaviour of consumers as well as the disputes between suppliers of steel and aluminium denote the complexity and scope of those factors that influence the structure of the automobile industry. The increased role of the use of electronic components, alternative plastics, and the potential of hybrid and electric powertrains to substitute for the traditional internal combustion engine (ICE) have increased the chances of success for new entrants in the auto industry in the last few years (Baukus Mello 2000). Fundamentally, the potential of the industry to undergo structural changes, as it is presently constituted, has reduced the relative importance of automakers as ‘elite actors’. Traditional manufacturing houses, or at least those of them still surviving in the 21st century, remain key players in this sector. However, the recent history of the industry requires one to recognise changes in the relative importance of players in the industry. Suppliers of electronics, for instance, have become substantially more influential over the past few years. Moreover, the potential of new entrants to become central payers in the industry is acknowledged by many industry experts. According to Nieuwenhuis and Wells (1997:3): “the automotive industry is indeed a

98 Several studies about limitations caused by contingent variables can be found in organisation theory literature.

vast area of economic endeavour, and to focus the analysis only on the vehicle manufacturers would be to miss the majority of the industry". In this respect, the understanding of the phenomenon of ecological modernisation, explored in Chapter 6, requires one to consider approaches that include emergent – and former outsider – players and the socio-technical dynamics coupled to their eminent entrance into the auto business.

Analytically, the concept of *organisational field* (from which the concept of an *automobile field* is derived) appears to encompass the context in which the ecological modernisation of the automobile industry might occur. DiMaggio and Powell (1983:148) define an organisational field as "a recognised area of institutional life: key suppliers, resource and product consumers, regulatory agencies, and other organisations that produce similar services or products." The idea of an organisational field differs slightly from the definition of industry or sector, since it also includes institutional elements that can influence the structuring process of firms and industries that are not recognised in classic definitions of industrial sectors. The concept includes both objective and subjective factors that shape the context in which innovations might occur. Scott and Mayer (1994) assert that the concept of organisational field has emerged as a critical locus of study bridging organisational and societal levels. The analysis of ecological modernisation in the specific context of the automobile industry requires such linkage.

By adopting the concept of *automobile field* this study proposes to merge the traditional concept of industry with the recently developed concept of the organisational field, in the specific context of automobiles. The merged concept denotes not only those traditional organisations that operate within the scope of the industry but also potential new entrants and agencies that might transform existing circuits of political ecology, as described in Chapter 5.

The importance of adopting a specialised concept of organisational field for the study of the automobile industry, besides having methodological implications, has direct implications for the introduction of radical innovations (see also the section on research sample and population in Chapter 7). These need not occur in the existing industry. The organisational field may be transformed in ways in which the existing

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See: Hall (1999), and Clegg, Hardy and Nord (1996).

industry members are not cognisant because they are locked into their traditional viewpoints. As the next section suggests, the technology embedded in the automobiles of the near future might depend on software expertise rather more than on the suppliers of mechanical parts. In this respect, limiting analysis to current market leaders might lead one to miss the most important elements influencing structural changes in the sector. Outsiders have been gradually reconstructing the field of the automobile. The case of the *hypercar*, described below, shows that one needs to consider not only innovations undertaken by automakers but also technological and market experiments conducted by those who, in the near future, might dictate the pace of innovation in the industry. In the power terms that frame this thesis, one needs to consider not only current decision-makers and issues but also those that are confined to the margins or are even non-decisions and issues at present (Bachrach & Baratz 1962).

8.4.2 The 'Ecological Maturity' of Automobiles

Although the automobile industry is a mature economic sector, the technologies associated with the current automotive system suggest that the automobile, as an industrial product, may not have yet reached its maturity. Generally, product designs evolve and change over long periods of time, through phases of experimentation, consolidation, maturity, and further innovation or decline (Anderson & Tushman, 1990). In order to have environmental benefits, products have to evolve from experimental designs into 'maturity'. According to Roy (1994), the rate and extent to which eco-designs go through evolutionary phases, depends on technical, commercial, market, and socio-political factors. For a product to succeed, going from experimentation to maturity phases, it is necessary for the product to achieve positive attributes in terms of most of the factors mentioned. The main barrier to the use of products, however, is not the design itself, but the lack of an appropriate context for its adoption. Restrictions on the use of a mature product, such as a bicycle, for instance, are more a function of lack of cycling facilities, safety problems, and the dominance of the automobile, rather than design difficulties or problems intrinsic to the concept.

Several initiatives have addressed the ecological efficiency of automobiles and related production systems. Rating schemes, such as the '*Green* Book', presented by the American Council for Energy Efficient Economy, or the '*Green* Index' of the California based Advanced Transportation Consortium, can indicate the leaders and laggards of the auto industry in terms of fuel use and air emissions[99]. However, being the leader in such rating systems does imply leadership in environment related vehicle innovations. It does not necessarily mean that the automaker's fleet is eco-efficient but only that a car manufacturer achieves better performance than competitors. As Section 8.2 showed, the competition is based on essentially equivalent technologies (all-steel car bodies and internal combustion engines), and very similar configurations (multi-purpose vehicles). Hence, ranking of carmakers' ecological efficiency is only relative and does not reflect the true potential of innovations in car design. Although such initiatives constitute important tools for the analysis of improvements in the industry, one should consider that significantly higher automobile environmental performance could be achieved with the use of alternative technologies.

In terms of environmental efficiency, today's automobile is in its infancy. Although the internal combustion engine is remarkably efficient in terms of its genesis as a technology system (Nieuwenhuis 1998), gasoline-powered vehicles are extremely inefficient in terms of the extent to which they convert resources into appropriate energy (Lovins 1995). The vast majority (precisely, 95%) of power generated in the engine is lost before it reaches the wheels (Graedel & Allemby 1998). Mainly, this is because of the way cars are designed, and the materials they use. Different concepts of what an automobile might be, which engender significant reductions of the environmental impact in all phases of the life-cycle, have proven to be technically possible (see, for instance: Riley 1994). Lovins *et al.* (1999), assert that a radical reconfiguration in car design could result in saving of up to 80% in the amount of fuel consumed by an average car. Lovins' concept car – the *hypercar*[100] – epitomises such claims. In simple terms, the *hypercar* is a lightweight, super aerodynamic vehicle built from advanced polymer composites and powered by a hybrid powertrain – ideally with a direct hydrogen fuel cell (Baukus Mello 2000). Although the *hypercar* has not yet become a market reality, the probability is that potential new entrants to the automobile field will

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99 See: *The Green Business Letter*, April 2000, p. 3. http://www.*Green*Biz.com (2000, September 28).

100 A detailed description of the *hypercar* can be found in Chapter 2 of Hawken *et al.* (1999).

base their car on this concept. In order to spur competition, Amory Lovins placed the *hypercar* concept in the public domain, so nobody could patent it[101].

One might ask why most carmakers have not yet made the *hypercar* a commercial product in their portfolio? The answer in not a simple one and constitutes the nucleus for the remaining chapters of this study. Nonetheless, in simple terms, the *hypercar* concept requires radical changes not only in the design of cars but also in the overall structure of the industry. According to Hawken *et al.* (1999), auto industrialists have considered the *hypercar* concept seriously. During the period 1993-1998 the industry committed €5.8 billion to developments on the lines of this new concept. But such changes, although technically possible, encountered a series of obstacles. They relate directly to an historical understanding of what constitutes the core competences of the industry.

8.4.3 Core Competences in the Automobile Field

The notion of an automobile field is fundamental when one considers the potential of radical innovations to trigger structural changes in the industry. When Prahalad and Hamel (1990) proposed the concept of *core competences*, they attacked the tendency managers have to perceive their business units and products as the most important management assets. The authors emphasised the importance of decoupling from the specific reality of the strategic business units and concentrating on real – and normally intangible – assets that can generate long-term competitive advantage. Prahalad and Hamel (1990:81) stressed: "in the long run, competitiveness derives from an ability to built, at lower cost and more speedily than competitors, the core competences that spawn unanticipated products". Technologies such as *mechatronics*, video display, bio-engineering, and micro-electronics were cited as examples of corporate core competences that might eventually be transformed into a competitive advantage by firms.

Most automakers have historically considered the manufacture of steel-based cars and internal combustion engines as their major core competences, as emphasised in Section 8.2 (Nieuwenhuis & Wells 1997). In the light of the concept proposed by

101 Information about the firm commercialising the *hypercar* concept can be found at: http://www.hypercar.com (2000, September 28).

Prahalad and Hamel (1990), viewing the production of car bodies and engines as the core competence of automakers represents, fundamentally, a misuse of the concept. The original understanding of core competence is much broader than that later popularised in the jargon of both business schools and the practice of business administration. A fair use of the concept would, possibly, result in automakers positioning themselves as 'manufactures of propulsion systems', or even as 'suppliers of mobility'. In such a view, they would not be 'locked in' a specific technological option, as it is the case of ICE-based powertrains. The factual possibility that a vehicle can be based on technologies that differ substantially from those of today's cars suggests that those corporations that do not move away from such competences might not be able to survive in the near future.

Indeed, almost four decades ago, Kuhn (1962) already provided evidence from the history of science to suggest that radical innovations have a better chance of being initiated by 'outsiders' to a paradigm by which a professional field guides its actions. Specifically, in relation to the field of the automobile, Lovins (1995) and Truffer (1996), among others, claim that innovative *milieu* with the potential to transform the industry's paradigm have a better chance of occurring in areas outside the industries existing boundaries. This is why the cases provided by *Strategic Niche Management* (SNM), to be explored in detail in Chapter 10, were of special interest for this study (see also Chapter 7). In their majority of initiatives researched by the SNM team new entrants (or 'outsiders') carried out market trials for the introduction of electric vehicles. Through analysis of the process of introducing radical innovations in the automobile field, such as lightweight electric vehicles, one might unveil the main limiting factors that lead to the apparent market failure of such technology.

There is another justification for establishing a link between the product (the *automobile*) and the *field* embedding its systems of production and consumption. Since the auto industry is a consequence, rather than a cause, of the invention of the automobile, systems of production essentially reproduce the outcomes of earlier theoretical conceptions about what should constitute a car. These become embedded in the design parameters and assumptions framing the production paradigm – they become deeply sediment in the materiality of the paradigm. Thus, production processes, factories, and entire industries are defined and designed *after* the conception of the vehicle, as the new assembling plant of the *Smart* car company, mentioned in Section 8.2, demonstrates[102]. Significant reduction in the environmental impact per car unit during manufacturing can simply be explained by the relative small size of *Smart*, its material specifications, as well as the organisational design and management techniques used in 'Smart Ville' in Hambach, eastern France.

In a potential future, capitalism might properly value service and preserve the natural capital of ecosystems rather than regard it as a non-issue that demands little or no attention (see: Lovins *et al.* 1999). In such a scenario a '*Natural Capitalism*' might well prevail, in which the core competence of auto companies could be based on know-how as diverse as telematics, hydrogen-powered fuel cells, or modular manufacturing management. The potential for such changes to occur seems sufficiently rational for Nieuwenhuis and Wells (1997:4), to pose the question "how, and to what extent, an existing and established socio-technical paradigm may change fundamentally in the light of growing pressure, leading to dysfunctionality and, ultimately, collapse"? In other words, the main issue surrounding the automobile field relates not to whether structural changes will occur but identification of the factors that can spur the changes and the characteristics of this transformation.

8.5 Conclusion

The automobile constitutes an industrial product that engenders both considerable economic wealth creation and serious burdens to the natural environment. Although governments worldwide regard the capacity of the auto industry to generate job as a political asset to be preserved, they have also pressured car manufacturers to improve their environmental records. The industry has responded to increasingly stricter governmental regulation by adopting cleaner manufacturing technologies and investing in environment-related research. Virtually every major high-volume car manufacturer is working towards increased levels of resource productivity. They have targeted energy and material conservation for both financial and environmental reasons (Knibb *et al.* 1998; Rogers 1993). From the second half of the 1990s, most European carmakers have also started to release annual environmental reports containing detailed information

102 For a review of how the design concept of vehicles influences the definition of manufacturing facilities and distribution outlets, see: Wells and Nieuwenhuis (2000).

about improvements in vehicle manufacturing, emission reduction in vehicle use, and recycling strategies for end-of-life vehicles.

There are no doubts that improvements have indeed been made by car assemblers. The average environmental performance of most fleets has significantly improved in the last quarter of the 20th century (Graedel & Allenby 1998). Such improvements, however, have not alleviated the pressure faced by firms operating in the industry. Regulatory measures on air emissions, as Chapter 9 and 10 will explore in more detail, have continuously intensified. During the 1990s, the industry has successfully lobbied against the imposition of direct regulations on end-of-life vehicles. Despite this, as Chapter 11 will demonstrate, the European Parliament approved a new Directive on ELVs in September 2000. In order to satisfy standards of environmental performance, the industry has also been obliged to invest increasing amounts of money in increasingly expensive research and development activities. Environmental issues have certainly become an important economic issue for the auto industry.

The saturation of mature markets and consequent intensification of rivalry results in an even more difficult situation for auto industrialists. Markets for new cars in Western European countries practically did not grow during the 1990s. The car business in most developing countries did not perform well, either. The emerging economies faced economic and structural problems in the second half of the 1990s and, although these markets still remain areas for potential market expansion, economic decline in this period produced poor performance in terms of car sales. In simple terms, car manufacturing was under pressure on both the economic and environmental fronts. At the same time as the profitability margins of car manufacturing were extremely low, the pressure to invest in product development and environmental protection has risen over time.

Automakers have responded to the regulatory and market pressure but the technological paradigm orientating car design and manufacture substantially limits the alternatives available to them. Most actions have been designed to increase capacity by reaching greater economies of scale in car production and sales. Platform consolidation and modular assembly constitutes the most widely adopted management initiative pursued among automakers in this direction. Such rationalisation practices have the potential to generate substantial cost savings in systems of production. However, in the opinion of many industrialists, they are not sufficient to remain competitive in the industry: mergers and acquisitions are viewed as a business imperative for auto companies of the 21st century. As a result, industry consolidation has assumed such a pace that many expect that by 2020 only six global corporations, each one producing around 15 million cars per year, will be competing worldwide (Eggleston *et al.* 1999; Feast 2000)**.**

Current transformations in the industry can be seen as indicators of different things. From the perspective assumed in this chapter, they represent the last gasp of the technological regime that framed the automobile industry during the 20th century. Although no one can forecast who will be the key players in an ecologically modernised industry, the technology used in the vehicles of the near future will differ substantially from those currently on the streets. The reason for such conviction is contained in the word ‘efficiency’. After more than one hundred years of technical improvements, current automobiles are absurdly inefficient. As has been explored throughout the chapter, all-steel car bodies require huge investments in tooling and other manufacturing apparatuses, and so does the production of internal combustion engines. These are the fundamental technologies used by virtually all cars sold today, resulting in extremely heavy vehicles that present both low energy and environmental performances. Because of the multi-purpose characteristics of today’s cars (Section 8.2), the way they are used in cities could be compared to the utilization of a jumbo-jet to fly to a destination 100km away (see section 9.1.3 in Chapter 9). Most automakers are already aware of the poor efficiency of their cars, and some are working towards major shifts in design and manufacturing technologies. The problem, for most of them, is that they lack the core competences required to produce radically more efficient vehicles.

A shift away from the current all-steel, internal combustion engine car requires automakers to fundamentally reform their systems of production – something not so easy for those who have sunk investments in current car manufacturing technology. This and other factors explain why eco-oriented innovations in the automobile industry are to have an incremental, rather than a radical, nature. Further improvements in the current technological regime can certainly reduce the environmental impact of current automobiles. These incremental advances represent the last gasp of an outdated technological option, which may eventually be replaced by ones capable of significantly increasing the energy efficiency of vehicles, as well as reducing their environmental impact. However, the market successes of more environmentally sound vehicles requires more than technological ingenuity. Ecological modernisation requires that institutions compounding the *automobile field* – the socio-technical context of the automobile industry – also be reformed. Chapter 9 describes the factors fostering or inhibiting this phenomenon.

9 Framing the Ecological Modernisation of the *Automobile Field*

Influences on the *greening* of organisations have a contingent character. Factors internal and external to the organisation, such as ethical motives of corporate managers, the role of consumers, regulation, and competition can foster the internalisation of ecological issues into organisational strategies and practices. The specialised literature has repeatedly mentioned such influences as the triggers of organisational changes that may result in more ecologically sustainable industries and societies (see, for instance: Bansal & Roth 2000; Berry & Rondinelly 1998, Bonifant *et al.* 1995). Less emphasis, however, has been given to the inhibiting character of such contingencies. The availability of cleaner technologies may not be sufficient for an industry to move away from those technologies that pollute. Companies may have significant sunk investments in existing systems of production as well as with the skills associated with such systems; industrial competition might not reward environmental investments, or consumers might be unwilling to buy products that perform differently to those they already know, (Kemp *et al.* 1998; Kemp 1994), as discussed in Chapter Eight.

If the *greening* of organisations is a situational matter, can such phenomenon be grasped in a systematic manner? Reinhardt (1998) emphasised that the environmental policies and strategies developed by firms depend on the structure of the industry in which they operate, the position of the firms within that industry, as well as their organisational capabilities. But if the structure of the industry is fundamental for the definition of strategies, how can one describe such a structure? According to Giddens (1984), because structures within an organisational field are constantly modified, one can only refer to the *process of structuring structures*, or *structuration* – in the concept of the theory that deals with such phenomenon. In these terms, the dynamic process shaping the relationships among actors would define the structure of the industry. Similarly to the lines formed by the tail-lights of cars caught in long exposure photography, structuration will be defined by the dynamics of relationships happening in a specific organisational field (Haugaard 1998). Metaphorically, this is what this chapter tries to portray: the frame where a systematic study of a specific setting (automobile field) can depict a particular phenomenon (ecological modernisation).

The development of the framework corresponds to the second stage (or Objective 2, described in Section 7.1.4 in Chapter 7) of the process of answering the research question guiding Part II of this study: Why is the automobile industry undergoing ecological modernisation? The first step (or Objective 1) was completed in Chapter 8, where the main elements forming the current technological regime of the automobile, as well as the economic and environmental implications of this regime, were identified. In this chapter, the development of the framework requires the specification of the influences of organisational *greening*, previously introduced by Chapter 4. Such influences are comprised by the environment-contingent factors (or simply *eco-factors*), presented in Section 9.1. The identification of eco-factors was made through the iterative process of confronting the theoretical influences discussed in Chapter 4 with the analysis and interpretation of data generated in the case studies, presented in Chapters 10 and 11. Hence, the ecological modernisation framework represents the systematisation of knowledge resulting from the interplay between empirical data and theory building for the particular case of the European automobile industry (for a description of the methods guiding the analysis of data, see Chapter 7).

The use of the term ‘ecological modernisation’ in the framework should not be understood as a prescription of eco-modern practices in corporations. Rather, it represents the analytic-descriptive scheme used to reveal the practices under development in the automobile industry. As it was explored in Chapters 6, such practices are expected to assume a particular character. They represent the ongoing process of the ‘emancipation’ of ecology in specific spheres of modern societies; thus, the concept of ecological modernisation. Such a concept seems to be more appropriate than terms such as ‘ecological sustainability’ or ‘sustainable development’. This is because there is a lack of consensus about how to measure whether current corporate environmental management practices are conducive to the ecological sustainability of societies (see also: Chapter 3). Hence, in the framework the term ecological modernisation represents a specific sociological phenomenon that is expected to facilitate the transition to more sustainable forms of organising.

In the organisational field of the automobile – or simply, *the automobile field*, as the previous chapter described it – eco-factors represent influences that are mediated through *circuits of political ecology*. Section 9.2 briefly readdresses the elements of political ecology that have the potential to do both: provoke changes and develop ‘lock in’ situations in organisations and industries, previously presented in Chapter 5. The role of the consumer alone, for instance, might not be sufficient to transform the circuits of political ecology of the automobile field. For changes to occur, other elements in the circuit must also be transformed. Since these dynamics and the elements forming the circuits of political ecology have already been presented in Chapter 5, Section 9.2 focuses on the explanation of the use of concepts in the ecological modernisation framework. Lessons learned from developing the framework, as well as its application to specific case in the automobile field conclude the chapter.

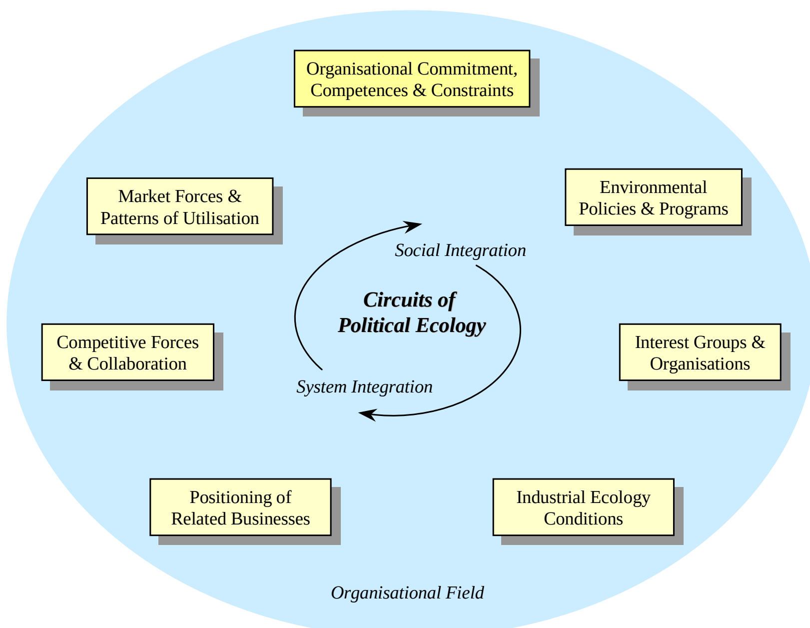
9.1 Environment-Contingent Factors

Environment-contingent factors (eco-factors) represent the influences fostering or inhibiting the process of ecological modernisation in the automobile field. Increasingly stringent regulations, consumer demand for cleaner industrial processes and products, the influence of related businesses, interest groups, and competition, all may be determinants. These factors range from the voluntarism of some ecologically driven practices by particular carmakers to the determinate will of government to regulate phenomena such as the emission levels of air pollutants or the rates of car recycling. Within this framework, eco-factors should be seen as interdependent components that might *sensitise* agents to the probable sources of innovation and resistance that are likely to occur in a specific organisational field. Figure 9.1 depicts the framework representing relationships among environment-contingent factors.

The framework expands the range of influences on the *greening* of organisations that were identified through the review of the literature, complemented by a sensitising fieldwork, as described in Chapter 4. In that chapter, the influences on the *greening* of organisations such as *ethical commitments*, the pressure from *environmental regulation*, *consumers*, and *industrial competition* were analysed. Not surprisingly, the same factors have also been identified as central variables influencing the structuration of the automobile field. Conversely, the importance that *related businesses*, the overall *industrial ecology conditions*, and *interests groups and organisations*, assume in the ecological modernisation phenomenon, is somewhat blurred in the literature. It is not clear how these elements influence the *greening* of organisations and industries. Since these factors are of crucial importance for the case of the automobile field, particular attention is given to them in this section.

Originally, the identification of environment-contingent factors was made through the analysis of the case studies, described in Chapter 7 – the diffusion of electric vehicles in the Western European context, and issues surrounding the development of schemes for collection and recycling end-of-life vehicles. Since an elaborated analysis of the cases on electric vehicles, as well as end-of-life vehicle strategies is developed in Chapters 10 and 11, respectively, this section extracts from secondary data to introduce the eco-factors as well to complement their concepts. Examples drawn from non-European contexts have also been used to enrich the explanatory power of the argument. The main reason for referring to a particular environmental initiative taken by the Japanese volume producer *Toyota*, for instance, relates to its clarity in explaining the concept of *organisational commitments*, and the importance of such enterprise in influencing innovations in the European context. As mentioned in Chapter 8, the auto industry has an increasingly global character and the use of such examples reflects this fact.

Figure 9.1: The Ecological Modernisation Framework



Finally, the examples used to explain each eco-factor are selective. The vast number of environmental issues associated with environmental impacts caused by automobiles creates multiple scenarios involving eco-factors, which simply cannot be portrayed here. Therefore, the examples should be seen, primarily, as ways of introducing the components of the ecological modernisation framework, which will be used in Chapters 10 and 11 for the systematic interpretation of specific issues in the automobile field.

9.1.1 Organisational Commitments, Competences, and Constraints

> Environmental activities in the transport equipment industry are influenced by a series of factors. Legislation, the demand for environmentally compatible products, the competitive situation and public opinion are the most important external forces. Just as important, however, are a *company's sense of inner conviction and capacity for technical innovation* (not italicised in the original).

This statement, quoted from the environmental report of the Swedish automaker *Volvo* (now owned by the American *Ford*), opens the section explaining the environmental programs of the company (*Volvo* 1998:8). It addresses one factor previously analysed in the review of the literature in Chapter 4. The *commitments* that some organisational leaders have towards ethical principles for the preservation of nature have the potential to motivate other members of the organisation and shareholders to commit to environmental protection (Egri & Herman 2000). Many auto industrialists have claimed they have been driven by similar values. They communicate their intention to protect the natural environment mainly through the publication of corporate environmental reports, open speeches, and generic media releases.

Mainly after the second half of the 1990s, environmental reporting (ER) became a tool for automakers to communicate their dedication to environmental protection. By 1999, virtually all volume carmakers have made their environmental initiatives public by releasing environmental reports. Since ER is not mandatory, such an initiative is, in itself, an indication of a corporate preoccupation with environmental performance (Bennett & James 1999; Kolk 2000). Data about environmental impact is normally counterbalanced by corporate initiatives to tackle them, and environmental reporting presupposes some preparatory work in order to show a positive attitude by the firm. Although the lack of standardisation of these reports still allows a great degree of evasiveness and ambiguity in the content of the information, their publication gives the public a better chance to evaluate how the company is portraying itself. In other words, by making environment-related information available to the public, firms are intrinsically opening more opportunities for dialogue with their stakeholders (Bolli 2000).

Media releases are also used to communicate organisational commitments oriented to ecological protection. The Japanese car manufacturer *Toyota* presents a good example of such practice. In 1997 *Toyota* publicised their strategic commitment towards organisational change that integrated environmental goals into business processes. *Toyota* took practical actions in the direction of its environmental commitment regarding new propulsion systems (or powertrains). In December of the same year, the company officially launched the *Prius* – the first commercial *hybrid* car for a mass market. A hybrid vehicle consists of the combination of two powertrains – an internal combustion engine (ICE) and one or more electric motors. Using a parallel or serial system, a hybrid car operates by using the powertrains (electric and ICE) concurrently or independently[103]. The technology itself is not new and most automakers have developed hybrid *concept cars*[104]. What is new about *Toyota*'s initiative is the transformation of the hybrid concept into a market reality (Maruo 1998).

The launch of the *Prius* was supported by an intensive marketing campaign promoting the determination of *Toyota* 'to go *green*'. *Toyota* representatives also emphasised the importance of motivating other members of the organisation towards environmental goals. Below are the statements of Hiroshi Okuda, *Toyota* President, and Akiro Wada, *Toyota* vice-president for research and development (R&D), respectively, publicised in a special section of *Time Magazine*, Australia. (*Time*, November 1997):

> We're changing the car, changing our business model. I spend a lot of time preaching change. I've been telling everyone at *Toyota* that anything and anyone that does not change - that resists change - is going nowhere

> We get a head start in putting *green*er cars onto the road through simultaneous engineering. At *Toyota* that means more than working concurrently on different phases of projects, like engines and bodies. It means swapping ideas constantly as if everyone was on one big team.

Such moral claims can obviously be influenced by instrumental rationality (see: Kalberg 1980). Organisational leaders may justify investments in ecologically sound industrial processes and products on the prerogatives of good citizenship but the main reason for such initiatives may lie, fundamentally, in the potential reduction of financial risks or the generation of financial returns (Reinhardt 1999). Many other reasons, rather than ethical and environmental commitments by the company's president, could explain *Toyota*'s move. The *Prius* is expected to comply easily with *EU IV* standards on emissions regulation in Europe, to be in effect only in 2005. There is also the possibility that regulation for ZEV (Zero Emission vehicles) in California will be modified to allow

103 For a detailed description of *hybrid electric vehicles*, see: Hawken *et al.* (1999; Chapter 2), Wouk (1997), Sperling (1995, Chapter 6), and Lovins (1995).

104 *Concept cars* are prototypes that point to future technological choices; "they narrow the pool of technologies from which manufacturers are likely to choose and as such are a valuable indication of future trends" (Niieuwenhuis & Wells 1997:121).

'Equivalent Zero-emission Vehicles' (EZEV)[105], as presented by hybrid cars (Maruo 1998). In this respect, the *Prius* is achieving the goal of complying with stringent environmental regulation. Moreover, the launch of a hybrid vehicle represents an important competitive edge based on 'first-mover advantage' prerogatives (see Section 4.4 in Chapter 4). The eventual market success of *Prius* certainly put the company ahead in the race for hybrid cars (see also Section 9.1.4). In an interview for the *Automotive News Europe*[106], Mr. Steve Settle, the director of customer service at *Toyota Motor* Europe in Brussels said: "We would not be frightened to see others offer a hybrid platform as well. But *Toyota* should always be associated with hybrid systems because we were the first to the market". Since the chances are that *Toyota* will reach the break-even point for its hybrid vehicle ahead of its competitors, the investment will satisfy both economic and environmental prerequisites[107]. In this perspective, *Toyota*'s move simply makes business sense (Reinhardt 1999b).

Toyota is not the only auto manufacturer claiming that environmental responsibility is a key factor influencing organisational action. In early 1999, the expectations of environmentalists were raised by the appointment of William (Bill) Clay Ford Jr. as the chairman of the *Ford Motor Co*. In two public speeches Bill Ford Jr. (in Motavalli 1999:18) declared:

> While my great-grandfather (Henry Ford) was a leader in the first industrial revolution, I want Ford Motor Company to be a leader in the second industrial revolution – the clean revolution (…). Our social obligation is much bigger that just supporting worthy causes. The responsibility to consumers – and society – of a company our size is defined in very broad terms. It includes anything that impacts people and the quality of their lives. A favourite example of mine is the environment.

Since the appointment of Bill Ford as the company's Chairman, *Ford* acquired *Volvo Car*, the Swedish automaker regarded as Europe's most environmentally proactive manufacturer. In 1999, Ford also bought *Pivco*, the producer of the *Th!nk*, a two seat electric vehicle (analysed in detail in Section 10.3 in Chapter 10). Since then, Ford boosted the profile of *Th!nk* as the precursor of the new generation of environmentally friendly vehicles of the company. In another bold move, in early 2000

105 The *Equivalent Zero Emission* (EZEV) is "an emissions standard intended to equate to the incremental emissions from power stations attributable to mains-charged battery electric vehicles" (Atkin & Storey 1998:279).

106 *Automotive News Europe*, September 24, 2000, page 13.

Ford withdraw from the *Global Climate Coalition*[108] – a lobbing group formed by auto and oil companies to oppose the Kyoto climate treaty – which represented a significant shift in the environmental policy of the company. In 1998 *Ford* was also the first automaker to have all its plants certified according to ISO 14001, showing its commitments to going *beyond-compliance environmental practices* (See Section 9.1.4). Such practices, however, have not yet changed the general profile of *Ford*. The company still lags behind most automakers in terms of its overall *green* performance[109]. *Ford* has three out of the twelve worst vehicles ranked by the *Green Guide* (see Section 8.4.1 in Chapter 8), having the *Excursion*, a SUV (Sport Utility Vehicle), championing the list for the worst fuel consumption in its class (23 liters/100km). The alleged commitment of *Ford*'s Chairman may result in better corporate environmental performance in the future but it seems that his commitments alone will not be enough to make the company a leader of the *clean revolution*.

The decision to invest in environmentally sound technology is rarely a result of personal or organisational commitment alone. Firms base their activities in specific *competences* that, ultimately, influence the scope of actions. Section 8.4.3 (Chapter 8) has debated the current core competences of automakers, and the limitations imposed by those competences on their possibilities to implement radical innovations. In order to minimise repetition, this section limits itself to reiterating the importance that competences assume in the possibility of firms to move towards ecological modern practices. In simple terms, in order to comply with regulatory systems or to transform ethical commitments or market opportunities into pragmatic actions, firms need also to have the appropriate skills, capabilities, or competences.

Organisations may possess competences but their size, complexity, and culture, among other factors, can limit their possibilities to implement *green*er strategies and practices (Griffiths 2000). Broadly, structural and behavioural *constraints* establish the basis of investment decisions and limit the scope of choices available to firms. For instance, the size of car manufactures makes communication difficult between divisions

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107 After the successful trial period in Japan and Australia, *Toyota* launched the *Prius* in The USA and Europe in October 2000. The company expects to sell 20,000 units between North America and Europe in 2001. See: http://www.global.toyota.com/ (2000, October 03),

108 http://www.globalclimate.org/home.htm (2000, October 9)

109 The *Green* Business Newsletter, April 2000, p.3.

and departments. By extension, the lack of dialogue between the various organisational areas may hinder the development and implementation of innovative approaches to material specification (Hall 2000).

Obviously, the chances of implementation of design for the environment (DfE) principles are not restricted to structural elements. The design principles based on DfE also depend on the perception organisational actors have of their context as well as their own capabilities. Some automakers, for instance, may not consider the substitution or elimination of hazardous chemicals an objective to be pursued by them. They may simply 'interpret' the automobile field in such a way that environmental investments may not become a significant influence in the firm's decision-making processes. What constitutes this 'external environment' encompasses the other environment-contingent factors, presented in the next sections.

9.1.2 Environmental Policies and Programs

The generic role that governments played in imposing obligations on organisations to conform to regulatory measurers and to achieve minimum levels of environmental performance was explored in Chapter 4. In the specific case of the automobile industry, improvements in the processes involved in manufacturing cars as well as their environmental performance during the other phases of the life-cycle have also been strongly influenced by environmental regulations. Grasping the importance of regulations as a factor triggering better environmental strategies and practices in corporations is, therefore, straightforward. Requiring further explanation, however, are the controversies surrounding the development of regulations for the particular case of the automobile industry.

The section about 'the political economy of regulation' in Chapter 5 showed that the economic importance of the automobile industry has a potential impact on the willingness of governments to subsidise the instalment of manufacturing facilities in developing countries (see also: Calmon 1999; O'Brian 1999). Such political economy factors are also present in the design of regulatory frameworks that aim to restrict emission levels of pollutants during automobile use. Carmakers have used the subtleties involved in the trade-offs between types and sources of pollutants, as well as competing goals between emission and safety standards, to protect their interests and to negotiate regulations that would not increase costs or hinder the overall viability of their business.

In this respect, a relatively recent dispute involving the auto and oil industries and the European Commission is a good case.

At the dawn of the 21st century, cars powered by internal combustion engines (ICE) are much cleaner than they were two decades ago (Graedel & Allenby 1998). But such improvements did not occur without extensive resistance and disputes among automakers, the oil industry, and governments. Oil companies were forced to bring lead-free fuel to the market, enabling the use of catalytic converters. As a result, automotive emissions have allegedly been reduced by 90 percent[110] in the last 20 years (Crosse 1999). The new *EU IV Emission Standards*, to be in effect by the year 2005, requires even further reductions in levels of oxides of nitrogen (NO_x) that can only be achieved by reducing the amount of sulphur in gasoline[111]. Manufacturers of catalytic converters and car engines are demanding that the oil industry invest in new refining processes. The oil industry, on the other hand, argues that changing refining processes to cut down on sulphur will add carbon dioxide (CO_2) to the atmosphere[112] – a chemical molecule allegedly associated with global warming (Peake 1997). Additionally, CO_2 emissions from ICE are directly related to fuel consumption, and regulatory demands for the use of safety systems and catalytic converters have increased vehicle weight and consequently both fuel consumption and CO_2 emissions (Nieuwenhuis & Wells 1997).

The example demonstrates that regulating emission levels from auto motors involves trade-offs. These trade-offs are between: (i) types and sources of pollutants – when lower emission levels are aimed for (sulphur from vehicles and CO_2 from refineries) and (ii) competing goals (standards of safety versus emission standards). In technical terms, these disputes lead to environmental regulations based on *acceptable* levels of pollutants, since the core ICE technology has not been challenged. The 'negotiated' characteristic of environmental regulations seems to have become considered as an acceptable, indeed desirable, practice by governments. Such understanding is, among other factors, one of the rationales behind the development of the Auto Oil programme – a collaboration involving the European Commission and the

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110 Mainly hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) have allegedly been reduced during car use. However, prior to the warming up of catalysts, emissions are much worse than a car without a catalytic converter. Emissions are also worse in case the catalytic fails (and they often do). Overall, emission rates of cars using catalytic converters constitutes a very controversial issue among industry experts.

