ENVIRONMENTAL MANAGEMENT IN THE PETROLEUM INDUSTRY

by

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"Submitted in accordance with the requirements

for the degree of Doctor of Philosophy"

THE UNIVERSITY OF LEEDS

LEEDS UNIVERSITY BUSINESS SCHOOL

June/ 1998

The candidate confirms that the work submitted is her own and that appropriate credit has been given where reference has been made to the work of others.

Abstract

Keywords: Strategic Management, Environmental Management, Green Issues, Environmental Management Systems, Oil Industry, Oil Refineries

The increased awareness of the deterioration of the biophysical environment and change in ecological values are affecting the relationship of organizations with the biophysical environment. The management of green issues has been peripheral to organizations' business strategy and dealt with in a piecemeal manner. However, organizations are recognising the strategic importance of the management of green issues and are introducing internal environmental management systems to deal with such issues.

The management of green issues has to be dealt with by most organizations, and virtually all industrial organizations. In this work an 'ecological complex framework' has been developed in order to systematically investigate and represent the social process associated with ecological forces and environmental controls affecting the relationship of organizations with the biophysical environment.

The aim of the framework developed in this work is first to understand how and what green issues are noticed by organizations and how they respond to them. Second to bring green issues into strategic management research.

To allow a coherent investigation of this issue this work has concentrated on one specific industry, the oil industry, with special focus on the refining activity. A case study of the Brazilian oil organization Petrobrás was undertaken to investigate the problem. In this case study representatives of Petrobrás were interviewed about their roles in the management of green issues. These representatives ranged from operational staff through to senior management at refineries and head office. In addition to the case study environmental managers from other oil organizations in the UK were interviewed and a content analysis of corporate literature of all oil organizations studied was undertaken.

The findings of this investigation have shown that the management of green issues have become an important issue in oil refineries' strategies. However, due to the complexity and uncertainty of stakeholders' ecological demands, oil organisations are still learning how to recognise their relevance and strategic implications.

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Acknowledgements

Taking part in a doctoral program has been an invaluable experience. A doctoral program is a process which involves not only the learning of research procedures and of a specific topic, but even more important; the learning about one's self.

The financial support of CNPq - Conselho Nacional de Desenvolvimento Científico e Tecnológico and the participant oil organizations were essential to the realisation of this research program.

A special thank you to my supervisor Dr. Richard Falshaw for his valuable guidance, patience and time.

Thanks to Liz Hodgen for her time, support and advice when it seemed that there was no light at the end of the tunnel.

Above all I want to thank Simon Drew, all my family and friends. Their love and support helped me to keep looking forward.

To my father (in memoriam) and my family

CHAPTER 1

INTRODUCTION

1.1 - The Research Problem

The modification of the biophysical environment as a consequence of the process of human adaptation to it has long been a cause of concern. It was only after the 1960's, however, that it emerged as a political, moral and social issue with wide-ranging economic and organizational implications (Carson,1963; Shrivastava,1992).

Chronic environmental episodes such as acid rain, global warming, toxic wastes problems, the stratospheric ozone layer depletion (Buchholz *et al.*,1992) and the consequence of major accidents such as Seveso, Bhopal, Piper Alpha and Chernobyl (Colby,1990; Shrivastava,1992a) highlighted the severity and consequences of ecological scarcity to humans themselves. To some authors (e.g. McCloskey and Smith,1995) such events illustrate the need for societies to adjust their economic ideologies, moving from short-termism to more sustainable strategies for development.

Increasing evidence of the link between an organization's activities and ecological damage is creating stricter ecological demands upon organizations as major generators of environmental problems, either through their activities or through their products.

To date studies of business organizations have in general concentrated on economic values, organization culture, internal structure, market environments and technology, ignoring the relationship between such organizations and their biophysical environment (Petulla,1987; Throop,1993; Dodge,1995).

Dunlap (1980) suggests some of the reasons for this neglect. Firstly, the anthropocentric approach that considers humans, and consequently human organizations, above and separated from the biophysical environment. Secondly, humans' view that the biophysical environment is unlimited. Academics are still considerably reluctant to introduce ecological issues as part of social science research (Smith, Hart and McCloskey,1994). However, this is slowly changing (Throop, Starik and Rands,1993). Environmental concerns and ecological forces are introducing a new paradigm for the social sciences (Throop,1993).

Interactions between organizations and their surroundings have normally been associated with economic, social, political and technological factors. Most of the investigations on the relationship between an organization and the biophysical environment are still very prescriptive, with little in-depth empirical research or analysis.

Only recently have green issues, as a consequence of organizations' actions upon the biophysical environment, become relevant to organizations' economic activity. The evidence that green issues are increasingly becoming a strategic problem for organizations requires the integration of environmental concerns and ecological demands into strategic management research (Throop,1993; Dodge,1995; Ketola,1995).

For researchers in strategic management the new ecological paradigm introduces the green issue as a strategic variable to be considered as part of an organization's strategies. The relationship of organizations with the biophysical environment must be reexamined and green issues considered, not only as a constraint but also as a business opportunity (Porter,1991). Welford (1995) suggests that investigations on green issues as part of strategic management research are still in their infancy. The investigations are underdeveloped and not tested empirically yet (Gladwin,1993).

Organizations have recognized the interaction between their economic activity and environmental protection to be among the most important and emergent topics to be included as part of their business's agenda (Hunt and Auster,1990; Kirkpatrick,1990; Smith,1992). Several organizations have already incorporated ecological issues as part of their strategic plans (Shrivastava,1992; Rappaport and Flaherty,1992; Rothenberg and Maxwell,1992); however, these initiatives do not provide any practical guidance on how and where to introduce environmental management efforts as part of their organizations' strategies (Hooper and Rocca,1991).

The investigation of green issues affecting organizations requires a multidisciplinary approach as it includes both social and biophysical aspects (Roome,1992). Because it is a very complex issue it also requires a systems approach (Callenbach *et al.*, 1993). Some researchers claim to have used a systems approach in their investigations of green issues affecting organizations' strategies (Throop,1993; Ketola,1995; Dodge,1995) but although they have succeeded in confirming that the deterioration of the biophysical environment is affecting organizations' economic activity they have failed to identify how organizations are part of the social process linked to green issues. This social process represents the competition for the use of the biophysical environment. It is society's attempt to achieve a balance between economic and ecological demands.

Throop (1993) proposed that organizations are part of a circular cause-and-effect loop where their actions can both influence and be influenced by others. In his circular model, organizational decisions provoke changes to an organization's environment (the environment includes: social, political, economic and biophysical forces). These changes affect government and social values. Government and social values affect organizational decisions. Throop recognized that, because of the complexity involved in the issue, he had to simplify his model. His model was limited to few elements and needed a much wider investigation to include, organizations' representatives

perceptions of environmental concerns, ecological forces and their effects on the organizations.

In order to address green issues affecting organizations a more comprehensive and systematic representation of the link between social and biophysical factors associated with green issues is necessary. This representation must show the link between the organizations' actions, the long-term consequence of them upon others and upon the biophysical environment. It should also represent the reactions to the modifications inflicted upon the biophysical environment. These reactions are likely to affect the organization's economic activity.

The objective of the research is to examine the relationship of an organization with the biophysical environment, that is, how the use and deterioration of the biophysical environment can affect organizations' strategies. The investigation shall address the new concern introduced by the increased relevance of ecological demands upon organizations. The research also aims to introduce ecological issues in the context of strategic management theory.

A practical systematic management tool will be proposed which is designed to represent the continuous social process associated with ecological demands upon organizations. This tool shall be developed based on the empirical investigation of the relationship of an organization with the biophysical environment. This tool may provide a framework for dialogue across disciplinary boundaries, anda systematic guide to the development of environmental management systems.

Four research questions have been proposed to guide the empirical investigations. These questions are as follows:

1 - *How does an organization perceive ecological forces and environmental controls*?

2 - *What are an organization's environmental policies*?

3 - *How are the environmental policies implemented?*

4 - *How are green issues linked to strategy*?

1.2 - The Research Strategy

This investigation consists of a detailed case study of the oil refining activity of a single organization. Evidence was also obtained from secondary and primary sources of the refining activity of other organizations in order to increase the generality of the findings.

A theoretical framework to represent the social process linked to environmental concerns and ecological forces is proposed. This is compared to the organization's actions in relation to ecological issues. The aim of the comparison is to identify the links which the organization acts upon and which have strategic implications for the organization.

The refining activity was chosen, first, because of the long-term involvement of oil refineries with environmental issues. Second, the worldwide use of petroleum. Third, the similarity of oil organizations' activities, products and effects upon the biophysical. As a result of this similarity, it is reasonable to assume that oil refineries also have similar strategies to respond to environmental concerns and ecological forces.

The organizations selected for the investigation consist of organizations with oil refineries in the UK and in Brazil. The organizations selected for the investigation include: British Petroleum, Conoco, Chevron, Elf, Exxon, Mobil, Petrobrás (Brazil), Petrofina, Phillips Petroleum, Shell, Texaco and Total. However, for confidentiality reasons specific oil refineries and the identity of representatives of organizations taking part in interviews are not explicitly revealed in the research.

The environmental controls and ecological forces affecting organizations are constantly changing, so the researcher was aware of the complexity and wider contextual framework surrounding the investigation of such issues. This investigation is intended to contribute to the better understanding of the constant changing social process, which generates environmental concerns, introduces ecological forces and environmental controls, and affects organizations.

1.3 - Outline of the Thesis

Chapter 2 - Theoretical discussion on the meaning of "environment", "green issues", the link between "green issues" and the economic process and the increasing relevance of green issues for organizations.

Chapter 3 - Theoretical discussion of organizations as an element of the process associated with ecological forces and environmental concerns.

Chapter 4 - Description of the research strategy of the investigation.

Chapter 5 - The aims of this chapter are: firstly to answer the following research question: "H*ow does an organization see ecological forces and environmental controls?*" Secondly to compare the ecological forces affecting UK and Brazilian refineries.

Chapter 6 - The aim of this chapter is to establish, through the analysis of environmental policies published by oil organizations, the organizations' commitment to green issues affecting the refining activity. This chapter addresses the second research question *"What are an organization's environmental policies?"*

Chapter 7 - The aim of this chapter is to investigate how oil organizations implement their environmental policies. This chapter addresses the third research question "H*ow are the environmental policies implemented?"*

Chapter 8 - The aim of this chapter is to investigate the link between green issues and the strategies of an organization. This chapter addresses the fourth research question "*How are green issues linked to strategy*?"

Chapter 9 - The aim of this chapter is to expand and adapt the ecological complex framework (see chapter 3) to represent the on-going social process associated with environmental issues affecting an organization.

Chapter 10 - Final conclusions and suggestions for further research.

CHAPTER 2

THE ENVIRONMENTAL ISSUE

The aim of this chapter is to discuss the meaning of "environment" and "green issues", the link between "green issues" and the "economic process" and the increasing relevance of green issues for organizations.

2.1- Definition of the Environment

> "*Science is itself in large measure an analysis of environmental pressures and conditions*" (Bernard, 1925, pp318).

The environment has been a topic of investigation for different disciplines. A general concept is to consider the environment as everything outside an established boundary or system. The concept of "the environment" becomes very complex when the researcher moves from a simple description to analysis of its properties (Dill,1979).

The definition of system from the Concise Oxford Dictionary (1990) is as follows: "A system is defined as a group of parts which interact and are interdependent among themselves". Depending on the system's interaction with its environment, it is represented as closed or open. The interactions for an open system are exchange of mass, energy and information. An example of an open system is a living organism, which has an established physical boundary and is composed of parts, which are functionally coordinated and integrated. In order to survive, a living organism must interact with its environment. For example, if the physical limit of the earth is

considered as a boundary, the environment of a living organism is everything between the organism's own physical limit and the earth's limit.

For the ecological system a physical outer limit can be defined which establishes the physical boundary between the earth and outer space. The ecological system receives energy from the sun and can be divided into systems that are composed of living organisms, non-living substances and interacting processes which produce the exchange of materials, energy and information between the living and the non-living components (Odum, 1971; Simmons,1981). These interacting ecological processes maintain the interdependence among the different subsystems of the ecological system and tend to an ecological equilibrium (Simmons,1981) which is dynamic and constantly changing.

2.1.1 - The Human Environment

A human is a living organism and part of the ecological system. The ecological system is indifferent to human survival, however, humans depend on the ecological system as a source of goods, services and life-supporting systems. As a source of goods the interaction of humans with the ecological system depends on human perception of a natural resource's value and usefulness.

The ecological system, apart from the provision of material goods or commodities, is also a source of services or non-commodities such as pleasure and enjoyment. The biophysical environment life-supporting systems are common and collectively shared by every living system within the ecological system. It is a common property that can not be privately owned or controlled, and every user or group of users have the legitimate right to use it (Hardin,1968).

Although the maintenance of the complex ecological processes on the planet is independent of the human process of adaptation to the biophysical environment, their continuity and equilibrium can be changed or destroyed as a consequence of human "reactions" to the biophysical environment. Human "reactions" are physically constrained by the ecological system's limits (Pirages,1977). The ecological system's physical limits are linked to the availability of natural resources, the ecological system's natural cleaning mechanisms and the maintenance of the ecological processes and equilibrium among the different systems of the ecological system.

Because of the interconnectedness between systems within the ecological system, the human "reactions" upon the biophysical environment affect physical, biological and chemical interactions among the systems and introduce changes to the biophysical environment. The biophysical environment "acts" upon humans, therefore changes inflicted upon the biophysical environment can also affect humans. Thus, the "environment" "acts" upon every human (through individual perceptions) and humans "react" individually or collectively to the "environment" in order to satisfy their needs and wants.

A simplified representation of different hypothetical and hierarchical levels of a human's "environment" is shown in figure 2.1. In this model, concentric circles represent different levels of "environment". Each circle represents a limit. Moving outwards from the center everything outside a circle is its "environment". Assuming that every circle represents the boundary of an open system, the "environment" can affect everything inside a circle (or system).

The "environment" of an individual can be represented as divided into two main levels (Bernard,1925): a social and a biophysical environment. The social environment represents the individual interaction with other human beings and the process of human adaptation to the biophysical environment. The biophysical environment

represents nature and also contains the changes, which are a consequence of human "reactions" upon it, for example, roads, and buildings. This is known as the modified and built environment (Dunlap and Catton, 1979).