111 An overview of the international developments in emission legislation is presented by Peake (1997).

112 According to Mike Frend, Director General of the UK Petroleum Industry Association.

European oil and vehicle industry associations[113]. In fact, the disputes mentioned previously are, in essence, part of the ongoing process of defining *Stage IV* of the regulations on vehicle emissions. Because the Auto Oil programme links the evolution of vehicle emissions standards to requirements to meet air quality goals, it constitutes a new approach to environmental policy. Such linkage, fundamentally, requires auto and oil industries to collaborate – a goal that is not always easily achieved, as the case has shown.

Collaborative resource and development (R&D) programs involving industry, governments, and other interest parties, which aim to achieve environmental targets at the same time as they promote the development of new technologies, seem to have increasingly become common practice in highly industrialised countries. Referring to the new regulatory trend in the automotive industry, Nieuwenhuis and Wells (1997:15-16) assert that:

> Regulation and collaborative R&D programs will go hand in hand (…) The character of government intervention is changing, from limited and essentially punitive control, towards a much more pro-active and collaborative stance (…) The combination of such R&D programmes with new regulatory instruments will have important effects at all levels in the automotive industry.

The concept of *environmental policies & programmes* embraces not only traditional mandatory policies and regulations but also collaborative programmes established between automakers, related industries, and governmental bodies, among other possibilities. The Partnership for a New Generation of Vehicles (PNGV) is an example of such collaborative schemes between industry and the government, undertaken in the USA. One of the three main goals of this programme is to develop a vehicle that achieves significantly higher fuel efficiency than today's average vehicle (see: Baukus Mello 2000). Voluntary agreements, such as those developed between the auto industry and the French government, setting targets for recycling rates of automobiles, constitute another example of such programmes, which will be analysed in detail by Chapter 11. Finally, environmental policies and programmes also encompass indirect subsidies and taxation, such as those commonly adopted by governments in relation to the price of petrol (Roodman 1998).

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113 A comprehensive explanation of the *Auto Oil Programme*, and analysis of the implications of the programme has been elaborated by Peake (1997).

Summarising, it is clear that environmental policies influence the ecological modernisation of the automobile industry. However, regulating environmental performance of vehicles is an extremely complex task; thus, it requires cautious examination. Besides the fact that environmental impacts take place in all phases of the life-cycle of automobiles, trade-offs may occur in and between different phases, as it was discussed in Section 8.4 (Chapter 8). As the disputes between the auto and oil industry exemplify, regulating levels of automobile air emissions is far from being a straightforward activity. The definition of what constitutes an 'issue' and what is not is normally at stake (see: Bachrach & Baratz, 1970): What should be regulated: sulphur or CO_2 emissions? Technical subtleties provide scope for a good deal of negotiations among interested parties. They become stakes in political disputes between those who are going to be affected by regulatory measures. The negotiated rule making in the area of vehicle manufacturing, use, and disposal are, in essence, a result of the use of technical arguments to support the political standpoints of various players. Influencing the positioning of the players is the supreme stakeholder of a commercial enterprise: the consumer.

9.1.3 Market Demand and Patterns of Utilization

Market demand can be generically divided in industrial (or business) markets and (final) consumer markets (Reinhardt 1998). In both circumstances, however, it is the final consumer who influences the developments in the value chain of car manufacturing. In other words, from a commercial point of view, consumers are the ultimate stakeholders of car assemblers. In this respect, the eco-factors representing *market demand*s consist of an obvious influence on ecological modernisation practices developed in the automobile field. Less straightforward, however, is the behaviour of consumers when confronted with choices involving performance, aesthetic preferences, self-image, and political correctness, among many other variables[114]. The apparent incongruent conduct displayed by consumers when ideological prerogatives are confronted with individual

[114] Private and public organisations are also 'consumers' of cars. For them, the technical performance is expected to be more central at the moment of car purchasing, when compared with aesthetics, for instance. However, since individuals constitute the vast majority of car buyers, this section in particular – and this thesis in general – focuses primarily on this type of client.

preferences has been introduced in Chapter 4. Similar behaviours are present in car purchasing.

The extensive research of Schafer & Victor (1997) about mobility patterns showed that personal income and traffic volume grow in tandem throughout the world. As income rises, automobiles replace slower public transport modes. This happens mainly because "around the world, one of the first things people buy when they can is a car" (Pusher in Gibbs 1997:35). Cars help people to fulfil common human desires for mobility, space and status (Freund and Martin 1993). Put simply, people want cars. One could question, however: what kind of cars do people want to buy? The answer is certainly not a simple one. Many conflicting signals jostle for the consumer's attention. The market is an economy of significations (Lash & Urry 1994) that mobilises consumer subjectivities. Car designs, colours or sizes can have as much to do with the unconscious mind as with demands for functionality. The consumer of cars is certainly a complex 'creature'.

The complexities involved in the activity of purchasing a car cause one to question whether the environment is a meaningful issue for the consumer. MacShane (in Gibbs 1997:32), for instance, asserts that "drivers seem less interested in cleaner vehicles than in safer ones: a third of the cars today are larger than any auto on the road in the 1950s". Such preoccupation with safety has long been a variable taken into account in the design of Swedish cars by *Volvo* and *Saab*. *Volvo* has also demonstrated itself to be a leader in terms of its commitments towards ecologically sound industrial processes and vehicle technology. But the success of the company in selling relatively large cars, which have low fuel economy when compared with smaller models, indicates that safety requirements remain most important for consumers buying *Volvo* cars[115].

Although what type of cars consumers want remains controversial there is an apparently consensus about what performance people expect from cars. In his study of the *Toyota Prius*, Coup (1999:261) asserted: "Customers do not want to sacrifice performance for environmental benefits. They want durability, performance in adverse weather, significant drive range between 'fuel ups', and enjoyable driving". In many

115 Mainly because the average size of vehicles sold by *Volvo* is relatively high, the overall fuel economy is low. See: http://www.ucsusa.org/ (2000 October, 17).

respects, the success of the experimental phase of *Prius* can be attributed to the fact that the vehicle satisfied these requirements.

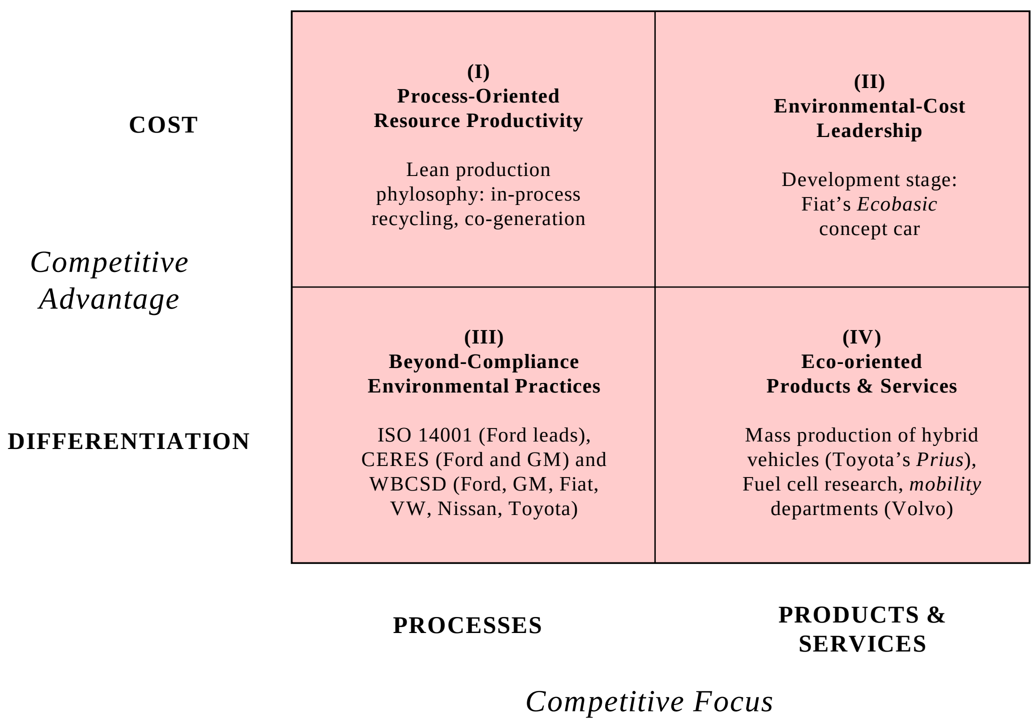
It is important to avoid oversimplifications of consumer preferences in the ecological modernisation of the automobile field. The review of the literature in Chapter 4 indicated that consumers constitute inherent stakeholders of most business organisations but understanding how consumers respond to new alternative vehicle technology, for instance, still requires a great deal of research (Chapter 10 will explore this point in more detail). Moreover, the development of new transportation regimes depends not only on *market demand* for more environmentally sound vehicles but also requires the transformation of those technological systems in which existing consumers and organisations are embedded (Schot *et al.* 1994). Within such regimes, specific *patterns of utilisation* have been developed. For instance, most consumers have historically considered individual ownership as an attribute inseparable from car use. This constitutes one, among many other reasons, why initiatives such as car-sharing are still restricted to very specialised contexts. As will be explored in Section 9.2, overall patterns of system and social integration may favour a specific type of utilisation of a vehicle and its disposal.

Finally, as described in Section 8.2.3 (Chapter 8), the ever-increasing industrial rivalry among auto assemblers in the last decades has also intensified the degree to which consumers have been exposed to marketing campaigns. The promotion to launch the 1998 model of the VW *Golf* illustrates the level of expenditure of such campaigns: In Germany alone, *Volkswagen* spent €113 million on the marketing campaign. Such efforts address issues ranging from lifestyle and self-image, to the advantages of private car ownership. From the emergence of *General Motors* in the 1930s as a company that could provide a wider range of models than *Ford* – its main rival at that time – to today's intensive battle to maintain margins in saturated markets, competition has evolved in tandem with market demand and patterns of utilization. In the last two decades, industrial rivalry has also influenced the pace of the 'emancipation' of ecology in the realms of the automobile field.

9.1.4 Competitive Forces and Collaboration

In this section the classificatory scheme of eco-factors is used to present the generic environmental strategies pursued by automakers motivated by competitive prerogatives (see Figure 9.2 in the next page). Because the main rationale of the section is to present the eco-factors representing competitive forces and collaboration, the generic strategies presented here are selective, rather than comprehensive. As the classification scheme suggests, they characterise generic developments in the industry. Rivalry, which has been widely addressed by the specialised literature, constitutes another environment-contingent factor inducing automobile companies to accept *green* imperatives. Chapter 4 presented an extensive analysis of how competition can influence corporations' adoption of environmentally sound technologies and practices. A scheme was used to classify the four generic types of environmental strategies that have been adopted by corporations when trying to transform environmental investments into sources of competitive advantage.

Figure 9.2: Automakers' Competitive Positioning



Intense industrial rivalry required carmakers to adopt strategies based on *process-oriented resource productivity*. Although such strategic approaches to manufacturing have long been used in the industry, they do not seem to relate to the search for competitive advantage. In the context of automobile assembling, organisational survival has demanded constant efforts applied to cost saving in industrial processes and practices. As Section 8.2.2 (Chapter 8) demonstrated, the rationalisation of systems of production became an imperative for car manufacturers not because they intended to obtain competitive advantage out of such practices. They did so simply to *remain* competitive. The pressure to cut costs in every possible manner has driven auto assemblers to minimise waste and to optimise the use of resources. Platform consolidation and modular assembly have been adopted by automakers as attempts to increase the overall resource productivity of automobile manufacturing. Nonetheless, as it has also been emphasised in the previous chapter, such optimisation is still attached to systems of productions designed to assemble internal combustion engines in all-steel car bodies. Mainly because significant gains in resource productivity have already been achieved within this concept of system of production, further gains are expected to be more difficult to achieve (see the debate about *double dividends* in Section 4.3, Chapter 4).

To a certain degree, it seems that competition has also influenced the development of strategies based on *beyond-compliance environmental practices* in auto-assembling. As was mentioned in Chapter 4, there is a close relationship between strategies based on process-oriented resource productivity and beyond-compliance practices, and the optimisation of systems of production involves also the simultaneous reduction of waste and by-products. For the specific case of auto assembling, these two generic strategies can be seen as encompassed in the concept of *Lean Production*, prescribed by Womack *et al.* (1990). Although the relationship between the adoption of lean production practices and environmental performance of industrial processes still requires research, the study of Maxwell *et al.* (1998) showed that lean production practices facilitated the process of improving the overall eco-efficiency of *Honda* factories in both Japan and in the USA. By the same rationale, the endorsement of principles proposed by CERES[116] and the WBCSD[117] by some automakers may represent an extension of practices already pursued by automakers irrespective of the principled decision involved. While ethical commitments might explain why some car manufacturers voluntarily adopt these principles it is possible that the search for a competitive edge may also influence such actions.

Although there are signs that competition may influence car manufacturers to develop strategies based on *environmental-cost leadership* in the near future, such

116 Coalition for Environmentally Responsible Economics - http://www.ceres.org/ (2000, October 17)

117 World Business Council for Sustainable Development - http://www.wbcsd.ch/ (2000, October 17)

strategies are still in the development stage. For instance, the *Ecobasic* – a concept car shown by the Italian automaker *Fiat* during the Geneva Motor Show in March 2000 – represents such strategies. The innovative space-frame design results in a vehicle weighing only 750 kg but capable of transporting five passengers – a significantly low weight for a car that uses steel as the main structural material. For the consumer, resource efficiency simply means fuel economy under 3 liters/100km. All consumers, ecologically oriented or not, will eventually benefit from enhanced fuel economy during car use. Because of its innovations in design and manufacturing techniques, the *Ecobasic* is a vehicle that has the potential to have both a (relatively) low environmental impact and *the* lowest price in its class[118]. By extending resource productivity efforts to the *use phase* of the product, as the example shows, *Fiat* would be able to explore strategies – and eventual competitive advantage – on the basis of the relatively low economic costs *and* the low environmental impact embedded in their products.

During the last quarter of the 20th century, environmental strategies focusing on automobiles (products) have been less ambitious than those focused on industrial processes. As addressed in Section 8.1 (Chapter 8), the vast majority of innovations have been developed without challenging the fundamentals of modern cars: powertrains based on ICE engines, all-steel car bodies and multi-purpose vehicles. The use of alternative materials, such as aluminium[119] and plastics[120] has increased during this period – even though the environmental benefits of such innovations are questionable (Morton 1997; see also Section 8.3.2 in Chapter 8). Only from the early 1990s onwards has competition become an increasingly decisive influence in the development of relatively more radical innovations, such as the use of aluminium for structural car parts[121], and alternative powertrains (Crosse 1999).

Considerable resources have been invested in hybrid powertrains and fuel cell technologies (discussed in Chapter 10) but the majority of these developments are still in the concept phase (Atkin & Storey 1998; Crosse 2000a). Although many automakers

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118 Although there is not guarantee that *Fiat* will go ahead with this project, according to the company, the *Ecobasic* will eventually be sold at around €5,000.

119 The aluminium content of an average European car grew from 33kg in 1986 to 80kg in 1997, and the projections indicate that an average of 115kg will be reached by the year 2005 (Weenink 1998).

120 The use of plastics in cars grew from 4% of the total vehicle weight in 1970s to 9% in the 1980s (Wells 1998).

121 The Audi A2 is the first volume-production car in the world to have a body made entirely of aluminium. In 1994, the Audi A8 pioneered the use of aluminium in spaceframe.

have presented their concepts for hybrid vehicles in Motor Shows during the 1990s, at the dawn of the 21st century it is the *Prius* – the hybrid sedan launched by *Toyota*, mentioned in Section 9.1.1 – the only vehicle of its category available in the marketplace. In this respect, *Toyota*'s car can be considered the only successful strategy based on *eco-oriented products* – in the strict context of the automobile industry (thus, not including potential new entrants in the *automobile field*). Although most car manufacturers say they intend to launch hybrid cars in the next few years, there is still a high degree of uncertainty about the reliability of the hybrid-related technology, and the possibilities of such objectives becoming a market reality (Crosse 2000a). The concept hybrid cars are normally advertised in Motor Shows on the basis of their fuel economy and low levels of emission; in other words, it is the environmental prerogatives of these vehicles that are marketed. But most (concept) hybrids consist of 'converted' models that formerly used powertrains powered exclusively by ICE engines[122]. The question triggered by such characteristics refers to the future vision of automakers with the commercialisation of hybrids: Is the development of hybrid powertrains in all-steel bodies (see Section 8.1 in Chapter 8) an attempt to prolong the life of the multi-purpose car concept?

A central element influencing the answer to this question relates to the players who currently are 'outside' the borders of the auto industry (but inside the automobile field). Today, there are a significant number of commercial alternatives to the current ICE-powered car. Potential *new entrants*[123] in the industry have long been producing lightweight electric vehicles (Cronk 1995). A wide range of options in terms of size and models is available in some locations, such as Switzerland (Lovins 1995). In fact, Chapter 10 tries to answer why this type of vehicles has not yet become a market success in urban areas. Since new entrants have historically challenged the dominance of the traditional players in industrial sectors (Porter 1985), one could question why new entrants have not yet become major players in the automobile field? Although answers to the questions presented here will be explored in the remaining chapters of

122 The platform, body structure, panels and interior parts of the *Almera Tino* were used in the gasoline-electric hybrid of Nissan; the hybrid presented by *DaimlerChrysler* at the 1999 Frankfurt Motor Show uses a *Mercedes-Benz* S-class; A converted *Multipla* is used for the hybrid of the Italian automaker *Fiat*.

123 For a thorough explanation of the concept of new entrants, see Porter (1980;1985, Chapter 1).

this thesis, it is clear that when new entrants exert pressure on the dominant actors in an organisational field, competition can assume a new character.

Competition is likely to be transformed into coalitions and collaborative schemes when external forces threaten the auto industry as a whole. For instance, the main reason European automakers engaged in R&D (Research and Development) partnerships such as the European Council for Automotive Research and Development[124] (EUCAR) in 1994 due to competition from Japanese manufacturers. EUCAR has one of the eight thematic groups dedicated to the development of electric-hybrid vehicles. It is an *ad-hoc* group for the study of recycling technology, but "the close link with [the] European Automobile Manufacturers Association (ACEA) suggests that the main focus may be on providing information for lobbying the European Commission and other governmental organisations in a 'defensive' role" (Nieuwenhuis & Wells1997:63). Indeed, Chapter 11 will show that the role of ACEA in trying to avoid direct regulation on end-of-life vehicles suggests the importance of interest groups in influencing ecological modernisation.

The possibility of *competitive forces* assuming a collaborative character justifies the use of the word *collaboration* in the definition of this eco-factor. In fact, the analysis of the case studies showed that this is a fundamental element defining the pace of environmental innovation of the automobile field. Although strategic alliances and networks constitute a practice both widely adopted by firms as well as being an established area in organisation studies and management, their importance in the process of the *greening* of industrial sectors still requires extensive research. This is where this study represents a distinct contribution to the field. As Chapter 10 and 11 will demonstrate in detail, industrial rivalry can assume several forms. When confronting similar problems, such as market saturation and low profitability, firms fiercely compete in the marketplace but they also contemplate collaborative schemes as a strategic asset that can benefit the industry as a whole. Such collaborative schemes are certainly not limited to the context of car assemblers. Other related businesses exert crucial importance in the process of ecological modernisation of the automobile field.

124 EUCAR members are: BMW Group, *DaimlerChrysler, Fiat, Ford of Europe, Opel, Porsche,* PSA *Peugeot-Citroen, Renault, Volkswagen Group, and Volvo.* See: http://www.acea.be/eucarinternet/index.html (2000, October 23).

9.1.5 Positioning of Related Businesses

The economic value of the automobile industry amplifies its value-chain beyond the frontiers of the industry complex. Changes in car design can have significant implications for an extensive number of actors directly or indirectly involved with this sector. A network of related and supporting industries supply the approximately 10,000 to 15,000 components of a car, effectively amplifying the sector across other economic areas (Nieuwenhuis 1998). This high degree of interdependency can cause organisational inertia, since automakers' innovations in design and material specification require time and resources for related business to adapt accordingly. Moreover, relative long cycles of model life also make it difficult to change the specification of materials. It takes five years to produce an original design for a car and it may undergo as many as five face-lifts, over a period of 15 years, resulting in an average life-cycle of 20 years for a model (Wittenberg 1992).

Car manufacturers can certainly influence the decisions of suppliers and determine the types of technologies to be used. *Ford*, *General Motors*, and *Toyota*, for instance, have virtually made it mandatory for their suppliers to be ISO 14001 certified by 2002[125]. The certification might not represent a first mover advantage for the suppliers; however, not having it will certainly represent a disadvantage. Nevertheless, the imposition of such demands on suppliers has the potential to promote the diffusion of *beyond-compliance environmental practices* in the automobile field (see Section 4.4 in Chapter 4). Conversely, the possibility of auto assemblers implementing changes also depends on the 'state of art' of supporting technologies, and the overall willingness of related business to cooperate with ecologically oriented strategies.

Significant attention needs to be paid to the choice of each material to be used in the automobile. As it was mentioned in Chapter 8 (Sections 8.1.1 and 8.3.2), the entrenched position of the steel industry makes it difficult to move towards lighter materials such as aluminium, plastics and carbon fibre. Steel makers have the advantage of the automobile industry being firmly adapted to the manufacture of car bodies based on steel. Sunk investments in systems of production adapted to such technological option implies that the substitution of lighter materials for steel in car-bodies will not happen without considerable upheaval and disputes between suppliers.

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125 *Business and the Environment's ISO 1400 Update*, Volume 1, No 11, November 1999.

Commenting on the problems associated with the substitution of aluminium for steel in car making, Chuck Risch (in Morton 1997:16) – the technology manager for *Ford*'s input into the American PNGV program (Partnership for a New Generation of Vehicles) – emphasised a central element in the interdependencies of the current systems of production in the automobile industry:

> The decision to switch to aluminium is too big for anyone to take (…) While you have the futurists who say we should all drive lighter cars, the industry has a responsibility for decisions on which the employment of thousands depend. There are engineers making aluminium cars in every corner of the industry, but engineering is not the regime. The question of confidence and business responsibility are bigger than the engineering aspect.

In essence, although focal firms can propose and indeed implement radical chances, the possibility of them becoming economically viable seems to depend on the positioning of related business. A substantial number of organisations are adapted to the current structure of the industry and its 'way of doing things'. The existing conditions in that industrial context satisfy their organisational structures and processes. Such conditions are themselves another environment-contingent factor.

9.1.6 Industrial Ecology Conditions

Automobiles are *congruent systems*, or systems of systems. They involve intricate processes for the transformation of design concepts into physical products. The use of cars requires the congruence of other systems such as refuelling stations and expert maintenance firms. The recovery of car parts involves a network of organisations for collection, dismantling, shredding, and recycling. Technically, the ecological modernisation of this intricate web of interdependencies demands what one can refer to as *industrial ecology conditions* – the conditions in the organisational field that facilitate the minimisation of environmental impact associated with the full life-cycle of a product. In many respects, industrial ecology conditions replicate the *factor conditions* proposed by Porter (1990). But while factor conditions influence the competitiveness of a specific industry, industrial ecology conditions refer to the specific concern of environmental performance of both focal firms and industrial clusters.

As it was emphasised in Section 2.4.2 (Chapter 2), within the discipline of *industrial ecology*, industrial systems are seen as integrated parts of the natural environment, and the total cycle of materials aims to be optimised in terms of resources, energy, environmental impact, and capital. From an industrial ecology perspective, firms are conceptualised in terms of their position in the 'chain of materials' and must consider the flux of energy and resources not only inside the firm but also in the overall industrial system. The cycle of industrial ecology extends its scope from *supply* (production) to *demand* (consumption). Similarities between the technical approach of *industrial eco-cycles* and the thesis of the ecological modernisation of production and consumption are obvious in this regard. Because both approaches place industrialism in similar terms, they are also complementary: industrial ecology conditions can be seen as technically oriented prerequisites for the more extensive development of ecological modernisation in industries.

Industrial ecology conditions can be thought of in terms of infra- and socio-structures[126]. The infrastructure available to firms can facilitate enormously the adoption of clean technologies during manufacturing. The pipelines extending from the Danish Trya Field in the North Sea to the Torslanda plant of *Volvo* in Sweden allow the company increasingly to substitute natural gas for oil to heat the ovens in the paint-shop, as well as to produce heat at the central energy unit. The use of natural gas makes it possible for the company to further reduce the emission of sulphur dioxide by some 90 percent, while also significantly reducing discharges[127]. *Fiat Auto* has also increased the use of natural gas – a primary source of energy with comparatively low environmental impact – for the co-generation of electricity and heat in its new factories. When operating with fuel loads, a back-pressure steam turbine transforms 82% of the energy content of the fuel into heat end electricity[128]. In this case, the company's investment in (internal) infrastructure allows the recovery of heat produced in power generation, increasing the overall efficiency in the use of the natural resource.

In theoretical terms, the examples of *Volvo Car* and *Fiat Auto* suggest that the adoption of cleaner technologies in manufacturing depends on conceiving production systems that are based on *design for the environment* (DfE) principles and techniques. DfE means considering the design of facilities, processes, products, and services with an awareness of both ecological and economic costs-benefits across the whole life-cycle of a product (Lowe 1993). Although the *infrastructure* comprises a crucial pre-requisite for adopting clean technologies, it is almost impossible to practice DfE without the

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126 An extensive definition of levels and types of structure can be found in (Fombrum, 1986, 1989)

127 *Volvo Environmental Report* n.35.

128 *Fiat Auto Environmental Report* 1995

widespread commitment of other companies, governmental agencies, universities and research centres. That is, it requires a *socio-structure* of labour skills, knowledge, and personal networks to function effectively. Data required for the evaluation of the environmental performance of products and processes across their life-cycles – technically denominated 'life-cycle analysis or assessment' (LCA) – are costly to collect, and depend on high levels of training. *Volvo Car* openly admitted: "the task of integrating LCA in *Volvo's* product and process development activities is proceeding more slowly than anticipated. This is due, in part, to the fact that the resources required for training and information programs have proved to be greater than envisaged" (*Volvo* 1996:19). As the experience of *Volvo* shows, private firms cannot easily implement design for environment and similar methods without a socio-structure that facilitates the development of environmental expertise (see: Section 3.3 in Chapter 3).

Although the local conditions of infrastructure may facilitate the adoption of industrial ecology principles by a firm or industrial cluster, the implementation of such principles depends also on the capabilities of people. This is why *industrial ecology conditions* require the consideration of both, infra and socio structures. As emphasised in Section 8.1.1 (Chapter 8), economies of scale and organisational size in automobile assembly and distribution represent industry's self-imposed business concept rather than an industrial imperative. Once car assemblers move away from the *Buddist* paradigm of car design, they also avoid the high level economies of scale that have characterised the more recent history of the industry. Such a move would make possible the implementation of the concept of *micro-factory retailing* (MFR), proposed by Wells & Nieuwenhuis (2000). By placing small factories within the markets they serve, the distinction between production and retailing would be practically eliminated. According to the authors, volume levels of 5,000 cars per MFR plant, compared with volumes of 250,000 in a traditional factory would be possible, representing, both economic and environmental advantages. From the engineering point of view, the industrial ecology conditions for such changes exist (see Section 10.3.5 in Chapter 10). But apart from the skills (socio-structure) that will allow automakers to move away from the *Buddist* paradigm, there are groups and organisations that have direct or indirect interest in the auto business. For some of them, as the next eco-factor will address, remaining big may represent an important asset.

9.1.7 Interests Groups and Organisations

The specialised literature generically labels any individual or organisation capable of influencing a focal organisation as '*stakeholders*' (see, for instance: Bansal & Roth 2000; Scott & Lane 2000). A multiplicity of variables, ranging from the structure of the industry and characteristics of the market, to the geographic location of industrial facilities, influences definition of stakeholders for an organisation. For this reason, the concept of stakeholder is normally very indistinct. Although this also holds true for this study, the characterisation in the previous sections of specific types of stakeholders, such as regulators, consumers, competitors, and related businesses reduces the scope of *interests groups and organisations* to a more particular set of interested parties. Of course, this term still embraces a wide range of groups and organisations that have direct or indirect interest in the automobile business. These groups and organisations range from the most obvious stakeholders, such as shareholders and industry associations, to ones that operate in areas of the economy that are quite distant from the automobile business.

Some interest groups and organisations are easily identifiable. They are the representative organisations that have the explicit mandate to influence the directions of the industry. The lobbying role of the European Automobile Manufacturers Association (ACEA) in the decision making of the European Commission is possibly the most evident in the automobile case[129]. ACEA is just one among several other organisations of the same nature. CLEPA, the trade association for automotive suppliers, was reactivated in September 1997 after 30 years showing the increasing importance of organisational representation in the industry. Several other interest groups were identified in the study, ranging from automobile clubs to *ad-hoc* organisations such as PRAVDA – a working group on end-of-life vehicle created in 1991 by German automakers. As Chapters 10 and 11 will demonstrate, these organisations are undoubtedly important players in the industry. However, there are less obvious groups that exert significant influence decision making within the context of the auto industry.

A closer look at the interdependencies between manufacturing firms and financial markets reveals the reasons why some groups of investors and investment fund

129 Progress reports can give an idea about the lobbying profile of ACEA. See: http://www.acea.be/acea/index.html (2000, October 29).

companies have a clear interest in large-scale car manufacturing firms. As discussed in Chapter 8 (Section 8.3) of the total profit in the value-chain of the auto business insurance makes 13% and the parts market 18%, while auto assemblers make as little as one percent. In the light of such data, one could ask why automakers bother to make cars at all? And why do creditors and shareholders encourage it? The explanation moves us away from the auto business and more precisely into its consolidation within the sphere of the financial sector. According to Golding (1999:21):

> As consolidation of investment funds continues, it is more and more likely that they will invest in the auto industry – because they have to do. Liquidity is the major issue. Big investment houses have to invest funds greater in value than the largest automakers. Active portfolio management means taking a limited number of big beats. If they want to take a significant shareholding in a company, it has to be a very big one. And there are few bigger than the auto companies.

As example suggests, there are a wide range of groups and organisations interested in the growth of the auto business (and corporations). Obviously, a great number of groups and organisations would like to see a reduction in the relative capacity of the auto industry to increasingly populate the planet with motorcars. In Europe, in particular, informal groups and non-governmental organisations (NGOs) have organised street protests against the dominance of cars in the urban environment. Although surveys about public opinion on such matters are still lacking, the European media in the last decade has portrayed increasing public support for anti-motorcars groups, such as the cyclist action group, *Critical Mass*[130]. The countervailing power of such groups is considerable smaller than those interested in the growth of the motor business. Nonetheless, they constitute a more genuine public representation that can eventually provoke changes in social and system integration – the fundamental elements of the circuits of political ecology.

9.2 Circuits of Political Ecology

The previous section identified seven factors that foster or inhibit the ecological modernisation of the automobile field. These are the main influences in a process that can eventually result in changes in the automobile field. However, the factors should not be seen as independent entities. As explored thoroughly in Chapter 5, every interaction

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130 Critical Mass comprise large numbers of cyclists who come together on the last Friday afternoon of every month and cycle, *en masse*, through city streets, to reclaim space for bikes rather than cars.

between the environment-contingent factors is mediated by the elements of political ecology. For instance, episodic power gains by environmental groups or legislators imposing better environmental performance on carmakers cannot alone sustain ecological modernisation processes. They need to have an impact on the overall circuits of political ecology, redefining their constituency. In other words, for ecological modernisation to occur, episodic power gains need to be institutionalised in the organisational field.

As can be observed in Figure 9.1, the way in which the circuits of political ecology are represented in ecological modernisation frameworks constitutes a simplification of its original presentation in Chapter 5 (see Figure 5.1). From the original elements forming the political ecology framework, only social and system integration are represented in Figure 9.1. The main rationale for this decision relates to the simplification of the use of the concepts of circuits of power, originally presented by Clegg (1989), and adapted in Chapter 5 for the specific use in environmental issues in organisations. Obviously, the remaining elements – obligatory passage points, standing conditions, and agency – are central for a systematic representation of an 'anatomy of power'. But mainly because these elements are embedded in the specific dynamics happening in the organisational field, their use in the ecological modernisation framework (Figure 9.1) emphasises their conceptual character, rather than the description of interdependencies in a flowchart, as it was presented in Figure 5.1.

Moreover, transformations in the elements of circuits of political ecology will eventually result in social and system 're-integration'. In other words, if eco-factors are to be effective in fostering ecological modernisation, they must redefine circuits of political ecology by transforming both system and social integration. This is why the concept of *structuration* (or the structuring of structures), proposed by Giddens (1984; see also: Haugaard 1998) best represents the dynamics happening in the organisational field. Mainly because social actors are constantly 'building' structures, the continuous process of configuring and reconfiguring social and system integration is what characterises the structuration of the automobile field.

New techniques of production entail new forms of power and knowledge but the dominance of the current power/knowledge should not be expected to fade away; more likely, people associated with them will resist. As the battle between the steel and aluminium industries over the use of materials has shown (see Section 8.3.2 in Chapter 8), technological innovation invariably entails struggles between the various actors involved in the process for the definition of the *obligatory passage points*. Although the steel industry is using the results of the MIT (Massachusetts Institute of Technology) study to secure its own interest in the industry, efforts have also been directed to reducing the environmental impact of cars made out of steel. Moreover, by promoting the study, the sector is actually helping to generate more knowledge about the real burdens associated not only with steel but also with other materials. The consideration of the entire life-cycle of aluminium reveals environmental impacts that have been previously overlooked. Aluminium, a material commonly seeing as a '*green* material', looses its prestige when one considers the real environmental impact during production.

Whoever 'wins' this battle is not relevant in terms of the transformation of the circuits of political ecology in the automobile field. More important is the fact that the debate itself has the potential to become an *agency*: it has the capacity to impact on future design concepts and corresponding specification of materials. The very necessity of the steel industry to defend the position that historically privileged the sector is, in itself, an indication of possible reconfiguration of *social integration*. The symbolic importance of the debate over the meaning of what constitutes a '*green* material' has the capability to define the category (supplier) membership in an 'ecologised' automobile industry. Similarly, the ways in which innovations in the use of materials may empower an industrial sector at the expense of the disempowerment of the other may modify the *system integration* encompassing the automobile field. In fact, the concept of 'system integrator' is already widely used in the context of the industry. Even though the use of the concept is limited to the description of the new role of *Tier One* suppliers, it provides a clear example of how a specialised form of *system integration* is already a materialised reality for many players in the sector. As Sage (1999) argues, the consolidation of the supply industry, with the reduction of 30,000 firms in 1986 to less than 5,000 in 2003, will require the remaining players to develop new strategic vision, skills, and competences. Such changes will certainly entail the redefinition of system integration not only of the supply base but also in the balance of power in the auto business as a whole.

Finally, the notion of circuits of political ecology may resemble more an intellectual exercise of political scientists than a concept that has empirical, indeed pragmatic implications. However, as the next two chapters will explore, the systematic description of the dynamics involved in ecological modernisation processes is fundamental for understanding the pace of environmental innovation in the auto industry. The use of the circuits of political ecology concept can significantly help one to understand, for instance, why the main developments undertaken by the automobile industry in the last quarter of the 20th century were limited to incremental upgrading of the internal combustion engine and all-steel car body technologies. The notion of circuits of political ecology can also help one to explain why the development of hybrid powertrains assembled in all-steel car bodies has been prioritised by automakers. From the perspective of social and system integration, the development of such technology can be seen as an attempt by car assemblers to innovate without having to move away from their core competences (see Section 8.4.3). As long as the existing and well-established industry complexes surrounding the petroleum engine can be secured, auto manufacturers can also maintain their centrality in the automobile field. By using the framework to analyse how eco-factors trigger changes in the circuits of political ecology, one can assess whether this centrality can be maintained in the next decades.

9.3 Conclusion

In late modernity, the natural environment has emerged as a central element of the socio-technical context of decision-making processes within the automobile industry. In this chapter that context has been addressed through the systematic description of the elements forming *the ecological modernisation framework*: environment-contingent factors and circuits of political ecology. Section 9.1 presented seven eco-factors, which may foster or inhibit organisations and the industry as whole to develop environmentally sound strategies and practices. For instance, *organisational commitments* and appropriate *capabilities* influenced the improvements made by automakers in energy and material savings during manufacturing and emission levels during car use. But structural and behavioural constraints have also limited the degree to which ecological modernisation occurred inside these organisations. In a similar model, the eco-factor named *competitive forces and collaboration* (Section 9.1.4) encompasses both rivalry, which may foster environmental innovation in the context of the industry, and collaboration among members, which may seek to maintain the social and system integration of the industry unaltered. In simple terms, eco-factors refer both to enhancing and inhibiting aspects involved in the *greening* of industries.

The research setting and the main technological, economic, and environmental issues surrounding the automobile field were described in Chapter 8, constituting the first step in the process of answering the research question that guided Part II of this research: why is the auto industry undergoing ecological modernisation? By presenting the ecological modernisation framework, this chapter represents the second step in the same direction; it provides a scheme that can be used for a systematic analysis of the innovations under development in the automobile field. As the examples used to describe the eco-factors suggest, technological incrementalism represents the vast majority of the innovations undertaken by auto industrialists, characterising also the ecological modernisation phenomenon currently under development in the sector.

The study does not intend to test the sensitising hypotheses that portray the ecological phenomenon, proposed by Mol (1995; see Section 6.3.1 Chapter 6). Nonetheless, the arguments presented in this chapter suggest that ecological modernisation principles are indeed becoming part of organisational practices in the automobile field. As it was stated in Chapter 6, Cohen (1997), suggested that ecological modernisation presupposes the intensification of: (i) organisational internalisation of ecological responsibility, (ii) the implementation of anticipatory planning practices, (iii) the implementation of strict governmental regulation, and (iv) the switch to the use of cleaner technologies through the process of *hyper-industrialisation*. In broad terms, such strategies are happening to different degrees in the context of the auto business. The reasons for such phenomenon can be located in several areas of influence, represented in this chapter by the eco-factors.

The use of the concept of *political ecology* to represent the (*structuration*) dynamics happening in the automobile field implies that any answer to the research question will not be simple. A broad explanation finds its roots in the pressure that auto manufactures have faced to improve their environmental performance. However, more specialised understanding about the characteristics and pace assumed by the ecological modernisation phenomenon requires additional, systematic analysis. This is what the ecological modernisation framework is supposed to provide: a ‘blueprint’ that can help one to develop a systematic analysis of the socio-technical context of a specific organisational field – the *automobile field*, in the specific case of this research. The next chapter will provide a test bed of the framework in respect of the case of urban electric vehicles.

10 Developing *Fields* for Electric Vehicles in Western Europe

Developments in engine technology and cleaner fuels during the last quarter of the 20th century have significantly reduced the emission of pollutants from cars powered by internal combustion engines (Peake 1997). The vast majority of these engines, however, still rely on hydrocarbon-based fuels. Moreover, cars powered by fossil fuels are also likely to be continuously under pressure simply because petrol – the main source of energy of motor vehicles – is expected to cost substantially more as overall world production decreases (see: Section 8.3.3 in Chapter 8). In simple terms, no matter what level of air emission reductions carmakers have achieved, they will be continuously under pressure to work towards zero emissions.

Interestingly, an alternative for internal combustion engines (ICEs) has been known since the invention of the automobile, more than a hundred years ago. The electric car, which lost its battle against gasoline-powered vehicles at the beginning of the 20th century (Yergin 1992), has long been considered a viable solution for urban personal transportation (Cronk 1995; Renner 1988). The lowest level of vehicle air emissions is achieved with electric powertrains using electricity generated from hydroelectric or other renewable sources of energy[131]. Hence, by commercialising electric vehicles (EVs) automakers would satisfy the strictest regulatory requirements on air emissions at the same time as they could, potentially, fulfil consumers' needs for private transport in urban areas. Indeed, several experts (see, for instance: Elzen *et al.* 1995; Sperling 1995; Cronk 1995) predicted that by the year 2000 a substantial number of EVs would be on the roads. Why then do electric vehicles continue to be 'marginal' products in the portfolio of traditional car manufacturers? Why has the opportunity to commercialise EVs (that is, to produce them in high volumes) has not been explored by new entrants to the industry? What explains the marginal market presence of this type of vehicles in the particular context of Western Europe?

131 For instance, gasoline engines generate a total of 222-282 g/km CO2 equivalent of *green*house gas emissions, while the range of a compressed natural gas (CNG) engine is 164-253. An electric motor using hydro/renewable source of electricity will emit only 44-48 g/km CO2 equivalent (Michaelis & Davidson 1996).

An unsophisticated answer to such questions would anchor its arguments in the technical performance of *electric vehicles*[132] (EV), which, currently, are the only commercially available *zero emission vehicles* (ZEV). Automotive experts and auto industrialists have time and again claimed that electric vehicle technology is not yet sufficiently developed and therefore is not an economically viable alternative to the petrol-powered car (see, for instance: Atkin & Storey 1998). More sophisticated answers can be found in studies based on evolutionary and quasi-evolutionary economics and in constructivist sociology[133]. According to these perspectives, the relative absence of EVs on the roads relates to the ‘lock in’ situation created around the ICE technology (Kemp 1994; Schot *et al.* 1994). A self-reinforcing system of rules and beliefs embedded in design and engineering practices have been created around the socio-technical context of the modern automobile, characterising what Nelson and Winter (1977) called a *technological regime*. Generically, these two set of answers – the intrinsic technological advantage of ICE-cars and their embeddedness in a broad technological regime – represent the scope of possible explanations for the (relative) market failure of EVs.

This chapter reiterates that the *‘meso’* level of analysis, represented by the *automobile filed*, can substantially help one to address the issues of the current marginal production, commercialisation, and use of electric vehicles. As it was elaborated in Chapter 8 (Section 8.4), the *automobile field* merges the traditional concepts of ‘industry’ and ‘organisational field’ for the study of the socio-technical context in which automobiles are embedded. This concept establishes a link between the product (the *automobile*) and the *field*, embedding the former in its systems of production and consumption. In other words, such an approach associates the intrinsic (mostly technical) properties of the product with the social context surrounding the scope of actions of the existing industrial sector. Hence, the notion of the automobile field implies that the analysis be located in the ‘surroundings’ of the industrial sector, rather than in a much broader scope, as implied in the notion of technological regime. In

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132 The concept of ‘electric vehicle’ (EV) is used here to designate only ‘pure’ or ‘battery’ electric vehicles. These vehicles do not use inboard engines, such as the small internal combustion engines or fuel cells to supply electricity to the electric motors or to the batteries, used by ‘hybrid (ICE-electric or fuel cell-electric) vehicles’.

133 An overview and comparison of these fields can be found in Schot (1992). See also Schot *et al.* (1994).

simple terms, one could say that the automobile field ‘localises’ the technological regime in the context of the automobile industry.

The automobile field has been (visually) represented in terms of the ecological modernisation framework, which was introduced in the previous chapter. This framework was created from *reflexive interpretation* on the empirical material addressed in this and the subsequent chapter. In such a reflexive process, “interpretation implies that there are no self evident, simple or unambiguous rules or procedures, and that crucial ingredients are the researcher’s judgement, intuition, ability to see and point something out” (Alvesson & Sköldberg 2000:248). In other words, the process of generating the framework was based on the analysis of the case studies presented in the following sections, which is now used as a product of such a process to *reflexively* represent the cases that were used for its own development.

Generically, this chapter addresses the third objective of Part II of this study, established in Section 7.1.4 in Chapter 7; it describes the pilot programmes for the introduction of (battery) electric vehicles in Western European markets. Section 10.1 presents the rationales for advancements on electric vehicle technology. Although at first glance, the inferior performance of EVs, when compared with ICE-cars, would detract organisations from investing in this technology, less apparent reasons for doing so are explored in the section. Governments worldwide have expressed such motivations, constituting the main reason to present, in Section 10.2, the generic characteristics of environmental policies and programmes adopted in the American and European contexts. Although the case studies presented in this chapter have been developed in Europe, the multinational nature of the industry as well as the scope of influences of regulatory measures imposed in the American State of California justify a brief explanation of the differences between the two systems. In this respect, the cases presented in Sections 10.3 and 10.4 constitute not only a sample of similar experiments developed in European countries (France and Norway) but they also reflect some of the characteristics of the generic European approach to the introduction of low emission vehicles.

Although *volume*[134] car manufacturers are represented in both case studies, their role is notably different in each case. In La Rochelle, the French PSA Group (the controller of the car manufacturers *Peugeot* and *Citroën*) was one of the three leading organisations promoting the use of *converted*[135] electric vehicles. Section 10.3 describes the role of PSA, as well as the other organisations – the Municipality of La Rochelle and EDF (*Electricité de France*), the French national electric utility – that supported the development of an experiment that has been considered a milestone for the decision of *Peugeot* and *Citroën* to commercialise electric vehicles[136]. In the second case study, a traditional automaker only entered the scene at a later stage. Section 10.4 describes the process of developing a two-seat EV for a (potential) niche market, which culminated with the American *Ford* taking over the enterprise in January 1999. The section explores the reasons why a potential new entrant in the automobile market eventually became an asset for the second largest automaker in the world.

The reports of Simon and Hoogma (1998) and Schwartz and Maruo (1998), describing the case studies of La Rochelle and *Pivco*, respectively, were used as the chief data for the analysis and presentation of the experiments in this chapter. The case studies were constituents of the *Strategic Niche Management* (SNM) project, developed in the period of May 1996 to October 1998, and explained in more detail in Chapter 7. As a 'guest commentator' of the project, I followed the main developments that culminated in the reports, and debated the contents of the reports with the respective authors. Additional (anecdotal) data are also used to describe the developments that occurred after the conclusion of the SNM project. As emphasised in Chapter 8, 1998 marked an intense change of pace in the auto industry; the developments that occurred

134 The definition of what constitute a 'volume' car manufacturer evolves with the firms' growth of production capacity. Nonetheless, if a production of 1 million units per year is considered a minimum quantity for a volume manufacturer, the worldwide industry would be comprised by fourteen corporations (*Automotive News Europe*: 2000 Global Market Data Book). Some analysts expect that industry consolidation will result in six global manufacturers with production capacity (volume) at around 15 million cars per year by the year 2020 (see: Feast 2000).

135 Basically, a 'converted' electric vehicle is a conventional car, which the internal combustion engine (ICE) has been removed to give way to electric powertrains.

136 The use of nuclear power accounts for approximately 75% of the electricity generated in France, a source of energy with relatively low levels of CO_2 emissions. However, one could certainly question whether the use of nuclear power, and consequent generation of radioactive waste, is acceptable from an environmental point of view.

in the period of November 1998-2000 are addressed in the case studies presented in Sections 10.3 and 10.4.

The analysis of these cases in this chapter is expected to satisfy the third objective of Part II of this study, presented in Section 7.1.4 in Chapter 7. In Section 10.5 the circuits of political ecology framework is used to explain why the experiments described in this chapter not only represent typical programs in Western Europe but also have become central in influencing the current features of the market of EVs in Europe. Finally, Section 10.6 presents the conclusions drawn from the analysis of ecological modernisation processes in both case studies.

10.1 The EV Technology Rationale

If electric vehicles (EVs) are technologically inferior to vehicles powered by internal combustion engines, why has there been an enduring interest in developing markets for them? To pose this question is to challenge those who use essentially technical (or *technocentric*) arguments to justify the dominance of cars powered by petrol engines. Technological dominance by ICE technology should, in theory, retard interest in electric powertrains. But historical evidence shows that, although interest in electric vehicles has always been subject to cycles, it has never faded away (Cronk 1995). Today, the interest seems to be on the rise once more but some auto industrialists and experts, such as Atkin and Storey (1998), believe that this is a cycle similar to the previous ones, and the technological superiority of the ICE-car will once again prevail – as has always been the case.

One explanation for the enduring interest in electric vehicles addresses a fundamental flaw in the argument that justifies the technological superiority of ICE-cars. Basically, the high-energy content of hydrocarbon-based fuels, rather than the overall efficiency of the ICE car, is responsible for its advantage when compared with electric vehicles (Lovins & Lovins 1995). In other words, the technological advantage of petrol-powered cars is located in the qualities of the fuel, rather than in the technology embedded in the vehicle *per se* (see: Section 8.4.2 in Chapter 8). Indeed, the energy content and qualities of hydrocarbons are so remarkable that it is almost impossible to imagine the technological development achieved in modern times without such fossilised form of energy (Fleay 1995). The keyboard I use to type these words represents one, among hundreds of thousands of products, which have petrochemicals as constituents. Hydrocarbons are so important to modern industrial society that justification for burning them may become increasingly difficult – not on the basis of the environmental impacts of combustion processes but because burning hydrocarbons may not make economic sense (Campbell & Laherrère 1998; see also Section 8.3.3 in Chapter 8).

The energy content of petrol allowed the automobile industry to produce car bodies weighting twenty or more times the weight of its driver – a significantly low ratio, if compared with the one for a pushbike, for instance – and still remain economically viable (Hawken *et al.* 1999). Although the vast majority of the fuel burned by ICE-cars serves to transport the vehicle mass, instead of the driver, the high energy content of fossil fuels allowed industry progress based on a design concept of (relatively) energy-inefficient vehicle. As posited in Section 8.4.2 (Chapter 8), even though the automobile industry is a mature economic sector, current ICE-cars cannot be considered *ecologically mature products*. In terms of environmental performance, a lightweight electric vehicle, for instance, outperforms a conventional automobile in almost any aspect, such as production of waste during manufacturing, energy demand during production and use, or recyclability rates of car parts (Whitelegg 1993).

Electric vehicles may present environmental advantages but it seems that motorists are interested (or have been persuaded to be) in a different kind of performance (see: Section 9.1.3 in Chapter 9). Among a multitude of merits attributed to motorcars, (high) speed and fuel autonomy appear to be the more important *motoring* variables for car users. Freund and Martin (1993) link such preferences with *the ideology of the automobile*, in which individual freedom has been associated with the speed and mobility that cars are supposed to provide. Indeed, the glamour and challenge presented by motor racing certainly encompasses the importance of such variables for automobile enthusiasts. Environmentally sound vehicles, such as lightweight EVs, tend to be slow to drive and to recharge. If ranges superior to 100km are to be achieved without recharging, the relative low energy storage capacity of commercially available batteries requires carrying substantial amounts of them. Hence, these two sets of automobile performance – environmental and *motoring* – have been in opposition throughout the history of the automobile and are one possible reason justifying the reluctance of automakers to commit themselves to the electric vehicle technology.

The inferior *motoring* performance of electric vehicles may not satisfy a great number of consumers but EV enthusiasts believe that such fact should not hinder the development of markets for this type of vehicle. One of the reasons for the continuing effort to transform EVs into a commercial reality is based on the assumption that they do not always require the equivalent performance of petrol-powered cars and that current levels of performance of electric vehicles make them suitable for specialised applications. Small lightweight electric vehicles could be used to perform short trips in the vicinities of households, for instance, characterising what Sperling (1995), among others, calls the *neighbourhood electric vehicle*. As the case studies presented in the following sections will demonstrate, the majority of potential EVs users are expected to use the electric vehicle for journeys that do not require equivalent performance to ICE-cars.

In the same line of thinking, some Municipalities around Europe have been working on schemes to restrict the access of automobiles to city centres. An example of such measures can be seen in the automated control access to the centre of Bologna (Italy) described by Hoogma (1998), which aims to reduce air pollution and traffic in the inner city. Although schemes such as that implemented in Bologna vary in their scope and objectives, electric vehicles are expected to have free entry in the areas that are restricted to ICE-cars. These schemes represent potential market niches for EVs, and have encouraged individuals, groups and organisations to develop and commercialise (low volumes) of such vehicles and eventually become *new entrants* in the industry. One of the rationales for the development of the *T!hink* electric vehicle, described in Section 10.4, was based on the market potential of these niches.

Although market niches for EVs might motivate some (small) new entrants in the auto industry, it is possible that the uncertain potential of these niches contributed to the reluctance of volume manufacturers to invest in EV technology. After all, during the greater part of their history car manufacturers have been busy commercialising high volumes of petrol-powered cars that (apparently) satisfied consumer preferences. It was only in the last quarter of the 20th century that automakers faced some pressure to reduce the environmental impact of their fleets. However, the pressures have increased to such an extent in the past decades that the environmental advantages associated with the EV technology have started to be (re)-considered by carmakers. As the case study of La Rochelle in Section 10.3 will demonstrate, during the past three decades some car manufacturers have invested considerable resources to make electric vehicles a commercial reality.

One of the rationales for investments on EVs relates to the expectation that an eventual breakthrough in battery technology will not only solve the problem of automobile emissions but also help automakers to reduce their dependency on the oil supply – a recognised weakness for the long-term survival of the business. Moreover, research and development (R&D) efforts that eventually result in a significant improvement in the overall performance of batteries could represent a 'first mover advantage' for the companies involved in such projects (see Chapter 9). The USABC (United States Advanced Battery Consortium) is a research project funded by the US Department of Energy, The Electric Power Research Institute and the car manufacturers *General Motors*, *Ford*, and *Daimler Chrysler*, which constitutes an example of such a venture. Improved performance of batteries could reduce the cost per unit, facilitate manufacturers to explore economies of scale, and make batteries more competitive in relation to the ICE technology. In other words, a self-reinforcing system could be created around EV technology, similar to the one that has historically favoured the automobile system based on the internal combustion engine (see Section 8.1 in Chapter 8).

Some experts assert that this is an unrealistic expectation. Sperling (1995) thinks that cost reduction resulting from improved performance of batteries and their mass production will never bring the price of 'pure' or 'battery' electric vehicles (BEVs) down to that of petrol-powered cars. Nonetheless, the author believes that the higher initial purchase price of EVs can be mitigated along the full life-cycle of the vehicle. Hawken *et al.* (1999) and Atkin and Storey (1998), on the other hand, have a more pessimistic view for the future of BEVs. In their opinion, the intrinsic weaknesses of pure EVs – mainly resulting from limitations in battery storage capacity – are extremely difficult to overcome with the only viable solution being the mass production of environmentally sound vehicles based on *hybrid* technology, which was mentioned briefly in the previous two chapters. Amory Lovins, the main proponent of this technological option, believes that the fate of the automobile industry will be determined by those who are capable of offering vehicles based on the concept of the *hypercar*: lightweight vehicles with bodies made of advanced polymers, and powered by fuel-cell-electric powertrains (Baukus Mello 2000). Whether the defenders of the hybrid technology are right or not, and what kind of technology will power the automobiles in the first decades of the new millennium, constitutes the debate around the solutions for auto emission in the long term; in this case, 2030 onwards. The future of powertrain technology is open to speculation. But if it is impossible to forecast the ‘winner’ technology of this ‘race’, there are already clear indications what will constitute its core elements.

Electric vehicles purely based on battery power may deserve some of the criticisms attributed to them, such as low speed and limited range, but the technology they encompass has been recognised as central for the directions the auto industry will take in the coming decades. As Nieuwenhuis (1998) signalled, all long-term alternatives for the ICE-car currently under consideration – ‘pure’ or battery-electric vehicles (BEVs), and vehicles combining ICEs or fuel cells with electric powertrains (*hybrid* EVs) – involve *electric traction*. The debate locates where and how the electricity that will power electric motors will be generated and stored and poses no question in regard to whether electric motors will be used in powertrains of future cars. Viewed from this perspective, developments in the field of electric vehicles assume a more strategic importance than the immediate results of real-life experiments, such as those presented in this chapter. The characteristics of policy-making promoting the EV technology will certainly influence the directions that developments take in this field. For this reason, the next section explains the generic differences between American and European legislation.

10.2 Environmental Policies and Programmes: The European Approach for EVs

Each of the case studies presented in this chapter is embedded within a particular regulatory framework. The countries where the experiments have been developed have specific environmental policies that promote programmes, which may facilitate or hinder the diffusion of more environmentally friendly technologies. For instance, the membership of France in the European Union (EU) entitled La Rochelle to be partially sponsored by an EU programme, while local government and interested groups and organisations provided the funding for the development of the *Pivco* experiment in Norway. Although specificities regarding regulatory framework and incentives exist, Western European countries have adopted a similar approach for the promotion of low-emission vehicles. Generically, the major difference in the regulatory framework is not among European countries, but between the general European approach for the introduction of EVs and the one adopted by some North American states.

Following a tradition of being in the vanguard of emission legislation, the American State of California has lead the ‘technology forcing’ approach for the introduction of *zero emissions vehicles* (ZEV)[137]. In 1990, the California Air Resource Board (CARB) established the 'Low Emission Vehicle and Clean Fuel Regulations', a ten year schedule, within which the emissions limits became progressively tighter for the model year (MY) of cars between 1994 and 2003. The legislation leads to the requirement that car manufacturers that have sold in excess of 3,000 light duty vehicles in California between 1989 and 1993 will need to sell 10% of that fleet as ZEVs in 2003(MY) cars. For example, in 1992 *General Motors* sold 330,000 cars in California. Consequently, out of the 2003MY cars the company must sell 33,000 ZEVs. *Ford-Mazda* combined will need to sell 36,500 units. *Toyota*, *Honda*, *Renault-Nissan, BMW*, *DaimlerChrysler*, and *Volkswagen*, although they are required to sell lower volumes of ZEVs in their Californian fleets, will also be affected by the Californian mandate.

There are subtleties in the regulation, such as giving credits to automakers that sell ZEVs in advance of the 2003(MY) mandate; however, its implementation will (in theory) eventually result in a total of 124,000 electric vehicles being on Californian roads in the year 2003. Many doubt that this is a possible scenario. After interviewing the CARB members and personnel in the automobile industry, Atkin and Storey (1998) were of the opinion that CARB will have no option other than to amend the ZEV legislation. Maruo (1998) believes that the introduction of the '*equivalent zero emission vehicle*' (EZEV)[138] will make it possible to use hybrid vehicles in order to comply with the Californian regulation (see Section 8.1.1 in Chapter 8).

Differently from the Californian mandatory framework, the introduction of EVs in Western Europe is based on R&D (research and development) programmes, involving the sponsorship of demonstration projects, subsidies, and tax reductions for this type of vehicles. Although emission regulations have become increasingly demanding in the Western European context in the past decades, there are no prospects for the introduction of legislation requiring manufacturers to make ZEVs available to consumers. For the country members of the European Union, the 'principle of *subsidiarity*' also makes it difficult for the Union to introduce regulatory frameworks similar to the ZEV mandate adopted in California. Under this principle, regional or local

137 For an overview of the evolution of the Californian ZEV mandate and the main players involved in the process see: Sperling (1995).

138 The Equivalent Zero Emission (EZEV) is "an emission standard intended to equate to the incremental emissions from power stations attributable to mains-charged battery electric vehicles" (Atkin & Storey 1998:279).

authorities devise the means by which the targets of aggregate air quality, defined by the European Parliament, should be achieved. Although local authorities could, in theory, impose a ZEV regulation, there is an apparent consensus among police-makers that the use of incentives, rather than disincentives, is a more effective way of promoting cleaner vehicles (Nieuwenhuis & Wells 1997). This is the main reason why, during the 1990s, European governments supported the dissemination of pilot projects, such as La Rochelle, which will be described next.

10.3 Automakers Initiatives: The Case of PSA in LA Rochelle

The La Rochelle experiment with electric vehicles was an extension of a long-term cooperation between three actors: the French PSA Group (the controller of car manufacturers *Peugeot* and *Citroën*), the state-owned electricity utility EDF (*Electricité de France*), and the Municipality of La Rochelle (located on the West coast of France). The experiment served both investigative and demonstration purposes. At the same time that the design of the experiment tried to evaluate whether electric vehicles (EVs) would satisfy the needs of private users, it was necessary for the partners to convince potential users that this was a reliable form of transport. The direct use of the vehicles and associated technologies would influence the pilot-users to consider the capacity of the technology to fulfil their daily urban transport needs. Overall, the good performance of the vehicle, the ease of recharging, and the level of technical support and maintenance were expected to influence users to have a positive view of the EV technology. On the other hand, the demonstration aspect of the project would also allow the partners to learn about the generic driver-vehicle relationship, which included driving and recharging behaviour, the evolution of the status and image attributed by the driver to the vehicle, as well as the integration of the vehicle into the travel needs of the users.

In order to study the behaviour of potential customers of electric vehicles, 25 'converted' *Peugeot 106* and 25 *Citroën AX* (today branded as '*Saxo'*) were rented to private users and companies. Although the *Peugeot* and *Citroën* cars have a slightly different body design, their components are similar. Compared with a normal retail model, structural alterations were made only to adapt them to EV-related apparatuses, such as electric motors, electronic control, and batteries. The luggage volume was reduced by the installation of batteries – a common characteristic of most converted vehicles – but the cars had the same external design features of their original counterparts powered by internal combustion engines.

Out of a total of 220 candidates, 30 were selected to participate in the demonstration project. The sample intended to represent the population of potential customers: users of second cars in the *low-range segment*[139] of the market who drive less than 10,000 km a year, mainly inside the city. The cars were not used for holidays, weekends, or for trips of more than 100 km a day more than five times a year and the vehicles were rarely used on highways. The sample also sought to represent potential EVs users in terms of gender, age, and professional activity. Nonetheless, the final sample had an over-representation of male employees and senior executives, while retired people were under-represented. Moreover, cars replaced by EVs were not always second cars, or belonging to the low-range segment[140]. The user-organisations were also chosen on the basis of their fleets to use cars in this segment[141].

The experiment had a total duration of eighteen months – from December 1993 to May 1995 – and, during that period, the behaviour of users towards the new technology was monitored and evaluated. Interviews and workshops with private users and decision-makers of the organisations that were testing the cars were used to evaluate the overall driver-vehicle interaction, the evolution of driving patterns, and the use of recharging facilities. Every two months, questionnaires were sent to users to measure their satisfaction with the EV performance. Drivers used an on-board logbook to register the distances and reasons for using the car, as well as the frequency and type of recharge. Altogether, the information was used to evaluate *patterns of utilisation* of the electric vehicles. At a more pragmatic level, the problems identified by the users were used by PSA to improve the vehicles, which were returned to the users for a six-month additional evaluation period – from June to December of 1995.

The evolution of the experiment is summarised in Figure 10.1. Obviously, the figure only indicates the major developments in a much more intricate field of influences. Nonetheless, using the ecological modernisation framework to guide analysis, the evolution of the experiment is organised according to the relationship among environment-contingent factors (eco-factors), which were central in the

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139 According to the classification of *Automotive World* – one of the main periodicals in the auto business – the *Peugeot 106* belongs to the 'A' market segment', and the *Citroën Saxo* to the 'B segment'.

140 14% of the users had the EVs as their first car, and only 64% of the 'first' cars belonged to low range segment. The sample represented 10% of the local customers for low-range segment – the potential users of EVs.

development of the experiment. As has been emphasised previously (and detailed in Chapter 7), the identification of the eco-factors was a result of the *reflexive interpretation* of the combined case studies, supported by the literature review presented in Part I of this study. Hence, the use of the framework to represent the evolution of each experiment is in itself a result of this analytical process.

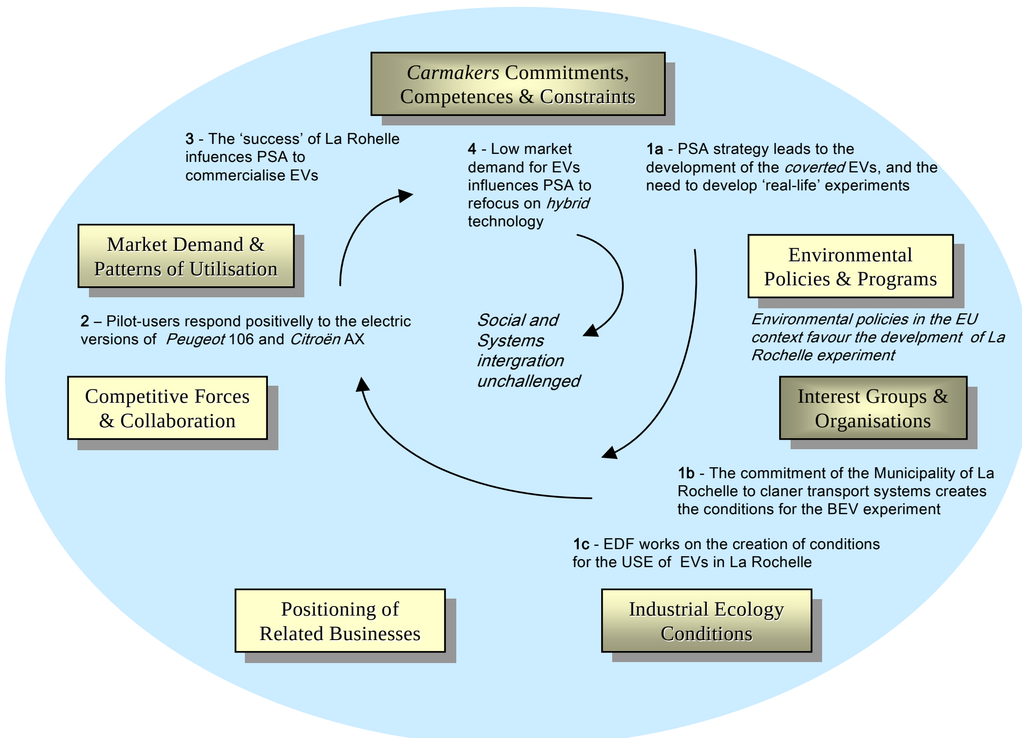
As it can be observed in the figure, the eco-factors 'organisational commitments, competences and constraints' and 'interest groups and organisations', are represented by a darker colour pattern, which symbolises their relative importance in the experiment, when compared with the other eco-factors. In La Rochelle, PSA Group represents the 'organisational commitments, competences and constraints' (OCs) of automobile manufacturers *Peugeot* and *Citroën* in that specific automobile field. The generic reference of OCs in the ecological modernisation framework, presented in Figure 9.1 (Chapter 9), is now substituted by a specific organisation (PSA). In other words, for the specific case of automobile field, a traditional volume car manufacturer represents the eco-factor OCs. On the other hand, both the Municipality of La Rochelle and EDF undoubtedly represent 'interested organisations', even though the role of EDF in the experiment was closely related to creating the 'industrial ecology conditions' for the use of electric vehicles.

A sense of proportion should also be recognized between the La Rochelle and *Pivco* experiments, in relation to the overall scope of the automobile field. The scale of these experiments could be compared with laboratory production volumes in relation to the mass-production of an industrial product (in that case, automobiles). When the fifty vehicles tested in La Rochelle are compared with an average of 12 million cars sold in Western Europe every year, their numeric significance becomes marginal. In this respect, the darker colour of the eco-factors showed in the figures; depicting the La Rochelle and *Pivco* experiments, refer to the relative importance of those eco-factors in each case. They do not mean that the overall automobile field has been influenced by the experiment. In other words, darker-coloured eco-factors characterise the relative importance of the players in that specific field, based on the generic classification proposed by the ecological modernisation framework. As it can be noticed in the figure,

141 The Municipality of La Rochelle and EDF tested five cars each, local authorities tested three vehicles, private firms tested five, and each of the *Peugeot* and *Citroën* dealers tested one car.

‘interest groups and organisations’ have a *relative* higher importance in the experiment when compared with ‘competitive forces and collaboration’, for instance.

Figure 10.1: The Evolution of La Rochelle Experiment



The figure shows that three actors initiated the experiment in La Rochelle. The role of PSA is depicted in Event 1a, while Event 1b describes the actions taken by Municipality of La Rochelle, and Event 1c, the strategic importance of EDF in the development of the recharging infrastructure, mainly. The three events should be seen as interdependent and occurring simultaneously. Mainly because the experiment in La Rochelle had strategic importance for the future of EVs at PSA, the analysis of its role in the overall experiment is reserved to the last part of Section 10.3.

10.3.1 Interest Groups and Organisation s: The Municipality of La Rochelle

The leadership of Mr. Michel Crépeau, a former Minister for the Environment, and mayor of the Municipality of La Rochelle for 28 years (from 1971 to 1999) was crucial for the direction the city took in terms of its environmentally sound initiatives. A comfortable majority in the city council allowed Mr. Crépeau to explore innovative policies and programmes, which had ‘quality of life’ as the central slogan. Several reasons justified the Municipality to adopt policies that would minimize problems with air pollution, noise, and traffic congestion. Tourism has been a central promoter of economic development in La Rochelle and, similar to many European city centres, the accumulation of smog from motor vehicles causes severe damage to the historic buildings. By promoting environmentally sound transport systems, the Municipality would preserve its cultural inheritance at the same time as being able to help enhance the overall quality of life for La Rochelle's citizens and visitors.

Several initiatives were undertaken in this direction during the 1970s. Even though the quality of the air in the city was satisfactory in that period, five stations were installed to monitor the levels of air pollution. In 1974, La Rochelle was the first French city to introduce a car-free street, followed by 'Free Municipal Bicycle', an experiment initiated in 1975 that generated substantial publicity for the city. In the early 1980s, the Ministry for the Environment supported the policies of the Municipality by focusing on potential solutions for the noise generated by cars, industries, and nocturnal activities. Experiments with electric and diesel minibuses started in this period and, although electric vehicles would have been a suitable solution for such problems, it was not until 1985 that more pragmatic steps were initiated in this direction.

Two events contributed to commit La Rochelle to the EV technology. The appointment of Jean-Louis Richard as the advisor of Michel Crépeau represented the first step towards the systematic incorporation of EVs in the transport policy of the city. The previous work of Richard influenced his views about EVs. At ADEME[142] (the French State Agency for Environment and Energy Conservation) he had accumulated experience in industrial policy dealing directly with the area of renewable energy technology, which included electric vehicles. Since Richard put the development of EVs as pre-condition to accepting the job in La Rochelle, his arrival represented a major episode in this direction.

A second episode in the development of EVs related to the shutdown of a local factory owned by PSA, which had significantly raised local unemployment. Michael Crépeau considered that the eventual transformation of La Rochelle into the national centre for the development and manufacturing EVs would be a logical solution for both the issues of noise and local unemployment. Apparently, the shutdown of the factory

142 *Agence de L'Environment et de la Maîtrise de l'Energie*.

became a basic *agency* for PSA and the Municipality of La Rochelle to develop a tacit contract of collaboration (see the concept of agency in Section 5.2.4 in Chapter 5). During the period of 1986-1993 several EVs were used and tested by different technical services of the Municipality. Overall, this early collaboration was fundamental for the experiment conducted in 1993-1995, reported in this section.

A new traffic plan was introduced in La Rochelle in 1994, which intended to make the city centre less accessible to private cars in order to preserve the air quality. The plan used the ‘traffic cell’ principle, in which cars enter the town centre but do not go through it. For instance, by making parking lots more easily available in the areas surrounding the city centre, inter-modality between public means of transport could be enhanced. Today, La Rochelle offers several options in terms of transport, such as public bikes, collective taxis to be called on demand, and specially designed vehicles for disabled people[143]. Since 1995, the *Autoplus* system has made it possible for drivers to rent EVs or electric scooters for a maximum period of one day. As an extension of the initiatives taken by the Municipality, 25 *Peugeot 106 Electrique* and 25 *Citroën Saxo Electrique*, have also been made available to residents on a subscription basis in the *Liselec* programme, in which subscribers to the system use a smart card to access the car and pay for its use. The similarities of this scheme with the experiment developed during 1993-1995 are obvious, and one could say that it represents a continuation of the developments that involved a central actor, who facilitated the use of electric vehicles in La Rochelle.

10.3.2 Industrial Ecology Conditions: EDF (Electricité de France)

According to the classification of eco-factors, proposed in the ecological modernisation framework, EDF (*Electricité de France*), the French national electric utility, can be seen as another *interested organisation*. Since most recharging of the vehicles is expected to happen during the night, the eventual success of EVs would allow EDF to sell dormant electricity and increase its income without the need to expand supply capacity. Put simply, recharging EVs would represent a great benefit for the company. Even so, because the work developed by EDF in La Rochelle impacted on the conditions for the

143 An overview of the policies and programmes of electric vehicles used the la Rochelle can be found in the official internet home-page: http://www.ville-larochelle.fr/frame-uk.htm (2000, November 1).

use of electric vehicles – more precisely, the recharging facilities – this section classifies this influence under the eco-factor representing *industrial ecology conditions* (see Event 1c in Figure 10.1). According to the definitions used in Section 9.1.6 in Chapter 9, industrial ecology conditions related to infrastructure and socio-structure that would facilitate the use of environmentally friendly technologies. In the case of La Rochelle, although other actors participated in the institution of such conditions, EDF played the most crucial role.