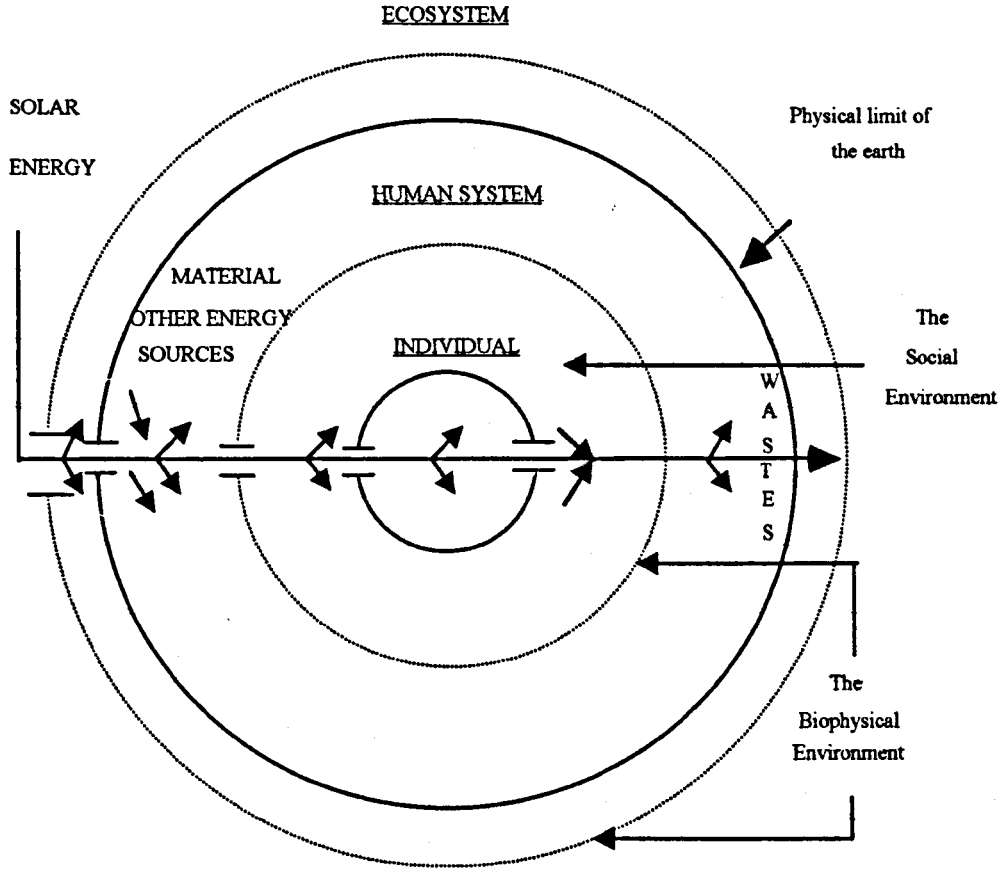

FIGURE 2.1: The Ecological System and Subsystems: A Hierarchical System Diagram (Source: Modified from Stead and Stead,1992, pp. 8). The outer circle represents the socially constructed limit of the ecological system. The inner circle represents the individual's physical limit. The middle circles represent the socially constructed limit of the human process of adaptation to the biophysical environment and the physical limit of the earth. The arrow represents the flow of energy and mass to and from the systems.

As depicted in figure 2.1 the first circle represents an individual. The second circle represents the limit of the human system. It is the individual's social environment. Humans are constantly creating systems within the human system in order to improve their on-going process of adaptation to their biophysical environment; therefore, the human system does not have a physical boundary but a socially constructed boundary, which is not easily defined. The third circle represents the physical limit of the earth

with outer space. The ecological system limit is represented by another circle. This limit is also socially constructed and is not easily defined. It depends on our understanding and perceptions of the biophysical environment and ecological processes. The biophysical environment is everything between the second and the outer circles.

2.1.2 - Investigations on the Human Environment

While the definition of the physical boundaries of systems are easily identified, the definition of any other boundary is elusive and so can not be defined with precision. Environmental consciousness is, therefore, a human construct which is interpreted through another set of human constructs, for example, politics, economics, science, culture and religion (O'Riordan,1981; Cooper,1992; Roome,1992).

Investigations of the human "environment" have always been very fragmented depending on perceptions and boundaries established by researchers' interests and disciplines (Starbuch,1976). Each discipline has considered only the part of the human environment that was considered relevant to their investigations.

This fragmentation of investigations on "the environment" has been very convenient because of the complexity involved in trying to identify all the possible existing interrelations. Despite the fact that this mechanistic approach has been very useful to increase the understanding of the relationships of humans and their environment, it has, however, an important drawback. This reductionist breakdown of the "environment" has resulted in the loss of a holistic perception of the "environment" and a great number of interrelations have inevitably been overlooked by researchers.

For example, early investigations considered the human system apart from the ecological system (Duncan,1950) and social mechanisms were considered to be the

key functions linking the human system with the biophysical environment (Hawley,1968). The physical boundaries of the ecological system were neglected (Dunlap,1980). A cross disciplinary and systems approach for the understanding of the relationships of humans and their environment has not been important in the mainstream academic tradition (Roome,1992).

Roome (1992) argues that it is more reasonable to consider "the environment" as an area containing a series of focal points for concern and representing an arena for complex, often unresolved debate. In this research the focal point of concern is to investigate how modifications to the biophysical environment are affecting organizations. Therefore, environmental issues, environmental problems, environmental behaviour, environmental performance and environmental policies all refer to perceptions of the impact of humans upon the biophysical environment or actions taken to control or reduce the impacts upon the biophysical environment.

2.2 - The Green Issue

There is evidence that the values and ethical forces that influence how the human system interacts with and perceives the biophysical environment are changing (O'Riordan,1991). The definition of the value of the "environment" is derived from individual experiences and society. Thus, the value of environmental components is different between individuals, between organizations and even between and within cultures (Roome,1992).

Individuals or groups of individuals' environmental values can influence one another. The difference between individuals (or organizations) and collective interests for the use of the biophysical environment and in environmental perceptions generates a continuous conflict among different users or groups of users within the human system (Boulding,1966; Naess,1973; O'Riordan,1991). Consequently, the definition of biophysical environment's use and limits for using it are also constantly changing.

The different perceptions of the biophysical environment, conflict for the use of it and concerns on the consequence of human activities upon it, are not new issues (Smith,1992). However, although the biophysical environment is common property and everyone can benefit from its protection, not everyone is willing to take responsibility for his/her actions upon it (Troop,1993). Individualist uses and choices on the use of the biophysical environment are frequently not limited only to the desired results but can have unforeseen results. Hence the social and physical effects of humans' "reactions" upon the biophysical environment can have predictable or unpredictable implications for the interest of others. The generation of wastes and pollutants is an example of unwanted results.

Although results from research in environmental concerns are still not being widely available, they have at least demonstrated that there is a growing trend towards an increase in public ecological awareness and concern (Dunlap and Scarce,1991; Kempton,1993). Some examples of issues which generate concerns and conflicts in relation to the biophysical environment include: competition for the use of potential natural resources; availability of potential natural resources; air, water and soil quality; quality and safety of the workplace, health problems as a consequence of pollutants or changes on ecological processes, wildlife, landscape (Stern and Oskamp,1987; Pitt and Zube,1987; Kirkpatrick,1990; Postel,1992; Roome,1992).

The concerns about green issues seem to have evolved in three main stages (BI,1990). The first stage is the awareness of local environmental problems, for example, impact on health, local natural resources depletion and industrial pollution problems. The second stage is the increased and broader perception about the consequences of humans' activities upon the biophysical environment including local to global ecological effects. The last stage is the increasing trend towards the recognition of the urgency in adopting a new and sustainable approach to the way the human system

interacts with the ecological system including economic development issues, social demands and ecological demands.

Roome (1992) argues that it is difficult to agree on universal definitions of "environmental problems" and set priorities for action. A complex and difficult issue involved in "environmental problems" is the definition of the importance of biophysical environment physical limits over time and the biophysical environment's quality standards. These are also socially constructed definitions and depend on the human system's users or groups of users needs, values, attitudes, behavior, concerns and knowledge about green issues (Firey,1960; Simmons,1981; O'Riordan, 1981; Cooper,1992). Because of differences and conflicts among different users, such definitions depend on: competition for different uses of the biophysical environment (Pitt and Zube,1987), how distant the causes and effects of environmental issues are in space, time and persons affected (O'Riordan,1981; Drysek,1987; Cooper,1992), the evidence of an environmental problem and association of the environmental problem with an appropriate solution (Kempton,1992), culture (Roome,1992), technical and organizational abilities (Mather and Chapman,1995), social and political relationships (O'Riordan,1991).

Another important issue identified which can influence the users or group of users' environmental concerns is the "commons dilemma"* (Edney,1980) and the "free-rider" problem** (Hardin,1968; Albanese and van Fleet,1985).

An user of the biophysical environment can be simultaneously an individual with private interest, taking private decisions, and also a member of the public having

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* Commons - Commons are any form of resources that are commonly used by different individuals (Edney,1980). For example: food, air, water and energy.

** Free-rider- "a member of a group who obtains benefits from the group membership but does not bear proportional share of the costs of providing the benefits" (Albanese and van Fleet,1985, pp244).

collective interest, therefore taking, collective decisions. The "commons' dilemma" arises when individuals have to decide on the importance of their own interest or the group's interest concerning the use of the commons. Any individual decision taken within the human system will somehow affect the biophysical environment. An individual can have a collective ecological behavior as a citizen. For example, the support for the protection of parks. On the other hand as a member of an organization or as a consumer the behaviour can be very individualist where ecological factors are not always considered. For example, the discharge of polluted water and the choice of transport used by individuals. The "free-rider" problem arises because environmental protection is a collective good that once produced can benefit everyone, however, not everyone is willing to pay for it or change one's environmental behaviour to protect and preserve the biophysical environment. For example, the urban air pollution problem which is increasing environmental controls on car emissions.

2.2.1 - Ecological Forces

The environmental concerns and conflict between different users has given rise to "ecological forces". Ecological forces are the consequence of human perceptions of side effects of their own actions upon the biophysical environment. The inclusion of ecological forces has not been widely considered in the social sciences (Dodge,1995); however, ecological forces are a type of social issue (Passmore,1974).

Ecological forces are nothing more than the social reaction of different users of the biophysical environment. They demonstrate different interested groups' perceptions on the use of and the impacts upon the biophysical environment. The ecological forces affect the definition of the socially constructed boundary between the human system and the biophysical environment shown in figure 2.1 (Kempton,1993) by demanding restrictions on the use of the biophysical environment. Ecological forces can also create opportunities and threats to different users of the biophysical environment.

The increase in ecological awareness, scientific knowledge and dissemination of environmental information about the effects of the production processes upon the whole ecological system, is gradually changing views on how humans should interact with the biophysical environment (WCED, 1987). Consequently, the demands for better environmental management and protection of the ecological system at all levels are also increasing.

The interdependence between ecological forces and social forces is demonstrated by the increasing socio-political importance of concerns about the quality of the biophysical environment and the way humans and organizations interact with it (Brown,1992). For example, with the introduction of environmental controls that restricts different users' actions upon the biophysical environment. These controls are the increasing and changing environmental legislation worldwide and international environmental agreements. Different researchers (Berglund and Lawson,1991; Greeno,1992; Hutchison,1992; Slavich,1993) have identified some of the ecological forces and environmental controls affecting organizations. They are depicted in table 2.1.

2.2.2 - Environmental Controls

As depicted in table 2.1 there are three main forms of environmental controls. They are: command and control (e.g. legislation and regulations), economic instruments and self-regulation.

The use of command and control by governments, through environmental quality standards on intrinsic waste (wastes linked to the process and products) and extrinsic wastes (byproducts) has been the most used so far on the control of organizations' environmental issues (Holdgate,1979; Berglund and Lawson,1991). Although environmental legislation varies from country to country there is an increasing trend towards stricter environmental legislation internationally. For example, there is an

increase and on-going introduction of new and stricter environmental legislation in developed countries such as the United Kingdom (Garner,1996), in emergent market economies such as Brazil (CONAMA,1992), in the European Union (Garner,1996) and also several international agreements which affects all countries (Maddox,1992; Garner,1996).

ECOLOGICAL FORCES	CONTROLS
Public ecological awareness	Stricter legislation
Scientific Knowledge	
Increase in environmental costs	
Demand for environmental performance information	Economic instruments
Consumer demands	
Competitive Advantage	
Staff demands	Self regulation
Globalization of the issue	

TABLE 2.1: Ecological forces and Environmental controls upon business organizations. The ecological demands upon organizations can be direct or indirect through the evidence of environmental damage produced by their activities and products. The ecological controls limit organizations' actions (Source: Slavich,1993; Berglund and Lawson,1991; Hutchison,1992; Greeno,1992).

Porter (1991) argues that environmental standards trigger innovation and upgrading. However, as Porter points out, to turn ecological demands into competitive advantage proper legislation and regulations have to be established, where pollution prevention and innovation is encouraged. Cairncross (1992) argues that environmental regulations and legislation can bring competitive advantage if organizations do not restrict themselves to compliance as a defensive tool. Environmental legislation and regulations are to be used as a starting point to plan environmental improvements. The enforcement of environmental regulations is also considered as an important issue to

be addressed. Poor enforcement is seen as a negative factor to environmental protection (IISD,1992).

The use of economic instruments as a type of control is increasing via, for example, marketable permits, emission charges, product taxes and deposit-refund taxes. It has been suggested that there is a synergy between market forces and environmental regulations (Barde and Opschoor,1994). Economic instruments are suggested to encourage a preventative approach to environmental pollution control by increasing flexibility, cost-effectiveness and raising revenues (OECD,1991). The effectiveness of the use of economic instruments largely depends, however, on how they are implemented (Barde and Owens,1993).

Self regulation is suggested by organizations to be the best option to control their environmental behaviour (Schmeidheiny,1992) but the evidence of the short and long term side effects of their actions upon the biophysical environment contradicts that. For example, the Bhopal accident in India (Shrivastava,1992a) and problems of overfishing (Emery and Trist,1973). This illustrates the "tragedy of the commons" suggested by Hardin (1968). The biophysical environment, which is a common property, when left without any control, individual interests will supersede collective interests and the biophysical environment will eventually be overused and overexploited.

It seems that individually none of the controls are effective. Schmidheiny (1992) suggests that environmental protection can be achieved through a combination and effective use of all three types of control. Government and business partnerships for the development of better environmental policies have been suggested as an important step towards effective environmental protection (UNCED,1992).

In summary, the changes in the biophysical environment, as a consequence of human actions, are generating ecological forces and environmental controls. Both are

introducing a new paradigm for the social sciences, where the influences of the environmental issues upon technological, economic, political and social factors can no longer be neglected (Kapp,1969; Commoner,1971; Daly,1973).

2.3- The Green Issue and the Economic Process

An important interaction of the human system with the biophysical environment as shown in figure 2.1 is represented by the flow of energy from the sun and natural resources from the biophysical environment to the human system and the flow of wastes back to the biophysical environment.

The input of materials and energy to the human system is associated with and dependent on the definition of the economic value of potential natural resources. Material and energy become commodities and part of an economic process. The wastes from the human system used to have no economic relevance. However, this has changed considerably with the passage of time.

"*Economics is the study of how scarce, or limited, resources are used to satisfy people's unlimited material wants and needs*" (Dolan,1986, pp3). In economics the biophysical environment is a source of potential natural resources that can become useful and valuable depending on product, technological and market forces.

In neoclassical economics the economic process is represented by the flow of goods and services in one direction and consumption or demand in the other direction (Figure 2.2). Internally, production and consumption are linked by exchange of money which represents the products' and services' economic value, savings, investments, the government and foreign sector inputs (Dolan,1986). The economic value of a natural

resource is therefore a social representation of the interaction between the human system and the biophysical environment. The economic system is considered as a closed system and the biophysical environment is considered physically unlimited (Boulding,1966; Georgescu-Roegen,1971; Daly,1973). The physical side effects of production-consumption are not considered within this model as they are considered to have no economic value.