Indeed, EDF has been one of the most active actors promoting the diffusion of electric vehicles in the European context. Since the 1960s, this French energy utility has invested in EV-related research and development, having often tested EVs in its own fleet. Since the potential growth in electricity demand for industrial and domestic applications is less promising in the long term, the growth in the transport sector has strategic importance for the company. But even though EDF has been supportive of the EV technology, the main increase in electricity demand is expected to come from a twofold increase in the energy needs for electric trains. In this respect, any eventual market success of EVs is not expected to represent more than 10% of the total market share (supply of electricity) of the company. Nevertheless, recharging EVs electricity during off-peak hours (at night) remains one of the most desirable scenarios for EDF (Simon and Hoogma 1998).

EDF also designed recharging equipment for normal and ‘quick’ charges using both cable and *inductive*[144] chargers. Normal chargers enable a full recharge in six to eight hours, while the equipment for quick charge allows an additional autonomy between 1 and 4 km per minute of recharge. The La Rochelle experiment allowed the assessment of both normal and fast equipment for charging batteries. Nine normal chargers were installed at different locations of the city: three quick chargers were placed in service stations, and one at the facilities of EDF. Information on EV recharging was recorded, making it possible to evaluate the efficiency of the each equipment, and the recharging system as a whole. Overall, the results were considered positive by EDF.

The La Rochelle experiment helped the other partners of the project to evaluate infrastructure needs for the widespread use of EVs. Although several types of

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144 Inductive recharging does not require physical contact (normally made by cables) between the vehicle and the recharger.

recharging facilities have been tested during the experiment, home charging is still the most desirable from of recharging, from the point of view of EDF. Although infrastructure for recharging along kerbside and parking lots remains a necessity, the promotion of recharging at home substantially reduces investment needs for EDF. Hence, the behaviour shown by users in La Rochelle was fundamental for the development of strategic actions that facilitated home charging, and the overall adoption of the EV technology by a large number of consumers. Other characteristics of the behaviour of pilot-users are described in the next section.

10.3.3 Market Demand and Patterns of Utilisation: Pilot Users in La Rochelle

The ultimate objective of the experiment in La Rochelle was to influence *market demand* through the analysis of *patterns of utilisation* of electric vehicles in a specific (semi-controlled) context. At the same time that the partners of the project needed to convince potential users that this was a reliable form of transport, they used the project to evaluate whether EVs would satisfy the needs of potential users. The use of the vehicles and associated infrastructure and maintenance support would influence users to consider the capacity of the technology to fulfil daily urban transport needs. A positive view of the EVs resulting from the experiment would also allow the partners to publicise the advantages of the 'new' technology, facilitating the efforts of *Peugeot* and *Citroën* to commercialise their converted (electric) vehicles.

According to the final report of the La Rochelle Municipality[145], the relation of users to the EVs evolved in three phases. In the first phase, pilot-users realised that the EV was a 'real' car, which could even increase the pleasure of driving, since it was a silent and comfortable vehicle. Maturity was reached when both qualities and limits of the EV were confirmed. Although users learnt better how to control the vehicle, they also perceived the limits of EV autonomy. This realisation influenced them to modify travel behaviour, reducing the number of long journeys made by car. In the final stage, users identified EVs as 'specific purpose vehicles' − an essentially urban vehicle that would be used only for short journeys.

145 *Opération 50 véhicules électriques à La Rochelle. Bilan final de l'opération. Retour d'expérience* (in Simon & Hoogma 1998)

Generally, private and corporate users were highly satisfied with the performance of the electric vehicles, ranking them at equivalent levels to that obtained in a previous survey conducted by PSA in 1994 of user satisfaction of the petrol-powered *Citroën Saxo* and *Peugeot 106* (see Event 2 in Figure 10.1). Learning to drive the vehicles also seemed easy. Starting the engine and driving in general were well rated all through the experiment. The behaviour of individual users showed that the EV was shared more easily between people in the same household than traditional cars. Although the use of the electric vehicle for short urban trips during the week did not differ from the patterns of use for ICE-powered cars, electric vehicles presented an average mileage of 167 km/week, while ICE vehicles were driven an average of 233 Km/week. The qualities users most appreciated were convenience, pleasure to drive, and the silence of EVs. A total of 700,000 km was driven during the experiment (Simon and Hoogma 1998) .

Roughly the same results were obtained for commercial users, but even if their overall satisfaction was high, they identified the limited range as the weakest point of EVs. In fact, performance ratings for energy autonomy and reversing decreased over time, showing a dissatisfaction of the majority of users with these parameters. They identified autonomy as largely inadequate and specific functions of the vehicle as insufficiently developed. The low efficiency and operating problems of the heating system were criticised. Because the electric motors are relatively silent, some other electric components, such as the vacuum pump and the power-steering pump were also perceived as noisy. Nonetheless, security, braking, and road-holding all received high ratings by private users.

In terms of recharging behaviour, private users tended to recharge their EVs at home, when an average of 34% of the energy was still available in the batteries. Such cautious behaviour indicated that users did not manage the EV autonomy properly, conducting unnecessary daily recharges. Nevertheless, the average number of recharges over a week decreased from 5 at the beginning of the experiment to 3.6 at the end, indicating that trust in EV performance increased over time. This was also valid for firms, although the recharging took place in a wider number of outlets than for private users. At the end of the experiment, users wanted PSA to extend its responsibility for the maintenance of the vehicles; they also required a denser infrastructure from EDF for easier recharging. Additionally they advocated that the Municipality of La Rochelle should establish policies that facilitated the use of EVs, such as the creation of free parking zones. The main responses of the PSA group to these requests, as well as the role of the French enterprise in the evolution of the La Rochelle experiment and the overall consequences for the commercialisation of *converted* EVs, will be presented in the following section.

10.3.4 Organisational Commitments, Competences, and Constraints: PSA Group

Although PSA Group started its involvement in the field of electric vehicles back in the 1960s, attempts to commercialise EVs gained momentum only in the 1980s. In 1983 PSA undertook the first important step in this direction by developing an experiment that involved the same organisations that 10 years later would become a milestone for the company. Fifteen prototypes of the *Peugeot 205 Electrique* were produced by PSA, which were rented to the Municipal Services of La Rochelle, the branch of EDF (*Electricité de France*) in La Rochelle, and the Ministry for Transport in Brussels (five vehicles for each organisation). The prototypes served as a platform for experiments with different battery types but, in general, the experiment was not successful. PSA had recently shut down a factory in the region and, the economic consequences of such decision, such as local unemployment, influenced the Municipality of La Rochelle to retaliate, refusing to include the *Electrique 205* in its fleet. Overall, due to its high price, the electric version of the *Peugeot 205* never succeeded in becoming a commercial reality.

Despite the problems with the previous project, collaboration between PSA and EDF continued through the 1980s. By the end of the decade, PSA was convinced that the EV technology was ready for commercialisation. After having overcome the main technical problems, the best possible integration of the electric drive system and battery had been achieved. The EV technology was ready to become a commercial product, and the strategy for alternative propulsion vehicles for the coming decades could be defined. During the 1990s, the company would start the commercialisation of ‘converted’ electric vans and cars and later the production of purpose-designed EVs and hybrid vehicles. Although PSA had accumulated sufficient expertise to start marketing the new product, an improved performance of the EVs would also improve the chances of the product to succeed in the marketplace. Moreover, after the initial experiment with corporate fleets, PSA needed to know whether individual consumers were willing to buy electric vehicles. In simple terms, further research was necessary. This was the main reason for the development of the experiment in La Rochelle in 1993-1995 (see Event 1a in Figure 10.1).

The experiment in La Rochelle was considered a success in terms of the achievement of its objectives (Simon and Hoogma 1998). The experience accumulated was later used in other demonstration projects, such as the 'Coventry EV Project', described by Lane (1998), which was carried out during 1997-1998. Overall, the La Rochelle experiment significantly influenced the decision of PSA to commercialise electric vehicles (see Event 3 in Figure 10.1). EVs proved to be reliable and well accepted by private users, and series production of the electric versions of the *Citroën Saxo* and the *Peugeot 106* began in September 1995 in the Heuliez assembly plant in Cerizay, France. Since the main buyers of EVs during the first three years of production were mainly business and government organisations, in 1998 PSA decided to include electric versions of the commercial vans *Peugeot Partner* and *Citroën Berlingo*. Both vans were manufactured at the group's plant in Vigo, Spain on the same lines used to assemble the combustion-engine equivalents. With total sales of 6,000 EVs in the five years of production, PSA became the market leader in electric vehicles in Europe – representing approximately 67% of the estimated total of 9,000 EVs registered on the continent (Atkin & Storey 1998). Not surprisingly, the majority of the users were organisations such as postal companies, prefectures, and power utilities, with EDF being one of the main clients of PSA.

Although such numbers indicate a substantial market growth in EVs, they were far from representing a commercial success. According to Simon and Hoogma (1998), PSA expected to sell 10,000 vehicles per year by the year 2000. If the experiment in La Rochelle had been considered a success, and the viability of the EV technology demonstrated, why then did the market performance of EVs disappoint? For the specific case of PSA, the characteristics of the current customers of converted EVs of *Peugeot* and *Citroën* indicated the roots of the problem. The vast majority of EV customers were fleet owners rather than private-individual users. In other words, PSA did not succeed in influencing private individuals to buy electric vehicles in significant numbers. In the opinion of the sales representatives for electric vehicles at *Citroën*[146], a simple answer was to be found in the price of the vehicles. On average, the purchase price of a converted EV, including the battery package, came in at around 50% to 150% more than

146 Interview with *Citröen* sales representatives for electric vehicles, during the environmental fair *Pollutec 96*, in Lyon, France 1996.

its ICE equivalent[147] (Atkin & Storey 1998; see also Section 10.3.5). Therefore, from the point of the view of initial prices, one should not be surprised with the lack of sales of electric vehicles.

There are, thus, clear limitations for the future of pure or battery EVs in general. The size of the market for fleet owners is significantly smaller than for individual users and it is more difficult to reach economies of scale in such niches. Although there are ways of overcoming the high purchase price barrier, solutions tend to be complex in nature; they are either beyond the control of the car assemblers, or they require changes in consumer perception about the costs-benefits associated with the vehicle. Governmental subsidies, for instance, have been common practices in the Western European context. Leasing the battery pack is another solution used by PSA and other manufacturers of 'pure' electric vehicles to minimise the impact of the initial price of the vehicle. But even though PSA has always considered tax benefits and governmental subsidies essential for the diffusion of EVs, subsidies of any kind do not constitute a solution in the long run. They simply cannot be considered a reliable strategy for the future of the electric vehicle programme at PSA. Finally, Sperling (1995) emphasises that once the savings along the entire life-cycle of EVs are considered, they may become competitive. But besides the fact that this mitigation depends on the local price of electricity, it also requires consumers to have a long-term commitment to their vehicles – something that has not been observed in practice.

The experience in electric traction that PSA accumulated in the last decades might not have served to transform the *Eletrique Citroën* or *Peugeot* into commercial successes but it has certainly cut development time of other EV-related technologies. For instance, a unique solution presented by *Citroën* to overcome the limited range of batteries suggests that their hybrid technologies programme benefited from the previous experiences with pure EVs. The van *Berlingo Dynavolt* (still in the 'concept' phase) is a *series hybrid* EV which has received positive comments from industry experts on the innovations brought by the automaker (Crosse 1999). The vehicle uses a gas turbine to provide energy directly to the electric motors (instead of sending it to the batteries), avoiding damage caused by charging the batteries on the move, as other *serial* hybrids

147 For instance, the electric version of *Peugeot 106* costs at around €20,000 while the petrol-powered version is sold in Western European countries at around €14,000, depending on local taxes, promotions, and currency rates.

normally do. With this system, the *Dynavolt* can reach a maximum range of 260 km with very low levels of emissions. Overall, similarly to other volume car manufacturers, PSA has integrated the program of EVs into the broad wide range of *alternative energies*, such as liquefied and natural gas, and hydrogen used in fuel cells. A similar case of integration of the pure EVs into a wider 'portfolio of solutions' has happened with a new entrant in the industry, described next.

10.4 Potential New Entrants: The Case of the Norwegian *Pivco-Th!nk*

In the early 1990s, the willingness to transform electric vehicles into a market reality reached the realms of a group of large organisations in Norway. In 1991, a consortium formed by some of the largest companies in the country, such as producers of aluminium and plastic, electric utilities, and financial institutions, joined forces to create *Pivco*, a (venture capital) company with the mandate to develop and build a two-seat lightweight electric vehicle, initially called *City-Bee*, and later renamed *Th!nk*[148]. The vehicle would target the niche markets of urban or sub-urban transportation, as well as a significant proportion of the market of environmentally friendly transport. *Pivco* wanted to develop not only a new type of vehicle but also to manufacture it in a completely new a new manner (Schwartz & Maruo 1998).

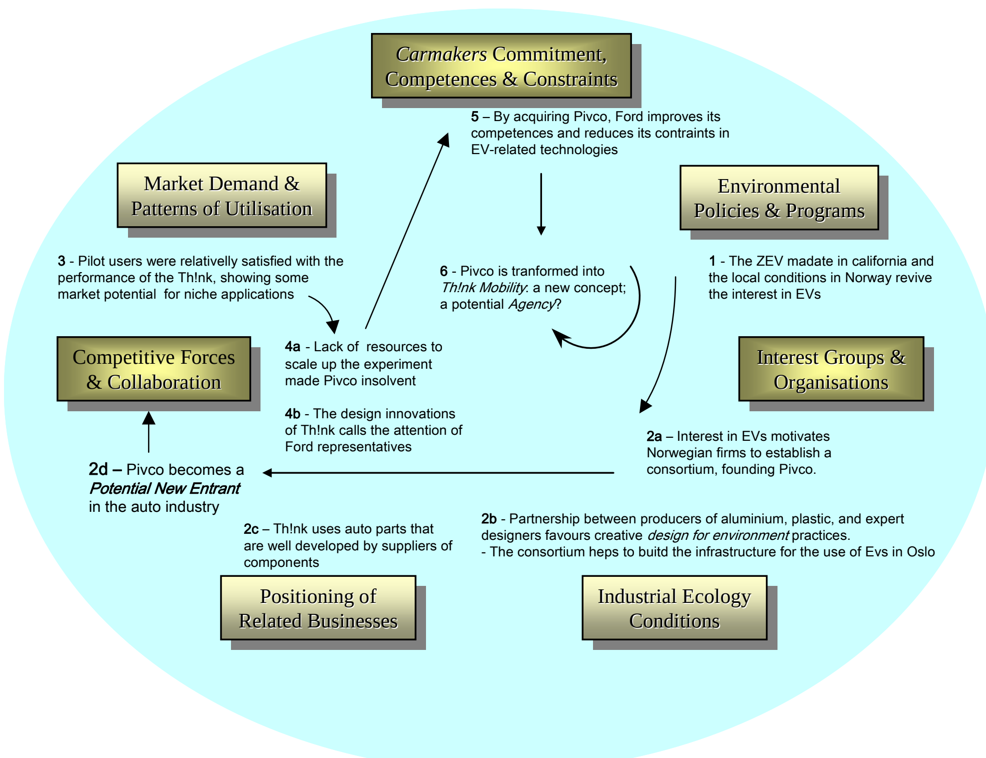
Figure 10.2 (in the next page) summarises the evolution of the case, presented in the following sections. Similarly to the experiment in La Rochelle, the figure only contains the major developments of a wider field of influences in the *Pivco-Th!nk* case. The figure depicts the main players in relation to the conceptually predefined eco-factors and is, obviously, a simplification of reality. The variation in the colour pattern of the eco-factors intends to symbolise their relative importance in the experiment. The darker colour of the eco-factors representing 'interest groups and organisations', competitive forces and collaboration, and 'carmakers (*Ford*) commitments, competences, and constraints', represents the higher importance of these eco-factors in the evolution of the case. The following sections present the context-specific eco-factors, which have been organised according to the order they surface in the case.

148 Although the vehicle developed and manufactured by *Pivco* was called *City-Bee* during the development of the prototypes (1991-1998), for reason of ease this chapter refers to the vehicle in any phase of its history as *Th!nk*.

10.4.1 Environmental Policies and Programs: The Uniqueness of Norway

Environmental policies and programmes favouring the use of EVs had been in place in Norway prior to the *Pivco* venture. Owners of electric vehicles enjoyed various benefits, such as exemption from sales taxes, registration fees, and the payment of road tolls in certain areas of the county, which conventional ICE cars must pay. The main rationale justifying such measurers was the widespread acceptance among politicians, business leaders, and the general public, that the use of electric vehicles has strategic importance for Norway. The country is not only one of the world leaders in the export of petroleum and natural gas but also supplies electricity to neighbouring nations. Moreover, almost all of the electricity is generated in hydroelectric power plants – a form of generation considered 'clean' for its low levels of emissions of CO_2.

Figure 10.2: The Evolution of the *Pivco-Th!nk* Venture



The use of a renewable resource (hydroelectric-generated electricity), of which the country is a net exporter, to power electric vehicles would represent a *win-win* scenario in macro-economic terms. By promoting the instalment of EV factories, the government could reduce the dependence of the two main imports of the country: machinery and motor vehicles. An eventual spin-off effect of the production of electric vehicles in Norway could also help the development of related businesses, reducing the current dependency of Norway on the exports of oil[149]. In sum, environmental policies and programmes promoting the development of an EV-based industrial sector have been pursued in Norway mainly because such developments could increase the overall competitive advantage of the nation (see: Porter 1990).

The developments of the regulatory framework in California, briefly discussed in Section 10.2, revived the general interest in EVs in Norway, and resulted in a more active role of the government in promoting such technology (see Event 1 in Figure 10.2). The Norwegian government moved from generic policies supporting the dissemination of EVs to a more direct involvement through the programmes founded by the Department of the Environment. In 1991 the Royal Ministry of Transport and Communications established a fund for supporting environmentally sound transportation technologies (*Statens Näringsdistrikts Kreditbank*). A yearly budget of 10 million NKr (Norwegian Kroner, around €1.25 million) was allocated to sponsor various transport-related projects, such as the use of natural gas as an alternative fuel, and new technologies in boat traffic, among others. In that same year *Pivco* was granted 1 million Nkr (approximately €125,000) from this fund. For a project to receive financial support from the fund, a public organisation should be willing to support the development of a product that could be used by the organisation in the future. *Oslo Energi* – the largest electric utility in Norway – fulfilled these requirements and, because of this, the organisation was approached by a key player in the enterprise that would eventually fund the *Pivco* company (Schwartz & Maruo 1998).

10.4.2 Interest Groups and Organisations: The Formation of the Consortium

The director of *Bakelittfabrikken*, a Norwegian company with more than fifty years of experience in the technology of thermoplastic moulding, was the central actor in the development of *Pivco*, an acronym that stands for '*Personal Independent Vehicle Company*'. Mr. Jan Otto Ringdal had personal and business motives for the interest in the development of an electric vehicle. His father, Lars Ringdal, conceived the idea of the vehicle during the oil crisis in the early 1970s. At that time, however, the overall

149 In 1995, 47,5% of the total earnings of Norway were due to the exports of oil and gas.

conditions were not favourable for the project to become a reality. In simple business terms, the wide use of thermoplastics in the vehicle, described in detail in Section 10.3.5, could represent a new market segment for *Bakelittfabrikken*. Mr. Ringdal contacted other large Norwegian companies and research foundations in order to engage them in the new venture. He has been described as both a charismatic and trustworthy person and his administrative and business skills were important attributes in the process of influencing other organisations to become members of the consortium that eventually funded *Pivco* (Schwartz & Maruo 1998).

In order to give status, institutional support, and financial endurance to the venture, Mr. Ringdal focused the first efforts on trying to convince large and reputable organisations to become members. *Norsk Hydro*, *Statoil*, *Oslo Energi*, and the Norwegian Research Council were organisations that fitted this profile, and the first ones to be contacted by him. The petrol stations of *Statoil* – the leading business in petrol distribution in Scandinavia – could be adapted and used as recharging stations for electric vehicles. The know-how in the production of aluminium made *Norsk Hydro* a potential partner, mainly because the vehicle concept allowed the use of lightweight materials. The company could participate in the *Pivco* venture through its subsidiary company *Hydro Aluminium* – one of the largest producers of aluminium in the world and a leading manufacturing of aluminium-based automotive components. In the case of *Oslo Energi* – the largest electric utility in Norway – the company was seen as both a potential user of the electric vehicle and as a key partner for building the EV recharging infrastructure. A partnership between *Bakkelittfabrikken* and these organisations would generate not only the necessary expertise to develop a lightweight electric vehicle but would also represent a powerful coalition that could 'defend' the venture in various political arenas.

Oslo Energi was the first organisation to join the *Pivco* network in 1991. A relatively comfortable financial position allowed the company to invest approximately €500,000 during 1991-1996. Mainly because *Oslo Energi* wanted to generate returns for its venture capital, after the vehicle was presented to the public at the Winter Olympic Games in Lillehammer (Norway) in 1994, the initial investment was transformed into shares of *Pivco* stocks, representing approximately 9% of the total value of shares. Even though after a new public offer of shares in 1995, the ownership of *Oslo Energi* decreased to 5%, the position of the company as a shareholder cemented its involvement in the *Pivco* project (Schwartz & Maruo 1998).

The motivation for *Oslo Energi* to participate in the *Pivco* venture seems to relate mainly to its public image. In 1991, the deregulation of the energy sector in Norway forced the company to redefine its organisational structure in order to increase its competitiveness. Not surprisingly, such reorganisation caused upheavals. In addition, there was adverse publicity around corruption issues. A positive image of the *Pivco* project portrayed by the media eventually mitigated the allegations of corruption occurring at *Oslo Energi*. Consequently, most management and company personnel supported participation in the *Pivco* enterprise. In fact, company representatives used the publicity generated by advertisements on external panels of the EV prototypes as an indicator of the success of the investment on *Pivco*. For instance, each of the 12 prototypes cost the company €26,000. This was certainly a high price for such a vehicle but the investment could be easily justified on the basis of advertising expenses. The cost of the prototypes, used to advertise the institutional image of the company, was equivalent to the cost of similar publicity in a newspaper (approximately €20,000). Hence, in the view of *Oslo Energi*, even if the vehicles did not reach the stage of mass production, the company considered the project a success for its positive public returns in public image (Schwartz & Maruo 1998).

Fundamentally, all organisations that participated in the consortium could be classified in this section under the *eco-factor* encompassing 'interest groups and organisations' (see Event 2a in Figure 10.2). They were all 'outside parties' interested in setting up an enterprise that, if successful, would become a *new entrant* in the automobile field. Nonetheless, as occurred with EDF in the La Rochelle experiment (Section 10.2.3), some organisations had a more specialised participation in the project. *Oslo Energi*, in this regard, could be seen as the equivalent of EDF in Norway. Together with *Statoil* and the Technological Institute, the role of *Oslo Energi* was directly related to the creation of the appropriate conditions for the use of electric vehicles in that specific context.

10.4.3 Industrial Ecology Conditions: The Role of Oslo Energi, Statoil, and the TI

Although the preoccupation with public image was a central motivation for *Oslo Energi* to become a member of *Pivco*, the company also played an important role in the creation of appropriate conditions for the use of EVs. In 1995, *Oslo Energi* built recharging stations for EVs at its own parking facilitates and allowed other EV users to access them free of charge. With this initiative, the company sought to demonstrate its competence in building infrastructure for EVs; if the Municipality of Oslo intended to promote EVs, the company was ready to contribute. During the development of the Pivco project, *Oslo Energi* was also running its own maintenance services for the EVs. According to company representatives, *Oslo Energi* intended to participate in the process of making the EV a viable alternative, and the future maintenance of EVs could become a new business for the company. Similar to the rationales of EDF, in the La Rochelle experiment (see Section 10.3.2), the engagement in EV technology was aligned with the intention of *Oslo Energi* to enter the transportation market. The EV technology could be used as a means to create collaborative schemes with other energy distributors, in particular, distributors of petroleum-based fuels such as *Statoil*.

Oslo Energi and *Statoil* shared the rationale for their participation in the *Pivco* venture. *Statoil* certainly had more than one motivation in becoming a founder of *Pivco* but according to Schwartz and Maruo (1998) the creation of a good environmental image was a central rationale of the decision. *Statoil* also saw itself as a supplier of energy, rather than a supplier of fossil fuels, and the involvement of the company in energy-related projects would then be aligned with its long-term strategy. Fundamentally, the company wanted to be able to deliver any kind of 'fuel' through its (petrol) stations. The engagement in the *Pivco* venture would allow *Statoil* to demonstrate its openness to 'alternative' technologies and new trends in society. The level of this openness remains unclear, however. According to Schwartz and Maruo (1998), the involvement of only three *Statoil* people in the *Pivco* project suggests that the company did not develop a coordinated effort for transforming such a strategic vision into reality.

Specifically related to the city of Oslo, the role of *Oslo Energi*, and *Statoil* were fundamental for the creation of the generic 'industrial ecology conditions' for use of EVs – in this case, the specific infrastructure-related technologies. Moreover, the city already presented some advantages to users of EVs. A battle between an environmental organisation and the Municipality resulted in the elimination, in 1995, of the toll fees for EVs entering the city centre. Free parking lots with recharging facilities were also made available to owners of EVs. Overall, although more quick-charge stations and parking lots with charging facilities are still required, according to the interviews conducted by Schwartz and Maruo (1998), infrastructure was not seem as a major problem for the future EV users in Norway. When one considers the potential to use the ordinary electrical power points connected to the grid, a large number of recharging facilities is in place already. Since the *Th!nk* (and equivalent neighbourhood vehicles) are supposed to be used only in urban areas – in the inner city in particular – infrastructure for quick recharging is only required in a few locations.

The industrial ecology conditions were also favoured by the participation of another important player in the *Pivco* network (see Event 2b in Figure 10.2). The *Technological Institute* (TI) – a renowned Norwegian research organisation with expertise in EV technology – was essential in the process of facilitating the development of the *social-structure* around a prospective EV industry. The accumulated expertise in EV-testing was the main rationale for the TI to become involved in the *Pivco* project but the institute also wanted to expand its competences in other areas of EV technology. The tests of the first 30 prototypes of the *City-Bees* (later renamed *Th!nk*) started in the end on 1993, and were an occasion for TI and *Pivco* personnel to accumulate data and later write a manual containing driving instructions for the prototypes used in the test program in California (see Section 10.3.6). The Institute was also an important player in helping *Pivco* not only to test the vehicles but also to develop the prototypes; a role that was also played by another 'supplier of technology' and member of the consortium (Schwartz & Maruo 1998).

10.4.4 Positioning of Related Businesses: Traditional Components, New Use

The company supplying the aluminium spaceframe used in the *Th!nk* played a key role in the development of the vehicle. As a member of the consortium that founded Pivco, *Hydro Aluminium* (a subsidiary company of *Norsk Hydro*) contributed significantly to the project by providing the expertise that made it possible for the vehicle to have a unique structural design. By helping *Pivco* to develop the vehicle, *Hydro Aluminium* would be working towards a new market segment of its auto components business, at the same time the company would accumulate expertise in lightweight spaceframes (Schwartz & Maruo 1998).

Outsourcing was the underlying principle of *Pivco* in terms of development of components. In other words, rather than developing the components in-house, the company chose to purchase the vast majority of parts from well-established suppliers in the auto industry (see Event 2c in Figure 10.2). For instance, the suspension and steering systems are the same as used by the *Peugeot 106* and are supplied by the

French automaker. *Pivco* also avoided developing the technology in electronics and batteries, purchasing parts that have already been tested by electric vehicles made by traditional carmakers, such as *Renault's Clio Eletrique* and *Fiat's Seicento Elettra*. Such practices significantly lowered the development costs, also giving the company a great degree of flexibility to incorporate updated electronic components and batteries when they become available. Overall, about 70 suppliers provide the components of the *Th!nk*, less than half the number of suppliers of the *Fiat Punto*[150], for instance, suggesting the reduced number of components used by the vehicle, when compared with ICE-cars. In fact, the uniqueness of the *Th!nk* is not only confined to its approach to suppliers. The entry of *Pivco* into the automobile field has been accompanied by a series of patents in the area of plastic body and aluminium spaceframe connection, as well as a radically new approach to manufacturing automobiles. The next section provides more details about the creation of the company.

10.4.5 Competitive forces and Collaboration: Pivco - The New Entrant

As was previously stated, in 1991 *Bakelittfabrikken*, a large Norwegian firm with considerable know-how in thermoplastic moulding, lead the consortium that founded *Pivco – The Personal Independent Vehicle Company*. The new company intended to develop and produce a unique vehicle to capture a considerable part of the (hypothetical) niche market for urban and suburban environmentally friendly transportation. The electric vehicle (initially called *City-Bee*, and later renamed *Th!nk*) was expected to be the second household car, or a vehicle used to distribute goods and services by organisations, such as energy utilities, municipalities with services for the elderly, telecommunications companies, and car rental firms, among others. According to Schwartz and Maruo (1998), the partners of the project emphasized that they did not develop a *car* but a *vehicle* for short-range transportation in cities. The rationale for such a distinction was based on the negative association some people make between the word '*car'* and environmental damage. The limitations of the battery technology would also make the comparison between the performances of electric *vehicles* with cars inappropriate, as it was emphasised in Section 10.1.

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150 According to *Automotive News Europe* (January 17, 2000 p. 17), *Fiat* has 150 suppliers of the production parts for the *Punto*.

Several innovations are associated with the *Th!nk*. Unique design and manufacturing concepts entail a minimal environmental impact, when compared with production systems of traditional car manufacturing, such as the ones described in Chapter 8 (Section 8.1). The use of aluminium in the spaceframe and thermoplastic in the body makes the *Th!ink* a distinctive vehicle. The aluminium spaceframe is mounted on a folded-welded steel platform. This design concept for the platform bypassed the high investments in press-shops, characteristic of traditional floorpans (see Section 8.2.2 in Chapter 8). The body is produced with the same industrial process formerly used by *Bakelittfabrikken* to manufacture boats. Because colour can be added during the process of moulding the thermoplastic body parts, painting is not necessary. Such innovation bypasses one of the most polluting of the processes in car assembling: it eliminates the need of a paint-shop, lowering significantly the capital necessary to set up the assembling plant. Although the thermoplastic body panels do not have the smooth finish of painted panels of traditional steel bodies, when dented, they have the advantage of not loosing the colour, as normally happens with painted panels. The thermoplastic panels are rustproof and recyclable, and the overall modular approach used by *Pivco* also facilitates disassembling and recycling[151].

A pilot assembly plant was established in Aurskog, 50km from Oslo. From 1992, when the consortium developed the first generation of prototypes, to 1998 when the last prototypes were considered ready for mass production, an average of 50 staff members among engineers and technicians with expertise in plastics, aluminium, and automotive technologies worked in the pilot plant. The second generation of prototypes (10 vehicles) were presented to the general public in 1994 during the *Olympic Winter Games* in Lillehammer, Norway. In 1996, 40 vehicles were sent to the Californian Bay Area Rapid Transit authority, and 60 were deployed in Norway for pilot tests (see the next section). In total, 120 prototypes were produced during the third generation. English car consultants *Lotus Engineering* (owned by the Malaysian Proton) were brought in in 1997 to coordinate a fundamental product redesign to accommodate problems with the early prototypes. By 1998 the fourth generation, the *Th!nk*, showed below, was ready for production.

151 Schematic drawings of the *Th!nk* are presented in the home-page of *Pivco Nordic* at: http://www.think.no/v2/look/construction.shtml (2000, November 7)

Figure 10.3: The Pivco-Th!nk Battery Electric Vehicle

The production paradigm orientating *Pivco* differs substantially from the traditional (and current) practices in auto manufacturing. The design concept permits relatively low volumes of production, if compared with similar car plants. Volumes of 5,000 units per year are expected to be sufficient to reach the break-even point. Although the high sales price of the *Th!nk*, at around €25,000 (see section 10.3.7) partially explains a lower break-even point of the *Th!nk* when compared with similar commercial vehicles, based on auto industry standards, this is certainly an impressively low volume. For instance, the two-seat *Smart* car, launched by Mercedes-Benz in 1997, requires minimum volumes of 200,000 units to pay for the depreciation on start-up costs. This means that the break-even point of the *Th!nk* represents 2.5% the one of *Smart*.

The impressive difference between the break-even point of these two-seat vehicles is located in the paradigm orientating design and production. Within the context of the auto industry, the Smart already presented substantial innovation in its approach to production. The industrial facilities where the *Smart* is assembled use the concept of *system integrator* for the management of the relationship between the manufacturer of the vehicle (*Micro Compact Car*) and its first-tier suppliers. In such a system, a better coordination in the business-to-business relationship can reduce development costs, while the overall management of quality can be improved. But apart from gains in cost and quality, because the Smart has been developed and manufactured based on the *Buddist* paradigm of production (see Section 8.1 in Chapter 8), its break-even point approximates those of traditional automobiles, at around 250,000 units. Hence, the high sales price of the *Th!nk* may countervail excessive optimism on the capability of *Pivco* to commercialise high volumes of the vehicle at competitive costs. Nonetheless, achieving an extremely low break-even point for the vehicle in a factory with also extremely low levels of air emissions challenges the paradigm of production used by the vast majority of volume car manufacturers.

The characteristics of the system of production for the *Pivco* also entail the company to use a novel approach in retailing the vehicle. Since its early days, the company intended to focus on the know-how in EV-development and manufacturing principles and establish joint ventures to produce the *Th!nk* close to targeted markets, mirroring, in some respects, the principle of franchising production. Similarly to the principles used for the instalment of the well-known *McDonalds* eateries, the same production principles and management techniques could be applied in other parts of the world, where the demand for the vehicle justifies the investment. As mentioned, factories can be established on the basis of production volumes of 5,000 units per year, and multiples of 5,000 could also be used for their expansion. In fact, Wells and Nieuwenhuis (2000) consider the unique design and manufacturing approach taken by *Pivco* to be a demonstration of the possibilities for the auto industry moving away from the traditional paradigm orientating the conception of both motor vehicles and the systems of production and distribution associated with their design. The concept of micro-factory retailing (MFR), briefly mentioned in Section 9.1.6 (Chapter 9) has apparently been inspired by the *Pivco* case.

Fundamentally, *Pivco* represents a classic case of a potential *new entrant* in the automobile industry. According to the definition of ‘competitive forces’, proposed by Porter (1985), the main elements characterising a new entrant were present in the case. In such classification, new entrants, among other ‘forces’, can threaten the competitive position of a firm in a specific industry. The consortium that formed *Pivco* did not have previous experience in the auto business, and was clearly a (potential) new entrant from the point of view of traditional car manufacturers. This is the main reason why this section places the *Pivco* venture under the *eco-factor* representing ‘competitive forces and collaboration’. An eventual success by the company that developed the electric vehicle would have the potential to influence the competitive position of all firms within the auto business (see Event 2d in Figure 10.2). Such capacity would not be possible, however, without some demand for electric battery vehicles in general, as well as the previous acceptance of the *Th!nk* by potential users.

10.4.6 Market Demand and Patterns of Utilisation: Testing the Th!nk Concept

The company leading the *Pivco* consortium (*Bakelittfabrikken*) did not research the market for electric vehicle (EV) before starting the venture. The decision to invest in an EV was based on the assumption that a niche market for such a vehicle in urban areas already existed. Another member of the consortium collected some data about market potential for EVs. Prior to engaging in the *Pivco* venture, *Oslo Energi* hired a Swedish consulting firm to investigate whether such a project would make business sense. The consultants suggested *Oslo Energi* as participants in EV-related projects, and who owned a fleet of 50 to 100 EVs, in order to accumulate expertise about their recharging, maintenance, repairing, and service. The research also suggested that the company participate in the development of battery technology – something that could be achieved with the participation in the *Pivco* experiment. In 1992, *Oslo Energi* carried out its own study regarding the potential for EVs in the Oslo region. Company personnel identified the patterns of utilisation of small vehicles in that area, and analysed statistics of sales of small cars in that specific area. Based on these statistics they estimated how many cars could be replaced by EVs (Schwartz & Maruo1998).

Fundamentally, it can be inferred that the founders of *Pivco* did not have a significant knowledge about market demand and patterns of utilisation of electric vehicles prior to the venture. The test of prototypes developed before the European autumn of 1995 did not allow *Pivco* to accumulate sufficient knowledge about patterns of utilisation of the new vehicle. The most important experience for *Pivco* in understanding user behaviour occurred only when the 120 prototypes of the 'third generation' were tested in programmes developed in Norway and California during 1995-1998. *Oslo Energi* and *Statoil* led the Norwegian pilot test, which consisted of a rental system that also involved the Commune of Oslo, a Norwegian bank (*Den Norske Bank Finans*), a Norwegian insurance company (*Storebrand*) and a Swedish construction firm (*Åke Larsson Construction*). A total of 10 prototypes were rented out to individual users in Oslo during the period of May to November 1996. Customers paid 300Nkr (€37.00) per day to rent the vehicles – a relatively low cost, if compared with 450Nkr (€56.00) per day for the rental of a *Volkswagen Golf* in Oslo at that time. The customers were informed that the *City-Bee* was a prototype that might eventually present technical problems. Indeed, during the five months rental scheme, the gearbox broke down in all 10 prototypes. In that case, they could catch a taxi at the expenses of the rental services. Although many corporations were interested in renting the vehicles for a fixed and extended period of time, the partners of the project tried to rent the vehicle to as many individual users as possible. Such practice would supply the partners with a better understanding of consumers' requirements and their overall evaluation of the vehicle (Schwartz & Maruo 1998).

The people who rented the vehicles characterised a specific group. Men interested in new technologies formed the majority of the users. There was some consistency in the (high) levels of education and age among them, and, according to Schwartz & Maruo(1998), many corporate executives rented the *Th!nk* to drive them to meetings in other firms, so they could 'confirm' their environmental commitment. Prior to renting the vehicles, some customers perceived EVs as slow and heavy with a short driving range. The acceleration and driving range surprised the users, and after driving the *Th!nk*, they were generally positive towards both the vehicle and the broad EV concept (see Event 3 in Figure 10.2). The gearbox failures did not seem to affect the overall positive perception of the vehicles.

The second demonstration project was developed in the American State of California, in the San Francisco Bay area. Similarly to the rental scheme in Norway, the project in California aimed not only to test the prototypes but also generate a positive perception by consumers towards the EV technology. The rationale of the choice of the California as a test bed for the *Th!nk* relates primarily to the Zero Emissions Vehicles (ZEV) mandate. As briefly remarked in Section 10.1, the ZEV mandate broadly revived the interest on EV technologies. In many respects, the mandate was a milestone in the foundation of *Pivco*. The possibility of participating in that niche market in America at some (undefined) stage was part of the business plan of the company. Nonetheless, other factors played a key role in the early – indeed, in the opinion of Schwartz and Maruo (1998), premature – introduction of the *Pivco* in the Californian context.

As a spin off effect of the ZEV mandate, several interest groups and organisations started joining forces in order to advance the electric vehicle technology. One such alliance was CALSTART – a consortium of more than 120 organisations, such as utilities, defence industry firms, national laboratories, government agencies, labour unions, and universities, among others[152]. The consortium had the ambition to make California an international leader in EV technology. The *National Station Car Association* (NSCA) had a more focused mandate but no less difficult task of putting into practice a new pattern of utilisation of automobiles. The member of the group – mainly transit experts and the electric utilities – intended to guide the development and test of the 'station car concept' through demonstrations projects[153]. *Station cars* are electric vehicles, used preferentially for trips to and from mass transit stations (trains, busses, ferries, etc.). In essence, station cars are *individual-public* forms of transport, which can also be used for short trips in areas where mass transportation systems cannot serve. In this respect, station cars also serve as *neighbourhood vehicles,* mentioned in Section 10.1.

The preference for electric vehicles as station cars relates primarily to their zero emissions characteristics. But due to their reduced number of components (around 20% of an equivalent ICE-car), EVs also have low-maintenance costs and prolonged lifespan. They are also easier to operate than ICE-cars. Because of these features, in the first half of the 1990 NSCA, together with the *San Francisco Bay Area Rapid Transit District* (BART)[154], initiated the procurement of EVs to be used as station cars in a demonstration project. After an American supplier failed to deliver the vehicles in early 1995, leaders of the 'Bay Area Station Car Demonstration' project encouraged *Pivco* to supply the EVs – still in the prototype phase – for the project. Forty *Th!nk* prototypes were tested in the San Francisco bay area during the period of October 1995 to March 1998. The vehicles were imported and leased to the pilot users by *Green Motorworks* – an EV importer contracted by the consortium. The pilot users paid a monthly fee of 100 dollars for the use of the vehicles, insurance, maintenance, and 24-hour road assistance. In case the pilot-user wanted to recharge the vehicle at home, one (night of) recharge cost an average of one dollar.

A large software firm was a key player in the project. *Sybase* paid $12,000 (€14,000) per month to lease the vehicles for its employees, who used them free of

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152 http://www.calstart.org/calindex3.html (2000, November 17).

153 Information about the NSCA can be obtained at: http://www.stncar.com/ (2000, November 17).

154 Information about BART can be obtained at: http://www.bart.gov/ (2000, November 17).

charge. Groups of ten people were selected among the 2,000 employees of the company to share nine *Th!nk*. Software specialists of both genders, aged between 25 and 45 years old, formed these groups. Their selection was based on the location of the homes of the employees in relation to the BART stations. Only people living within less than 45 miles from the station and who did not need to enter the freeway were entitled to participate in the programme. These criteria were based on the limited range of the prototypes, and the fact that they did not comply with minimum speed limits and safety requirements for use on highways (Schwartz & Maruo 1998).

Most users from *Sybase* enjoyed driving the *Th!nk*. They also had a positive impression of the external design of the vehicle and with its scratch-resistant thermoplastic body, its interior, as well as its quiet riding, and easiness of parking (see Event 3 in Figure 10.2). Nonetheless, they did not appreciate the short driving range, low speed, and limited horsepower capacity. From the perspective of the *Sybase*, the overall result was negative towards the two-seat EVs in particular and the station car scheme in general. According to company representatives (in Schwartz & Maruo1998), two-seat vehicles were not adequate for *Sybase,* as the car was shared among the participants of the group and the cost-benefit of the scheme could not be justified. In essence, they needed larger cars with longer driving ranges.

In the opinion of representatives of BART and NSCA the lack of previous experience in car manufacturing was a significant weakness of the *Pivco* project. The inexperience of *Pivco* in the auto business would make it especially difficult for the company to succeed in the American market (Schwartz & Maruo 1998). As the next section will demonstrate, this inexperience would indeed become crucial for *Pivco* in a later stage; it cost the ownership of the enterprise.

10.4.7 Commitments, Competences, and Constraints of Ford Motor Co.

The relatively low capital necessary to establish the *Pivco* business, when compared with similar investments in the auto industry[155] was not sufficient to prevent the company from financial crises when the vehicle was ready for commercial production. The involvement of large companies as owners, suppliers, and pilot users gave the

155 According to Schwartz and Maruo (1998), the total investment in the Pivco venture represented approximately 3% of the investment of General Motors in the program for R&D, manufacturing and commercialisation of the electric vehicle EV1.

experiment considerable status, knowledge, and financial endurance during the development phase. Between 1991 and 1998, *Pivco*, relied on the members of the consortium and the Norwegian government to invest approximately 280 million NKr (€35 million). But when an extra amount of Nkr70 million (€8.8 million) was needed to recruit workforce and purchase the components for the production of 5,000 commercial vehicles per annum, *Pivco* faced an enormous challenge. After the company went public in 1991, with *Bakkelittfabrikken* and *Oslo Energi* being the major shareholders, additional cash was obtained from another round of stock emissions in 1995. But a combination of crisis in the stock market in 1998 and the refusal of the Norwegian government to continue to invest in the company made *Pivco* insolvent (see Event 4a in Figure 20.2). At the same time that the *Th!nk* impressed auto industrialists, and the public in general, during the European Electric Vehicle Show in Brussels and the *K'98 Plastics* fair in Dusseldorf in October 1998, its financial crisis forced *Pivco* to close its factory and declare bankruptcy at the end of that same month. Two weeks later, the company was bought back by *Bakkelittfabrikken*, the management team and employees of *Pivco*.

Ford representatives had formed a positive impression of the *Th!nk* and the innovations associated with it, when visiting the fairs in Belgium and Germany. In January 1999 this was transformed into shares in the Norwegian firm: *Ford* bough 51% of *Pivco* (see Event 4b in Figure 10.2). Since then, *Ford* has created an umbrella company to bring the electric and other alternative vehicles to the market. The think group is formed by two divisions, *Th!nk Mobility,* a firm that incorporates the concept of design, manufacturing and retailing developed by *Pivco* to sell electric vehicles and bikes, and *Th!nk Technologies,* which is responsible for developing and commercialising fuel cell vehicles (FCV). *Th!nk Mobility* is fundamentally an internet-based company[156] that commercialises the *Th!nk* currently produced by the former *Pivco,* now renamed *Th!nk Nordic*. Jan Otto Ringdal, the main actor in the process of founding *Pivco* remained in the company as the Vice-Chairman and Executive Director of the company[157], now under *Ford*'s supervision (Wernle 2000).

156 http://www.thinkmobility.com/ (2000, November 23).

157 http://www.think.no/v2/default.asp (2000, November 23).

The commercialisation of the electric vehicle (renamed again *Th!nk City*) by *Th!nk Nordic* started in November 1999. Although there is some enthusiasm about the market potential of the vehicle, its initial sales price seems to remain an obstacle for mass commercialisation. In December 2000, the retail price for the *Th!nk* in Norway – the only country where the vehicle was commercialised – was Nkr 199,000 (€25,000), of which Nkr 60,000 (€7,500) was due to the costs of the battery package, which could be financed separately. Apparently, the innovative approach and resulting savings in the overall manufacturing costs of the *Th!ink* have been countervailed by the high costs of the Nickel-Cadmium (NiCd) battery pack used in the vehicle. The batteries have the advantage of a useful lifespan of approximately 200,000 km, or the equivalent of 10 years of use, at 20,000km per year. But the 247kg battery pack weighs not only one third of the *Th!nk* (917kg unloaded) but is also equally reflected in the final price of the vehicle. For consumers in Scandinavian countries – the initial market for the *Th!nk* – the high initial purchase price can be partially mitigated throughout the life-cycle of the vehicle, since the price of electricity is expected to remain cheap. Nonetheless, it certainly constitutes a barrier for ‘private independent’ consumers – the former target market for the vehicle.

More recently *Ford* announced that the *Th!nk City* would be leased through its subsidiary *Hertz Norway*, one of the world leaders in car rental services. Overall, the importance given to the *Th!nk* group by *Ford’s* Chairman Willian Clay Ford Jr. and the President Jack Nasser, demonstrates that the concepts used for the development of *Pivco-Th!nk* are significant for the long-term strategy of the second biggest global automaker. The acquisition of *Pivco* resulted in *Ford* possessing not only innovations in colour extruded plastic mouldings and panels but also a design concept that can help the American automaker to test a new paradigm of manufacturing and retailing. With one of the lowest development costs in the history of the auto industry, the *Pivco* venture has already become an *agency* challenging circuits of power within *Ford*. The question remains whether the new enterprise will contribute to change the circuits of political ecology in the automobile field as a whole.

10.5 Circuits of Political Ecology in the *Field* of EVs

The previous sections used the *a priori* defined eco-factors to narrate two ‘stories’ and frame unfolding processes related to them, which may eventually foster ecological modernisation in that context. As elaborated in Section 9.2 (Chapter 9), if the episodic power provoked by eco-factors is to be effective in transforming practices within the automobile field, they must impact upon the circuits of political ecology that currently favour the internal combustion engine (ICE) technology. The rationalities embedded in existing structures seem to be inimical to innovations, such as those encompassed by electric vehicles. But even though the ‘lock in’ situation around the *automobile regime* presents high degree of resilience, the case studies analysed in this chapter show that there are signs of changes underway in the socio-technical context of the automobiles.

There is an apparent acceptance that the profound changes in the context of the automobile industry are inevitable. The enduring efforts and trials to make EVs a commercial reality seem to have uncovered new business opportunities. A significant number of interest groups and organisations consider electric vehicles as having the potential to empower those who possess the technological competencies necessary for the development, manufacture and use of the new technology. The cases of *Bakelittfabrikken* and the *Hydro Aluminium* are examples in this regard. The two companies realised that they could use their expertise to redefine some taken-for-granted design principles used in car manufacturing. If successful, these companies would be able to supply to a new market niche and diversity their portfolio of products.

Other organisations, such as *EDF*, *Oslo Energi* and *Statoil*, assumed that some expertise in the existing and well-established industry complexes surrounding the petroleum engine could also be redirected to the EV technology. These organisations see themselves in the energy business, rather than as exclusive suppliers of electricity or petroleum. In doing so they have made themselves available for EV-related experiments, such as the ones described in this chapter. Although their level of commitment towards the new technology requires further investigation, the experience accumulated through these experiments may result in new capabilities in one of the most fundamental areas for the diffusion of the EV technology: infrastructure. The transportation infrastructure is not exclusive for the automobile use and its optimisation represents the first step towards the reduction of the environmental impact of transport systems as a whole (Graedel & Allemby 1998). For the firms operating in the energy sector, the optimisation of infrastructure for alternative forms of transportation, such as electric trains and busses, as well as lightweight electric vehicles, can represent a significant new business opportunity.

The French and Norwegian electric utilities have the potential to exert substantial pressure on the *system (re)-integration* of the infrastructure within the automobile field.

Nonetheless system integration certainly cannot be reduced to infrastructure needs. New patters of utilisation, such as those based on the concept of a station car, as proposed in California, seem to be fundamental to overcoming barriers in the diffusion of EVs. The introduction of a new technology is not just a matter of superiority or finding acceptance in terms of system requirements. There is also the matter of *social integration*: the complexities of a socio-technical system need to be accounted for. The development of markets for electric vehicles presented in this chapter show the importance of the social embeddedness of electric vehicle technology. Technological options are associated with a wide range of related techniques and social systems and the development of emerging technologies such as the EV requires social embedding (Kemp 1994; Schot *et al.* 1994).

Social integration over-determines system integration because it makes meaningful specific artefacts and technologies in distinct ways. Material things have no meaning in themselves. Existing relations of meaning may facilitate or restrict the reception of change introduced through system integration. In this respect, it seems clear that the 'meaning' of conventional car has been historically superimposed on the performance possibilities of EVs. Mike Monaghan (in Daniels 1999:14) – the technical director at *Ricardo*, a leading powertrain and vehicle engineering technology provider – emphasises this aspect asserting that:

> The internal combustion engine has created a particular combination of cost, performance, power density, range and usage patterns against which any competitor must be judged. Without major changes in transportation behaviour this combination is unlikely to change.

As pointed out earlier in this chapter (Section 10.2), the established patterns of auto performance seem to limit the diffusion of *greener* cars. Deeply rooted patterns of performance associated with ICE vehicles tend negatively to influence consumer's opinion about alternative electric vehicles. Although the technological potentiality of ICE cars is under-utilised in practice, their potential peak performance is used in comparisons with electric vehicles. Chapter 8 noted that today's *multi-purpose* cars can carry five passengers, drive for about 500km without refuelling, and reach top speeds of more than 200km/h. Most city cars travel for an average of only 60 to 90 minutes at low speeds, do not usually travel more than 150km a day, and stand in parking lots 96% of the time (Gibbs 1997; Hawken *et al.* 1999). The relatively higher negative perception some motorists in California had about the *Th!nk*, when compared with the pilot users in

Norway, suggests that performance standards based on ICE-cars influence the American users in a higher degree than the Norwegian sample.

The La Rochelle case represents a tendency of traditional car manufacturers to use all-steel car bodies from conventional models to build their (converted) electric cars. As was the case with the electric versions of the *Peugeot 106* and *Citroën Saxo*, the performance of these converted cars, in terms of range and maximum speed – the meaningful attributes of existing ICEs – is inferior to ICE powered counterparts. The heavy steel car body significantly increases the need for storage capacity and power from the electric motors. Hart (1997:74) goes as far as stating that: "electric-vehicle programmes have been used to demonstrate the infeasibility of this technology rather than to lead the industry to a fundamentally cleaner technology". For the specific case of PSA in La Rochelle, such statement may not represent the real efforts of the company. After all, the alliance established with the Municipality of La Rochelle, and EDF indicated the existence of a genuine interest by the company in promoting the electric vehicles. Nonetheless, explanations for the exclusive use of converted EVs – and their well-known limitations – by PSA would certainly benefit from further investigation.

New entrants normally develop electric vehicles with lightweight bodies, but they lack the expertise in car manufacturing and cannot sustain the high investments necessary to achieve economies of scale. The *Pivco* venture is certainly a classic case in this respect. The *Th!nk*, may yet be the precursor of major changes. An unduly proprietary attitude towards the technology might explain some of the problems faced by the company but it certainly does not diminish the positive outcomes brought by the enterprise in relation to the overall ecological modernisation of the automobile field. The developments of the *Pivco*, resulting in the incorporation of the business into *Ford's* strategy for future propulsion systems and mobility services certainly exerted some pressure on the current *obligatory passage points* of the industry. This pressure does not relate to the advancements embedded in the EV technology, such as battery storage capacity, high performance electric motors and electronic control systems. Rather, the innovations brought by *Pivco* may unleash some new approaches to manufacturing and eventually reduce the dependency automakers currently have on the impressively high volume sales of petrol-powered cars.

10.6 Conclusion

With today's technology, electric vehicles (EVs) not only represent the cleanest available technology for automobile powertains; they also constitute means by which the current industry paradigm could undergo radical changes. According to Nieuwenhuis and Wells (1997:97):

> A wholesale move towards electric traction would render existing engine production systems obsolete. In addiction, it would have the strongest impact on the future of car body and chassis design; in particular, a switch to electric traction exposes the problems of overall vehicle weight, which are currently obscured by the power delivered by internal combustion engines. (…) Any move to increase the number of electric vehicles is likely to have a greater impact on the basic design of the motorcar than most of the other alternatives that are likely to be available over the next few decades. A significant move towards electric vehicle (…) has serious implications for our existing transport infrastructure as well as for the design of cars themselves.

This statement explains why the two case studies presented in this chapter have the potential to become milestones in the history of the automobile industry. Their impact might not be noticed in the short run; in many respects, it is too early to infer whether they will become *agencies* in the process of ecological modernisation of the auto industry. Nonetheless, EV technology is present in all longer-term alternatives currently under consideration by automakers and new entrants – i.e. 'pure' electric vehicles or hybrid powertrains combining ICE or fuel cells with electric motors (Nieuwenhuis 1998). In this respect, the experiences of La Rochelle and *Pivco-Th!nk* have been crucial not only for advancement of the intrinsic EV technology but also for testing new patterns of utilization, and the fundamentals of vehicle design, manufacturing and retail.

Fundamentally, the presentation of case studies was intended to uncover the main problem-areas associated with the EV technology. They are certainly not new problems for experts in the field of innovation economics or even for a substantial number of 'lay citizens'. Factors limiting the use of electric vehicles have been identified in several studies (see, for instance: Schot *et al.* 1994), and significant number of non-expert persons have a fairly good idea about these limitations, such as the lack of infrastructure for recharging and the relatively high price of electric vehicles. Nonetheless, in trying to answer why electric vehicles remain 'marginal' products in the portfolio of traditional car manufacturers, the La Rochelle case study showed that two main elements are in the core of the explanation.

First, the cases demonstrated that the existing battery technology makes it extremely difficult for EVs to compete with traditional *multi-purpose* cars in similar applications. Current battery technology simply limits EVs to niche market applications. In this respect, it seems that the approach of PSA towards the commercialisation of EVs has been biased by their assumption that individual customers would be interested in buying EVs as the second car. At least in the La Rochelle experiment, PSA did not address the issue of ownership[158], being limited to trying to motivate car owners to substitute their former cars for electric-powered ones. From the La Rochelle case study it is not possible to generalise to other car manufacturers, although it is likely that firms that have sought to commercialise converted cars have been working on the basis of incorrect assumptions about consumer behaviour. Moreover, in both cases – La Rochelle and *Pivco* – the initial price consisted of a substantial barrier to individual consumers, and developing a new approach towards vehicle ownership and use may be the only way to overcome such obstacle. In this respect, the participation of *Pivco* prototypes in the station car demonstration project may have brought some negative results for the company but, possibly, it paved the way for the formation of the *Th!nk Mobility* – a business that focuses on the supply of mobility solutions, instead of car ownership.

Second, the use of the ecological modernisation framework for the analysis of the cases suggest that eco-factors are required to be ‘aligned’ for the EV technology to have a chance to succeed. In other words, for ecological modernisation to occur, it is necessary that the majority of the factors favour the new technology. For instance, in 1970 the revival of EV technology emerged as a consequence of the scarcity and increase in the price of petrol. Some may see today’s resurgence of interest in EV technology as another ‘wave of despair’, one which will certainly fade away. Fluctuations in the price of petrol caused by changes in production targets of OPEC (Organisation of Petroleum Export Countries) in the year 2000 recalled the oil shortages of 1973 and 1979-80 (see: Yergin 1992). Prices of oil during the last quarter of the 20th century have behaved similarly to other commodities[159]. New technologies increased productivity and resulted in a steady fall of prices over the years. In trying to raise

158 This issue was addressed in the follow up project of the EV experiment in La Rochelle. In the *Liselec* project, 270 subscribers share the fifty EVs that are parked in six stations. For more information on the project, see Crosse (2000b)

159 After the second oil shock, during 1979-80, the price of barrel felt from €53 to €10 per barrel, approximately. See: The Economist (March 6th, 1999), pp. 21-23.

prices, OPEC reduced oil production and, as a result, prices jumped from €10 per barrel in March 1999 to over €30 in September 2000, causing substantial political turmoil in Western Europe and elsewhere[160].

Even though such 'shocks' may influence automakers and politicians to reduce dependency on cars, the current wave of environmentalism differs substantially from that of the 1970s. Although ironic, the risk of scarcity of oil is not seen as the main factor influencing the development of more eco-efficient vehicles (Wells 1998). Rather, as the La Rochelle case has shown, traffic-related problems have become a key factor in promoting the use of low and zero-emissions vehicles, mainly in urban municipalities in Europe. Inner-city pollution caused by auto motors have grown significantly in the past decades, exerting pressure on public administrators to reduce the dominance of the automobile as a means of urban transport (Newman & Kenworthy 1999). Although the difficulties associated with the introduction of EVs are very much still in place, public opinion is apparently shifting towards the support of policies encouraging the exclusive use of electric vehicles in congested urban centres. Moreover, among other factors, as was demonstrated throughout the chapter (and depicted in Figure 10.2), supporting such changes are related business, a significant number of interest groups and organisations. Environmental policies and programs have increasingly supported EV developments and appropriate conditions for the use of EV have improved in selected locales. In sum, the eco-factors have slowly aligned towards the support of EV-related technologies.

The final question that needs to be addressed relates to the role of potential new entrants in the automobile field. If car manufactures were unable to succeed with their converted vehicles, why then have new entrants into the auto industry not fulfilled such a market niche? In this respect, the *Pivco* case study showed the problems new entrants face when trying to develop and commercialise EVs. Besides the general conditions necessary for the use of such vehicles, the main problem they face is the high purchase price of EVs. While traditional carmakers have been unwilling to adopt a completely new concept of the car body, new entrants face significant technological, economic, and political limitations to develop, manufacture and commercialise their products. The overall conditions within the automobile field require resources that are not so easy to

160 *The Economist*, September 2nd, 2000.

acquire or maintain. As a result, the niche market for EVs remained quasi-dormant for many decades.

Finally, it should be clear that this chapter did not intend to 'defend' the use of electric vehicles but rather explain why its presence in the marketplace has so far been marginal. As has been shown through the case studies, it is possible that at the turn of the millennium, the factors are better aligned to trigger more radical innovations in the industry (Cronk 1995). The convergence of the interest of energy utilities in selling dormant electric capacity, the demand for new jobs in EV-related businesses, and the increasing request for more environmentally sound automobiles have apparently given the electric vehicle (EV) a new competitive edge (Atkin & Storey 1998; Sperling 1995). Even if it is not possible to foresee the future significance of these eco-factors, their systematic identification and analysis through the use of the framework sensitises one to the most probable sources of innovation and resistance that are likely to occur. Such sources of innovation have also been identified in the case of end-of-life vehicles, the theme of the next chapter.

11 The End-of-Life Vehicle *Issue* in Western Europe

Every car, powered by internal combustion engines, electric motors, or any other propulsion system has a limited useful life, and sooner or later will become an *end-of-life vehicle* (ELV). In Western Europe, around 12 million cars become ELVs every year, generating approximately 2.2 million tonnes of permanent waste (Wright *et al.* 1998; Kurliko 1997). Remarkably, such an environmental impact only became an *issue* in the context of Western European countries in the last decade of the 20th century. Although Sweden pioneered environmental policies for ELVs with the institution of a recovery tax back in 1976 (Rydén 1995), only in 1990 was attention galvanised around the waste generated by cars at the end of their useful 'life'.

The German Ministry for the Environment was the first governmental agency to propose a draft regulation requesting automakers to take-back their cars without any costs to the consumer – hence, the popularised notion of '*take-back* regulations'. At that stage, the position of the German government was clear: carmakers should find solutions – and carry the eventual costs – for the collection, recovery, recycling, and final disposal of cars they put on the roads. Fundamentally, this was a new regulatory framework based on the concept of *extended producer responsibility*[161], which threatened to impose extra costs on car assemblers (see Section 4.1 in Chapter 4).

Nine years later, representatives of the German government lead the countries lobbying European Union (EU) diplomats to delay full producer responsibility regulations. One may wonder how this change of the German government position could be explained. What made the Ministry for the Environment radically change its standpoint? A simplistic answer would explore the proposition that a powerful automotive industry succeeded in imposing its interests on a less powerful government. Although this is certainly part of the answer, this chapter tries to avoid an eventual over-simplification of both the technical and economic complexity of the problem. Instead, one must investigate the constitution of power relations within the context of the *automobile field*. The understanding of the ELV issue requires one to consider not only

161 For an overview of the *Extended Producer Responsibility* (EPR) concept, see Lindhqvist (2000).

the technical and economic nature of the problem *per se* but also the *'politisation'* of technical and economic arguments used by various players to secure their interests.

Research by Groenewegen and den Hond (1991; 1993), Matysiak (1992), and den Hond (1996) concluded that the ELV issue was political, rather than technical. Chapter 5 also emphasised that environmental issues in the context of the automobile field engender relations of power and one should not be surprised that this is also the case for the ELVs. Nonetheless, it seems that even those who analyse the ELV issue from an essentially technical perspective (Wright *et al.* 1998, for instance) agree that this has became an overly political matter. One could ask then, what makes ELVs a politically charged subject? Why has this topic galvanised so much discussion – and so little practical change, one could say – during the 1990s?

Fundamentally, answers for these questions encompass the scope of this chapter. In doing so, the chapter addresses the fourth objective of Part II of this study, described in Section 7.4.1 of Chapter 7. Section 11.1 demonstrates that a source of political disputes arise from the necessary changes in the traditional ELV processing system. First, there are well-established business practices around car ELV dismantling, recovery of parts, shredding and disposal. The new requirement for ELV treatment placed pressure on these businesses to change. Second, ELV-related activities have been organised around an industrial sector that, apart from dealing with the same product, has historically had little association with car manufacturers. Any future direct participation of car manufacturers in ELV activities would require transformations in the traditional value-chain of the waste management industry, engendering power struggles among those who have present interests in the business.

Since multiple solutions are also possible in terms of the management of ELVs, political disputes are also generated in the process of defining new ELV schemes. The collection, recovery, recycling and disposal of ELVs can be organised according to several criteria and can be managed by different actors. Obviously, because each system engenders costs and responsibilities, the definition of who designs and manages them results in political disputes between the interested parties. As Section 11.2 will describe, in the early 1990s the German Minister for the environment tried to impose responsibilities for the collection, recovery, recycling and disposal of ELVs on automakers. Conversely, as Section 11.3 presents, the French government relied mostly on the initiative taken by a traditional shredding company to work with auto manufacturers, and other partners, towards solutions for the waste generated by ELVs.

Section 11.4 explains that in Italy, although the main proponent of solutions for the ELV problem was the national-flag automaker *Fiat*, the nature of the solution was similar to the one proposed in France. Overall, carmakers operating in Western Europe tried to convince their national governments that *voluntary agreements* would be the best option for dealing with the waste generated by ELVs.

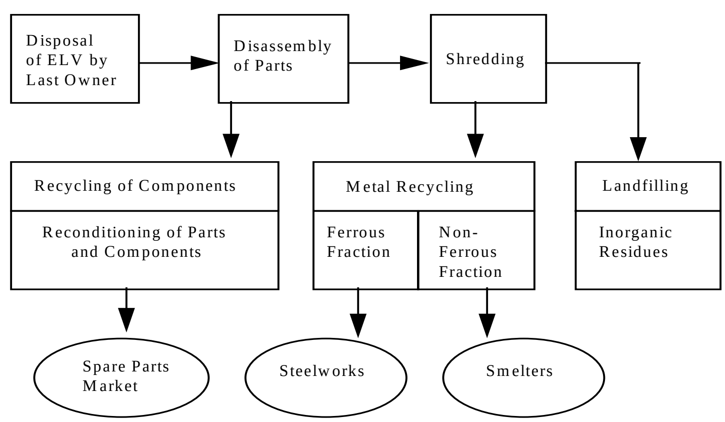
ELV developments in Germany, France, and Italy are addressed through a framework of ecological modernisation, as in Chapter 10. Initially, the evolution of the ELV issue in each country was organised according to the pre-defined environment-contingent factors (*eco-factors*). Three 'stories' are presented based on the collection of primary and secondary data, described in detail in Section 7.2 (Chapter 7). Germany was the country that triggered the ELV issue in the European context. For this reason, the evolution of the German ELV issue is systematically organised by subheadings in Section 11.2, according to the eco-factors – in the same way as in the case studies presented in the previous chapter. The French and the Italian cases present a less systematic account. In these countries, attention is called to the *eco-factor* that relates to each 'episode' as the narrative unfolds.

The developments in each country during the period of 1990-1996 certainly influenced the general positioning of the European Commission regarding the ELV issue, as well as the content of the draft regulation proposed in July 1997. Because of this, Section 11.5 'opens up' the core of the ecological modernisation framework and describes the *circuits of political ecology* evolving at the juncture of the European Union. By doing so, the chapter presents not only the evolution of the ELV issue based on environment-contingent factors, as it was done in Chapter 10, but it also explores the capillary flows of power in the Western European automobile field. In sum, the section provides some insight into the disputes and explains the reasons for the pace of ecological modernisation of the industry in the area of car recycling during the period 1990-1996. Finally, Section 11.6 presents a brief overview of the developments from 1997, when the European Community proposed the Directive on ELVs, until its final adoption by the European Council in September 2000. An evaluation of the use of the ecological modernisation framework for the analysis of the ELV issue in Europe concludes the chapter.

11.1 The Traditional End-of-Life Vehicles (ELV) System

Cars are among the best recycled of consumer products, with about 75% of the vehicle weight being recovered for recycling. Such a relatively high recycling rate is due to the metal content of cars, more precisely steel. A comprehensible recycling infrastructure has made the recycling of steel a profitable economic activity in the vast majority of countries where the automobile is an essential part of (private) transport. Although such recycling rates may suggest a substantial achievement of the auto industry, the 25% that remains waste constitutes a problem of great magnitude. The 9 million ELVs generated in countries within the European Union (EU) account for approximately 2.2 million tonnes of waste every year, representing 10% of all hazardous waste and 60% of the shredded waste (Wright *et al.* 1998). Figure 11.1 shows the overall (simplified) system of ELV processing and its main actors and activities, briefly described in the following sections.

Figure 11.1: The ELV Processing System



Source: den Hond (1996)

The current ELV processing system comprises the disposal of the vehicle by the last owner, its dismantling and shredding, and the recovery of metals. The profit motive driving the system is to be found in the value of parts and components as well as the scrap metal value of the end-of-life vehicle. Due to rapid and often dramatic fluctuations in scrap metal prices, the system has become very flexible in responding to changing market demands (Field & Clark 1994). Today, ELV processing is complex system comprising several interdependent and competing economic agents (Groenewegen &

den Hond 1992), which starts with the transformation of cars into three basic types of ELVs.

11.1.1 Sources and Types of ELVs

Cars can become end-of-life vehicles for different reasons. The *natural* circumstance occurs when car owners are no longer able to extract additional use value from their vehicles. In such condition, private owners sell their cars to dismantlers. But when the car has a negative value, it is very common that the last owner will (illegally) abandon it. In this case, local councils normally have to bare the costs of transporting the *abandoned* ELV from the dumpsite to a scrap-yard or a shredder firm (in this case, bypassing dismantling activities). Another situation, and indeed an economically significant one, happens when cars become *premature* ELVs. The research of Ghering and Teulings (in *CAIR & MVDA* 2000) found that around 22% of the cars taken off Dutch roads, for instance, were written off because of accidents. Depending on the degree of the vehicle damage, the components of these premature ELVs can be significantly more lucrative than natural ELVs. Mainly because accidents normally involve compensation by insurance companies, these firms are normally the ones who deliver premature ELVs to car dismantlers. In the end, whatever the source or type of ELVs, they will almost certainly be delivered to a car dismantling firm.

11.1.2 The Car Dismantling Business

Dismantling has traditionally been an area of low technological qualification and little capital investment. One may think of the typical operators, living in the ‘wastelands of consumer society’, where the main asset is the land where the scrap-yard is located, and the survival of the business depends on reducing costs to minimum levels. For instance, in order to reduce labour costs, some car dismantlers ask their customers to disassemble the parts they want to buy. The nature of the business also results in disassemblers refraining from investing in equipment for the collection and disposal of hazardous automotive substances, such as the car’s solvents and oils – a common source of soil contamination. As a result, scrap yards are often repositories of years of abuse, neglect and contamination of the natural environment, as oils have spilled, fuels run, and batteries leached into the surrounding topsoil.

Car dismantling is normally formed by a large number of small firms sparsely distributed, normally in the highly urban industrialised neighbourhood of towns and cities. This characteristic is mainly a result of the localised nature of the ELVs supply. Small-scale has been a (relatively) successful business model in the sector because it can deal directly with both the local supply base and the clientele, to whom second-hand parts and components are sold. Moreover, because of the low profit margins, any transportation costs would render the business unviable. Car dismantlers normally compete with franchised dealers in the automotive after-market parts, putting pressure on the prices of original car parts sold by them. This cost-driven competitiveness (see Section 4.4 in Chapter 4) of dismantling firms resulted them to be regarded with suspicion by automakers. Furthermore, the image of the car disassembling business has also been damaged because of its links with illegal operations. Because car parts are worth more individually than assembled in a vehicle, organised crime has transformed car dismantling in an activity that can make the robbery more lucrative, at the same time as it renders identification more difficult. As a result of these circumstances, the overall image of the dismantling sector in the European context has not been a very good one (*CAIR & MVDA* 2000).

The very nature of the dismantling business has been an impediment to revitalization of the sector. Only a few car dismantlers have the capacity to acquire equipment and the management capabilities to upgrade the business. The relative low profitability of the business and problems associated with soil contamination has also been a barrier for firms who might have sought to attract investors. Nonetheless, current limitations also imply that this is an activity that presents the highest potential for change within the entire ELV system. There is scope for both increased professionalism and scale of operations of firms within the industry. As the next section will discuss, other businesses operating in the ELV system have already achieved a high degree of consolidation and economies of scale. The recipient of the vehicle hulks is one such activity. After taking the components that can be reused, car dismantlers sell the remaining vehicle wreck to a shredder company, the next actor in the traditional value-chain of ELVs.

11.1.3 Shredding, Metal Recycling, and Landfilling

Shredding operations differ significantly from car dismantling. The shredder industry is capital-intensive and there are apparently few opportunities for improving both the sheer efficiency of metal recovery and the overall consolidation of the industry. Under normal conditions, recovery rates exceed 95% for ferrous and 90% for non-ferrous metals. Such rates are achieved by destroying the ELV into fist-sized pieces and using magnetic sourcing, amongst others technologies, to separate ferrous and non-ferrous metals. If vehicles were just made of metal there would be little more to add. However, increased application of non-metal materials, notably various types of plastics and composite materials, has resulted in increased *automotive shredder residue* (ASR)[162]. Such a situation has threatened the profitability of metals recycling in two ways. First, decreasing metals contents results in lower valuable materials turnover for the shredder and, as a consequence, lower revenues. Second, the disposal costs of shredder residues have steadily increased in Western European countries. Reduced capacity for landfill and more stringent controls on waste disposal has further increased landfill costs.