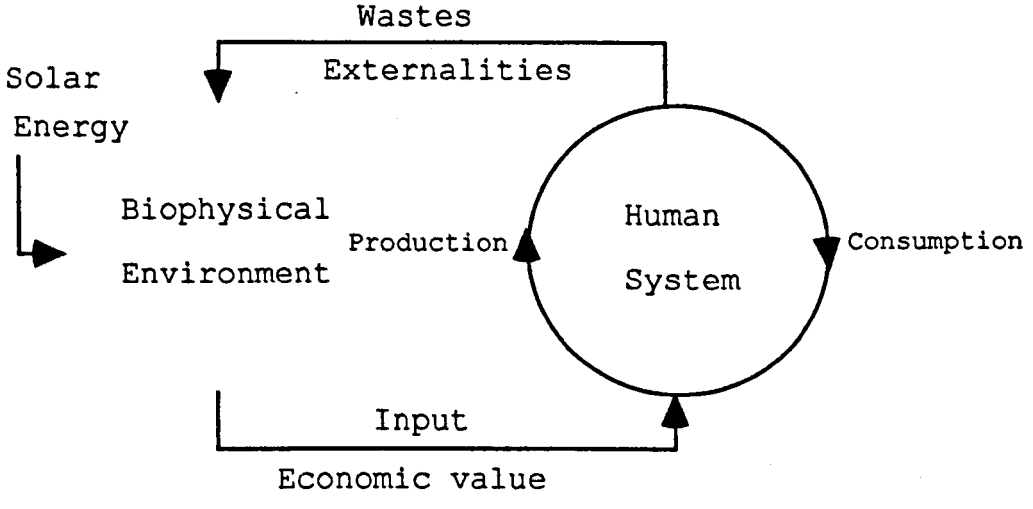

Figure 2.2: The representation of the economic process. The ecological system is considered physically unlimited (Boulding,1966) and the human system apart from it. The inputs from the ecological system to the human system are represent by their economic value and the wastes are externalities. The flow of material, energy and service within the human system is considered continuous.

The availability and use of natural resources in the production process depend on the human system's perception of the potential resources' usefulness and value and the side effects of this process are considered externalities* (Commoner,1971); for example, air and water pollution.

The economic value of a natural resource is determined by the relative scarcity of that resource. In economics scarcity can be distinguished between absolute or Malthusian scarcity and relative or Ricardian scarcity (Barbier,1989). Thomas Malthus (1766-

*Externalities- "social costs considered as losses by the productive activities and borne by third persons or as cost elements shifted to society as a whole" (Kapp,1969,pp334).

1834) assumed that the stock of land was the limiting factor on growth while David Ricardo (1772-1823) assumed that the quality of the land was the limiting factor (Barbier,1989; Mather and Chapman,1995). Hence Malthusian scarcity applies to physical limits of a resource while Ricardian scarcity applies to the quality of the resource.

It has been argued (Ophuls,1977), however, that the definition of scarcity is very controversial as the human system has always faced scarcity problems in order to satisfy its needs and wants. The relative wants of the human system can be unlimited which satisfies the circular consumption- production model and constantly demands unlimited growth. On the other hand it fails to consider that the biophysical environment has physical limits. For instance, increasing global population has shifted what were previously considered local and regional scarcity problems to global ones (Meadows,1972).

One of the consequences of the neglect of the side effects of the production process is the increased stress upon the biophysical environment and this has given rise to a new type of scarcity. It is called renewable and ecological resources scarcity (Ress,1991) or simply ecological scarcity (Ophuls,1977) and is associated with landscape, wild life, and the quality of air, soil and water (Roome,1992).

Over the years societal pressures to improve the environmental performance of industrial processes and environmental quality of products has increased. Although there has always been some environmental concern about industrial activities, the major environmental concerns started in the late 1950's (Ansoff and McDonnell,1990).

The increase in environmental concerns resulted from the creation of new industrial areas where pollution was still a local problem, but with higher intensity, and with an increasing local concentration of different sources of pollution. However, it was only

after the 1960's that the ecological and social side effects of the economic process started to be considered as a sociopolitical issue (Carson,1963).

Consequently some modifications of the production-consumption model have been suggested by Pearce(1976) and Tietenberg (1988) in order to better represent the material and energy flow between the biophysical environment and the human system and vice versa. However, it is still not very clear how the balance between economic and ecological demands is to be achieved.

Other criticisms to the unlimited approach of the biophysical environment used in the economic model were also suggested by Georgescu-Roegen (1971), Kneese *et al.* (1970) and (Daly,1977). Georgescu-Roegen (1971) argued against the continuous growth assumption proposed in the consumption-production model. He used two of the basic laws of thermodynamics* to demonstrate his argument that the consumption-production model is limited to the earth's physical capacity.

The first law of thermodynamics is the principle of energy and matter conservation. It states that matter and energy can neither be created or destroyed. It can only be transformed from one form to another. The second law, which is also known as the entropy law, refers to the measurement of energy availability. Entropy indicates the energy's variability in quality and ability to do work. It is an irreversible process which represents the changes from a compact order to a random, dispersed form (Miller,1980). For instance, petroleum is an input of energy to the production process which can be transformed into final useful products that after use are converted into heat and other substances with very little ability to do work.

In the circular consumption-production economic model the inputs of energy and potential natural resources are considered to have low entropy values. They are transformed into goods and eventually into wastes, which are considered to have

* There are three laws of thermodynamics (Tipler,1991)

higher entropy values. The transformation of low entropy in high entropy is irreversible so more energy is necessary to maintain the economic system. The matter that goes into the production-consumption model is limited but can be recycled within the system. This will require, however, the consumption of more low entropy energy and eventually either material or energy will be disposed of back into the ecological system. Most systems that are part of the ecological system consume energy from the solar source. The human system, on the other hand, consumes energy from the solar source and from terrestrial sources that are non-renewable and limited.

The use of thermodynamics, therefore, demonstrates that to consider the production-consumption model unlimited is a drawback on the representation of human interaction with the biophysical environment. The human system must function within the physical boundaries of the biophysical environment.

Kneese *et al.* (1970) argue that the main concern of the circular production-consumption model is merely with services and the way goods are transformed into services. As they have pointed out, the inputs, which are represented by their economic value, and the outputs, which are externalities, of the production-consumption model are still physical objects, which after having been converted into services have to be disposed of either in the soil, water or air. They have, therefore, applied a material balance approach to demonstrate the material flow of the economic activities, where the biophysical environment should be seen as a whole. Although their model included the idea of the physical flow of resources, goods and wastes to the biophysical environment, they have considered the biophysical environment as a static system and have not included the physical limitations of the ecological processes and the ecological scarcity issue.

The principles of thermodynamics have been used in another model. The material and energy balance were used to propose the steady state economy model (Daly,1977).

Daly (1977) argues the driving force of the economic process proposed by Adam Smith (circa 1770) which has been called the "invisible hand", in which private self-interest leads to serve the common good. Daly (1977) states that the externalities or side effects of the economic process which he called the "invisible foot" leads the private interest to "kick the common good to pieces".

The ecological system is a common good or common property. For instance the atmosphere, oceans, biodiversity, the climate, silence and aesthetic surroundings. This common property has a physical limit to support and maintain all the subsystems that are part of it. If the natural system is, therefore, overused with no control, this can result in the "tragedy of the commons" proposed by Hardin (1968) where the biophysical environment's physical and biological limits will be exceeded and the systems' carrying and assimilative capacities reduced.

In order to achieve a balance between the "invisible hand" and "invisible foot" Daly (1977) proposed a steady or stationary economic process. In this stationary process the use of the potential natural resources could be reduced and extended by increasing the quality and durability of the goods and services produced within the economic process. These should reduce the energy and material input to the economic system; maintain the economic process over a longer period; and reduce the amount of wastes disposed of in the biophysical environment.

This model has some similarity with other living systems where young ecosystems are mainly productive, growing and require large quantities of energy and matter while mature ecosystems are characterized by maintenance, stability and quality (Odum and Odum,1981).

Despite the idea of a stationary economic process, originally proposed in 1857 as Daly (1977) has pointed out, the difficulty is still the definition of the limits to the model and also the inclusion of technological improvements over time.

Another model has been proposed using a systems approach to demonstrate the link between environmental and social problems with the economic process. This model suggests a limit to economic growth (Meadows,1972), but it has caused several controversies based on the assumptions used to establish the limits (Pearce,1976; McCutcheon,1979). The introduction of ideas about zero economic growth (Boulding,1966; Daly,1977) proposed were also controversial because of the social and economic differences among nations (McCutcheon,1979). On the other hand the increase in environmental awareness has highlighted the important interaction between environmental, social and economic demands (Mesarovic,1975).

The above critiques demonstrate that the economic process model is too narrow to represent the human system's process of adaptation to the biophysical environment.

Firstly, because the use of the potential natural resources (as a sink) is considered physically unlimited and dependent on technological, political, social and economic factors. Environmental factors are not included in the model.

Secondly, the unwanted results such as pollution, that are considered useless and with no value, are of no economic relevance and considered as externalities. However, these side effects can deteriorate the biophysical environment and affect other users, generating collective social costs (Kapp,1970).

Thirdly, the immediate economic approach for the use of the biophysical environment aiming to the rapid achievement of profit goals neglected the long term physical consequences and stresses upon the biophysical environment which are resultant of the production and consumption process. Some of the differences between the economic process and the actual characteristics of the biophysical environment are summarized in table 2.2.

It was only after the 1970's that the side effects of economic activities upon the biophysical environment slowly began to increase in economic, social, political, ethical and moral relevance (Shrivastava,1992). These pressures reduced considerably during the energy crisis in 1973 (Miller,1980) and started to grow again in the 1980's (Smith,1992). In the late 1980's the ideas of ecodevelopment culminated with the concept of sustainable development. The definition of sustainable development is

> *"development that meets the needs of the present without compromising the ability of future generations to meet their needs"* (WCED,1987,pp43).

The meaning of sustainable development is still vague and controversial (O'Riordan,1988,1993; Baroni,1992; Souza,1993). In 1992 the concept of sustainable development was launched as the cornerstone of the international environmental movement during the United Nations Conference in the Environment and Development - UNCED that took place in Brazil (Brown,1992). The outcome of this is yet to be observed but it has increased the relevance of the issue in government agendas. The international social and political debate about environmental issues has also introduced pressures and disagreements among nations concerning green issues, for example global warming and use of CFC (Buchholz *et al.*,1992). The essential idea about sustainable development is the requirement for governments to seek a balance between social needs, economic development and environmental demands, where they must address topics such as the demands of future generations, the biophysical environment, equity and participation of citizens in countries' strategies and planning (WCED,1987).

Major accidents, for example the chemical plant explosion in Bhopal (Shrivastava,1992), the nuclear power plant accident in Chernobyl (Soussan,1992) and the Exxon Valdez oil spill in Alaska (Buchholz *et al.*,1992) have highlighted and increased concerns about the possible major ecological consequences and threat of

human activity upon the biophysical environment, and the impact on human beings themselves.

FACTORS	BIOPHYSICAL ENVIRONMENT	ECONOMIC PROCESS
USE	collectivist	individualist
APPROACH	common property rights	private property rights
TIME SCALE	long term	short term
PERCEPTION	interrelated	fragmented
PHYSICAL LIMITS	limited	unlimited
INTERACTION	independent	dependent
IMPORTANT VARIABLES	chemical, physical, biological	technical, social, economic, political

TABLE 2.2: The Ecological System Characteristics and the Human System's Perceptions. The biophysical environment is a collective and interdependent system while the human system can be socially divided according to human, perceptions and actions (Source: Boulding,1966; Odum,1971; Simmons,1981; Hardin,1968; Kapp,1970; Commoner,1971; Daly,1973,1977; Meadows,1972; Georgescu-Roegen 1971; Kneese *et al.* 1970; Throop,1993).

Organizations are among the users of the biophysical environment; and the economic process that they are part of is within the ecological system. The balance between economic and ecological demands has therefore become a challenging issue for government and organizations on the setting of policies and strategies. It is also a major challenge for academia, because of the cross-disciplinary characteristics of environmental issues. The challenge is to establish the relationship between important economic and ecological elements. This will demand change and require the

development of a dialogue across disciplinary and organizational boundaries (Roome,1992).

2.4 - The Organization and Green Issues

Organizations are part of and instrumental to the economic process. They are created and developed around specific issues associated with the human system's adaptation to the biophysical environment. Organizations are socially constructed systems, which have individual objectives. These objectives can include business objectives such as profit, growth, stability and survival (Mikdashi,1986) and basic objectives such as social responsibility, environmental protection and quality standards (Steger,1993).

Organizations are considered as open and dynamic "living systems" (Miller,1955). However, there are important differences between a living system and organizations (Hannan and Freeman,1977). The first difference is that the definition of a population of organizations is an abstraction, which varies according to the investigator's interest. The second difference is that human organizations' structures can be decomposed in parts, but these parts are more difficult to identify. The third difference is the difficulty in defining "species" of organizations. The fourth difference is the definition of limits of the system of analysis. The last difference is that human organizations can expand over time.

Early investigations on organizations have considered it as a closed system having no influence or interaction with its surroundings. These investigations concentrated on the understanding of the various internal processes and their relations to the whole of the organization internal system. Organizations however are part of a wider process of human adaptation to the biophysical environment. They influence and are influenced by their surroundings. The closed system approach proves to be too narrow and simplistic because many of the problems occurring inside organizations could not be explained within this limited framework (Burrell and Morgan,1979).

Based on the work of von Bertallanfy (1950), that describes the characteristics of a living organism and its interactions with its environment, Katz and Kahn (1978) draw the similarity between organizations and living organizations and identified the characteristics of an organization. As a result, further investigations on organizations started to consider the importance of an organization's surroundings and also the existing interactions between an organization and its surroundings.

A historical evaluation of the changes occurring in the organization's "environment" has been suggested by Ansoff (1979) where he tried to demonstrate the increasing complexity and dynamics of the changes occurring outside the organizations and compare these to the internal changes occurring inside business organizations. This has been criticized as not a comprehensive history (Newman,1979), however, it can be very useful to demonstrate the complexity that numerous external factors can strongly affect and influence an organization's stability.

It has been suggested that the central role of organizations in the human system, and the legitimacy gap between organizational effectiveness and societal expectations, is shifting and changing (Ansoff and McDonnell,1990). These changes result in increased external demands upon organizations.

Strategic management is a discipline that investigates the strategic interactions between an organization and the organization's constantly changing surroundings. Lenz and Engledow (1986), however, argue that until recently no integrative guiding framework including and linking all the organization's "environment" external factors, which are considered to affect and have influence on organization's actions, have been developed.

That little consensus exists among researchers on the concept of an organization's "environment" is not surprising as it depends on different individuals' subjective perceptions. Other researchers (e.g. Duncan (1972)) have already found that the

perception of environmental dimensions varies among individuals. No organization in fact can entirely define and know its environment. Organizations are constantly monitoring, learning and changing to adapt themselves to their "environment". Hence the definition of the boundary of both an organization and its "environment" will depend on the level of analysis and dimension of investigations (Scott,1981) and on the focus of inquiry (Fahey and Narayanan,1986).

Throop (1993), Shrivastava (1994) and Ketola (1995) argue that definitions of organizations' "environment" are too narrow and do not include the biophysical environment. The short-term profit goals do not take into account the impacts and long term consequences upon the biophysical environment. As with other disciplines in social science research, researchers in strategic management still seem reluctant to consider the relevance of ecological forces upon organizations (Smith,1993; Dodge,1995). Although there is evidence that some organizations are already considering ecological forces as part of their activities and plans (Fischer and Schot,1993; Starik *et al*,1996).

It is argued that most organizations have a very utilitarian perception of the biophysical environment (Colby,1990). The biophysical environment is a source of potential resources that can become useful and valuable depending on product, technological and market forces. The side effects of the production processes are mostly neglected. This has been considered the "technocentric approach" applied by business organizations in their interaction with the ecological system and this conflicts with the "ecocentric approach" where the ecological system is considered for its intrinsic values (O'Riordan,1977).

The organization's representatives' perceptions of external forces and interpretation of the external influences, the "subjective" or "enacted environment" of an organization,

(Weick,1969; Pfeffer and Salancick,1978) will therefore affect the organization's choice of actions and directions, its structure and its internal processes (Pearce II and Robinson,1994). To achieve their business objectives organizations have to match their internal organization's capability with external and internal demands (Ansoff,1979). Therefore, different perceptions of organization's "environment" can have great influence on the organization's plans which are designed to achieve the organization's business objectives (Lenz and Engledow,1986).

Five social factors have been identified in organizations' "environment" that can affect any organization (Andrews, 1980; Pearce II and Robinson, 1994). These social factors are irrespective of a single organization's activities but they introduce opportunities, threats and constraints to any organization. These factors are technological; social; economic; political; and ecological (Andrews,1980).

The physical consequences of human actions upon the ecological system can no longer be disregarded and seem to be introducing a new paradigm to research on organizations. Therefore, green issues must be considered in investigations of an organization's "environment" (Throop,1993; Ketola,1995; Dodge,1995).

It has been suggested that to understand the interdependence of organizations with their environment three different concepts should be simultaneously considered (Pfeffer and Salancick,1978). The first concept is effectiveness, which can be considered as an external standard of the organization's performance. The second concept is the definition of the organization's boundaries, which can be a very difficult task and depend on several internal parameters to be determined within the organization itself. The last concept is the constraints upon the organization that will impose certain limits to its actions. These constraints can be generated by the organization's own history, the variability of internal and external information, legitimacy and the collective rationale (Hannan and Freeman,1977).

Ecological forces acting upon organizations can increase their vulnerability. These forces bring organizations great uncertainty because of the complexity associated with environmental issues (Roome,1992) and also because organizations have little control over some of the emerging ecological demands (Longsdon,1985).

Ecological forces are a demand on organizations' overall performance. Environmental controls are constraints setting limits to organizations' actions upon the biophysical environment. These limits can be opportunities or threats to organizations.

More recently however environmental management system standards have been proposed to enable organizations to develop an integrated system to manage green issues (Welford and Gouldson,1993). Environmental management systems should allow organizations to achieve and systematically control the level of environmental performance that they set themselves (Gilbert,1993).

Environmental management systems are still at an early stage of implementation by organizations. The first environmental management system standard was launched in 1992 by the British Standard Institute as a voluntary and systematic approach to the management of environmental issues by organizations (Gilbert,1993). An environmental management standard is considered to be a guide to the development of effective environmental management systems and to allow constant assessment of the organization's environmental performance.

Other standards have also been proposed since 1992 (Starkey,1996); however most of these standards will probably be superseded by the standard included in the current ISO 14000 series launched by the International Standard Organization in September 1996 (BSI,1996). This has already happened in the UK (BSI,1996).

The elaboration of the ISO 14000 series has been very closely monitored by government and businesses from all over the world (ASTM,1996). The ISO 14000

series consists of several standards related to the management of environmental issues. It aims to provide organizations with a more level competition when considering environmental issues.

Some of the definitions and boundaries established by the standard are very broad; for example, according to the standard the definition of "environment" is as follows:

> "*The surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation. Surroundings in this context extends from within an organization's location to the global system*" (BSI, 1996,pp9).

This definition includes the two "environments" discussed previously. However, because of the complexity and difficulty in establishing the global impacts of the organizations' actions the standard also defines a boundary for its application. It establishes that it is to be applied to:

> "*those environmental aspects which the organization can control and over which it can be expected to have an influence*" (BSI, 1996,pp9).

This is too vague and can be open to dispute because an organization's decisions on this limit may not be considered enough to satisfy other stakeholders' expectations and ecological demands. This suggests that an investigation on how organizations perceive ecological forces should be undertaken which gives rise to the following research question: "*How does an organization see ecological forces and environmental controls?*"

According to environmental management system standards BS EN ISO 14001 (BSI,1996) and BS7750 (BSI,1994), the cornerstone of the implementation of the environmental management system is the establishment of the environmental policy.

A policy can have either a wide view or a narrow and specific view (Pearce II and Robinson,1994). In the first case it can be compared to a strategy and will provide the framework for making decisions. In the second case an environmental policy is an administrative tool to managerial action. It has been suggested that an environmental policy should in fact include both strategic elements and administrative tools (Gilbert,1993).

Ketola (1995) also argues that an environmental policy should be based on the organization's representatives strategic vision on green issues but they must also reflect the organization's responsibility for the use of the biophysical environment and take into consideration society's ecological demands and changes in ecological values.

According to the environmental management system standard an environmental policy is

> " *A statement by the organization of its intentions and principles in relation to its overall environmental performance which provides a framework for action and for the setting of its objectives and targets* " (BSI, 1996,pp10).

Environmental policies have normally been a public relations tool (Ketola, 1995), however, the BS 7750 standard suggests that they should "*provide a framework for action and for the setting of organizations' objectives and targets*". Organizations have therefore to demonstrate in their policy that the environmental concerns of different stakeholders are included and are consistent with the issues set in the policies. The organizations' economic and ecological goals must be reflected in the policies. The organizations' environmental policies must match with their environmental behaviour. Consequently, this gives rise to another research question: "*What are an organization's environmental policies?*"

2.5- Summary

In this chapter the idea of systems and their environment were introduced. An organization is an example of an open system that exchanges matter, energy and information with its environment. Investigations on organizations' environment depend on researchers' focus of inquiry. In this research the biophysical environment of an organization is the focus of inquiry. The biophysical environment does not act upon organizations. Organizations' actions upon the biophysical environment contribute to the development of a social process (associated with green issues) that eventually affects organizations.

Ecological forces, environmental controls and the growing importance of green issues in economics have been discussed. The strategic implication of green issues for organizations depends on the organizations' representatives perceptions of the biophysical environment; for example, through ecological forces and environmental controls which will consequently affect the organizations' choice on how to: address them; organize its response to the ecological demands; and establish the balance between economic and ecological demands.

The first research question for this investigation is to establish "*How does an organization perceive ecological forces and environmental controls*?" However, the ecological forces and environmental controls perceived by organizations may be different from those that the organizations take action on (Ketola,1993). Therefore, a second research question should be made as follows: "*What are an organization's environmental policies*"?

Organizations are part of the social process associated with green issues. The organization as an element of this social process is discussed in the next chapter.

CHAPTER 3

ORGANISATIONS AND THE GREEN ISSUE

The objective of this chapter is to identify organizations as an element of the process associated with ecological forces and environmental concerns.

3.1 - Organizations' Economic Activity and Green Issues

In this research "economic activity" means the strategic process of an organization. Strategic process is defined as "a set of decisions and actions that result in the formulation and implementation of plans designed to achieve a company's objectives" (PearceII and Robinson,1994, pp3).

There are different views on how strategies are made and implemented to achieve an organization's business objectives (de Wit and Meyer,1994) but not much has been done concerning organizations' basic objectives. For instance, environmental protection, or even how the achievement of basic objectives may affect business objectives (Steger,1993). Traditionally environmental protection has been thought to conflict with organizations' business objectives (Schot and Fischer,1993) as it could bring additional costs to organizations and affect the organization's competitiveness. Evidence shows that depending on the environmental issues associated with an organization's activities and products, the applied technology and market conditions, this is not generally the case (Winter,1988; Shrivastava,1992; Steger,1993). This strengthens the idea that the conflict between environmental and economic demands is "a false dichotomy" (Porter,1991). Hence it is reasonable to assume that ecological protection and environmental management may in fact enhance economic competitiveness in the long term but this will depend largely on appropriate strategies

to coordinate and minimize conflicts between ecological and economic demands (Steger,1993).

Steger (1993) suggests the impact of ecological forces and environmental controls on organizations' "economic activity"(strategic process) depends on two main factors: the environmental impacts and risks associated with an organization's activities and products (generation of constraints) and market opportunities for environmental protection (opportunities or threats). The inclusion of environmental demands as part of an organization's strategy involves therefore a mix of managerial, technical, ethical, social, operational and competitive aspects (Walley and Whitehead,1994; Corbett and Wassenhove,1993).

It has been argued however (Welford and Prescott,1992) that there is no single model of environmental strategy. In this research environmental strategy means any change introduced in an organization's strategic process as a consequence of an organization's perceptions of and response to environmental controls and ecological forces.

Several researchers (Winsemius and Guntram,1992a; Pauchant and Fortier,1990; Hunt *et al.*, 1990; Scher,1991; Brehaut,1991; Steger,1993; Roome,1992; Slavich,1993; Newman and Breden,1992; Schot,1992; di Norcia *et al.* 1993) have proposed or empirically identified different stages of an organization's response to ecological demands. Although the identification of different stages confirms that organizations have gradually included green issues as part of their strategic process and also suggests that organizational response to ecological demands vary, it does not give much indication of the real implications for organizations' strategic process. The integration of green issues with the organization's strategic process can be a very complex and difficult task (McCloskey and Smith,1995).

Dill (1979) has suggested that to be effective, strategies must include a base building

process and a direction building process. In the case of environmental strategies the base building process relates to the continuous search for the legitimate use of the biophysical environment and the direction building process relates to product, technology and market opportunities.

It is argued that an environmental strategy includes three different dimensions (Rothenberg *et al.*,1992) which are not exclusive between one another. The three strategic dimensions are the business dimension, the political dimension and technical dimension. The business dimension involves the link between green issues and competitiveness. The political dimension involves the organization's interaction with other stakeholders. It is the base building process of the strategy. The technical dimension guides the changes to organizations' environmental performance. These strategy dimensions include the five social factors (Andrews,1980) that affect an organization.

3.2 - Organizations and the Green Issue: The Cause-and-Effect Process

Understanding the process associated with ecological forces and environmental controls can be very complex as it involves considerations of time, space, organizational, technical and human and natural resources issues (Roome,1992). Therefore, a systems approach (Roome,1992; Stead and Stead,1992; Callenbach *et al.*,1993) and a theoretical ecological complex framework, proposed by Duncan (Duncan,1959; Dunlap and Catton,1979) that represents the process of human adaptation to the biophysical environment are suggested to describe the social process associated with ecological forces and environmental controls. The systems analysis provides flexibility and gives a framework for multidisciplinary analysis while Duncan's framework provides a theoretical guide to represent the process.

Duncan (1959) argues that the process of humans' adaptation to the biophysical

environment depends on four elements that are functionally interdependent as depicted in figure 3.1. These elements are: population, social organization, technology and the environment. Social forces represent the interdependence between these elements. For example, Andrews' (1980) five social factors. For the purpose of this research the social organization is represented by the economic activity of an organization.

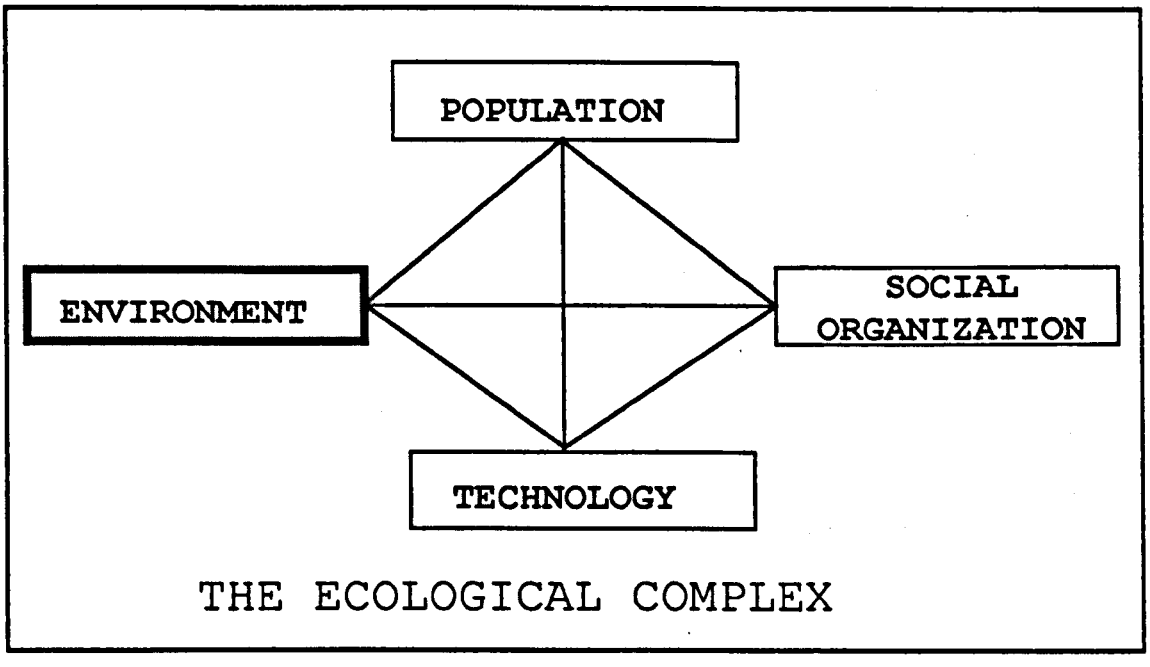

FIGURE 3.1: The Ecological Complex Framework. (Source: Duncan,1959, pp683). The ecological complex framework theoretically represents the process of humans' adaptation to the biophysical environment. It is formed by four elements that are functionally interdependent and linked by social forces.

Duncan's framework was limited to represent the social links associated with the process of humans' adaptation to the biophysical environment (Hawley, 1968; Dunlap and Catton,1978); however, this proves to be too narrow to represent green issues. Similarly to previous economic models (see section 2.3) the flow of material and energy need to be added to his framework.

In this research the main focus of inquiry is the relationship of an organization to the

biophysical environment. Organizations have already been defined in section 2.4. They are part of the economic process (discussed in section 2.3) and also part of the process of human adaptation to the biophysical environment. The achievement of organizational business and basic objectives (see section 2.4) depends on the organization's strategic process.