The automotive industry has explored solutions for ASR. For instance, shredder residue can be transformed – normally by separating the organic content (plastics) – into fuel for energy-intensive industries, such as cement or steel. Another solution is to adopt a new technological approach to the ELV processing. The joint project of *Mercedes-Benz* and *Voest-Alpine* is an example of such approach; they developed a process for 'metallurgical recycling' in which the ELV hulk and most of its organic components (i.e., without dismantling) are fed into a melt-reactor for the production of steel. In this reactor, the incineration of the organic materials adds carbon to the production of steel, while inorganic materials and impurities are separated into inert slag. Although such an approach is technically viable, it is not desirable from the perspective of the waste hierarchy for consumer durables. From an environmental perspective (based on life-cycle assessment), reuse and recycling of car components should be prioritised over energy recovery. Such prioritisation, however, is beyond the scope of action of the shredding industry.

11.1.4 The Ecological Modernisation of the ELV Processing System

As outlined, the main waste problems generated by ELVs in the past decades have been as a result of the decrease of the relative share of metals in the overall composition of cars. Materials based on thermoplastics and thermosets have increasingly been substituted for metals, and numerous new parts composed of different materials have

162 *Automotive Shredder Residue* (ASR) is formed by what is left over from a shredded ELV once the useful materials have been removed for recycling or reuse.

been added to the vehicle in order to offer novel functions to the customer. As a result, the volume of permanent waste has grown significantly.

Individually or in partnership with other organisations, carmakers in Europe started a series of programmes that mainly aimed to increase the recycling rates of ELVs. Understanding the principles of these initiatives would certainly help one to recognise the potential solutions for the waste generated by ELVs. However, if an understanding of the pace of ecological modernisation in the automobile field is necessary, any analysis focusing solely on the initiatives of car manufacturers would certainly be misguiding. As den Hond and Groenewegen (1993:362) have emphasised:

> The *greening* of the automotive industry cannot be understood just by looking at individual strategies toward vehicle recycling. It is clear from this industry's example that solutions to environmental problems, such as waste issues, involve cooperation among a number of differently located industrial actors. To understand *greening*, technical and organisational solutions must be assessed in an integrated way.

As will been shown in the following sections, during the period 1990-1996, developments involving a multitude of organisations directly and indirectly related to the auto business in countries that are the home base of volume manufacturers have proved to be very influential in the final positioning of the European Union. In 1997, the Commission of the European Union drafted a proposal for a directive on the treatment of ELVs. Since that time, lobbying by both industry and national governments has resulted in several changes to the final document – the 'Proposal for a Council Directive' of 1997 (COM 97-358). The document was finally approved (with modifications) in the year 2000. To understand the changes that have been made one needs to grasp the early developments of the ELV issue in the automobile field of the three major car producers in Europe – Germany, France and Italy – during the period 1990-1997. The next three sections are dedicated to this presentation.

11.2 The Evolution of the ELV Issue in Germany: The *Take-Back* Concept

The origins of the debate about the environmental impact of changing material choice in vehicle design dates back to the early 1970s. In that period, some individuals within FAT[163] – the long-term research institute of the German automotive industry – became concerned about the conjuncture of increasing use of plastics in vehicle design, limited

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landfill capacity, and the scarcity of natural resources. The topics were considered important enough to justify a dedicated working group on automobile recycling. During the 1970s and 1980s, this working group published a number of studies on various related topics, including the use of non-ferrous and other metals, and plastics, in vehicle design and design for recycling and disassembly, among others (den Hond 1996).

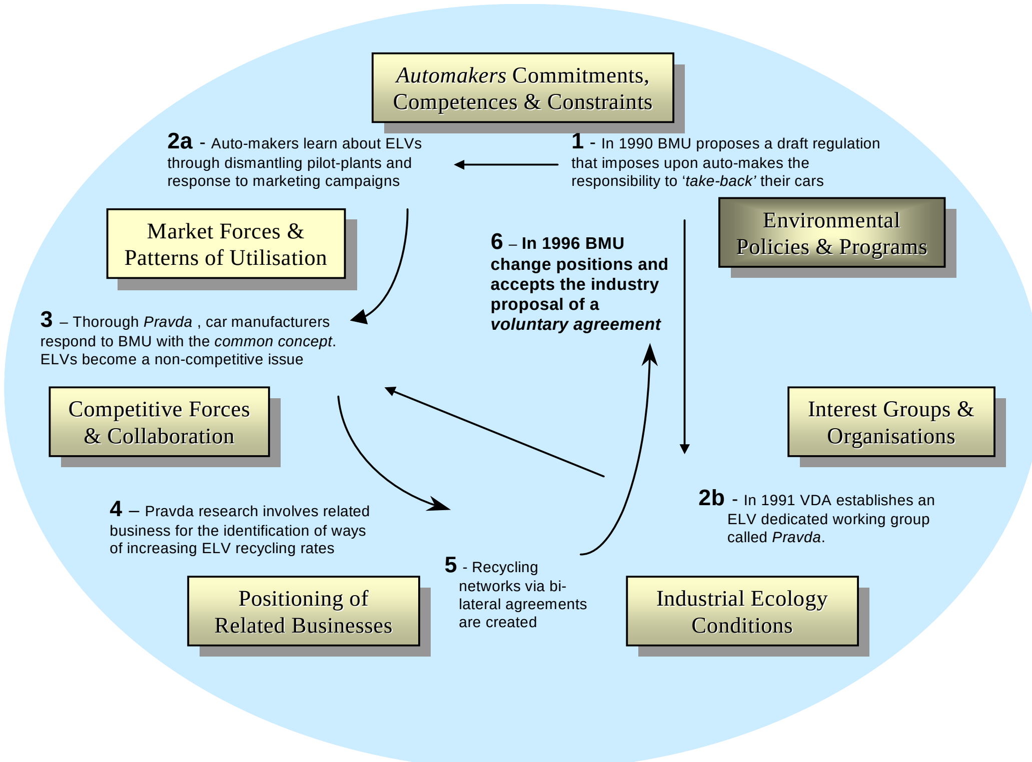
The German Federal Department of the Environment (BMU) was represented in several of the working group's studies indicating that the work done under supervision of FAT set the agenda, as well as providing arguments for the policy debate around the recycling of end-of-life vehicles in the second half of the 1980s. In November 1986, when the Waste Avoidance and Waste Management Act (WMA) was launched in Germany, the legal foundation was provided for a *take-back* and recycling policy regarding ELVs. The WMA specified the duty to minimise waste generation by waste avoidance and re-utilisation, making it a priority for waste treatment: re-utilisation is preferred over incineration and disposal. The WMA announced the introduction of producer liability for the treatment of post-consumer waste, which includes product take-back and mandatory recycling, and specific measures with respect to end-of-life vehicles were announced (den Hond 1996).

The evolution of the ELV issue in the German automobile field can be observed by following the arrows in Figure 11.2 (in the next page). Of course, the figure is a simplification of reality and the arrows represent only the main influences involved in the process. As stated in Chapter 9, all *eco-factors* intertwine and influence each other, and circuits of political ecology intermediate the influences represented by the arrows. Hence, although the arrows are pictured as direct influences, they would be better represented as a series of power struggles, visually resembling something more intricate and chaotic than the current representation. In fact, later in the chapter, Section 11.5 tries to portray such 'anatomy of power', opening up the circuits of political ecology, which have previously been explored in Chapter 5.

11.2.1 Environmental Policies and Programmes: BMU

By the 1970s, the automotive industry had become aware of the problem that end-of-life vehicles represent in environmental terms. However, it was only in 1990, with the draft '*take-back*' regulation proposed by the German Federal Department of the Environment (BMU) that the automobile industry developed explicit recycling strategies for ELVs (see Event 1 in Figure 11.2). The initial policy objectives with respect to end-of-life vehicle waste were characterised by three principles: (i) producer responsibility for handling end-of-life vehicles –the polluter pays principle; (ii) preference for waste prevention and recycling over incineration and landfill; and (iii) stimulation of environmentally conscious product development (den Hond 1996).

Figure 11.2: The Evolution of the ELV *Issue* in Germany



The draft regulation provoked direct actions by car manufacturers, since they feared that the costs associated with its eventual implementation could result in loss of competitiveness. Simply, if approved by the local government, the internalisation of ELV costs would increase the expenditures of German carmakers. Indirectly, the proposal also alerted other European nations to the possibilities of the emergence of similar regulation at the EU level. The German policy was an indication that other governments in Western Europe could adopt the same approach, and most volume automakers initiated ELV-related work in the early 1990s. At that stage, there was a high level of uncertainty about how the problem could be framed and solved, and as den Hond (1996) explained in detail, a multiplicity of strategies and initiatives were developed at both the organisational (carmakers) and the industry level (mainly though the automaker's association). The first set of initiatives is described next.

11.2.2 Commitments, Competences, and Constraints of German Automakers

Attempting to cope with the new constraint, German automakers took action in two complementary directions. Event 2a in Figure 11.2 depicts the initial response of German automakers towards the ELV issue. Generically, they tried to demonstrate their *commitments* to finding solutions for the ELV problem at the same time they developed *competences* in recycling techniques and learnt about the economics of recycling (Bylinsky 1995). In order to learn about dismantling times and identify the economic limits of recovering car parts, they established several disassembling pilot-plants. Even though political lobbying could delay the implementation of regulatory measures, car manufacturers felt the need to develop practical alternatives to the problem. Pilot-plants were either established by single manufactures or in cooperation with dismantlers and shredding companies.

Through the research conducted at these 'dismantling laboratories' carmakers identified the limits of increasing current recyclability of non-metallic car parts. *Ford*, for instance, in its disassembling plant in Koln-Niehl (Germany) found that disassembling plastic components was no longer economic after 30 minutes of work (Wright *et al.* 1998). In most cases current design and associated systems of production of automobiles make disassembling and recovery extremely difficult. Plastic materials, for instance, are difficult to detach from the car body and their identification also demands costly time. Research developed in pilot-plants certainly helped carmakers to identify key-areas that should be addressed if faster and easier disassembling were required, such as the necessity of involving suppliers in the design of the new models. Nonetheless, the most important conclusions relate to the identification of carmakers' *constraints* in complying with the 'take-back' proposal, without incurring in extra costs. For instance, the absence of *design for disassembling* principles in the old models simply reduced the chances of extracting enough value out of ELV that would compensate the costs of the processing them. Indeed, in a later stage, German automakers would argue that each ELV would cost them €187 (Kurylko 1999). Such realisation influenced automakers to put their efforts into another direction, using their peak organisation to lobby government.

11.2.3 Interest Groups and Organisations: VDA-Pravda

At the same time that automakers were learning about the economics of recycling in various pilot-plants, they also put tried to convince legislators that the ELV responsibility should be shared with related businesses – mainly suppliers of car parts and components. Based on previous discussion among automakers, dismantling, and shredding companies, in October 1990 VDA – the German automobile industry association – responded to BMU with a 'concept for the future processing of end-of-life vehicles' – later to become the *common concept* (see next section).

Event 2b in Figure 11.2 depicts the role the association of German automobile industry association (VDA) had in constituting and acting on behalf of carmakers' interest. The objective move of the association was the establishment of a special group. In February 1991, VDA established a dedicated working group on end-of-life vehicle recycling, called *Pravda*[164] in which every German car manufacturers were represented. *Pravda* aimed at political and technical cooperation among its participants in order to advance industry-wide recycling activities. In practical terms, *Pravda* materialised the collective opposition of German carmakers to the 'take-back' regulation. Such a move had an indirect influence on the ELV-related competition in the German automobile field.

11.2.4 Competitive Forces and Collaboration: The 'Common Concept'

Around 1993, car manufacturers realised that: (i) consumers were not responding to marketing campaigns that emphasised the recycling attributes of cars (den Hond & Groenewegen 1993) and, (ii) the costs of recycling ELVs exceeded the revenues. Such conclusions were sufficient for them to refocus attention on the political side of the equation – they needed to find ways of convincing the German government to withdraw the take-back proposal. They did so through *Pravda*. Under the *Pravda* 'umbrella', car manufacturers further elaborated a 'common concept for the recycling of end-of-life vehicles'. The result was the 'common concept', which was later communicated to BMU and the general public. Since all automakers endorsed the proposal, the 'common concept' was used more as a political stake than as a technical document. Political lobbying was intense at that stage, gaining momentum after the French 'framework agreement' was released in 1993; it gave German automakers the alibi to force BMU to accept a similar procedure in the country. As will be elaborated later in this chapter the position of German and other European car manufacturers transformed ELVs into a non-competitive issue (see Event 3 in Figure 11.2).

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The common concept was also used by *Pravda* to guide technical and market research. It was intended that the data generated in this research would be used during the implementation of the concept in a later stage. Thus, dismantling pilots were coordinated and results were discussed among the *Pravda* members; material recyclability was studied in close cooperation with the plastics, rubber and glass industries; and new dismantling tools, information systems, and advanced material sorting techniques were developed. In theory, the research should help *Pravda* members and related businesses – in this case, in the waste management sector in general – to increase recycling rates of ELVs (see Event 4 in Figure 11.2).

11.2.5 Positioning of Related Business: Dismantling, Shredding, and Recycling

While the political battle was underway, automakers kept working on the technical side of the problem. Since it was necessary to have a better understanding about problems associated with the recyclability of materials currently used by car manufactures, they developed closer relationships with dismantling, shredding and recycling companies (see: Event 4 in Figure 11.2). Dismantling companies, historically marginal players, gained a new status and became a new *agency* in the auto industry (see Section 11.5). Disassembling activities were now to be integrated into the life-cycle of cars, such that manufacturers needed to identify problems associated with them. Shredding processes also received attention, since the increasing number of plastic parts was not disassembled and ending up in landfills – thereby also increasing costs for that business. Overall, businesses within the waste management sector that historically have had little relations with the auto industry became central for the establishment of the conditions that would facilitate carmakers to increase recovery and recycling rates of ELVs.

11.2.6 Industrial Ecology Conditions: Creating 'Recycling Networks'

Automakers were also pro-active in trying to create logistic systems and markets for non-ferrous car components. Although questions about the economics of recycling of plastic and other car components remained, automakers started directing attention towards the materials that were easier to disassemble and more cost-effective to recycle. The creation of *recycling networks* via bi-lateral agreements with car dismantlers and shredding companies was the next measure taken in this direction by automakers during the period 1991-1995 (Event 5 in Figure 11.2). It should be observed that even though automakers did establish recycling networks, they were restricted to a few car parts.

Mainly because disassembling car parts is increasingly time demanding, as components get smaller and require more tooling, car manufacturers have limited their recycling efforts to a few big plastic pieces (den Hond 1996).

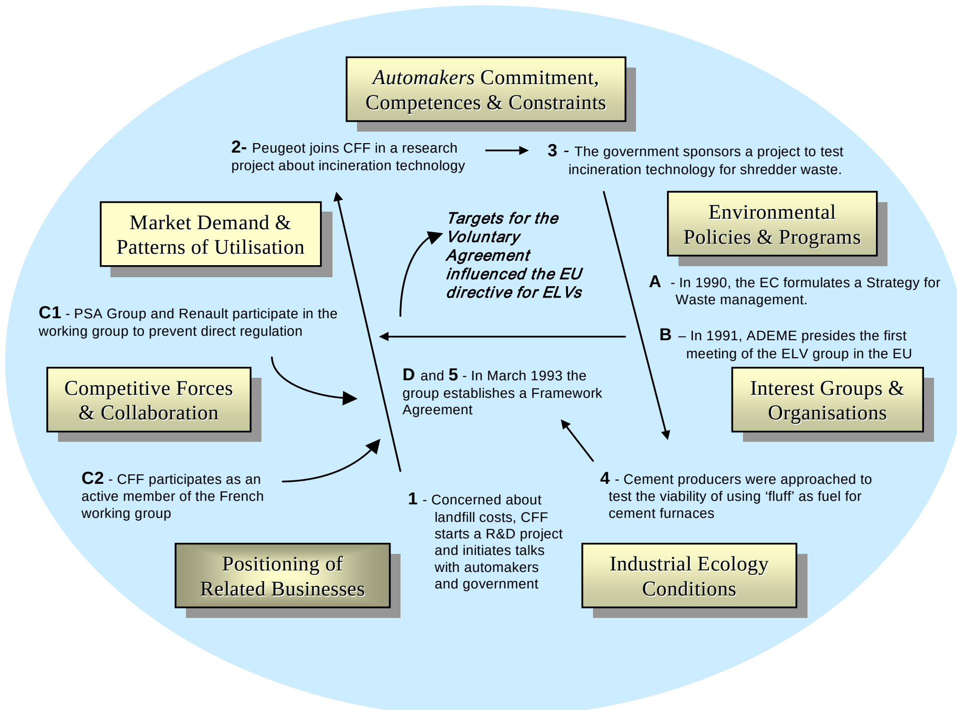
In February 1996, the initiatives taken by the German car industry, such as the bi-lateral agreements, resulted in the German Minister for the Environment (BMU) finally accepting the sector proposal of a voluntary agreement. Some recycling targets were established, but they were obviously less demanding than the first draft regulation proposed by BMU in 1990 (Event 6 in Figure 11.2). It is noteworthy that the capacity of German carmakers to convince their government was actually influenced by the developments in a neighbour country – France.

11.3 The Evolution of the ELV Issue in France: Voluntary Agreements

The German government chose a unilateral approach to regulating end-of-life vehicle processing while, in France the ELV issue developed in a different direction. There was less historical and legal background in environmental policy and no strong internal dynamics developed around waste management policy. Greater cooperation amongst all the actors involved characterised the process, which was directed towards a voluntary agreement (*accord cadre*). In France, it was the eco-factor *positioning of related businesses* in the automobile field that initiated the ELV process. During the 1980s, the leading French shredder company – *Compagnie Française des Ferrailles* (CFF) – became concerned about increasing landfill costs, as a result of the expanding amount of shredder residues. Figure 11.3 (in the next page) describes the evolution of the ELV issue in France, highlighting the key role played by CFF as the initiator and major player in the process. Observe that there are two parallel developments described in the figure. One numeric sequence is numbered from 1 to 5; the other uses the letters ‘a, b, c and d’ to illustrate the sequence of events occurring in the French automobile field.

The sequence in Figure 11.3 is initiated by the eco-factor characterising the *positioning of related businesses*. CFF – a firm operating in the waste management business related to the car industry – discussed the ELV problem at various times with the French government and organisations in the automotive industry. Event 1 in Figure 11.3 shows that the company triggered off the ELV process by initiating an internal R&D (research and development) project with the aim of reducing the amount of shredder residue. After having dismissed material recycling as a viable solution, the company developed a new potential solution in using the calorific value of shredder residue to fuel cement ovens.

Figure 11.3: The Evolution of the ELV *Issue* in France



In September 1990, together with *Peugeot*, CFF began research to prepare a pilot project to further develop and test the technology (Event 2 in Figure 11.3 shows the participation of *Peugeot* in the process, indicated by the eco-factor characterising *automakers' commitments, competences and constraints*). The pilot project was launched in June 1991 for a period of two years, with financial support from the Ministry of Industry, characterised in Figure 11.3 by *environmental policies and programmes* (Event 3). Also in 1991, the Ministry sponsored a comparable project with a consortium around *Renault* to test a slightly different incineration technology for shredder residue. Event 4 in Figure 11.3 indicates the initiative taken by *Renault* and cement firms to create the appropriate *industrial ecology conditions* for energy recovery of automotive shredded residue.

The second sequence in the evolution of the ELV case in France relates to the *environmental policies and programs* occurring at the level of the European Union. In 1990, the European Council adopted a 'community strategy for waste management' based upon the principles of waste prevention, source reduction, and the ‘polluter pays’ principle (see Event A in Figure 11.3). This strategy applied to both products and production processes, and aimed to close material flows into loops. With respect to waste prevention, the strategy explicitly called for the marketing of products developed in such a way as to minimize waste during all stages of the product’s life-cycle. These principles can be used by the Commission and by member states as a means to restrict the use of certain materials and to develop specific waste policies for products. Furthermore, a number of waste streams were declared ‘priority’ in the document, and member states were invited by the Commission to prepare a European approach for specific waste streams.

In June 1991, France accepted responsibility for the coordination of the ELV waste stream. In December of the same year, the French State Agency for Environment and Energy Conservation (ADEME) presided over the first meeting of the European ELV Project Group (Event B in Figure 11.3 classifies ADEME in the *interest groups and organisations* ‘box’). ADEME considered it fundamental to start a parallel ‘French group’ on end-of-life vehicle recycling. The first director of the European ELV Project Group emphasised that France should take a proactive role in the process and anticipate emerging policies dictated by the European Parliament (den Hond 1996). Very quickly, the French Ministry for Industry took over the direction of the French working group from ADEME. The French group was represented by the automotive industry, its suppliers, ELV-related sector, the Ministries of the Environment and Industry, as well as ADEME. Clearly, the coalition transformed ELVs into a non-competitive issue in France. Event C1 in Figure 11.3 identifies the *collaboration* established among French automakers regarding the ELV issue, while Event C2 indicates the *positioning of a related business* – in that case, the active role of CFF in the French ELV group.

When the French working group was formed in 1991 – at about the same time as the European working group started – neither a specific waste policy on end-of-life vehicles nor recycling targets (as it was the case in Germany) existed. Moreover, no preparatory policy studies had occurred. Industry, comprising notably *Renault*, the PSA Group and CFF, agreed to participate in the working group in order to prevent regulations similar to those that were being proposed in Germany. They considered that industry-wide cooperation, collective liability, and commercial relations between the various parties involved were better points of departure for solving the waste problem of shredder residues. The working group intended to reach a ‘voluntary agreement’ on the reduction of waste from end-of-life vehicles. Indeed, such objective was achieved in March 10, 1993.

The group agreed upon a number of targets in a voluntary ‘framework agreement’ (*accord cadre*): (i) a maximum 15% waste disposal per car, with a maximum of 200 kg per vehicle, by 2002; (ii) for new models marketed from 2002 onwards, a maximum 10% waste disposal, and; (ii) in the long term a maximum 5% waste disposal (Events D and 5 characterise the main outcome of the ELV issue in France).

The agreement stated that operators in the ELV system (car dismantlers, shredder companies, metal recovery firms, etc.) might freely choose among the different technologies and the various modes of valorisation possible. The coordination of the different activities to be undertaken by each of the parties was supposed to take place via a free market. The market would fix the prices paid for the various transactions of vehicle collection, pre-treatment, disassembly, recovery and recycling. There would also be market determination of the conditions under which the end-of-life vehicle is to be accepted by the operators. The agreement also stated that such a mode of coordination would be a prerequisite for the economic and environmentally friendly processing of end-of-life vehicles as well as constituting an important incentive for car manufacturers to market cars that are easily recycled[165]. Overall, the French voluntary agreement generally influenced ELV developments in the context of the European union and, in particular, in neighbouring countries such as Germany and Italy, where the auto industry is a dominant economic and political powerhouse.

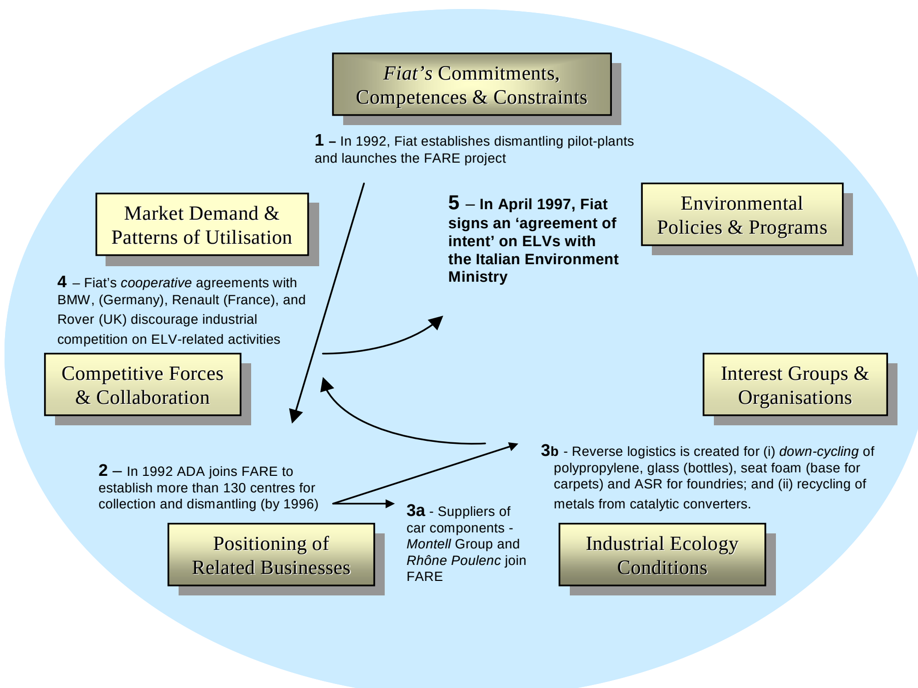
11.4 The Evolution of the ELV Issue in Italy: The Pragmatic Approach

When compared with the German and French experiences, the Italian case of ELVs follows a somewhat different trajectory. The dominance of *Fiat Auto* as the leading Italian manufacturer and the second largest manufacturer in Europe confers a particular characteristic to the Italian context. Organisational commitments towards better environmental performance and the threat of an emergent new regulatory imperative were the main reasons for *Fiat* to establish the *Fiat Auto Recycling* (FARE) scheme. Similarly to the majority of European automobile manufacturers, the scheme was a

165 It should be noted that lack of detailed information about the discussions during the regulatory process and of clear position statements by the various actors, made it impossible to know which were the controversial points, as well as if, and how, the positions of the various actors shifted during the process.

component of the overall environmental efforts of the company[166]. Nonetheless, *Fiat's* role in the definition of the problem and the proposal of solutions for the ELV issue in its home country went far beyond any other carmaker in the European context. Figure 11.4 describes the evolution of the Italian ELV issue in which the *organisational commitments, competences and constraints* were the eco-factors that started up the process (see Event 1).

Figure 11.4: The Evolution of the ELV *Issue* in Italy



After having developed some expertise in dismantling techniques and (the limits of) recyclability of materials, *Fiat* officially inaugurated the FARE system in September 1992. Economically, the main guideline of the system was its self-sufficiency. According to *Fiat* (1995:78):

> To be desirable from an industrial point of view, the recycling process developed by Fiat Auto must fully satisfy the criterion of economic self-sufficiency. This means, as far as Fiat is concerned, that the cost of a part made of virgin material must be substantially equal to the same part made of recycled material. For example, the total cost of an air duct made of

166 The information presented here was obtained through interviews with personnel of the Project Management and Industrial Development, Central Laboratory of Fiat Auto, and the Direction of Environmental Affairs of Fiat, Torino, Italy.

recycled material from a bumper must be equal to the cost of the same part in virgin material plus the cost of disposing of the bumper.

In 1992, in order to learn about the economies of recycling, one of the first steps taken by the company was to establish the *Mirafiori* dismantling pilot-plant, in Turin, Italy. The research in the pilot-plant resulted in the identification of non-metallic car components that could become economically viable to recover, recycle and 're-market' (since the metallic part was not a problem). Bumpers made of polypropylene were easily identified as a potentially economic viable material because of the low dismantling time in proportion to the weight of material to be recycled. Glass from windshields and windows, and seat foams were the other products in the same category and, late in 1996, the chemical components of catalytic converters were also included. Event 1 in Figure 11.4 shows the *commitments* of *Fiat* to learning about ELVs, creating the necessary *competences*, and identifying its main *constraints*.

In order to put an ELV recycling system into practice, the collection of materials was the first problem to be tackled by the company. For this reason, *Fiat* established '*Green* Centres' throughout the *Fiat* sales network. In the research conducted by CAIR and MVDA (2000) this type of scheme was classified as the 'franchise approach', since carmakers use the existing network of franchised dealers as centres for collection of ELVs. The consumer receives economic and technical incentives to deliver his/her car in one of these centres. In practice, this activity also works as a promotion of sales, since it is directly related to the core business of the company. Once the car is lodged at the centre, personnel will prepare the vehicle for disposal by recovering fluids and the battery, which are then sent to a waste disposal centre (*Fiat Auto* 1995).

Since it would not be possible to collect all ELVs through the '*Green* Centres', *Fiat* also joined the Italian Association of Auto Dismantling (ADA)[167] to select dismantling companies throughout the national territory, where the cars could be delivered by the last owner (Event 2 in Figure 11.4 indicates the *positioning* of ADA, a *related business* that facilitated the process of establishing a network for ELV collection). ADA elaborated the pre-requisites that dismantling companies should reach in order to become members of the system. By the end of 1996, more than 130 of these centres were formally in operation. Although *Fiat* and ADA initially intended to expand this

167 *Assoziazione Nazionale Demolitori Autoveicoli*.

network to 200 centres, it would still only be big enough for the collection of approximately 15% of the 1.5 million vehicles that reach their end-of-life every year in Italy[168]. *Fiat* argued that the project was not part of the core competence of the company and other organisations should take over the business in the future. The FARE system should be seen much more as a demonstration project in which other businesses and government should be more directly involved in the near future[169].

Another central principle of the FARE system is its ‘learning by doing’ approach. *Fiat* representatives claim that if the system is not the most sophisticated technically, it is an empirical project in which the recovery of materials is already in place. This practice permits the company to identify the main problems of dismantling, collecting, recycling and reusing materials from a real situation. Not only technical problems but also issues associated with the expansion of legally approved centres for collection of cars and the creation of markets for recyclates have emerged as outcomes of this pragmatic approach.

With the centres for collection and dismantling being gradually expanded, *Fiat* identified companies that potentially could recycle the materials from car parts. *Montell Group* – one of the largest suppliers of plastics for the automobile industry in Europe – became a key player in the scheme, reprocessing polypropylene from bumpers that would be re-used in less demanding applications, such as air filter housing and dashboard cables (Event 3a identifies the *positioning* of these *related businesses* in relation of the FARE system.) In fact, this example suggests another characteristic of the FARE system: the cascade (or down-cycling) principle. In this concept, materials will be used in less demanding applications until they are not suitable for use (normally after three generations – approximately 30 years) and then become ‘fluff’ (or automotive shredder residue – ASR) that will be used by foundries as a substitute for carbon coke. Based on the same principle, glass from windows will not be reused for new windows but will become raw material for bottles. The seat foams from disassembled cars are transformed into the base for carpet pads by a firm based in the Northeast region of Italy.

168 In fact, by 31 May 1997, the FARE system had 251 affiliated car dismantlers (Wright *et al.* 1998).

169 Interview with the Vice-president of the Italian Association of Auto Demolition Companies (ADA), in November 1996, Milan, Italy.

In the first two years of operation the system recycled more than 100,000 ELVs (*Fiat Auto* 1995). According to *Fiat* representatives, this figure means that FARE recycled approximately 82% by weight of the cars that have been collected. In 1995, the French group *Rhône Poulenc* became another FARE member, assuming the responsibility of recycling the chemical elements present in catalytic converters (see Event 3a). By the end of May 1997, the FARE framework had processed 275,000 ELVs. From these vehicles, the (precious) metal content of 2,000 catalytic converters was recycled. The system also transformed (down-cycled) 4,670 tonnes of glass into 7.8 million bottles, 132 tonnes of polypropylene from bumpers into 530,000 air ducts, and 1.59 tonnes of foams into 1.8 million m^2 of underlay for carpets (Wright *et al.* 1998). Overall, the FARE scheme demonstrated that the involvement of business operating beyond the frontier of the auto industry, such as makers of carpets and glass bottles, was fundamental for both the economic viability of the system, as well as for the creation of the appropriate *industrial ecology conditions* for ELV processing (see Event 3b in Figure 11.4).

The relative success of the FARE scheme in Italy predisposed *Fiat* to seal bi-lateral agreements with automakers in Germany (BMW), France (*Renault*) and England (*Rover*), in which each company would handle the ELVs of the partners throughout their respective recycling schemes. Event 4 in Figure 11.4 indicates that these agreements discouraged industrial competition on ELV-related activities; as it happened in Germany and France, *collaboration* among car manufacturers transformed ELVs in a non-competitive issue at both the national and the European contexts.

The pro-active role that *Fiat* has played in the ELV issue in Italy – with the installation of the FARE system and its claimed success – provided a compelling argument for the company to argue against the implementation of a national ELV legislation. The real intention of the company in finding a solution of the waste generated by ELVs in Italy could be measured by the pragmatic results of the FARE system. Such results provided the company with the grounds to convince Italian legislators to wait until a standard regulation would emerge in the European Union. Nonetheless, in April 1997, *Fiat* signed an ‘agreement of intent’ with the Italian Environment Ministry, formalising the intention of the company to increase the recycling rates of automobiles to 85% (by weight) by 2002, and 95% by 2010 (see event 5 in Figure 11.4).

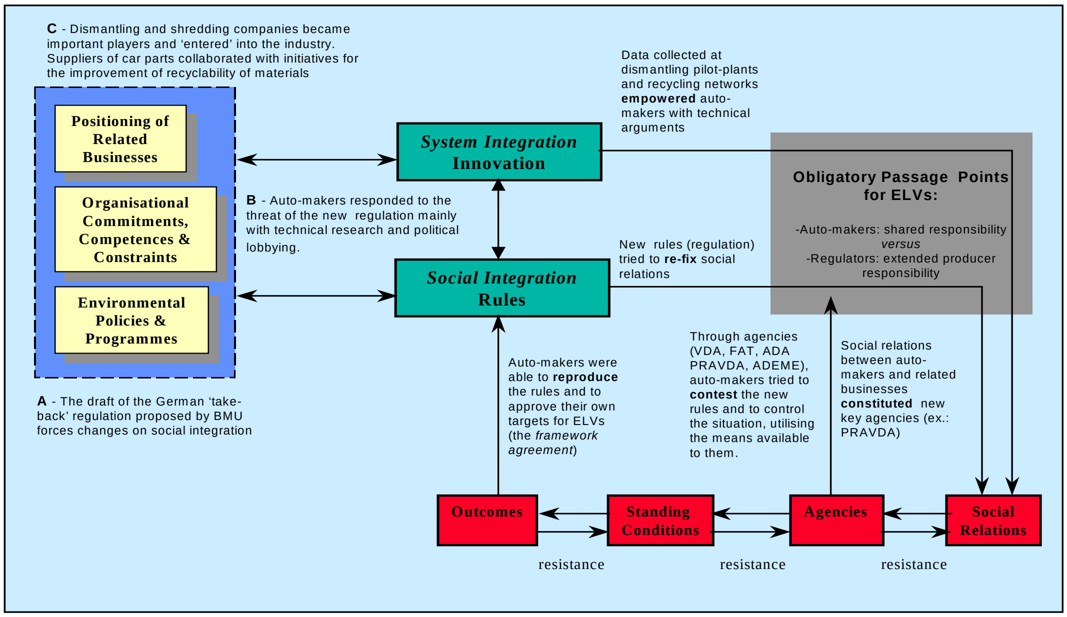
Within the ecological modernisation framework, the environment-contingent factors were used in this and in the previous two sections to frame the ‘stories’ explaining the evolution of the ELV issue in Italy, France, and Germany. Although the dynamics in each country were significantly different, the use of the same factors provided a systematic description of all three cases. Also, the start-up process in the automobile field of each country was initiated by a different eco-factor: *environmental policy and programmes* in Germany, *related businesses* in France and *organisational commitments*, *competences and constraints* in Italy. Local institutional-power frameworks and cultural peculiarities resulted in different dynamics in each country. Nonetheless, as one would expect, the automobile industry also acted cross-nationally. All European car manufacturers market their products in countries other than their home base and developments in foreign nations influence the evolution of politics at the national context. Hence, some developments occurring in each one of these countries can only be understood through the analysis of the circuits of political ecology occurring at the international level. This is what the next section addresses.

11.5 The Political Ecology of the European ELV Issue

The first significant move in the domain of ELVs in Europe happened with the draft regulation proposed by the German Federal Department of the Environment (BMU), in August 1990. In some ways, this was the ‘alert’ for the European auto-industry to start thinking seriously about the problem. However, resolution of the ELV issue in France and Italy occurred as a result of developments in areas characterising other eco-factors. For this reason, three environment-contingent factors are represented on the left side of Figure 11.5 (in the next page), which represents the circuits of political ecology of the ELV issue in Europe. These factors were the main contingencies affecting the circuits of power of the European automobile industry. The influences do not happen directly, as one may assume. To be effective, environmental factors should impact upon and change the elements of *social* and *system integration*.

Although the representations in Figure 11.5 are related only to three environment-contingent factors (in the left side of the figure), other factors (not represented in the figure) are, in reality, working simultaneously. The emphasis locates the dynamics of the main factors in the political ecology of the European automobile industry. The same circuit *blueprint* could be used to describe, for instance, the influences that automakers exerted on the development of *industrial ecology conditions* or the motives that lead automakers to assume a collaborative approach with their rivals. In other words, circuits of power mediate the relationships between environmental factors. The framework can be used to describe any one of these relationships of interest of the analyst.

Figure 11.5: Circuits of Political Ecology of the European ELV *Issue*



In Figure 11.5 it is possible to follow the dynamics related to each element of the circuit. Basically, there are simultaneous processes represented, a subtle struggle between automakers, related businesses and legislators. In this sense, the best way to read the figure is to go from the left to the right side – even though the picture should not be seen as a linear series of events. The main players tried to act in each element of the circuit; automakers basically trying to maintain the current circuits unaltered, legislators forcing changes in the rules and consequent social integration of the industry, and related businesses assuming a 'medium' position. Because actors aim to direct the elements towards their interest, there are power struggles in every element of the circuit. Finally, the circuit is not a linear series of events and should be imagined more as a battlefield on which a not so well coordinated scene develops.

Event A in Figure 11.5 identifies the draft regulation issued by BMU as the main force triggering the ELV issue in the German automobile industry. This new law intended to change the rules driving the industry and, consequently, force a redefinition of social integration. New rules would try to re-fix social relations through the alteration of obligatory passage points. The central issue sought to impose a new set of responsibilities for automobile manufacturers, now making them accountable for the end-of-life of the cars they put into the market.

Automakers responded to the threat of the new regulation through technical research at dismantling pilot-plants as well as political lobbying. The implementation of pilot-plants in several European countries served the objective of improving the knowledge of manufacturers about dismantling problems. This learning process, for instance, was one of the motives for *Fiat* to install a disassembling plant in Turin, Italy (Event B in Figure 11.5). Mainly in the early stages of the developments of the ELV issue, research about disassembling times and cost-benefit of recovery of materials represented big practical steps towards ELV know-how. Later in the process, when automakers started to identify significant problems and associated costs involved in dismantling, separating and recovering smaller car parts, research in pilot-plants was also used as technical argument against the implementation of the '*take-back*' regulation. Because the theme was also new for legislators and technical information was so scarce, data originating from pilot projects empowered automakers to argue against the legislation. Therefore, here was an innovative process happening that was not associated with any changes in design or manufacturing techniques. *System integration* was preserved by 'innovating the argument' with hard data collected at the pilot-plants, at the same time that manufacturing technology remained practically unaltered.

The political lobby is not represented as a direct response to regulation in the figure but it should be understood as being embedded in the elements of the circuit. The new set of *social relations* between automakers and dismantling and shredding companies constituted a new *agency* that could help to preserve industry interests. Through this and other agencies automakers contested the proposed legislation and tried to control the situation, keeping *the obligatory passage points* unchanged. In other words, the central dispute was related to those who would be able to define what should be done in relation to the cars at the end of their lives: automakers, forcing 'shared responsibility', and legislators, working towards a more 'extended producer responsibility' approach. Fundamentally, the definition of the *obligatory passage points* at the European level was strongly influenced by the disputes occurring between the German automobile industry association (VDA) and the German Federal Department of the Environment (BMU), the developments of the framework agreement (*Accord Cadre*) in France, and to a less extent, by the Italian experience.

Even if the *Fiat* auto-recycling programme was not so central for the definition of the obligatory passage points of the industry at the European level, it provides evidence concerning the role of related businesses and the industrial ecology conditions of the country. The Italian case is an example of how re-fixing social rules of related businesses can influence the *social integration* with the context of the automobile field. By organising a network of dismantling and recycling companies, the Italian association of auto demolition firms (ADA) re-fixed the rules of a business that historically had been marginal. Becoming a member of the network represented a new status for car dismantlers who struggled to change the image of the sector from one normally associated with illegal operations, as mentioned in Section 11.1.2. The re-definition of membership inserted car dismantlers into the organisational field of the automobile industry as constituent parts of an extended value-chain of the automobile business. Relations of meaning and membership facilitated ways in which environmental strategies were achieved by the FARE scheme in Italy.

Closely related to what happened in Germany, the role played by the biggest shredding company in France (CFF) raised the importance of related business in presenting solutions to the ELV problem (see Event C in Figure 11.5). Dismantling, shredding and supplying companies were important players in the ELV issue in France and this was possibly an additional argument for German automakers to claim the 'shared responsibility' approach. Especially after 1993, when the ELV French Group reached a 'voluntary agreement', German automakers gained more support in fighting against the imposition of a direct regulation. Both the political lobby by VDA and its working groups, and the numerous activities that German car manufacturers and importers took in the field of end-of-life vehicle recycling, are most likely to have influenced the position of BMU.

According to den Hond (1996), concessions occurred on both sides in the German case. For instance, BMU systematically opposed the idea of manufacturer-specific vehicle collection and dismantling networks for fear of trade barriers, since low-volume importers would have difficulties in setting up their own recycling facilities. Rather, the Ministry favoured pooled arrangements with specialist third parties. The automotive industry implicitly gave in on this point. In its *Common Concept* of March 1995, VDA stated (through *Pravda*) that car manufacturers would concentrate on the development and marketing of recyclable vehicles and that any car dismantler would have free access to the market of vehicle recycling. Other concessions also occurred in the area of recycling targets and disposal of ELVs. Whereas VDA initially opposed any specific recycling targets, in 1994 the association adopted the recycling targets that were proposed in the French *Accord Cadre*. These targets were close to the recycling targets proposed by BMU in 1992. On the other hand, in its second draft regulation of 1994 BMU accepted incineration as a contribution to solving the waste problem of shredder residue, as was demanded by VDA.

Although the positions of both parties converged to some extent, no agreement was reached over the type of regulation that should be enacted. VDA kept to its self-regulatory scheme and followed a regime of accomplished facts. BMU wanted to directly regulate end-of-life vehicle recycling. Two views were opposed: one of ‘shared responsibility’ and another of strict ‘producer responsibility’ (see the box representing the *obligatory passage points* for ELVs in Figure 11.5). Regulatory uncertainty remained, but most likely the French *Accord Cadre* influenced the final positions of both organisations. Indeed, by February 1996, BMU accepted the industry proposal for a voluntary agreement[170] similar to the *Accord Cadre*. In simple terms, the German automotive industry was able to counteract regulatory pressure from the Ministry, allowing the ‘reproduction’ of their rules and, with some minor concessions, to approve their own targets for ELVs.

11.6 From National Voluntary Agreements to the European Directive on ELVs

As the four previous sections demonstrated, from 1990 to 1996, a series of disputes occurred around the two potential solutions (direct regulation and voluntary agreements) for the problems generated by ELVs in the European context. The automotive industry, with the collaboration of suppliers of materials and parts, car dismantlers, metals recovery and recycling firms, successfully influenced national governments to accept voluntary agreements as an appropriate strategy to deal with ELVs. Given industry commitment, government promised to refrain from direct regulation. Overall, by signing voluntary agreements, the industry and national governments accepted the resolution that the automotive waste problem should be based on a ‘shared responsibility’ of firms in industries involved the ‘total value-chain’ of automobiles. By

170 According to official information from the Federal Environment Ministry (Translation ZI4-4081/5/359, page 1): “on 12 June 1997 the Bundestag gave its consent to the ‘Ordinance on the Disposal of End-of-life Vehicles’ and the adjustments under the Road Traffic Law, also called End-of-Life Vehicle ordinance, which has been adopted by the federal Government in November 1996 and approved by the Bundesrat in may of this year with a number of modifications”.

the end of 1996, the German, French, and Italian governments – the three major car manufacturers in Europe – supported the position of the respective national auto industry.

The relatively comfortable situation carmakers had ‘at home’ was counterbalanced by the plans of the European Commission (EC) to regulate car recycling. Indeed, in July 1997 – shortly after the German agreement was reached – the Commission presented a ‘Proposal for a Council Directive on End-of-life Vehicles’ (COM 97-358). According to representatives of the European Parliament, the national voluntary agreements in the context of the European Union, besides differing from each other, were based on conditions that weaken the potential of measuring their performance (Kurylko 1997). After intense negotiations, the legislation was officially adopted by the European Parliament[171] three years later, in September 2000. Among other requirements, the directive requires that: (i) recovery of materials reach 85% by 2006, of which 80% shall be recycled, and; (ii) recovery of materials reach 95% by 2015, of which 85% shall be recycled. Member states shall bring into force the laws, regulations and administrative provisions necessary to comply with the Directive by 21 April 2002.

Although the ultimate implications for car manufacturers will depend on how each member state ‘translates’ the Directive into national laws and regulations, it does not explicitly impose the responsibility on them. Article five, for instance, asks member states to assign the responsibility for the collection of ELVs to ‘economic operations’; hence, the responsibility will not necessarily be imposed exclusively on car manufacturers. Moreover, the targets established in the directive do not differ significantly from those considered feasible by some individual automakers, such as *Fiat*, PSA, and BMW (Wright *et al.* 1998).

The evolution of the ELV issue in Western Europe during the period 1997-2000 has not been presented in this chapter. Such a task would require additional research on the process that occurred in the context of the various institutions of the European Union; in a similar fashion to the way the previous section charted affairs in the automobile fields of Germany, France and Italy. The rationale is clear – at this early stage the determinants were principally national rather than federally European in their origin,

171 Directive 2000/53/EC of the European Parliament and of the Council of the 18 September 2000 on end-of life vehicles – Official Journal of the European Communities (L269/34).

although they had implications at the Community level. Nonetheless, the information presented here should be sufficient for one to identify the reasons for the pace of ecological modernisation in the area of automobile recycling during the 1990s.

The analysis of the evolution of the ELV issue in Europe presented in this chapter should be sufficient for one to realize why these pragmatic measures, requiring several years of negotiations between diverse members of the automobile industrial field, and legislators, had considerable impact on the recyclability of 9 million ELVs per year in the EU. Starting from the initial intention of the German Minister for the Environment to regulate car recycling in 1990 the implementation of a specific ELV law was delayed by more than a decade. Such a relatively long period for the industry to increase the rates of materials recovery and recycling of a product that, in theory, can be 100% recyclable, demonstrates the usefulness of analysing the problem from perspectives that do not limit themselves to technical or economic aspects of the problem. The emphasis placed in this chapter on political ecology dynamics, anchored in the ecological modernisation framework, is one of such perspectives. It demonstrates, clearly, that the nature of the problem is neither wholly economic nor technical but political – hence it requires a political ecology framework to be addressed adequately.

11.7 Conclusion

This chapter used the framework presented in Chapter 9 to analyse the evolution of the end-of-life vehicle issue in the Western European context, addressing the fourth objective of Part II of this study (see Section 7.1.4 in Chapter 7). As the previous sections confirmed, the issue that emerged around ELVs in Western Europe became irremediably political. In large part this was a result of uncertainty about the potential solutions to the problem of the waste generated by ELVs – uncertainties that significantly limited the capacity of governments to legislate. Amongst these uncertainties, first, was the fact that the ELV issue involves *trade-offs* between environmental impacts during the use and the end-of-life phases of vehicles. For instance, a regulation that would influence automakers in using more steel (since it is relatively easy to recycle) would result in heavier vehicles and therefore reduce fuel efficiency during the use phase. Second, there is more than one technology for ELV processing and no technological determinism can be ascribed to such an issue. As the sections explaining the developments in Germany, France and Italy suggested, there are also several possible ways of designing and managing the system for collection, treatment, reuse, and recycling motor vehicles. As a result, the selection of one particular solution tends to be controversial. Hence, the uncertainty about both the nature of the problem and potential solutions makes it difficult to identify responsibilities and, in general, to legislate. Such a situation favoured auto industrialists in Europe who sought to transform ELVs into a non-competitive, indeed essentially political, issue.

The use of the framework for the particular case of ELVs suggested that technical and economic expertise is vital for the study of business-environment relationships but that the political ecology perspective encompassed by the framework can significantly improve analysis. In doing so the chapter frames and resolves a central criticism of approaches to environmental issues in organisation studies: that more political perspectives are necessary.

The analysis of the eco-factors triggering changes in the context of each country suggests that any conclusion that voluntaristic actions of auto-makers 'cause' outcomes, such as postponing of ELV regulation, are to be balanced by pointing out the need for social integration in that organisational field. Although automakers indeed worked to secure their interests (den Hond 1998b), they eventually succeeded in maintaining the elements of the circuits of political ecology unaltered because other players within the circuitry were not forcing its transformation – such as consumers provoking changes in social integration. In this regard, the analysis tried to demonstrate that power did not simply reside in automakers' hands. Instead, the flow of power relations is what defined the elements of the circuit, eventually favouring automakers interests but not because of some 'reproductionist' logic of action.

In a similar fashion, the aim of national governments – the one in Germany, in particular – to instil positive power by imposing *take-back* regulations did not succeed, mainly because there were no objective beneficiaries of such a strategy within that national automobile field. Environmentally committed consumers, who might have voiced ecological prerogatives as stakeholders representing nature, were practically absent in the whole process. National governments (or potential regulators) faced the threat of higher levels of local unemployment if cars that must be recycled would cost more; the capitalist need for continuous growth and its mechanisms possibly hit home with some high-ranking legislators. By looking at these developments occurring within the organisational field, instead of focusing on recycling strategies of single companies, the chapter shows how external factors significantly influenced the general positioning of car manufacturing firms.

Although voluntary actions of corporate environmental management can partially explain the evolution processes of the *greening* of industries, the chapter emphasised the importance of looking at business-environment relationships from a perspective that considers the ways in which episodic power relations are stabilised by players within an organisational field. The usefulness of the ecological modernisation framework resides exactly here: as a practical response to theorising about ecological issues in management it can help one understand the context in which environmentally oriented disputes occur. The use of the framework for the analysis of the ELV issue addresses another criticism of studies of environmental issue in organisations. That is, according to Russo (1999), the industry level of analysis has not been widely used by researchers in the emerging field of the *organisation & environment*. By using a specialised concept of organisational field – the *automobile field* – as the basic level of analysis for the study of the ELV issue in the European context, this chapter helped to bridge the gap between the firm and the societal levels of analysis.

The use of the framework also emphasises that relationships between automakers and regulators are deeply embedded in the circuitry of power in a particular organisational field. Technical information – normally used with claims of neutrality – assumed non-technical dimensions and is used as a political stake, as the use of the data collected at dismantling pilot-plants suggested. The identification of the disputes around what were to be *obligatory passage points* of recycling practices is crucial in one understanding why *social* and *system integration* remained practically unchanged in the European auto industry during the 1990s. Episodic power wins, such as the initial imposition of direct regulation by the German government, were not sufficient to cause changes in the circuits of political ecology of the industry. The continuous and collaborative work of industry organisations was more consistent in preserving their resources and reproducing existing social rules.

The use of the model has generated many other specific conclusions related to the content of the case. The ELV issue is very complex and much more could certainly be said about its potential techno-economic solutions, as well as political ecology dynamics. However, it should be emphasised that the general aim of the chapter relates less directly to conclusions reached around the ELV issue in Europe and more explicitly to the use of the framework to describe its evolution. Overall, the chapter used the framework to demonstrate that the transformation of environmental practices in organisations requires the stabilisation of changes of the circuits of political ecology at the level of the organisational field – in this case, the *automobile field*.

The ecological modernisation framework can be applied to another industry or different ‘issue’ in the same industry and different narratives will certainly unfold, as the next chapter will comment in more detail. Although the substantive characteristics of elements of the framework will be specific to those contexts, in the process of identifying these elements, the researcher will be indirectly using formal, classical concepts from power perspectives, such as those elaborated by Clegg (1989), Haugaard (1998) and Flyvberg (1998). In this respect, the concepts presented here are not tentative elaborations dissociated from more substantive works on power. Rather, they represent a long trajectory initiated in the studies of Clegg (1975) that, more recently, have been developed as a specific application of a power perspective for the analysis of business-environment relationships, as presented in Chapter 5. Using the political ecology perspective to analyse American or Asian ELV issues, for instance, could generate useful information about the main obligatory passage points within these contexts, as well as the main actors influencing social and systems integration. The information could substantially help to improve knowledge about the political elements involved in fostering or limiting industries in adopting environmentally friendly technologies and products. This understanding can serve both analytical and prescriptive purposes, since forcing better environmental practices requires grasping the world of organisations and their socio-political environments.

As an unintentional outcome of the analysis of the ELV issue, the chapter also presents a contribution to studies of both competition and collaboration. First, it is possible to recognise that industrial competition can assume a profile of inter-organisational collaboration. Throughout the chapter, it was emphasised that collaborative organisation among car manufacturers transformed the ELV into a non-competitive issue in Europe. Second, it demonstrates clearly how, even in the middle of inter-organisational collaboration, power relations were irremediable. Collaborative strategies are becoming increasingly important in both business and non-business sectors (Clegg *et al.* 1996). In management theory, collaboration has been argued to be more effective than either confrontation or competition (Kanter 1994). By linking the analysis of inter-organisational collaboration with the analysis of power, the framework demonstrates that collaboration is not some utopian panacea, inimical to competition, but that it is an essential business strategy shaped by power relations.

Finally, by identifying the institutional specificity of each national case, the chapter demonstrates how organisational analysis requires embedding. It stresses the necessity of theory that is, paradoxically, sufficiently abstract as to be able to address particulars. In this respect, the role of theory – embedded in the ecological modernisation framework – has been to provide narrative structure, to organise disparate empirical detail into a likely story, a probable and indeed refutable analysis. The use of the framework for the analysis of the case studies presented in this and the previous chapter provides a structured narrative, a setting that can simplify reality, help the comprehension of its dynamics, and eventually identify pressure points for policy-making.

12 Conclusions and Implications

This chapter concludes the *research journey*, presented in the previous two parts of this thesis. Generically, the chapter evaluates the limits of ecological modernisation in the automobile industry to determine whether this phenomenon is conducive to sustainable industrial development – satisfying the last objective of the study, presented in Section 7.1.4 (Chapter 7). The chapter opens up with the review of the main issues forming Part I of the study. The research problem-areas that eventually culminated in the definition of the *principal research question* are briefly revisited in Section 12.1. Conclusions about the principal research question are systematically explored in Section 12.2. The sub-divisions of this section reflect the distinct phases of the life-cycle of automobiles – manufacturing, use, and end-of-life vehicles. This section concludes by addressing a central issue for the economic *and* ecological sustainability of the car business: vehicle population.

By delving into the nature of *reflexivity* in modern societies, Section 12.3 focus on implications of the study for the development of ecological modernisation theory. An approximation of the theories of ecological modernisation and risk society is facilitated by the use of the concept of *fallibility*, and a framework for their integration is presented in the section. Additionally, the concept of *radical reformism* is proposed as a guidepost for the development of the normative aspect of the theory. The implications of the use of these principles and concepts – which themselves constitute outcomes of the study – for policy and practice is presented in Section 12.4. Finally, Section 12.5 presents the implications of the study for future research in the (parent) discipline of organisation studies, as well as in *organisation & environment*, and other *hybrid* environment-related disciplines.

12.1 Revisiting Modern Organisations and Sustainable Industrial Development

This study was developed in two clearly distinctive parts. Part I delved into the world of environment-related theories, as well as the practice of pro-active environmental management in organisations, while Part II researched the socio-technical context of the automobile – the automobile field. Six chapters composed Part I, beginning with Chapter 2 which explored the academic context within which ecological issues were gradually being incorporated into traditional areas of science. Industrial organisations have long been identified as the main causes of disruptions to the natural environment. How, then, should one explain the relatively low organisational response to an increasing rate of environmental degradation? Why have only a relative small number of organisations committed themselves to *internalising* environmental costs in their processes, products, and services?

Surprisingly, few answers to these central questions were to be found in the scientific field that most directly deals with these types of social system. Organisation studies, as a scientific field, historically had neglected research about the relationship between organisations and the natural environment (Shrivastava 1995). Even though the environmental impact of industrialisation has been felt since its very early stages, it was not until the 1990s that organisation studies started paying attention to the causal impact of formal organisations on natural ecosystems (Egri & Pinfield 1996).

A significant growth in the number of publications concerning environmental issues in organisations were registered in the second half of the 1990s but this body of knowledge remains marginal when it is compared with other scientific streams within organisation studies. In understanding the role organisations play in defining current systems of production and consumption more progress has actually been made by new '*hybrid*' disciplines. Interdisciplinary studies, such as environmental accounting, industrial ecology and ecological economics, have emerged in the nineties as useful bodies of research literature in the area of the *organisation & environment*. Indeed, Chapter 2 concluded that the use of multiple hybrid disciplines, as well as a focus on the interdependencies among them, would substantially help one to better understand environment-related studies in organisations and industries.

If theories concerning environmental issues in organisations are still scarce, empirical evidences of ecologically sustainable organisational practices are even more difficult to find. Chapter 3 analysed some programmes that promote pro-active (or beyond-compliance) environmental practices, which have become common practice for a few organisations – normally large firms operating in highly industrialised countries. Increasing costs of pollution control, the development of new technologies for pollution-prevention, and cost-savings from waste reduction have all emerged as driving forces for pro-active corporate environmental management in the mid-1990s. Public and private initiatives, such as industry codes of environmental practices and the standardisation of environmental management systems, also served to promote pro-active environmental practices in organisations (Krut & Gleckman 1998). From 1985 to the mid-1990s, industry associations, in partnership with governments and other interest groups, responded to consumer and public demand for environmental protection, as well as shareholder rejection of environmental risks, by instituting voluntary business codes of environmental practice. The standardisation of environmental management systems, such as the *International Organisation for Standardisation* (ISO) 14000 environmental series, constitutes another type of voluntary programme developed in the 1990s.

Pollution prevention was the basic principle guiding these initiatives, focused on minimising or eliminating waste before it was created by production processes. As a whole, these schemes have not reduced the impact of industrial activity on the natural environment. Nonetheless, they represent an important step towards better environmental practices in organisations (Hart 1997). However, in simple terms, they do not indicate any appropriate levels of ecologically sustainable practices in organisations (Nash & Ehrenfeld 1997) and, in fact, there is increasing scepticism about effectiveness of these programmes in promoting sustainable development (Brophy 1998).

If such schemes are insufficient do develop organisational practices that are ecologically sustainable organisation, what additional factors might influence organisations in 'going *green*'? In most of the pioneer studies in the field of *organisation & environment* (see, for instance: Bonifant *et al.* 1995; Srivastava 1996) some influences on the *greening* of organisations could actually be found, that were, seemingly, indisputable, as analysed in Chapter 4. Studies such as those by Berry and Rondinelli (1998) identified factors that seemed to function as determinants of ecological modernization. Among these were regulations, consumer preferences, and the needs of resource productivity. This literature emphasised the urgency of both scholars paying attention to business-environment relationships and of managers adopting *greener* strategies in corporations. While the identification of driving forces in the *greening* of organisations and industries constitute a central contribution of such studies exploration of the conditions within which these determinants are framed still remained to be explored (Fischer & Schot 1993; Roome 1998). For this reason, Chapter 4 analysed some determinants of organisational *greening*, such as environmental regulation, consumer behaviour, competitiveness, and intra-organisational factors, as well as discussing potential inhibiting conditions in for such strategies. The analysis revealed the dual nature of these factors. Although regulations, consumers, and competition, for instance, may be considered influences on the *greening* of organisations, they can also act as inhibitors of such phenomena.

A central influence on organisational *greening* identified in Chapter 4 was based on the so-called *double dividend* approach. The central hypothesis of double dividends relates to the possibility for firms to simultaneously pursue both resource productivity and corporate competitiveness, based on environmental prerogatives (Porter & van der Linde 1995a; 1995b). Economic incentives for the incorporation of ecological issues into business practices became more evident in the environmental management literature during the second half of the 1990s. Finding hidden opportunities for organisations to profit from environmental strategies became an appealing theme for both business and academic communities. Ecological requirements started to be seen as an integral part of quality management principles and as a potential source of competitive advantage.

By analysing the rationale of the double dividend argument, Chapter 5 established a link between political economy factors and internal organisational elements. The characteristics of the institutional-power context in which organisations operate were identified as central elements fostering or inhibiting pro-active environmental strategies in corporations. In essence, the chapter contended that political economy factors would influence the willingness of companies in developing ecologically oriented strategies. Such influences, acting on the context in which political and strategic disputes about environmental issues occur, constitute the *political ecology of organisations*. A framework based on concepts drawn from classic works on power in organisations was proposed for the analysis of such contexts, which was later integrated in the framework presented in Chapter 9.

The rationale for pro-active environmental management was also addressed in Chapter 6. While the environmental impact of industrialism could be felt from its very early days, pro-active practices only emerged in the last decades of the 20th century. How should one explain such a late development phenomenon? Why should pro-active environmental management in organisations only emerge in *high* or *radicalised* modernity? There is a theory, one that emerges from the (hybrid) discipline of environmental sociology, known as ecological modernisation theory that attempts to explain such an ‘emancipation of ecology’ from the economic and technological spheres. According to this theory, proactive environmental management practices in organisations constitute part of a broader phenomenon, the move in the last quarter of the 20th century towards a *high* or *radicalised* modernity in some sectors or industrial societies (Beck 1997; Giddens 1990). In this respect, the process of emancipating the ecology from the economic and technological spheres is a dynamic result of one of the sources of modernity: the *reflexive* appropriation of knowledge. In this perspective, the increasing adoption of ecologically efficient practices by firms can be interpreted as a phenomenon resulting from the extension of reflexive thinking to environmental issues in business. In sum, in the analytic-descriptive character of the theory, '*modernisation*' indicates the dominant characteristic of western industrialised societies, while '*ecological*' expands this recognition to the advancement of industrialism based on ecological principles.

Chapter 6 also showed the remarkable impact of this phenomenon in certain domains of industrialism and, in Section 6.3.1, presented six *sensitising hypothesis*, initially proposed by Mol (1995), to characterise the phenomenon of ecological modernisation occurring at the societal level. In fact, the Mol's (1995) study of the chemical industry represented a significant 'refinement' in ecological modernisation theory. It represented one of the first steps in the empirical evaluation of eco-modernisation occurring in a specific industrial sector. In this respect, the study demonstrated that evaluation of the nature and degree of ecological modernisation occurring in distinct industrial settings would be fundamental for further theoretical and practical advances. It was this insight that provided the main justification for developing Part II: the study of the ecological modernisation of the automobile industry. In the next section I present the main conclusions of this analysis.

12.2 Conclusions about the *Principal Research Question*

Generically, Part II of this study was developed in order to answer the *principal research question*: why is the European automobile industry undergoing ecological modernisation? In Chapter 7 the methodology used in the research process was explained and then its results were subsequently presented in Chapters 8, 9, 10 and 11. Together, these chapters answer the research question by individually addressing distinct aspects encompassed in the question. In other words, the chapters presented specialised answers to the principal components of the research question. For instance, the analysis in Chapter 8 of the economic constraints faced by automakers showed that these companies were working towards an extreme rationalisation in their systems of production. Such economic constraints demand a better utilisation of resources, influencing the adoption of cleaner techniques in car manufacturing. In this respect, the analysis of the topic of economic profitability in the auto assembling business, among other topics presented in that chapter, constitutes a *specialised answer* to questions concerning the phenomenon of ecological modernisation as it was occurring in the socio-technical context of the European auto industry.

As Chapter 9 suggested, through presentation of an analytical framework that prefigured its use in Chapters 10 and 11, several factors simultaneously foster or limit the ecological modernisation of a specific industrial context – in the case of this study, the *automobile field*. In fact, the use of the framework, in the context of Western European countries, to analyse cases of electric battery vehicles (Chapter 10) and end-of-life vehicle schemes (Chapter 11), showed the concurrent influence that *environment-contingent factors* (*eco-factors*) exert on the process of 'emancipating ecology'. The use of the framework also encompassed the analysis of *circuits of political ecology*, explaining the 'politicisation' of some potential solutions for reducing the environmental impact automobiles throughout their life-cycle. Together, the information presented in Chapters 8 and 9, and the use of the ecological modernisation framework for the analysis of the cases in Chapters 10 and 11, answered the principal research question of this study. The next sections summarise these answers as well as presenting the main conclusions concerning the principal research question.

12.2.1 Eco-Modernisation in Car Manufacturing: It Makes Business Sense

Generically, the arguments developed in Chapters 8 and 9 suggested that the vast majority of automakers have adopted a pro-active attitude towards the reduction of the environmental impact of their production processes. During the 1990s, they have consistently developed strategies based on *process-oriented resource productivity* and *beyond-compliance environmental practices*, as these are described in detail in Section 9.1.4 of Chapter 9. The industry has responded to increasingly strict governmental regulation by adopting cleaner manufacturing technologies and investing in environment-related research. Virtually every major high-volume car manufacturer has worked towards increased levels of environmental performance and there are no doubts that improvements have been made. Such strategies and practices are aligned with one of the characteristics – or, as Mol (1995:58) prefers to call them, *sensitising hypothesis* – of eco-modernisation. One of these traits, described in Section 6.3.1 of Chapter 6, states that: "the design and evaluation of performance of production (and consumption) are increasingly based on ecological criteria, besides economic criteria". Following the rationale embedded in the principal research question, such a scenario requires one to ask, "Why is this happening?" "What explains the incorporation of ecological principles in the management of automobile factories?"

Straightforwardly: it makes business sense. In the context of automobile assembling, organisational survival has demanded constant efforts to reduce the costs of industrial processes. Section 8.2.2 in Chapter 8 explained that the rationalisation of systems of production became an imperative for car manufacturers not because competitive advantage was expected to emerge out of such practices. They did so simply to *remain* competitive. Fundamentally, the pressure to cut costs in every possible manner has driven auto assemblers to work towards the minimisation of waste and optimisation of resources usage. In this respect, *platform consolidation* and *modular assembly*, similarly to several other initiatives, have been adopted by automakers as attempts to increase overall resource productivity in automobile manufacturing and to increase the chances of reaching greater economies of scale. In this case, a potential reduction of the environmental impact of car manufacturing can be seen as a consequence of strategies that aimed at increasing the overall productivity of the firm. Besides, even if such practices have further potential to generate cost savings in manufacturing, further (economic and environmental) gains are expected to be more difficult to achieve.

The economic principles guiding business action, among other factors, also justified automakers in developing strategies based on *beyond-compliance practices* in auto-assembling. As articulated in Chapter 4, there is a close relationship between strategies based on process-oriented resource productivity and beyond-compliance practices, and the optimisation of systems of production involving also the simultaneous reduction of waste and by-products. For the specific case of auto assembling, these two generic strategies can be seen as encompassed in the concept of *lean production*, prescribed by Womack *et al.* (1990). Although the relationship between the adoption of lean production and the environmental performance of industrial processes still requires research, one can anticipate that such an approach will facilitate the process of improving the eco-efficiency of automobile factories. By the same rationale, by adopting standardised environmental management systems (EMS), such as ISO 14001, some of the business codes of environmental practices adopted by automakers might have been pursued irrespectively of their commitment towards environmentalism.

While ethical commitments might explain why some car manufacturers voluntarily adopt these principles, such as *Ford* and *Toyota*, it is possible that the search for a competitive edge also influences such actions.

Finally, the optimisation of systems of production in car manufacturing is still attached to the *Buddist* paradigm of car design: they are mostly adapted for assembling internal combustion engines into all-steel car bodies (Nieuwenhuis & Wells 1997). This technological paradigm orientating car design and manufacture substantially limits the alternatives available to automakers. The adoption of the *Buddist* paradigm requires high investments in manufacturing, and consequent high *break-even points*, with volumes of production for individual car models situated at around 200,000 units per year. In other words, the concept inherited from the past and reproduced in the present practice of car design imposes a specific set of technologies that have to be adopted in production, significantly influencing the environmental performance of cars during their use phase.

12.2.2 Car Performance and Eco-Modernisation: Incrementalism Versus Factor 20

Regarding air emissions, the average environmental performance of cars has significantly improved in the last quarter of the 20th century. At the turn of the millennium, the internal combustion engines powering (new) cars that enter Western European roads emit around 95% less pollutants into the air than their counterparts did in 1975 (Graedel & Allenby 1998). From a perspective privileging *incrementalism*, these figures suggest that automobile manufacturers have indeed pursued ecological modernisation of the existing vehicles: the environmental performance of internal combustion engines (ICEs) has been greatly enhanced in the past decades. A clear-cut explanation for such achievements can be located in the imposition of emission standards upon car manufacturers. In the ecological modernisation framework, the eco-factor representing *environmental policies and programmes* would explain the ecological modernisation of conventional cars (i.e.: multi-purpose cars based on all-steel bodies and internal combustion engines).

Improvements in automobile air emissions in the last decades, however, have not alleviated the pressure faced by car assemblers. Regulatory measures have continuously intensified in Europe and other industrialised countries, such as Japan and some states of the United States of America (USA). Satisfying standards on air emissions has required the industry to invest increasing amounts of money in increasingly expensive research and development programmes. Basically, the easy technological fixes in controlling auto emissions have already been achieved, and even though further improvements are still possible, they are both expensive and limited by the technology embedded in ICEs.

In light of ever-tightening regulations on automobile emissions, one could ask then: why have alternatives for the internal combustion engine, such as battery electric vehicles, which have long been available to auto industrialists, not yet succeeded in the marketplace? Chapter 10 explored answers to this question. Initially, it explained that the basic advantage in motoring performance of current ICE cars is not due to the technology embedded in their design. Rather, it is the high energy content of hydrocarbon-based fuels that gives a competitive edge to ICEs, when compared with their electric counterparts. Such an explanation was fundamental in demystifying some assumptions about the efficiency of conventional automobiles. Section 8.4.2 of Chapter 8 had previously commented on the low levels of both energy efficiency and the environmental performance of cars, indicating a low level of ‘ecological maturity’ in conventional automobiles. In this type of car, 95% of the power generated in an ICE is lost before it reaches the wheels (Graedel & Allemby 1998). A radical reconfiguration in design could result in saving up to 80% of the amount of fuel consumed by an average car (Hawken *et al.* 1999). Hence, modern cars are embarrassingly inefficient in terms of energy utilisation. Nonetheless, for the consumer – who is not aware or interested in issues of energy efficiency and environmental performance – ICE-powered cars still provide better *motoring* performance than electric vehicles (EVs). The result has been a persistent failure of markets for such alternative.

Could this situation change in the 1990s? In addition to these apparent technological imperatives, are there other factors that inhibit automakers in the mass commercialisation of EVs, which remain the best available technology in terms of air emissions? If car manufactures were unwilling or unable to supply EVs, why then have new entrants into the auto industry not fulfilled such a market niche? To answer these questions the analysis of two market trials for electric vehicles in Europe were analysed. Chapter 10 explored in details the experiments in La Rochelle (France) and the Norwegian enterprise *Pivco-Th!nk*. The analysis of the cases showed that while traditional carmakers have been unwilling to adopt a new concept of the car body, converting (heavy) all-steel cars into EVs, new entrants face significant technological, economic, and political limitations in developing, manufacturing and commercialising their vehicles. For the new entrants, the overall conditions within the automobile field require resources that are not so easy to acquire or maintain.

Both cases confirmed the main (explicit) barriers for the market success of electric vehicles, previously addressed by the specialised literature. They demonstrated that the existing battery technology makes it extremely difficult for EVs to compete with traditional *multi-purpose* cars in similar applications. Simply, current battery technology, with its relatively low capacity for energy storage which consequently produces a limited range for EVs, limits these vehicles to market niches. In urban or neighbourhood niches, for instance, adequate infrastructure and general conditions for maintenance are the basic requirements favouring the adoption of EVs. Overall, existing *industrial ecology conditions* in most places do not favour the use of such vehicles. When proper *expert systems* (see: Section 6.2.1 in Chapter 6), such as recharging stations and technical support are available – as was the case in the cities of La Rochelle and Oslo – they enable consumers to have confidence in EV technology. However, for such confidence to be reflected in EV sales, another barrier has to be overcome: the relatively high purchase price of EVs. Due to the battery package, most electric vehicles available in the market are more expensive than their petrol-powered counterparts. Put simply, individual consumers have no incentives to pay a higher price for a car that has a relative lower *motoring* performance than its ICE counterpart.

Developing a new approach towards vehicle ownership and use may be the only solution to this obstacle. In this respect, the participation of *Pivco* prototypes in the 'station car demonstration project' may have brought some immediate negative results for the company but, possibly, it paved the way for the formation of the *Th!nk Mobility* – a new business (under the 'umbrella' of *Ford*) that focuses on the supply of 'mobility solutions', instead of car ownership. In this respect, how new *patterns of utilisation* of cars can also result in new business opportunities for automakers is an important finding of the study. Through new forms of ownership, the specialisation of car use becomes economically viable. Hence, current market demand seems to be limited by the established pattern of utilisation based on ICE-related technologies and associated expert systems.