By drawing a comparison between Johnson and Scholes' (1997) internal and external organizational strategic elements and Duncan's framework, the environment of the organization is divided into two components. The first component is represented by the biophysical environment as shown in the framework and the second component is the social environment which is represented by the social links between population and organization, and by technology. Population represents the stakeholders of the biophysical environment, including the stakeholders of the organization. The stakeholders of the organization are every individual or organization who is affected by or can affect the organizations' actions. Organization culture and resources are internal to the organization. Both have influence on the organization's process of adaptation in response to environmental controls and ecological forces generated by the stakeholders.

3.2.1- The Organization's External Strategic Elements

The environment is considered to be everything outside the organizational boundary but as discussed previously the organization and its environment boundaries are not easily identified. Green issues are part of the human biophysical and social environment therefore both "environments" are relevant and are to be considered. The competition and conflict for the use of the biophysical environment occurs in the organization's social environment, however, the physical impacts of an organization's actions affect the biophysical environment. The biophysical environment is not exclusive to any organization. It is a limited "common property" (Hardin,1968) where

any action upon it is limited to its carrying and depurative capacity, and can affect other "users".

The biophysical environment is the human system's source of commodities, non-commodities and life supporting systems. It is also the depot of byproducts produced by humans. One of the functional links between the biophysical environment, stakeholders and organization, which was not considered by Duncan (1959), is the physical flow of energy and materials. The social representation of flows of energy and materials from the biophysical environment to organizations and to stakeholders is part of the economic process discussed in the previous chapter (section 2.3).

Organizations transform potential natural resources (material and energy) into commodities that flow into the human system. Within the human system there is a flow of intermediates, material to be recycled and products. The products flow between an organization and stakeholders, for example, from the organization to other organizations and customers. Within the human system there is also a flow of services and money between the organization and stakeholders.

While the flow of material and energy can be assessed by economic variables, the effects of the organization's actions upon the biophysical environment recognize no economic or political variables.

Although the final flow of byproducts generated by stakeholders and the organization are externalities to the economic process, this flow exists and must therefore be considered. This flow generates ecological scarcity. The flow of non-commodities from the biophysical environment to stakeholders represents other uses of the biophysical environment, for example the direct use of the biophysical environment as a source of materials and energy that are not considered within the economic process, recreation and enjoyment.

The analysis of the biophysical environment and the assessment of the impacts caused upon it are crucial to the implementation of any green strategy by organizations, however, it is impossible to analyze all the global ecological effects of a specific organization upon the biophysical environment (McCloskey and Smith,1995).

The increase in population has been considered among the causes of environmental problems because of the increased demand upon the biophysical environment to satisfy peoples' wants and needs (Meadows,1972). This debate is included as an environmental concern of stakeholders. In this research the stakeholders represent everyone who is affected or has any interest in a specific organization's actions upon the biophysical environment. Stakeholders represent any individual or group of individuals that have interest in the organization's environmental behaviour, independently of having any other link with the organization. These individuals or groups of individuals are therefore not exclusive between one another. It is very likely that individuals, who are at the same time part of an organization and also members of the public, will be faced with the "commons dilemma" (Edney,1980), where the organization's objectives are against the individual's demands of environmental quality.

The identification of main stakeholders and their environmental demands is crucial to determine the ecological demands that can affect the organization or how environmental controls and ecological forces may affect other factors already known to affect organizations.

Humans (stakeholders and organization) perceive the biophysical environment usefulness and the changes inflicted by the human system's actions upon it. Some of the changes upon the biophysical environment or upon human health are easily observed, for example, the consequences of accidents. However very often the relationship between actions and their ecological effect are delayed in time and not

easily noticed. As a result of the complexity involved in the ecological process and not enough knowledge about the ecological process' mechanism there is great dispute on the definition of the biophysical environment's capacity (carrying and assimilative capacity) and the "real value" of the biophysical environment (O'Riordan, 1991).

The consequence of the changes inflicted upon the biophysical environment by humans' actions is the generation of environmental concerns (Kempton,1993), changes on individuals' ecological values (O'Riordan,1991) and, conflict and competition between stakeholders and between stakeholders and the organization for the use of the biophysical environment (Pitt and Zube,1987).

It is argued that technology is considered the main cause of deterioration of the biophysical environment (Commoner,1966). The development of technology not only contributes but is also very significant to the process of human adaptation to the biophysical environment. Organizations and stakeholders can influence and be influenced by technology.

The increase in environmental controls and ecological forces has promoted the development and economic importance (DTI,1991; Porter,1991; DTI,1994) of environmental technology. Environmental technology includes: clean technology and monitoring technology. Monitoring technology provides the means to increase the scientific knowledge about the effects of human actions upon the biophysical environment. The increase in environmental information increases environmental awareness and concerns and demands technological improvements to reduce the side effects generated which cause the deterioration of the biophysical environment. Environmental information generates the demand for clean technology to remedy when possible environment impacts caused in the past. Technological developments and changes in technology can affect the way humans interact with the biophysical environment.

It is argued that technology can fix the problems caused by technology itself (Weinberg,1993). This has been considered the "technocentric approach" applied by some users of the biophysical environment in their interaction with it. This conflicts with the "ecocentric approach" of other users, where the biophysical environment is considered for its intrinsic values (O'Riordan,1977). Organizations have a technocentric approach to ecological demands, which sometimes creates the illusion that science and technology are infallible (Collingridge and Reeve,1986). Technology is also the cause of physical modifications of the biophysical environment, for example, buildings, roads and water reservoirs. This is the modified biophysical environment suggested by Dunlap and Catton (1979).

Stakeholders and the organization are socially interdependent among themselves. The social link between stakeholders and the organization are represented by political, economic and social factors, as identified by Andrews (1980). All these factors are a combination of issues that are constantly being generated by the on-going process of human social development. The increased relevance of environmental concerns is among these issues and is influencing the other factors. As discussed previously ecological factors are the changes or constraints introduced to other social factors and technology as a consequence of environmental concerns (McCloskey and Smith,1995).

Duncan's (1959) framework is useful to demonstrate that any action upon the biophysical environment can not be investigated in isolation. For example, an organizations' actions upon the biophysical environment will certainly affect other users and the organization itself. Human actions upon the biophysical environment and their perceptions are dynamic. They change both in time and space.

The challenge to the organization is: to perceive the links; to identify the organization's absolute and relative contribution to the changes inflicted upon the biophysical environment; to identify how its actions affect other stakeholders and the

stakeholders' environmental concerns; to identify how stakeholders' actions can affect the organization's environmental behaviour; and decide on the actions, for example technological improvements, that can be taken to balance the organization's economic objectives with ecological demands.

The actions taken by organizations to integrate green issues as part of its existing management systems can provide an indication of management priorities. This requires further investigation to compare an organization's environmental policy to their actual environmental behaviour. This gives rise to a third research question, "*How are the environmental policies implemented?*".

3.2.2- The Organization's Internal Strategic Elements

The balance between economic and ecological demands is greatly influenced by external factors but the organization's capability to achieve this balance depends on its internal strategic elements. The adaptation of organizations to the changes occurring in the organization's environment and to stakeholder demands depend on their ability to match them to the organization's capability, which includes organizational elements such as organization culture and resources.

The organization's ecological behaviour is associated with the organization's actions upon the biophysical environment and its response to environmental controls and the ecological demands of different stakeholders.

The organization's culture represents the internal values and beliefs that guide the organization's actions. However, because of the "commons dilemma" individual ecological values may be different from the organization's actions and environmental behaviour. In this research an organization's response to ecological forces and environmental controls are considered to represent the collective organizational values and beliefs in relation to ecological issues.

Organizational resources provide the means to the achievement of an organization's objectives. Some organizations are able to comply with a more stringent standard than required by existing external agents. However, in this work only what organizations do will be reported, not what they are capable of doing in terms of compliance with environmental legislation and regulations.

3.3 - Organizational Response to Ecological Demands

Organizations seem to acknowledge that virtually all their activities and products have some sort of ecological implication (McCloskey and Smith,1995). However, organizations have always been reactive and resisting to ecological demands (Steger,1993). The inclusion of ecological demands as part of an organization's strategic process has initially been "added-on" in a piecemeal approach depending on emergent external conflicts on the use of the biophysical environment and internal conflicts between economic and ecological demands (Longsdon,1984; Petulla,1987).

Green issues however increased in socio-political importance (Carson,1963; Shrivastava,1992) and the change in society's ecological values became more widely accepted and recognized (Dunlap and Scarce,1991; Löfstedt,1995; O'Riordan,1991), organizations slowly started to change and recognize the strategic importance of environmental management (Smith, 1992; Shrivastava,1992).

A great number of managers have already realized that ecological and economic demands must be linked together (Vandermerwe and Oliff,1991); however, there still seem to have been some confusion as to what exactly constitutes environmentally acceptable practices (McCloskey and Smith,1995).

Petulla (1987) has investigated the response of business organizations to ecological demands and observed three different categories of environmental management as

shown in table 3.1. These patterns can be applied to actual business organizations' responses to the management of environmental issues, for example the environmental management of oil organizations (Longsdon,1985).

The first reaction pattern is described as crisis-oriented, where conflict prevails and the actions are very reactive. The second pattern is cost-oriented where negotiation, compliance and prevention are seen as the best alternatives for the management of green issues. Some environmental responsibility is accepted. The last pattern is enlightened where green issues are considered to have strategic importance. Cooperation, planning, innovation and research become relevant to the management of environmental issues. Green issues become more integrated in the organization's management systems and strategic processes.

The change of organizational structure with the creation of boundary-spanning* functions, for example, is a common response of organizations to protect themselves from uncertainties generated in the organizations' environment (Longsdon,1985) as shown in table 3.1. However, the more pervasive the issue, the organization structure becomes more permanent and the boundary-spanning function takes a higher level in the corporate hierarchy (Holmes,1978).

The management of environmental issues was primarily considered as an operational constraint to organizations, as observed by Longsdon (1985) in her investigations on oil organizations. The initial options chosen to comply with ecological demands were the implementation of fast and short-term solutions, for instance end-of-pipe technologies, as opposed to long-term solutions, such as the incorporation of environmental considerations as part of process technology and products.

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*Boundary- spanning functions- functions created to protect organizations from disruption. "The goal is to improve the organization's ability to deal with uncertainties generated in the external environment" (Longsdon,1985,pp60)

ISSUES OBSERVED	Crisis-Oriented	Cost-Oriented	Enlightened
ENVIRONMENTAL POLICY	no	yes	yes
STRUCTURE Environmental Unit	no environmental unit	environmental unit	environmental unit
BEHAVIOUR	conflict	negotiation	cooperation
STRATEGY	crisis management	prevention	planning/strategy
EXTERNAL ENVIRONMENTAL INFORMATION	none	corporate reports	corporate reports and others
PARTICIPATION	none	government	government and others
INTERNAL INFORMATION	no training	some training	training/education
ATTITUDE	denial	compliance	innovation
INTEGRATION	-	some technical studies	research

TABLE 3.1: Categories of Business's Environmental Strategy. The different categories are classified according to management issues observed in different business organizations. These issues are the results of an investigation in environmental management of oil organizations (Modified from Longsdon,1985 and Petulla,1987).

Steger (1993) conducted empirical work involving senior managers of German organizations and found that environmental issues are increasingly becoming a market issue. From Steger's findings, ecological demands are considered both as a threat or an opportunity.

At the time of his research most organizations still considered ecological demands as

a threat which explains the reactive behaviour of most organizations found by Petulla (1987). The response of organizations was found to be mostly externally driven by environmental legislation and regulation. However, according to Steger (1993) later investigations show that the organizations no longer perceive ecological demands as conflicting with other organizations' business objectives; they recognize a growing market for environmentally friendly products and are implementing preventative measures. The organizations are still not implementing a comprehensive environmental strategy as not all the activities in the organizations take green issues into consideration. He found that compliance with environmental legislation and regulation was still the main factor inducing changes in organizations' behaviour.

Longsdon's (1984) and Steger's (1993) findings were very similar. However, the trend shows that organizations have started to recognize and accept their responsibility for the side effects of their activities (Schot,1992). The main reasons that lead organizations to change their behaviour and integrate environmental issues as part of business strategies have been suggested and investigated by Steger (1993) as follows:

Importance of the Issue - ecological and social responsibility; legislation and government regulation; safeguarding of corporate viability and risk aspects; image and public relation; employee protection; market pressure, market potential and sales possibilities; protection of the environment and quality of life; and value adding potentials and revenue;

Reasons for Organizational Change - statutory obligations; better efficiency of environmental protection management; better public image; better motivation and identification of employees; environmentally oriented change in individual and divisional policies; exploitation of market opportunities; and environmentally oriented change of business policies.

Recent investigations (Shrivastava,1992; Rappaport and Flaherty,1992) show that certain organizations have changed their approach to environmental management. Organizational responses are becoming more internally driven, innovative and in certain cases new market opportunities and cost reduction as a consequence of pollution prevention and reduction of emissions and wastes, have been identified. However, Ketola (1995) argues that the potential of environmental policies is still to be recognized by organizations. In her investigations of oil organizations she has found that environmental policies are still not fully integrated and co-ordinated with their business goals and general strategies.

Steger (1993) suggests that it is just a matter of time for organizations to learn how to deal with environmental issues. Further research is therefore necessary to understand how organizations' environmental policies are linked to organizations' strategies. These gives rise to a further research question, "*How are green issues linked to strategy?*

3.4- Environmental Management Tools used by Organizations

Organizations have developed various management tools in order to respond and manage the ecological demands on their activities and products. These management tools are programs or techniques to identify, reduce, monitor and improve the organizations' environmental performance. Some examples of these tools are: environmental, health and safety auditing, product life cycle analysis, environmental risk assessment, product stewardship, waste minimization programs, zero pollution production strategies, business portfolio strategies, recycling and crisis decision-making simulations (Shrivastava,1992). The investigation on the effectiveness of each different management tool is beyond the scope of this research.

3.5- Summary

Organizations are part of the social process associated with the reaction of different users to the use of the biophysical environment. They have to share the biophysical environment with all the users. The increasing socio-political importance of green issues and the growing pressure, through ecological forces and environmental controls, for organizations to be responsible for their actions upon the biophysical environment are demanding changes in their actions. Previous researchers show that organizations have previously been reactive to demands on their actions upon the biophysical environment. The organizations are, however, increasingly changing and adapting themselves to this social process.

The intensity with which organizations are affected by this process is reflected in the change in their actions and behaviour towards the biophysical environment. Therefore, the third research question for this investigation is: "*How are the environmental policies implemented?*" This question shall provide the indication of issues that the organization considers as a priority and acts upon. The fourth research question is: "*How are green issues linked to strategy?* This question shall indicate how the adaptation of the organization to ecological demands can affect the organization's business goals and general strategies.

The research strategy used in the investigation of the research questions established in this chapter and in chapter 2 is discussed in the next chapter.