Real-life experiments in the field of electric vehicles, such as those presented in Chapter 10 have a more strategic importance for the future of the automobile than the immediate results might suggest[172]. This is because the technology embedded in battery electric vehicles is central for the directions the auto industry will take in the coming decades; all long-term alternatives for the ICE-car currently under consideration involve *electric traction* (Nieuwenhuis 1998). The debate about the future of powertrain technology centres, on where and how the electricity that will power electric motors will be generated and stored: stationary generation ('pure' battery-electric vehicles), or in-board generation (*hybrid* vehicles combining ICEs or fuel cells with electric powertrains). There is simply no question in regard to whether electric motors will be used in the powertrains of future cars. In this respect, the case studies of EVs, analysed in Chapter 10, represent experiments that today are still at the 'periphery' of the auto industry but, because they can help corporations to improve their overall knowledge of EV-related technologies, they will have the potential to become embryos of change in the near future.

Some industry experts (Maruo 1998, for instance) believe that developments in hybrid powertrains will make the pure battery obsolete. Essentially technical arguments justify this understanding: by generating the electricity on-board, hybrid vehicles solve the problem of low battery storage capacity and the consequent limited range of 'pure' EVs. Hence, an essentially technical perspective may explain why the development of hybrid powertrains assembled in all-steel car bodies has been prioritised by automakers. From the perspective of *political ecology*, however, the development of such technology can be seen as an attempt by car assemblers to innovate without having to move away from their core competencies (see Section 8.4.3). As long as the sunken investments in systems of production based in petroleum engines and all-steel car bodies can be secured, auto manufacturers can also maintain their centrality in the *automobile field*.

In sum, improvements in engine technology in the last quarter of the 20th century made possible *factor 20* reductions in air emissions of motorcars (i.e.: 95% lower). Even though this achievement was mainly provoked by imposed regulations, the automobile as a whole could be seen as being in a process of ecological modernisation.

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[172] Recently, Crosse (2000b) nominated the La Rochelle project as a milestone in the development of markets for EVs.

However, if one assumes that radical innovations in product design, manufacturing, and material specifications can result in further *factor 20* improvements in the overall energy and environmental efficiency of automobiles, a more accurate impression of ecological modernisation in the industry would require a move away from the ICE car. Viewed from this angle, the auto industry is still in its infancy. The *incremental* improvements of the *Buddist* paradigm seem to represent the 'last gasp' of an outdated technological option, rather than a characteristic of ecological modernism in the industry. Hence, concerning the environmental performance of cars during their use, the ecological modernisation of the automobile industry still requires the replacement of conventional cars by ones that present *factor 20* improvements in energy as well as environmental efficiency. Such improvements will also have an impact on the end-of-live vehicle management.

12.2.3 Eco-Modernisation in End-of-Life Vehicles: Not in My Backyard!

Independently of the type of cars used by consumers, they will inexorably become *end-of-life vehicles* (ELVs). Even thought 75% (by weight) of the material content of cars is already recycled (mainly steel), how to process the remaining 25% became a major political *issue* in the European context during the 1990s. Chapter 11 paid special attention to these disputes around the ultimate phase of life-cycle of cars. The quarrel between governmental agencies in Germany, the elaboration of a voluntary agreement in France and Italy, and the later release (September 2000) of a Directive on ELV management by the European Commission, showed that a controversial attitude had been assumed by the auto industry as whole. While individual car manufacturers seemed to accept car recycling as a new ecological imperative, they battled against direct regulation imposing a statutory requirement on them to take back the cars that they had produced. During the 1990s, the automobile industry as a whole repudiated ELV legislation.

The 'politicisation' of the ELV issue in Europe is largely due to uncertainty about the potential solutions to the problem of the waste generated by cars, and consequent limitations of the capacity of governments to legislate. First, the issue involves *trade-offs* between environmental impacts during the use and the end-of-life phases of vehicles. A regulation requiring automakers to use more steel, for instance, would result in heavier vehicles and therefore reduce fuel efficiency during the use phase. Seen from a life-cycle perspective, such regulatory measure would not result in any environmental performance improvements.

Second, as developments in Germany, France and Italy suggested, there are also several possible ways of designing and managing the system for collection, treatment, reuse, and recycling cars, and the selection of one particular solution tends, obviously, to be controversial. In such a situation auto industrialists in Europe favoured the transformation of ELVs into a non-competitive issue. Automakers formed alliances among themselves and, later in the process, with local governments. The ‘ideology of growth’ and its mechanisms possibly justified the position of the German government to change its initial attitude and back up the position of automakers. Automakers eventually convinced national authorities that the costs of taking back and processing ELVs would have be incorporated into the prices of new cars, and such a situation would eventually result in lower levels of consumption and consequently higher levels of local unemployment. While car manufacturers did not want to be the only players who would bear the costs of processing ELVs, national governments did want to run the risk of causing a negative economic spiral of both higher prices and unemployment. In general, the economic principles guiding current systems of production significantly inhibited ecological modernisation of end-of-life vehicle practices.

The use of the ecological modernisation framework in Chapter 11 made it possible to identify key environment-contingent factors in the particular context of Germany (*environmental policies and programmes*), France (*related businesses*) and Italy (*organisational commitments, competencies and constraints*), as well as the circuits of political ecology that shaped the disputes between actors in those *automobile fields*. The analysis suggested that automakers certainly worked to secure their interests. However, their success in maintaining the elements of the circuits of political ecology practically unaltered during the 1990s was only possible because other players within the circuitry were not forcing its transformation. For instance, the aim of the German government to impose *take-back* regulations in the early 1990s did not succeed mainly because there were no objective beneficiaries of such a strategy within that national automobile field. Apart from the efforts of the German Ministry of the Environment to incorporate ecological prerogatives into the rules governing the management of ELVs, no other groups or organisations backed up such measurers. Hence, for ecological modernisation to occur, it seems necessary to have ‘eco-factor alignment’, explained next.

12.2.4 Eco-factor Alignment for Ecological Modernisation

The use of the ecological modernisation framework for the analysis of the cases presented in Chapter 10 suggests that *eco-factors* are required to be 'aligned' for environment-related innovations to have a chance to succeed. For ecological modernisation to occur, in the area of EVs, for instance, it is necessary that the majority of factors favour the new technology. In this respect, even though the abrupt rise of oil prices causing 'shocks' may influence automakers and politicians to reduce dependency on internal combustion engine (ICE) cars, this influence alone is not enough to trigger eco-modernisation, as the oil shocks of the 1970s and 1980s suggested. As ironic as it might seem, oil scarcity has not exerted noteworthy pressure on the development of more eco-efficient vehicles.

At the turn of the millennium, the situation might favour EV developments because the benefits of this technology are more extensive than in previous decades. As the La Rochelle case study suggested, traffic-related problems in urban Europe have become important influences on the use of low and zero-emissions vehicles. Pollution caused by auto motors has grown significantly in the past decades and public administrators have started searching for alternatives to the automobile as a means of urban transport. Although the difficulties in expanding the use of EVs in the inner city context are still in place, public opinion is apparently shifting towards the support of policies encouraging the exclusive use of electric vehicles in congested urban centres. Furthermore, as was demonstrated throughout Chapter 10, a significant number of related businesses, interest groups and other organisations support such changes. The convergence of the interest of energy utilities in selling dormant electric capacity, the demand for new jobs in EV-related businesses, and the increasing request for more environmentally sound automobiles have apparently given the electric vehicle a potentially new competitive edge. Environmental policies and programmes have increasingly encouraged EV developments and appropriate conditions for their use have improved in selected locales. In sum, the *eco-factors* have slowly come into alignment in support of EV-related technologies.

Similarly, the aim of national governments – Germany, in particular – to impose *take-back* regulations on ELVs did not succeed mainly because there were no objective beneficiaries of such a strategy within the national automobile field. Environmentally committed consumers, who might have voiced ecological prerogatives as stakeholders representing nature, were practically absent in the whole process. National governments (or potential regulators) faced the threat of higher levels of local unemployment if cars that must be recycled would cost more; the capitalist need for continuous growth and its mechanisms possibly hit home with some high-ranking legislators. By looking at these developments occurring within the organisational field, instead of focusing on recycling strategies of single companies, the chapter shows how external factors significantly influenced the general positioning of car manufacturing firms.

12.2.5 Eco-Modernisation and Political Ecology: Agents for Nature?

This study emphasised the importance of looking at business-environment relationships from a perspective that considered the ways in which episodic power relations are stabilised by players within an organisational field. In Chapter 11, the analysis of the *eco-factors* triggering changes in the context of each country suggests that any conclusion that voluntaristic actions of auto-makers ‘cause’ outcomes, such as postponing of ELV regulation, are to be balanced by pointing out the need for social integration in that organisational field. Although automakers indeed worked to secure their interests, they eventually succeeded in maintaining the elements of the circuits of political ecology unaltered because other players within the circuitry were not forcing its transformation. In this regard, the analysis tried to demonstrate that power did not simply reside in automakers’ hands. Instead, the flow of power relations is what defined the elements of the circuit, eventually favouring automakers interests.

The use of the political ecology perspective within the ecological modernisation framework emphasised the embeddedness of relationships between automakers and regulators in the circuitry of power of the *automobile field*. Technical information – normally used with claims of neutrality – assumed non-technical dimensions and is used as a political stake, as the use of the data collected at dismantling pilot-plants suggested. The identification of the disputes around what were to be *obligatory passage points* of recycling practices is crucial in understanding why *social* and *system integration* remained practically unchanged in the European auto industry during the 1990s. Episodic power wins, such as the initial imposition of direct regulation by the German government, were not sufficient to cause changes in the circuits of political ecology of the industry. The continuous and collaborative work of industry organisation was more consistent in preserving their resources and reproducing existing social rules.

The study also suggests that environmental innovations have not yet had a significant impact on these elements. The chapters forming Part II of this study showed that the auto industry has indeed developed strategies and practices that resemble the pre-requisites for ecological modernisation, but *radical innovations* are more likely to be initiated by outsiders. Automakers have so far been successful in securing circuits of political ecology that favour the current paradigm of production and consumption of automobiles. As the case studies on EVs and ELVs suggest, the transformation of practices inside an organisational field occur only when episodic power, triggered by *eco-factors*, can transform the circuits of political ecology within that context. In this respect, if sustainable industrial development is a desirable goal for modern societies, the political ecology of organisations within the automobile field will need to transform current systems of production and consumption associated with automobiles.

12.2.6 Automobile Population and Profitability: Sustainability Indicators?

Today, there are approximately 550 million vehicles in the world. This is due to the exponential growth in their supply during the last fifty years – a tendency that auto industrialists can be expected to maintain. By the year 2020, extrapolating present tendencies, the combined production of the auto industry will be around 100 million units per year (Feast 2000). Interestingly, during the 1990s, the mature markets of the Western European countries, as well as Japan, and Korea, amongst others, have shown signs of saturation. The car business in developing countries did not perform well, either. In simple terms, this means even more intense competition. The business of car manufacturing is expected to remain under pressure on both the economic and environmental fronts. At the same time as the profitability margins of car manufacturing are extremely low, the pressure to invest in product development and environmental protection will continue to rise.

Such a scenario indicates that both economic sustainability in auto manufacturing and the ecological sustainability of modern societies maybe in jeopardy. In economic terms, the rationalisation of systems of production adopted by auto assemblers does not seem to be sufficient for them to remain competitive and, more importantly, profitable. Car assemblers largely adopted mergers and acquisitions during the second half of the 1990s as a strategy to cope with increasing economic pressure. Regarding the environmental aspect, the (historic and expected) growth of the car population also imposed continuous growth in the *ecological footprint* of the industry. Even if more environmentally sound technologies for manufacturing and powering automobiles were to be adopted by automakers, eventually reducing the environmental impact per unit, the ecological impact of the industry as a whole would grow inescapably with the car population. Such a scenario is clearly not sustainable in ecological terms. Hence, the tremendous economic and environmental challenges faced by the industry are indicative of the flaws embedded in the system of production and consumption associated with the modern automobile.

Fundamentally, the main fault of the system may be located in the *taken-for-granted* principles of value generation in the industry. Today, the main source of income for carmakers is attached to car sales. Irrespective of how responsible automobile firms are in terms of their environmental principles, strategies and practices, corporate performance is measured ultimately in economic terms (see: Section 2.1 in Chapter 2). If automakers attach income to car sales, car production becomes the imperative of the industry. From this viewpoint, alternatives to cope with the current levels of economic and environmental pressure remain confined to the analyses in this study and summarised in the previous sections. However, if auto industrialists are able to dissociate themselves from the principles guiding current systems of production and consumption, them the cope of alternatives open to them would be expanded.

The seed of this transformation can already be seen in the automobile field. *Th!nk Mobility* is possibly one of the best available examples of what a firm operating in the auto industry may be offering to consumers in the coming decades (see the Conclusion of Chapter 10). Instead of generating income from selling cars, firms operating in today's *automobile field* would profit from supplying mobility solutions (hence, operating in a renamed *mobility field*). Obviously, besides the production side, such an approach requires changes in patterns of utilisation. Authors such as Freund & Martin (1993) and Whitelegg (1993) have emphasised that, from the demand viewpoint, a cultural shift is necessary in order to reduce the dependency of transport based on private ownership and individual use of cars.

Such changes, however, are extremely difficult to achieve. Politically correct consumer behaviour is unlikely when product performance and the overall convenience of the transport system do not support its requirements. It is exactly because these obstacles exist, that automobile companies that genuinely pursue ecological modernisation strategies and practices need to put more effort in creating the appropriate conditions for a shift from a product-cantered industry (automobile) to a service-oriented one (mobility solutions). In sum, if ecological modernisation is expected to be conducive to sustainable industrial development, irrespective of *factor 20* achievements, a stabilisation or decrease in some national vehicle populations would clearly be necessary.

12.3 Implications for Theory

The confrontation of the *incremental* practices developed by auto industrialists with the steady growth in the automobile population suggests that there are theoretical implications in the use of these two variables to indicate levels of ecological sustainability. A more precise set of definitions and indicators would avoid such theory being equated with isolated practices of environmental management. These isolated incidents do not represent the complex character that the phenomenon of ecological modernisation assumes. Section 6.2.1 in Chapter 6 argued that the development of empirical research would eventually make it possible to sharpen the definitions forming ecological modernisation theory. In this respect, the systematic identification of factors influencing the ecological modernisation of specific industrial sectors, developed throughout this study, could be used to sharpen such theory. The ecological modernisation framework, in this respect, represents a significant contribution to theory, since it constitutes an outcome of the empirical work conducted in this study. According to Jay (1996:178), a theory must satisfy some basic pre-requisites:

> In whichever of theory's guises, it should be immediately conceded; theory cannot be justified as autotelic or autonomous. In fact, it can be only become effective when it acknowledges its inherently parasitic relation to what it distances itself from; there is no theory without an opaque object to be interpreted, a practical implication potentially to be drawn, a pre-reflexive experience prior to theoretical reflection, modes of representation and understanding irreducible to general theoretical principles, and institutional context enabling the act of theorizing itself.

The grounding of ecological modernisation theory on the phenomenon of the 'emancipation of ecology' in specific sociological spheres of hyper-modern societies represents the 'parasitic relation' with the object to be interpreted that is referred to by Jay (1996). In other words, if theory is expected to have some usefulness, it must be grounded in observable phenomena. The study of eco-modernisation in the socio-technical context of the automobile industry addressed in previous sections was the source of contributions that can significantly enhance the theory. Throughout the development of the thesis it was possible to incorporate additional insights on the main research problem-area, as well as those that could enhance the ecological modernisation theory. These insights are presented in the next three sections.

12.3.1 Refining Reflexivity: Fallibility as the Guiding Principle

Proponents of ecological modernisation argue that rather than dismantling the foundations of industrial societies, the only viable alternative to solve the ecological crises – the continuous burdening of the sustenance base of the planet – is to fully explore the potential of wealth creation. This would be done through the use of one central source of dynamism of modernity: the *reflexivity* of knowledge appropriation. The use of rational capabilities should allow us to install a process of continuous revaluation and redesign of modern institutions. Over time, systems production and consumption would be redefined according to ecological requirements, besides economic and technical ones. The intensification of reflexive thinking would, ultimately, allow modern societies to redefine the rules governing the economy, as well as its social extensions.

Such a view is quite appealing. Maintaining modern institutions is an alluring argument for those who benefit from the current state of affairs in highly industrialised societies. This is why critics of ecological modernisation theory see it as another neo-liberal ideology in *green* camouflage. Fundamentally, the notion of *win-win* scenarios does not challenge capitalism and its associated dysfunctions, such as the tendencies towards monopolistic organisation, social inequality, and the appropriation and exploitation of nature. Moreover, the theory of ecological modernisation apparently ignores the institutionalisation of doubt, the disenchantment of science, and the endangering characteristics of modern science and technology (Beck 1997; Mol 1995).

Potential behaviour by prices in stock markets constitutes an exemplar of the undesirable effect of reflexivity. Section 6.2.1 in Chapter 6 showed that the reflexive nature of financial markets eventually *transforms* shared expectations among players about potential downfalls in future share prices into factual reality. The reflexive nature of knowledge about future prices *produces* the expected reality (Soros 1998). This is an indication that more knowledge about social life will not necessarily increase control over the fate of human condition. On the contrary, knowledge has a destabilising effect on the social world, one which should be considered by ecological modernists. There is no guarantee that the reflexive character of the accumulation of knowledge can produce pro-nature behaviours.

While the academic and popular debate about the meaning of ecological sustainability or sustainable development proceeds, a more pragmatic set of issues related to the limited character or reflexivity needs to be addressed by ecological modernists. Some vital questions need to be addressed: How can the reflective awareness of the possibilities of ecological modernisation be increased? How can the theory and practice of ecological modernisation become sufficiently open in order to examine the fundamental principles guiding its own definition of problems and programmatic strategies? It seems that the answer is located in the incorporation of another concept into the reflexive nature of knowledge appropriation, as well as the development of science and technology. *Fallibility* is the only certainty we have about human action. For this reason, it need to be linked with the notion of reflexivity when considered as both a source of reflection about human knowledge and a principle used for the definition of eco-modernising strategies and actions. If it is at all possible to do so, ecological modernisation theory must incorporate the concept of fallibility to provide a countervailing view of the role of modern science and technology: in this way ‘risk society’ theory was born.

12.3.2 Complementing Ecological Modernisation and Risk Society Theories

The acceptance of *fallibility* as an immanent characteristic of human action is critical for the reflexive appropriation of knowledge, which is expected to lead societies to ecological modernisation. In the opinion of Soros (1998), only when we start accepting our tendency to *fail* in interpreting reality will it be possible to reform the institutions governing economic and social action. In this process, open consultation and debate are pre-requisites for more stable and egalitarian economic systems and societies. Interestingly, the notion of fallibility is also central for risk society theory. According to the leading proponent of the theory, Ulrich Beck (1992a; 1992b), societies in times of high or reflexive modernity are seen as organised around the negative process of distributing ecological risks; hence they are *risk societies*. The secularisation and high degree of industrialisation achieved by some countries transforms (traditional) insecurity about natural forces into fear of environmental catastrophes generated by human science and technology. In this perspective, the escalation of unintended consequences generated by expert systems is inescapably attached to hyper-modernity. The accident in the Russian nuclear power plant of Chernobyl is the example used by

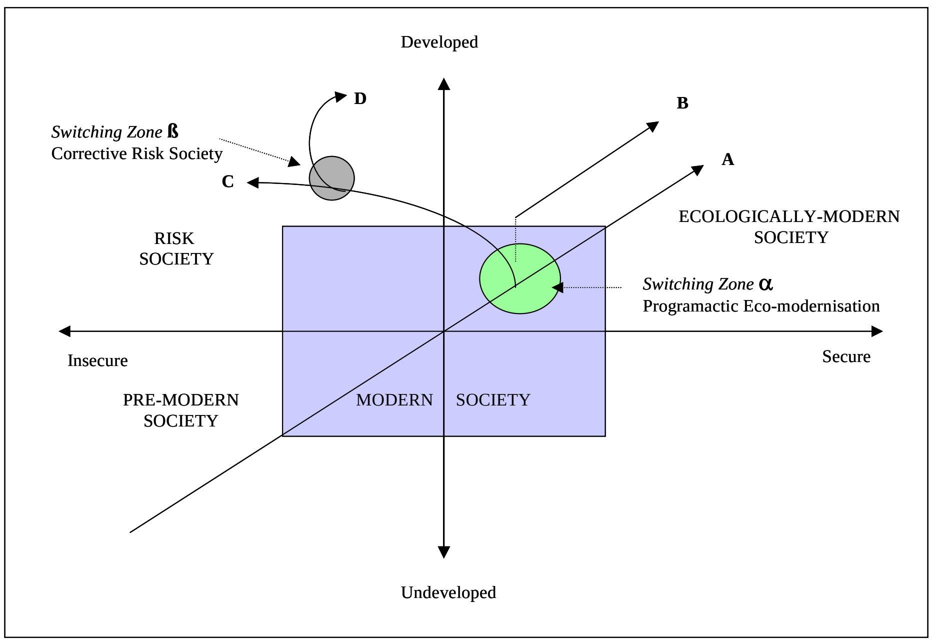
Beck to explain why high consequence risks in industrial societies cause a permanent sense of insecurity in lay citizens.

The risk society theory takes a sceptical view of the contribution of modern science and technology to bringing about the ecological switchover proposed by ecological modernists. Nonetheless, some eco-modernists have suggested that rather than conflicting theories, risk society and ecological modernisation have the potential to complement each other. As mentioned in Section 6.3.3 of Chapter 3, Mol (1995:395) understands that there is an opportunity for some kind of 'specialisation' of the theories, in which risk society theory would be used for the analysis of high-consequence and low probability ecological risks, whereas ecological modernisation would direct attention to 'normal' environmental problems such as water pollution, waste management, and soil acidification.

Ulrich Beck seems to substantiate this view. By proposing a new model of politics for times of *radicalised* modernity, Beck (1997) goes beyond the identification of immanent problems of industrialism and recognises the need for theoretical frameworks that can also be normatively used for environmental protection and restoration. Cohen (1997) goes even further by proposing a framework for the approximation of risk society and ecological modernisation theories. Figure 12.1 presents a framework that positions the theories in opposition to one another but as part of the same two-dimensional typology. The vertical axis depicts developments from pre-modern societies to advanced industrial societies; from 'undeveloped to 'developed'. The horizontal axis represents environmental and technological security; from 'insecure' to 'secure'. In the left-hand side of the figure are societies still in the pre-modern stage. Typically, these societies present high levels of insecurity and low levels of economic development. 'Insecurity' in this respect concern non-empirical, non-rational perception of exposure to risk of natural forces and fatalities, such as hurricanes and fatal infectious diseases.

The central area of the diagram represents the stage of development when societies become modern. Section 6.2 in Chapter 6 extensively articulated the main sources of dynamism leading to modernity, as well as the main institutional dimensions constituting modern societies. As was subsequently explained in Section 6.3, some societies have achieved high levels of industrialisation, accompanied by the gradual 'emancipation of ecology' from the economic and technological spheres. This linear trajectory – from a pre-modern, through modern, to ecologically modern societies – is represented by Path A in Figure 12.1. Nonetheless, as Cohen (1997:111) pointed out, most modern societies are not expected to follow a liner trajectory in order to achieve ecological modernisation. To climb up the upper right-hand quadrant, "a society must substantially modify its institutional structures, develop new policy tools, and adapt its lifeways to accommodate environmental limits". These modifications are covered by the normative character of the ecological modernisation theory, explained in Section 6.3, and encompassed in the *Switching Zone* α (alpha) of Figure 12.1. Hence, the implementation of the ideological programme of ecological modernisation should result in a move from Path A to Path B, leading to ecologically modern societies.

Figure 12.1: Techno-Environmental Risk and Development



Source: Adapted from Cohen (1997:110)

The *Switching Zone* α also represents the context in which potential solutions for environmental problems need to be negotiated by the various interest groups in society. The ELV *issue*, presented in Chapter 11, constitutes a didactic example in this regard. Although technical solutions for the problem of waste generated by cars were available to automakers, intense negotiations among them and national and supra-national authorities delayed practical actions by at least ten years. Even with the imposition of the Directive by the European Commission in September 2000, it is still not possible to foresee whether future ELV management will lead to Path B – i.e., to ecologically modern societies. Chances are that those practices will lead nations to follow Path C, which represents the failure of decision makers to establish the strategies and practices conducive to eco-modernism. In this respect, *political fallibility* may produce a path of economic development leading to an essentially risk society.

In Path C, the erratic economic development and the increasing disbelief of lay citizens concerning both expert systems and institutions of governance, leads to high levels of insecurity. Although this insecurity might mean ‘perceived insecurity’ in terms of Beck’s (1992a) notion of the risk society, in the approach presented here it also represents the factual danger embedded in the unknown consequences of modern science and technology – such as those associated with human consumption of genetically modified organisms GMOs. Additionally, the unintended consequences of social action can also be seen as potential sources of deviation from Path A to Path C (see: *Switching Zone* α in Figure 12.1). After all, risk societies are characterised by their failure to develop effective institutions that acknowledge and control the limitations of ‘reductionist’ science and associated systems of production and consumption.

In *Switching Zone* β (beta), risk-prone societies have the chance to correct the course form Path C to Path D. This will require social actors to formulate restorative strategies in order to overcome science, technology and resulting production systems that generate high levels of ecological risks. Fundamentally, they need to recognise the *fallibility* of contemporary forms of scientific enquiry so as to promote institutional flexibility and prioritise technologies that make social learning possible. These restorative strategies, although located in the area representing risk society, will need to have an eco-modernist character in their approach. In many respects, they are similar to those strategies developed in the context of a *Switching Zone* β, since they should ultimately be conducive to eco-modern societies. Possibly, the similarity of approaches used in both Switching Zones best represent the approximation of the ecological modernisation and risk society theories. As proposed in the previous section, in the reflexive evaluation of science and technology that guides industrialism *fallibility* should be a leading principle. This principle, however, needs to be complemented with another concept that also is based on an apparent dichotomy.

12.3.3 The Need of ‘Radical Reformism’ in Ecological Modernisation

Are *radical* changes imperative for the ecological sustainability of modern industrial societies or is *incrementalism* enough to lead them towards sustainable patterns of production and consumption? According to the conclusion of this study, the answer is both: incrementalism and radicalism, which directs us to the concept of *radical reformism.* Although this notion may seem a paradox – since one term contradicts the other – the concept of *radical reformism* may become vital for the development of ecological modernisation theory. Similar to the notion of *utopian realism*, which characterises both the visionary and the pragmatic aspect of ecological modernisation, radical reformism requires the qualification of the terms. Thus, in the context proposed here, the radical aspect relates to technological innovation while the incremental refers to institutional reformation.

Section 12.2 showed the limitations of environment-related solutions that favour the current paradigm of production in car manufacturing. Incremental improvements in internal combustion engines (ICEs) have resulted in significant environmental gains but also limit the possibilities of alternative powertrain technologies to succeed. The high-energy content of hydrocarbon fuels used in ICE-powered cars allows automakers to maintain steel as the main material used in car bodies – a heavy metal that significantly reduces both the energy and environmental efficiency of cars. This example exposes the limits of *incrementalism* in ecological modernisation. Put simply, technological incrementalism avoids questioning the principles embedded in specific technological applications and, by extension, does not question the fundamentals of science guiding industrialism. Hence, if ecological modernisation is expected to facilitate sustainable industrial development, *radical technological innovations* may be necessary in several instances.

Radicalism in technology may need the incremental transformation of the institutions of modern societies. The radical view envisions essential dramatic changes to both the products and the industry, which are to be accommodated within a more ecologically sustainable framework. On the other hand, radical technological innovations will certainly displace those associated with outdated technologies. For instance, the substitution of carbon fibre for steel in car bodies may become economically feasible in the coming years – since, technically, the substitution is already possible. But what would happen to those who lose their jobs in the steel industry as a result of such changes? Who would pay for the decommissioning of steel furnaces, among a series of other economic activities associated with this industrial sector?

This hypothetical example suggests radical technological innovations, such as those embedded in the *hypercar*, mentioned in Section 8.4.2 (Chapter 8), require the development of macro-strategies for the *management of transition* between modern to ecologically modern societies (see: *Switching Zone* α in Figure 12.1). Because such reforms engender ample democratic negotiation among social actors, they are inescapably reformist in their character. In other words, ecological modernisation demands *incremental institutional reform*. Therefore, radical technological innovations and incremental institutional reform, together, constitute the concept of *radical reformism,* which may have important implications for both the development of ecological modernisation theory and its normative application.

12.4 Implications for Policy and Practice

Basically, the implications of this study for policy and practice have been expressed in the previous sections. The findings of the study, summarised in Sections 12.1 and 12.2, can be used to inform the process of restructuring not only in the auto industry but also in other sectors with which it has close interdependencies. Revealing the factors fostering and inhibiting ecological modernisation has a crucial importance for management and policy-making; they identify the pressure points for the promotion of change.

For policy makers interested in applying ecological modernisation normatively, the arguments presented previously serve as a guidepost for the definition of strategies and programmes. They are mechanisms for the realignment of relationships between nature, technology and society, and for the creation of alternative routes, as well as the implementation of strategies based on *utopian realistic* visions of sustainable industrial development. In such a view, strategies can be designed for both environmental protection and economic prosperity. Guided by the principle of *fallibility* and the concept of *radical reformism,* suggested in the previous sections, policy makers should be able to develop strategies that are socially grounded. As Beck (1997) suggested, the creation of a transition between modern and ecologically modern societies requires '*the reinvention of politics*'. According to the conclusions of this study, a pragmatic reinvention of politics should be based on human fallibility and radical reformism.

For carmakers, the fundamental implication of this thesis refers to the questioning of what constitutes the business of the auto industry. If selling increasingly high volumes of vehicles is the 'name of the game', then this thesis has little to add. The paradigm of production and consumption upon which the modern automobile industry is based shows clear signs of exhaustion. As mentioned in previous sections, incremental changes within the same *regime* will not generate palpable outcomes in environmental terms. However, if auto industrialists are interested in alternate routes for the current *regime of the automobile*, then this study presents some insights. As previously expressed, a transition to an eco-modernised auto industry will not happen without upheavals. If the current situation does not seem too favourable for the industry, a transition period will certainly be traumatic for many in the business. But without such efforts to redefine the nature of the auto business, not only the economic viability of car manufacturing will be in jeopardy, but also sustainable industrial development will remain an evasive concept for this remarkable sector.

12.5 Implications for Future Research

The study showed how external factors significantly influenced the general positioning of car manufacturing firms by looking at the developments occurring within the *automobile field*, instead of focusing on the recycling strategies of single companies. By doing so, the study demonstrated that the incorporation of environmental practices in organizational strategies is not a voluntaristic matter for most organizations operating in the socio-technical context of the automobile industry. Ecological innovation results from the influences that contingent factors exert on each other, which are shaped by political ecology dynamics. Understanding these phenomena requires the consideration of the logic of the business, the structure of the industry, the positioning of the firms within that industry as well as their organizational capabilities (Reinhardt 1999a). This study is expected to have addressed all these aspects, which were presented in the previous sections. The implications of this for future research are presented in the following sections.

12.5.1 Contribution to 'Organisation & Environment'

The analyses presented in this study showed that the surge of *greening* in organisations could not be fully understood from the organisational level of analysis. For the environmental practices of companies to become an empirical phenomenon, episodic environmental gains need to have an impact upon the entire industrial system. Hence, a *meso-level* of analysis that links organisations to societal phenomenon is required. The understanding of ecological modernisation as a sociological phenomenon makes it possible to establish this link. Organisational *greening* can be seen as an integrated dimension of the historical process of modernisation undertaken by societies. The study of pro-active environmental management in a specific industrial sector can be insightful for the identification of the underlying forces of ecological modernisation at the societal level. Instead of analysing determinants of *greening* in organisations *per se*, a multi-disciplinary analysis of organisational fields revealed factors limiting the achievement of ecological sustainability.

The effort to develop *multi-disciplinary* research is expected to represent a contribution to the field of *organisation & environment*, as well as to facilitate dialogue among researchers working in various environment-related disciplines. The use of areas ranging from applied environmental management in organisations to political economy and environmental sociology constitutes an attempt to refine some of the connections between these *hybrid* disciplines. Moreover, the generation of knowledge in the area of *organisation & environment* requires investigation of *why* modern organisations present specific behaviour towards environmentalism. In this respect, the use of the framework for the analysis of electric vehicle trials, as well as the end-of-life vehicle issue in Europe, addresses another criticism of studies of environmental issues in organisations: that more political perspectives are necessary in the study of environment-related organisational studies. Hence, the development of this study constitutes a practical response to theorising about ecological issues in management; it can help one understand the context in which environmentally oriented disputes occur.

12.5.2 Designing Research From The Ecological Modernisation Framework

The identification of factors that are central for ecological modernisation in the automobile field resulted in the design of an analytical framework that can be used in further research. The framework can be used to map the context in which ecological modernisation might occur, and systematic analysis of the interdependencies among *eco-factors* can indicate areas where intervention is required if ecological modernisation is to progress. The systematic identification and analysis of *eco-factors* through the use of the framework sensitises one to the most probable sources of innovation and resistance that are likely to occur in a specific organisational field. In this respect, the ecological modernisation framework is not predictive but rather it provides a cognitive map within which interpretation of a complex reality can be structured.

Within organisational studies, the framework can assist one to develop (positivistic-oriented or otherwise) research questions and hypotheses combining institutional and power perspectives (Haugaard 1998) with the resource-based view of the firm (Hart 1995). Research themes deriving from these approaches relate to the understanding that corporate strategic actions are only possible within the range of available options defined within the organisational field. As it was explored throughout this study, environmental innovations of focal organisations will only transform the organisational field when specific institutional-power frameworks favour the redefinition of the circuits of political ecology. In this regard, there is the need to develop research following the approach adopted by Hoffman (1999) for the identification of elements causing both the stabilisation and changes of industrial sectors. Transaction costs that might justify the adoption of environmental standards, for instance, are themselves dependent on the configuration of the organisational field in which corporations are embedded. Thus, potential competitive advantage resulting from the adoption of certified environmental management systems is context-specific. This justifies the need for the analysis of conditions that would favour environmental innovation within a specific organisational field.

The political ecology framework could also be applied to study environment-related issues in another industry or to another context in the same industry. For instance, it would be productive to study the American or Asian ELV *issue* and compare these different institutional contexts with the European case from the political ecology perspective. This could generate useful information about adequate forms of regulation, necessary industrial ecology conditions for the development of recycling networks, forms of cooperation between firms, etc. The information could substantially help to improve knowledge of why companies and industries adopt (or not) environmentally friendly technologies and products. This understanding is crucial from both analytical and prescriptive viewpoints. Forcing better environmental practices requires grasping the complex world of organisations and their natural and socio-political environments.

12.6 Final Considerations

This *research journey* suggests that there are two distinct views of environment-related improvements achieved by modern societies. The first regards the technological and economic developments of the 20th century as outperforming the environmental costs generated by them. In this view, the indicator of performance is based on the levels of environmental restoration resulting from the substitution of older industrial and social practices for less environmentally damaging ones. For instance, the emergence of cars as the main means of transportation in the early 1900s solved the problem of the accumulation of horse manure in major cities, and with it the consequent risk of proliferation of diseases, such as tuberculosis (Yergin 1992). Higher life expectancy in industrialised countries and the tripling of the world population in that period has also been considered a great achievement of modern science and technology. Indeed, when the analysis focuses on relatively short time spans, these are remarkable achievements. On the other hand, the certainty of the ever onward and upward trajectory of modern science evades some issues, especially when one considers the impact humans have had on pristine ecosystems and on other species, and the constant consumption of the *sustenance base* of the planet that their actions have created.

Therefore, the benefits of human science, technology, and production have historically been anthropocentric; they served human needs, exclusively. From this perspective, one could consider that the ecological modernisation theory, in general, and this thesis in particular have an anthropocentric bias. They were developed for both a better understanding of a specific sociological phenomenon and the redesign of human organisation, making ecological sustainability a viable trajectory for modern societies. Nonetheless, if ecological sustainability requires the expansion of enclaves in which the *sapiens-sapiens* is not the only species benefiting from the transformation of nature, we need first to redefine the ‘rules of the game’ that produced ecologically unsustainable human organisation. It is necessary to work within the realms where the main damage has been literally ‘produced’: the world of modern industrial organisation. In this perspective, the transformation of current paradigms of production and consumption could be seen as a *pre-requisite* for the creation of conditions for inter-species equity and, hopefully, ecologically sustainability. This study is expected to have contributed to such aim.

13 References

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