CHAPTER 4

RESEARCH STRATEGY

4.1 - Research Questions

The review of previous research outlined in the preceding chapters has identified four research questions to be addressed by this thesis. These look at the relationships between an organization's economic activity, "green issues" and the social processes linked to environmental concerns and ecological forces, which are affecting organizational strategies. The purpose of this chapter is to identify a research strategy and methodology for answering these questions.

The first question is: *How does an organization perceive ecological forces and environmental controls*? For an organization the boundary and context of its environment depends largely on how the organization, through its employees, interacts with the external surroundings and perceives the external forces affecting the organization. Employees' perceptions of ecological forces and environmental controls, at any level, provide crucial information about environmental issues to be included as part of the strategies of an organization.

The second and third research questions are W*hat are an organization's environmental policies*? and *How are the environmental policies implemented?* The investigation of internal changes in an organization as a consequence of the external ecological pressures affecting it, and the actual response to these pressures, provide information on the importance of green issues to the organization. This information allows for the assessment and identification of the relevant environmental issues that are taken into consideration by the organization.

The fourth research question is *How are green issues linked to strategy*? The investigation of organizations' adaptation and response to environmental concerns and ecological forces also provide an indication of the balance between organizations' economic and ecological demands.

4.2- Research Strategy

The advantages and disadvantages of different research strategies depend upon the characteristics of the topic under investigation (Yin,1994). A research strategy provides "*the overall structure and orientation of an investigation*" (Bryman,1989, pp 28).

4.2.1- Methodological Approach

The methodological approach chosen for this research took into consideration the difficulty of data access and reliability, the relatively small sample size, and the contemporary characteristic of the phenomenon under investigation.

The available information on organizations' environmental management strategies is still very small despite the increase in external ecological forces affecting organizations. It is suggested that oil organizations are "pretty cagey" about their strategies for competitive reasons and also to avoid too much exposure (Ross,1987). Organizations have begun only recently to provide environmental policies and reports describing objectives, environmental programs and results achieved. As a consequence most of the investigations undertaken in this topic are still very prescriptive, with little in-depth empirical research or analysis.

For research into a new area of investigation an exploratory approach was appropriate. The organizations' environmental management decision-making processes were

observed and described from empirical observation. The use of modeling and statistical techniques would have been too narrow in focus and, therefore, inappropriate at this early stage, where the primary objective was to explore and unveil the actual structure, process and driving forces behind the decision-making of organizations' environmental management.

The use of a qualitative approach was appropriate for the empirical analysis of the investigation. The use of qualitative research gives priority to the perspectives of those being studied and examines reality in processual terms (Bryman,1989). Walker (1985) has argued that the use of qualitative research is useful in investigations where there is not sufficient information or adequate theory to form a basis for analysis or the subject of inquiry is complex, not easily measured, and very sensitive.

4.2.1.1-Case Study

Case study was chosen as the research strategy for this research. It is applicable to empirical inquiries where the investigator "*has little control over events, and when the focus is on a contemporary phenomenon within some real-life context, especially when the boundaries between phenomenon and context are not very clear*" (Yin,1994,pp 1 and pp 13). It also "*allows an investigation to retain the holistic and meaningful characteristics of real-life events*" (Yin,1994,pp 3).

The aim of the case study was not to obtain accurate numerical quantification for the responses but an indication of the flow of events and patterns associated with organizations' environmental management decision-making.

Two other important characteristics of the case study inquiry that supports its use in this investigation are; first it relies on multiple sources of evidence which decreases the difficulty of data accessibility and improves reliability; second it can benefit "*from*

the prior development of theoretical propositions to guide data collection and analysis" (Yin, 1994,pp 13).

The use of a case study strategy satisfies the exploratory, phenomenological and systematic approach proposed for this investigation.

4.2.1.2- Possible Problems in Using Case Study Research Strategy

There are important points to be considered when a case study is chosen as a research strategy: data interpretation, bias avoidance, generalization and research time required (Bryman,1989; Freeman,1993; Yin, 1994).

> *"The fieldworker's understanding of the social world under investigation must always be distinguished from the informant's understanding of this same world.... To argue that we have become part of the worlds we studied, or that we understand them in precisely the same way as those who live within them do, would be a grave error." (Van Maanen and Kolb,1985)**

> *"researcher's claim to neutrality, objectivity, descriptive faithfulness, or benign intent is a matter of perspectives."(Punch, 1986)***

From the quotations above the possibility of different views of social reality are recognized which can affect data interpretation and also the influence of the researcher's own experience which can increase the research bias.

The use of a single researcher was therefore a limitation. Since research of environmental issues certainly needs a multidisciplinary approach, a team of experts from different backgrounds should be involved. Such a team would make it possible to cover several aspects of environmental management and emphasize the different approaches, which are fundamental to the interpretation of social reality.

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* (quoted in Bryman, 1989, pp 164)
** (quoted in Freeman, 1993, Ch 2)

To reduce data interpretation and bias avoidance problems the use of multiple sources of evidence and a theoretical framework were used. The framework was adjusted to allow the inclusion of new facts and ideas and provided guidance for data collection and analysis. The use of multiple sources of evidence increased the opportunity for checking interpretations and identifying patterns.

A third problem in case study research has been "*the accusation of limited generalisability*" (Bryman, 1989, pp 177). The main goal of a case study, however, is "*to expand and generalize theories (analytic generalization) and not to enumerate frequencies (statistical generalization)*" (Yin, 1994, pp 10). In this research the use of different organizations and refineries in the first stage provided sufficient evidence to depict patterns and linkages of theoretical importance. These patterns provided the means to the identification of the final strategic environmental management framework, which was later used in the in-depth investigation of the single organization.

In this research "*the general validity criterion is whether the researcher has gained full access to the knowledge and meanings of the informants*" and "*the reliability question is whether similar observations will be made by different researchers on different occasions*" (Ketola, 1995,pp54). The path chosen in this research to improve validity and reliability aims towards these goals.

The last problem is the research time required to do a case study. Although the investigation of any contemporary topic has to take into account the possible changes that might occur during the research, a time limit had to be established that would allow enough material to be gathered. The period 1993-1995 was decided on because it is a period subsequent to the launch of the first environmental management system standard and allowed sufficient time to gather the necessary research data.

4.2.2- The Research Context

The decision to concentrate this investigation on the environmental concerns and ecological forces associated with the use of energy was because of the importance of energy to any living system within the ecological system. However, only in the human system is energy a commodity, which can be sold and bought.

The use of energy has changed the way the human system interacts with the biophysical environment and is crucial for human development. Energy use, however, gives rise to local, regional and global pollution. The balance between the importance of energy and its ecological consequences may be considered as "*the hardest challenge in the search for sustainable development*" (Schmidheiny,1992, pp 34).

The investigation of ecological forces affecting all the organizations involved in the production of energy proved too complex because of the different processes, environmental effects and controls affecting each one of the different sources of energy used by the human system.

A single source of energy was, therefore, chosen for the investigation. For a number of reasons the petroleum industry was selected. First, the human system has a high dependence on the use of petroleum. Second the ecological stress caused as a consequence of petroleum use. Third the similarity between oil organizations' activities, products and ecological effects. This allows a better comparison between organizations within the oil industry both in terms of management strategies and environmental behaviour. Fourth the physical limit associated with the use of a non-renewable natural resource which can jeopardize future human development. Fifth the long term concern about the effects of the industry's activities and products upon the biophysical environment. Last the constant change and stricter controls affecting oil organizations' activities and products.

Within the oil industry the refining activity was considered to be more suitable for this research as it links all the other activities within the industry. The refineries are responsible for the implementation of technical and operational changes required in order to comply with ecological and economic demands upon final products. The stricter external ecological controls on emissions generated by the industry and especially on oil products directly affect the refining activity's strategies and management systems. In addition other interested groups such as local communities more easily identify the local effects of the refining activity.

There is evidence that the initial ecological pressures upon the refining activity started in the 1940's (Longsdon,1985) which coincides with the increased use of petroleum as a source of energy. For the purpose of this research, the following issues are considered among the relevant factors to increase the uncertainty and strategic importance of environmental issues for organizations. First the increasing trend towards the introduction of legislation allowing public access to organizations' environmental performance information. Second the proposition of environmental management systems standards. Third the United Nations Conference on Environment and Development of 1992.

This investigation concentrated primarily on the contemporary phenomenon associated with ecological forces affecting business organizations. The main time period considered in the research extends to cover from 1993 to 1995, however, because most of the environmental concerns and ecological forces affecting organizations refer to the effects of past actions upon the ecological system a flexible approach for the investigation was required.

4.2.3 - The Sample Selection and Access

The decision on the sample of organizations had to be based on constraints of time, finance and accessibility and at the same time define a practical and significant grouping, which represented the population of oil organizations.

A decision was made to base the research on oil organizations, which have the full cycle of oil operations including both upstream and downstream operations. A sample frame of 83 oil organizations around the world was selected (FTOGI,1993). An initial letter was sent in April, 1994 to all of the organizations requesting general information on the organizations and their respective environmental management systems. The initial rate of response was 25%. A follow up letter was sent to those organizations not initially responding which increased the rate of response to 53%.

The aim of this initial selection was to examine the environmental information published by oil organizations and also to conduct a further selection of organizations that included information about environmental issues in corporate annual reports, environmental reports, or published environmental policies.

The publication of environmental information provides the organizations' views on the issues and the elements considered relevant by organizations when including green issues as part of their management systems. Environmental information is becoming a legal requirement in several countries (IISD,1993). However, beyond legal requirements the organizations decide on the information they provide.

It is argued that the comparison of statements from organizations' publications are limited because of the accuracy of reporting, and also because reporting might not represent real performance differences (Abbott and Monsen,1979; Ryan,1981; Ross, 1987). These publications, however, are a means of communication of organizations' views, performance and perception of the expectations of their stakeholders, which make them a useful source of information on organizations.

Logistic difficulties made it impossible to investigate the whole sample. It was therefore decided to define a geographical location criterion, which included a significant and broadly representative sample of oil organizations. The United Kingdom and Brazil were selected for the following reasons:

•in the UK most of the large oil organizations have oil refineries and these refineries have to comply with the same external ecological controls (in the case of product exportation, the refinery has to comply with the importing country's ecological demands);

•all the oil refineries in Brazil are part of the same organization and have to comply to the same federal environmental controls. Different state or local environmental controls apply in different parts of the country. In the case of product exportation, the refinery has to comply with the importing country's environmental controls;

•the UK is a developed country and Brazil is an emergent economy, which allows for the comparison of economic and ecological demands in two different markets;

•in the UK the oil organizations are worldwide integrated oil organizations while in Brazil the oil organization was a Brazilian state monopoly until 1995;

•the UK was the first country to launch an environmental management standard, the BS7750 while Brazil has still not established one (although the indications are that the country will follow the ISO 14000 series);

•the UK and Brazil have environmental legislation affecting both the refineries' products and activities. The Brazilian legislation is mostly based on American legislation;

The final sample of organizations selected included: British Petroleum, Conoco, Chevron, Elf, Exxon, Mobil, Petrobrás (Brazil), Petrofina, Phillips Petroleum, Shell, Texaco and Total. This sample represents 85% of the population of oil refineries in the UK (in total 11 out of 13 refineries including two refineries with a very small refining capacity) and 100% of the population of oil refineries in Brazil (10 refineries, four located in the same state and the other six in different states).

Total and Petrofina jointly own one of the refineries in the UK so both organizations were included. Elf is the majority shareholder (70%) in another refinery so only Elf

and not the minority shareholder was considered because of its small participation. Phillips Petroleum and Imperial Chemical Industries jointly own a refinery, however, this study concentrated only on oil organizations, therefore of these two only Phillips was considered. Shell has two refineries in the UK but because they are part of the same organization only one was selected to be part of the research. The final research sample selected in the UK comprised respectively of 11 oil organizations and 10 oil refineries, and, in Brazil, one oil organization and 10 oil refineries.

The difficulty of gaining access to organizations suggested by other researchers (Bryman,1989) was experienced and different strategies had to be used in order to obtain a sample considered to be large enough for the comparison of organizations. Organizations took considerable time to reply to the initial letter sent to the oil organizations' UK office and to the Brazilian oil organization's main office in Brazil, inviting them to take part in the research.

In the UK only two of the organizations selected initially accepted to take part in the research. One of them, however, withdrew later because of the length of time required for the interview. This refinery was contacted once more by telephone and they finally agreed to the interview. Another letter was sent but this time directly to the refineries' site managers. Three more organizations agreed to take part in the research, bringing the sample to a total of five refineries (50% of the final sample of oil refineries selected). In terms of refining capacity the refineries represent large (one), medium (two) and small (two) refining capacity which was considered to be a representative sample of the population of UK refineries.

In Brazil, the state owned Brazilian oil organization's head office agreed to take part in the whole research including the comparison of refineries' environmental managers' perceptions and the in-depth case study including the whole of the refining activity. Only one of the Brazilian refineries did not agree to taking part in the investigation

because of the time required for the interviews. Because of time and financial constraints only five refineries were finally selected. This allowed for the comparison between refineries in the same state and in three different states (three refineries in the state of São Paulo, one in the state of Minas Gerais and the last one in the state of Paraná).

Further contacts with the organizations were undertaken later on different occasions and when necessary, to obtain additional information.

4.3- The Research Aims

The aims of this research are firstly to answer the four research questions presented previously in this chapter (section 4.1); and secondly to develop a management tool to guide strategic managers in the monitoring of these changes, in order to include them in their organizations' strategies.

In order to achieve these aims an empirical study was undertaken on the refining activity of the oil industry. Oil organizations in the UK and Brazil were investigated. The empirical investigation of the perceptions and responses of oil organizations to ecological issues affecting them was divided into three main parts. These parts were divided according to the research questions and also accessibility to oil organizations. Each part aimed to provide the basis for the following part. The three research parts were divided as follows:

Part 1- investigation of environmental policies and corporate literature;

The aims of the first part were: firstly to obtain basic background information about the oil organizations; secondly to identify the issues considered relevant by oil organizations concerning the biophysical environment; thirdly to answer research questions 2 and 3;

Part 2- research on the response to environmental concerns and ecological forces of oil refineries in the UK and Brazil (actions and perceptions of organizations' representatives);

The aim of the second part was firstly to answer research question 1 and secondly to compare the information provided in environmental policies and corporate literature with the views of organizations' representatives.

Part 3- Case Study - research of the response of the refining activity of a single oil organization to environmental concerns and ecological forces;

The aim of the last part was to obtain a more complete investigation of the refining activity as a whole; secondly to identify the link between environmental issues and the refining activity strategy. This is research question 4.

In the first part the selected oil organizations were examined in terms of

- Commitment to ecological issues;
- Co-ordination and integration of ecological issues within the organization;
- Implementation of programs linked to ecological issues;
- Evaluation of environmental performance;
- Feedback on organizations' environmental performance;

The examination was undertaken using secondary source data (corporate annual reports, environmental reports and environmental policies). A profile of organizations' perceptions and response was established and a comparison between the organizations' environmental policies and the information provided in corporate annual reports and environmental reports, was undertaken (Chapter 6 and 7).

In the second part a comparison between the perceptions of organizations representatives of the refining activity in the UK and Brazil was undertaken. The investigation consisted of

- Description of the refining activity both in the UK and Brazil;
- Comparison of external environmental control systems;
- Experience of environmental representatives in oil refineries in the UK and Brazil;

The main goal of the empirical work was to analyze, first, the organizations' representatives' perceptions of ecological forces affecting refineries and the refineries' stakeholders. Second, the internal changes introduced to address such forces, including environmental goals and environmental performance monitoring. Third the environmental managers' vision of the continuous process associated with the formation of ecological forces affecting the refineries (Chapter 5). For this investigation primary sources of data were obtained using semi-structured interviews.

The third and last part consisted of the investigation of the whole of the refining activity of a single organization (Chapter 8). The aim of this empirical work was to obtain a more complete perception of the links between the organization and other elements of the social process associated with environmental concerns and ecological forces, how they affect the whole of the refining activity and how the refining activity respond (Chapter 9). In this investigation primary and secondary sources of data were used, including internal corporate documents.

4.4- Data Collection and Field Work

The data collection was divided into three stages. In the first stage corporate literature was used (secondary data-annual reports, environmental reports and environmental

policies). In the second stage semi-structured in-depth interviews (primary data) with a limited degree of observation were undertaken. In the last stage semi-structured in-depth interviews (primary data) with high degree of participant observation** were undertaken.

The use of corporate literature provided the organizations' perceptions of their external environment and their environmental performance. Caution, however, had to be taken with the public relations approach associated with the information provided.

The primary data was collected during the period June,1995 until December,1995. This period was not previously fixed as it depended on the organizations' representatives' time availability. This includes the interviews in the UK oil refineries and in the Brazilian State owned oil organization. Environmental authorities, both in the UK and in Brazil, and a representative of the UK oil organization were also interviewed. Later occasional contacts were made when necessary during the analysis of the data.

In the refineries in the UK and the initial interviews of refineries in Brazil there was a limited degree of information from observation. During the last part of the research, however, the researcher was an "observer as a participant" (quoted in Ketola,1995, pp50). The researcher was allowed to observe and discuss with individuals the issues related to the research during their normal activities for a period of two months. This participant observation allowed for a better understanding of the organizations' ecological behaviour and the organizations' decision-making process.

In total 67 interviews were undertaken with representatives of oil refineries in the UK and Brazil, environmental authorities and the UK oil organization. A list of the

** Participant Observation- "comprises the fairly prolonged immersion of the researcher in the context that is to be studied with the purpose of gaining first-hand knowledge of that context." (Bryman, 1989, pp142)

interviewees is presented in Appendix 1. A reference code has been used to identify each interviewee.

The environmental managers of UK refineries were interviewed. They were appointed by the organizations to be their representative in environmental matters. It was assumed, following the recommendation of the ISO 14001, that environmental managers are responsible for the development, implementation and control of environmental management systems in refineries.

In Brazil an initial meeting took place and key informants selected. An effort was made to interview as many employees as possible, from many different areas and different levels, which were associated with environmental issues of the refining activity, within the time limit. A consistent number of key informants were maintained for all the refineries.

The use of multiple sources of information (corporate literature, official documents, interviews and participant observation) strengthens grounding of theory by triangulation of evidence (Eisenhardt,1989).

4.4.1 - Questionnaire Design and Interviews

The questionnaire was used as a guide to provide a standard structure for the interviews. Its design was based on aspects of environmental management proposed in environmental charters (CBI,1992; Sun Company,1992; API,1990), environmental management standards BSI,1994; BSI,1996). The ecological complex framework identified in Chapter 3 was also used as a guide during the interviews. The questionnaire is shown in Appendix 2.

The use of open questions was appropriate to the exploratory approach of the research. It increased the flexibility of the interviews allowing for the provision of

additional information which was not expected, and allowed clarification and expansion of information gathered from the secondary data.

The questionnaire was initially tested in one of the oil refineries in the UK. The pilot study took considerably longer than expected, however, the result provided a more comprehensive perspective of the actual environmental management in an oil refinery and indicated the changes, which were needed in the initial questionnaire. It also ensured the final questionnaire provided consistent, relevant and comparable data, which added new insights to the discussion and understanding of the complex process, associated with environmental management.

The interviews did not have any pre-existing schedule. The questionnaire was used only to ensure that every topic was covered. During the interviews, notes were carefully taken and when necessary particular points were discussed with the interviewee at the end. Final reports were written immediately after concluding the interviews to assure that all the information was recorded. Interviewees were further contacted in case of any discrepancy. This more informal approach allowed the interviewees freedom to talk more openly about such a conflicting and sensitive issue without being hindered by a predetermined direction (Dey,1993). However, the researcher had to be much more attentive during the interviews to record the crucial information provided by the interviewees. Similar procedures have been previously used by other researchers (e.g. Freeman,1993). The results of the interviews were latter sent to all participant organizations for comments.

Because of the perceived sensitivity of the issue, to avoid restraining the interviewees and to retain confidentiality the interviews were not tape-recorded. The decision not to tape the interviews was reached during the pilot study. The interviewee point out that tape-recording would restrict the detail of his answers. Therefore, to maintain the same standard throughout the research none of the interviews were tape-recorded. Not tape-recording the interviews proved to be very beneficial. It provided an opportunity to gain plenty of additional information that was not previously foreseen by the

researcher and would probably not have been made available if the interviews were recorded.

The interviews lasted between one and two hours depending on the receptivity, expansiveness and time availability of the interviewee. The quality of the information obtained was largely dependent on the interviewee-researcher interaction. The researcher's ability to objectively direct the interviews, avoid any conflicting issue and improve cooperation was essential to the development of the investigations.

The interviews with other relevant bodies were undertaken in order to understand the existing relationships between an organization and an environmental authority and also to obtain the environmental authorities' perception of organizations. In the UK a representative of the oil association was also interviewed because the negotiations of environmental issues between the government and oil organizations usually involve the association.

4.4.2- Details of Secondary Sources

The secondary sources of information used in this research are those provided by the organizations. A list of the corporate literature used is listed in Appendix 3.

The information provided in the environmental reports normally refers to the environmental performance in the previous year except Phillips Petroleum which also includes the information for part of 1993.

The year of the environmental policies vary according to the organization's latest revision or date of publication.

By the time the organizations were contacted last, Elf had not published an environmental policy, and, Elf, Petrobrás and Total had not published an environmental report.

4.5- Data Analysis

Data analysis is a combination of data reduction, data display and the drawing of conclusion from data (Miles and Huberman,1994).

4.5.1 - Content Analysis

Content analysis was the research technique chosen for this investigation. Content analysis has increasingly been adopted as a suitable technique in the investigation of contemporary issues (Freeman,1993). It brings discipline and rigor to the description and inferential procedure of analyzing the communication under study, for example corporate literature and responses to open-ended questions (Freeman,1993). The use of content analysis was appropriate for this investigation as it is an unobtrusive technique which accepts unstructured material to be investigated (Weber,1990).

Content analysis *"refers to any procedure for assessing the relative extent to which specified references, attitudes, or themes permeate a given message"* (quoted in Hosti,1968, pp597). It is "*a multipurpose research method developed specifically for investigating a broad spectrum of problems in which the content of communication serves as the basis of inference*" (Hosti,1968). It is "*any technique for making inferences by objectively and systematically identifying specified characteristics of messages*" (Hosti,1969).

The aim of content analysis is to compare the data it extracts against some norm, standard or theory, "pattern-fitting" (Carney,1972). Pattern fitting means the comparison of a set of interrelated words or views with other model sets, to identify the relevant importance and characteristics of specific issues.

There are no rules for defining recording units and categories that can be used in a variety of different studies (Carney,1972). These are defined according to the context of the data (Krippendorff,1980).

Different studies require investigators to design and implement coding schemes. The investigator has initially to identify the questions to be investigated and the messages to be classified, followed by the definition of recording units and categories (Weber, 1990). Recording units are the basic units of message to be classified. They may be words, themes, characters, or even interactions (Carney,1972). Categories are the classifications into which the recording units are counted. There are however no rules for forming categories, and very few standardized categories which may be used in a variety of studies (Carney,1972).

Carney (1972) suggests the use of standards if the research questions arise *"from an informed awareness of related background matters"* (Carney,1972,pp40). The use of standards avoids two forms of bias. First the investigator can not adopt an approach which favours a particular case, and second as the standard is determined by outsiders' findings the investigator's subjectivity is reduced.

Although an acceptable level of reliability is one of many issues some which there is no ready definition (Hosti,1968). The establishment and use of a norm increases the reliability of the content analysis (Weber,1990).

A native English speaker also independently verified the content analysis in order to avoid hidden assumptions, misinterpretation of the language and research bias. This is define as intercoder reliability (Weber,1990).

4.5.2 - The Coding Procedure

There is not a clear theoretical definition of the relevant issues to be considered in the process of environmental management. A standard was therefore used to create and design the coding procedure used in this investigation.

The definition of the standard to be used in this research is based on the definition of an environmental policy stated in environmental system standard ISO 14001 (BSI,1996). The definition is as follows:

> "*A statement by the organization of its intentions and principles in relation to its overall environmental performance which provides a framework for action and for the setting of its objectives and targets*" (BSI,1996, pp9).

The ISO 14001 environmental management standard does not specify what are the issues to be included in the policy. For the purpose of this research environmental charters are used to identify the themes of relevant importance in environmental management. This is sometimes called the process of "unitizing" (Hosti,1968). The definition of categories is based in environmental management systems standards BS7750 and ISO 14001. The stages proposed for environmental standards are compared to stages of the "rational" decision-making process.

4.5.2.1 - The Themes

The recording units, in this case themes, used in the content analysis of corporate literature research were designed based in environmental charters published by three different organizations. They include: a general and international business approach to environmental management- The ICC Business Charter for Sustainable Development: principles for environmental management (CBI,1992); an approach representing different interested groups - The CERES Principles (Sun Company,1992); and an

industry approach - Strategies for Today's Environmental Partnership-STEP (API,1990).

Some oil organizations have used ICC, CERES and/or STEP charters to guide the design of their environmental policies. These organizations are: Sun Company (1992)* Shell (1992) Phillips Petroleum (1993) Conoco (1993) British Petroleum, (1993) Exxon (1991) Mobil (1993) Chevron (1990). Texaco claims to work with the ICC. However, there is no reference of any link between its policy and the ICC's environmental charter (Texaco,1994).

The Chemical Manufacturers Association's Responsible Care initiative have also been mentioned by Chevron (1990) Mobil (1993) Phillips Petroleum (1993) Petrofina (1995). However, this charter has not been used because this research is restricted to oil refineries only.

The three environmental charters suggest the issues that organizations must prioritize to increase their responsibility towards the biophysical environment. These issues are to be included as part of an environmental management system of an organization.

4.5.2.1.1 - The Environmental Charters

4.5.2.1.1.1- The CERES Principles

The VALDEZ or CERES Principles were the first environmental principle to be proposed as an international environmental charter. It was proposed by the Coalition for Environment Responsible Economies: a non-profit organization comprised mainly of social investment professionals, environmental groups, religious organizations, public pension trusts and public interest groups.

* Sun Company is not included in the sample selected.

It was proposed in 1989 just after the Exxon Valdez oil spillage in Alaska. It was first called the Valdez Principles, changed to CERES Principles and had its first revision in 1992. It comprises of 10 principles, which are considered to be relevant for good environmental management. The CERES principles are as follows:

- theme 1 - protection of the biosphere;
- theme 2 - sustainable use of natural resources;
- theme 3 - reduction and disposal of wastes;
- theme 4 - energy conservation;
- theme 5 - risk reduction;
- theme 6 - safe products and services;
- theme 7 - environmental restoration;
- theme 8 - informing the public;
- theme 9 - management commitment;
- theme 10 - environmental audits and reports.

The above principles were considered to be symbolic but not practical and not addressing the balance between environmental protection, conservation and economic growth (Feates and Barratt,1995). It includes concerns for the biophysical environment conservation and preservation. In relation to energy use it considers the sustainable use of natural resources and energy conservation. It can be argued that the principle, which proposes that 'nonrenewable sources should be used efficiently' and 'make effort to use environmentally safe and sustainable energy' do not effectively addresses the energy problem. It is prescriptive and simple. On the other hand by including the energy issue, organizations which accept the principles would have to manage their energy problems and be part of a much broader energy debate. There is no doubt that energy is very important for economic development.

4.5.2.1.1.2 - The ICC Business Charter

In 1990 the International Chamber of Commerce proposed its *Business Charter for Sustainable Development: principles for environmental management.* This charter

was proposed during the preparations for the UNCED-92# and probably this is the reason for this title. However, despite its title it narrows down sustainable development issues to environmental management issues. This charter has been proposed with the intention of giving business organizations guidance on environmental management. It comprises 16 principles:

- theme 11- corporate priority/key determinant to sustainable development;
- theme 12 - integrated management;
- theme 13 - process of improvement;
- theme 14 - employee education;
- theme 15 - prior assessment;
- theme 16 - products and services;
- theme 17 - environmental advice to different users;
- theme 18 - facilities and operations;
- theme 19 - research;
- theme 20 - precautionary approach;
- theme 21 - contractors and suppliers;
- theme 22 - emergency preparedness;
- theme 23 - transfer of technology;
- theme 24 - contributing to the common effort;
- theme 25 - openness to concerns;
- theme 26 - compliance and reporting.

It is very comprehensive and has a very "technocratic" approach where science is the limit to any action, that is, businesses are not considered to be a polluter until science proves otherwise. It agrees with the proposition of economic growth but seems not to address the full concept of sustainable development, which must include many other issues. The dialogue with interested parts concerning global issues is included.

4.5.2.1.1.3 - The STEP Environmental Principles

The last charter to be used in this research is the environmental charter introduced by the American Petroleum Industry Institute. It is related to the industry, which will be

UNCED-92 - United Nations Conference on the Environment and Development

used in the case study of this research. In 1990 the American Petroleum Institute launched a program called STEP- *Strategies for Today's Environmental Partnership* to promote the environmental health and safety awareness of its members. The program is based on the institute's environmental 11 guiding principles, which are the following:

- theme 27 -community concerns;
- theme 28 - facilities and operations;
- theme 29 - planning and development;
- theme 30 - crisis readiness;
- theme 31 - safe products and services;
- theme 32 - resource and energy conservation;
- theme 33 - research;
- theme 34 - waste minimization;
- theme 35 - work with others on environmental problems related to product and operations;
- theme 36 - participation on the establishing of laws, regulations and standards;
- theme 37 - promote the principles.

The above principles are very technocratic where science will set the limits for the environmental problems related to the petroleum industry. The concern for the global biophysical environment is included in some of the principles, such as research and participation with governments, to define the limits for the use of the biophysical environment.

4.5.2.1.1.4 - Comparison between the Environmental Charters

The ICC principles highlight the importance of taking into account environmental issues and the inclusion of stakeholders' concerns about environmental issues related to a specific business. Openness to concerns is very important and includes the environmental demands of different interest groups.

The Step principles are much more concerned in defining a clear boundary of responsibility. It goes as far as to include environmental issues in planning and development of products and processes.

The CERES principles include management commitment but the main importance of these principles is the stress on protection of the biophysical environment. The other two principles have not been so open in highlighting the importance of defining goals for the use of the biophysical environment.

ICC claims that environmental, health and safety management is "*a key determinant to sustainable development*" but further research is necessary to define what is really the definition of sustainable development for different interested groups as it is such a controversial definition (Souza,1993).

Research has been considered in both ICC and STEP. This agrees with the "technological fix" approach proposed by Weinberg (1993). However, the effectiveness of technological solutions to the biophysical environment depends largely on the boundary defined by environmental demands, controls and the organizations themselves.

The ICC principles try to introduce some of the requirements of sustainability, which addresses the difference of Less Developed Countries - LDC and Developed countries - DC by transferring technology.

Environmental performance should be measured and informed to stakeholders. Both ICC and CERES include the public but the sort of information depends largely on the boundary established previously.

As already mentioned the purpose of all three environmental charters or environmental principles, *The CERES Principles*, *The ICC Business Charter for Sustainable Development* and *The STEP Principles*, is the same. They have all been proposed in order to help organizations to respond to the increasing ecological pressures upon them and also to be used to demonstrate the awareness and social responsibility of organizations to better environmental management. They are based

in a voluntary approach to environmental management where business is responsible to set, assess and review environmental objectives and targets.

It has been argued that the principles are not enough to assure good environmental performance (Brophy *et. al.*,1995) but at least they propose a framework for action which organizations may consider useful and they may even be effective depending on the organizations' commitment to the issue.

The principles propose that dialogue and information may be some of the means used to set the appropriate ecological targets. However, these ecological targets can be open to debate and not satisfy all the interested groups. This agrees with Brophy's *et al.* (1995) argument that environmental principles are not enough to assure good environmental performance. The set of ecological targets is linked to whom an organization considers as its stakeholders and their respective ecological demands. Therefore, the definition of the environmental performance of an organization is still vague and controversial.

4.5.2.2 - Categories

The themes identified above are the issues recognized as relevant by an organization to demonstrate responsibility towards the biophysical environment. These issues are part of the decision process of the organization. Therefore, to identify the different categories a comparison between different stages of the decision process and the stages of an environmental management system standard was undertaken.

Gore *et al* (1992) have compared the work of different authors and have identified 9 different stages in the decision-making process. However, none of the authors investigated by them consider all the stages identified. These stages include: set objectives, problem recognition, problem definition, information gathering, develop

alternatives, evaluate alternatives, choice, implementation, monitoring or evaluation and feedback.

The environmental management standards provide guidance and specify the main elements to be considered as part of an environmental management system. The elements of an environmental management system include: commitment; initial review; environmental policy or purpose definition; implementation elements; evaluation elements; and review elements (BSI,1994; BSI,1996). All organizations' activities, products and services interact with, and have some effect upon the biophysical environment. Therefore, "*effective integration and co-ordination of the overall system components* " is considered essential to ensure consistent decision making on environmental issues (BSI,1994). Commitment, initial review and integration and co-ordination are categories, which are not mentioned by Gore *et al* (1992). However, commitment to manage ecological issues is demonstrated by the actions taken by the organization in relation to different ecological demands.

An organization to define its objectives in relation to environmental management has to recognize and define the main issues that lead to ecological problems. It has also to identify the external ecological demands upon the organization. These are part of the initial review that an organization undertakes in order to set its objectives. The objectives are the commitment statements of the organizations. Commitment is therefore the category that represents the issues the organizations propose to take action upon.

To achieve the objectives set and respond to ecological demands the organization has to propose alternatives to solve the problems, evaluate the alternatives in order to satisfy both economic and ecological demands and propose a plan of action. This represents the integration and co-ordination of environmental issues as part of an organization's overall management system of strategy formulation. Strategy

formulation is a category that represents issues on how the organizations will include environmental issues as part of their existing management system.

Implementation seems to be a stage ignored by the majority of authors (Gore *et al*,1992), however, it is essential for the success of the previous stages. The implementation refers to all the programs and actions introduced to achieve the objectives and in this case comply with ecological demands. This category includes programs at every stage of a product life cycle.

Evaluation or monitoring is essential to assess the effectiveness of the previous stages. It provides information for immediate action and also to review further improvements. The evaluation or monitoring category is relevant to the organization as it provides means to operational control.

Feedback is defined as "*a collection of post-implementation results to enhance future decision making*" (Pearce II and Robinson,1994, pp19). Feedback is the category that represents the constant flow of internal and external information between the organization and different stakeholders. It provides means to verify the objectives set and also review them.

The categories identified above are not mutually exclusive between one another (Weber, 1990). However to avoid conflict of results the themes were only considered under one of the categories.

Judges from different academic backgrounds independently checked the categorization of the themes identified in the previous section (section 4.5.2.1). The aim was: first to see that congruent categorization was identified; and second to avoid hidden assumptions. It was previously established that to be under a certain category a

theme should comply with a minimum of 50% agreement. All themes complied with the minimum required. The results of the verification are shown in table 4.1.

The themes identified are classified according to each category as follows:

Commitment (Category 1) - This category includes the principles where organizations demonstrate their environmental concern and set the boundaries to manage the concerns through the establishment of objectives and goals. This stage is crucial to the following stages, as the definition of the boundaries of environmental responsibility is normally a very controversial issue if all different interested groups are to be represented. The following principles are included under this 'commitment' category:

ICC:- Corporate priority/key determinant to sustainable development (theme 11);
Process of improvement (theme 13);
Products and services (theme 16);
Transfer of technology (theme 23);
Contributing to the common effort (theme 24);

STEP:- Planning and development (theme 29);
Resource and energy conservation (theme 32);
Safe products and services (theme 31);

CERES:- Protection of the biosphere (theme 1);
Energy conservation (theme 4);
Safe products and services (theme 6);

Strategy Formulation (Category 2) - This category includes the principles that define how environmental issues are to be incorporated as part of other existing management systems. The following are the principles, which are considered relevant to the strategy formulation category:

ICC:- Integrated management (theme 12);
Employee education (theme 14);
Prior assessment (theme 15);
Facilities and operations (theme 18);
Research (theme 19);
Precautionary approach (theme 20);
Emergency preparedness (theme 22);

CATEGORIES // THEMES	1	2	3	4	5	TOTAL	%
1	6					6/6	100
2		4	2			4/6	67
3	3	1		2		3/6	50
4	1	3	2			3/6	50
5	1	3			2	3/6	50
6	5				1	5/6	83
7	1	1	3			3/6	50
8		4	1		1	4/6	67
9	1	3			2	3/6	50
10	1	3			2	3/6	50
11		1	5			5/6	83
12	1	3	2			3/6	50
13	3		2		1	3/6	50
14	3	2			1	3/6	50
15		2			4	4/6	67
16			2	4		4/6	67
17	6					6/6	100
18	1	5				5/6	83
19		3	2		1	3/6	50
20	4	1	1			4/6	67
21	1	3	2			3/6	50
22	4		1		1	4/6	67
23	1		3	2		3/6	50
24	1	2			3	3/6	50
25	1	1	3	1		3/6	50
26				4	2	4/6	67
27	2		1		3	3/6	50
28	2	3	1			3/5	50
29	4		2			4/6	67
30	2	3	1			3/5	50
31	4		2			4/6	67
32	4	2				4/6	67
33	1	5				5/6	83
34		6				6/6	100
35		5			1	5/6	83
36		3		1	2	3/6	50
37		1	3		2	3/6	50

Table 4.1: Verification of Coding Procedures. Six judges independently verified the themes and categories proposed. This table depicts the judges' selection and final results.

CERES:- Sustainable use of natural resources (theme 2);
Reduction and disposal of wastes (theme 3);
Risk reduction (theme 5);

STEP:- Research (theme 33);
Waste minimization (theme 34);
Facilities and operations (theme 28);
Work with others on environmental... (theme 35);
Participation on the development of laws...(theme 36);
Crisis readiness (theme 30);

Implementation (Category 3) - The success of the previous stages depend on the programs and plans to be implemented. The previous stages of boundaries, objectives and goals setting are more technical and managerial while the implementation stage is also operational.

The environmental principles do not specify how organizations should implement an environmental management system. Therefore not many themes are part of this category. The themes to be include in the implementation stage are:

ICC: - Environmental advice to different users (theme 17);
Contractors and suppliers (theme 21);

CERES:- None;

STEP:- Promote the principles (internally) (theme 37);

Evaluation or Monitoring (Category 4) - to verify the result of the previous stages a performance assessment is necessary. The results are to be assessed according to the boundaries, objectives and goals defined previously. The themes to be included in this category are:

ICC:- Compliance and reporting (theme 26);

CERES:- Audits and reports (theme 10);

STEP:- None;

Feedback (Category 5)- This stage should provide means to review the objectives set and also provide information to stakeholders. Feedback is the provision of information either internal or external that can affect any of the other precedent stages.

ICC:- Openness to concerns (theme 25);

CERES:- Informing the public (theme 8);

STEP:- Community Concerns (theme 27);

Most of the themes are categorized under commitment and strategy formulation categories. During the analysis similar themes were grouped together for simplification and some changes were introduced. The changes are as follows:

To promote the principle was substituted by "*maintenance and communication of the policy*", as it is a requirement of environmental management standards (BSI,1994; BSI,1996).

Work towards the achievement of sustainable development is included as a separated theme from corporate priority (from the ICC environmental charter). Sustainable development is an issue considered relevant in the BS7750 (BSI,1994).

4.5.3- Content Analysis of Interviews

The result of the interviews were coded using the same procedure used in the analysis of the secondary sources and also by matching the responses to the ecological complex framework presented in chapter 3. The aim was to establish from the responses, the stakeholders of the refining activity, classify them according to the elements of the framework and identify the links between the elements of the framework (see discussion in chapter 9). The use of different organizations within the same industry increased the reliability of the information provided.

The coding and content analysis of the interviews were checked by two independent assessors. The independent assessors were used to reduce research bias and avoid hidden assumptions. The content of each individual interview was also matched with the information provided in the secondary sources of the interviewee's organization. to assess the consistency and reliability of the information. The decision to limit the investigation to organizations with similar processes, products and green issues affecting them provided a means for comparing discrepancies in the information obtained in the interviews.

The interviews in the Brazilian State oil organization allowed for a more complete verification of the strategic environmental management framework. This was made possible by interviewing a number of people within the same organization. The in-depth investigation of a single organization provided the opportunity to compare different people's perceptions, of the environmental concerns and ecological forces affecting the organization and also on the ecological behaviour of the organization. It also provided a much more complete representation of actual environmental management and the dynamic decision-making process associated with environmental issues of the oil refining activity of an oil organization.

4.6 - Problem of Investigating a Contemporary Issue

In the investigation of a contemporary issue the rapid rate of change must be taken into account. The framework developed in this research is not a final representation of the events and forces but is an attempt to create an initial model that can be used as a basis for further research. As suggested by Ketola(1995) further empirical research may change the empirical evidence and will consequently change the arguments of this research, given opportunities to further develop and improve the ideas.

4.7 - Summary

In this chapter the research strategy used in this research is described. The research topic is a contemporary issue therefore an exploratory, phenomenological and systematic approach was proposed for this investigation. The petroleum industry was selected as the subject of this investigation. The use of case study strategy was chosen taking into consideration data analysis, bias avoidance, reliability and research time required. The use of multiple sources of evidence, different oil organizations, various respondents within the same organization, a questionnaire, verification of the responses summary by independent assessors and by each organization, a theoretical framework and the establishment of a coding procedure for the content analysis were the paths chosen to improve validity and reliability of this research.

The empirical investigation of the first research question "*How does an organization perceive ecological forces and environmental controls*"? is discussed in the next chapter.

CHAPTER 5

The Organizations' Perceptions of Ecological Forces and Environmental Controls

The aims of this chapter are, firstly, to answer the following research question: *How does an organization perceive ecological forces and environmental controls?* Secondly, to compare the ecological forces affecting UK and Brazilian refineries.

5.1- Ecological Forces and Environmental Controls affecting the UK Refining Activity

The environmental managers of UK refineries are mostly responsible for co-ordination of environmental issues that arise as a consequence of the refinery process at local level. They have no direct involvement with the environmental quality of final products. Therefore, the information provided by environmental managers of UK oil refineries in 1995 and other representatives of these oil organizations in the UK in 1997 were complemented by secondary sources: ENDS** Report (1990-1997), ETSU***/DTI**** report: An Appraisal of the UK Energy, (DTI/ETSU,1994) and Financial Times Newspaper (1990-1997).

The ecological forces and environmental controls considered to affect the UK oil refineries are (content based on interviews of environmental managers and environmental advisors that took place in 1995 and 1997):

- environmental legislation and economic instruments;
- local community concerns;
- non-governmental organizations' environmental concerns;

** ENDS - Environmental Data Services LTD;
*** ETSU - Energy Technology Support Unit;
**** DTI - Department of Trade and Industry;

- physical evidence of environmental degradation;
- environmental information and awareness;
- competitors;
- shareholders;
- customers;
- employees;

5.1.1- Environmental Legislation and Economic Instruments

Environmental legislation is suggested as the main factor causing organizations to pay attention to the biophysical environment (Maddox,1992). It is the major ecological demand upon UK oil refineries (EM1 to EM5*, 1995; EA1 to EA3, 1997). The environmental controls affecting UK refineries fall into two groups: environmental controls on refinery operations and environmental controls on the quality of refineries' output (EM1, 1995; EA3,1997; DTI/ETSU,1994; Thomas,1990).

Although previous environmental controls upon the refineries activities and products existed in the UK, over the past years the pressure to improve environmental performance has increased steadily (EM2,1995). First, because of recent changes in UK environmental legislation (EM2,1995); for example, the Environmental Protection Act 1990. Second, the internationalization of environmental issues. Stricter worldwide environmental legislation affects UK environmental legislation (Hunt,1991). For example, EU environmental legislation and international agreements.

The external influence upon UK legislation is caused because of (EA2,1997): increasing awareness of specific issues; setting of environmental standards; and also increasing political pressure to introduce stricter environmental controls.

The evidence of deterioration of air quality in urban areas, transboundary air pollution

* For reference code see chapter 4 and Appendix 1

issues and the increased scientific knowledge of the global impacts associated with fossil fuels usage is increasing demands for improvement in refineries emissions and products (ENDS, 1996). Most of the controls associated with air problems are initially set by the EU and then incorporated in UK environmental legislation. They have direct impact upon oil refineries. For example: controls on sulphur dioxide, suspended particulate, lead, nitrogen dioxide and vehicular emissions (ENDS,1991; ENDS,1993).

The Global Climate Change International Treaty (reduction on greenhouse gases) is a major threat to oil organizations (Thomas,1990). It has been suggested that "any strategy adopted to mitigate possible climate change will be bound to have considerable impact on the core of the oil industry" (Thomas,1990). Although international legislation affects the refining activity, refineries do not have much involvement with it (EM1 and EM2,1995). It eventually has to comply with environmental legislation requirements.

Another example of international legislation affecting refineries is the Oslo Paris Convention. It has presented the result of oil refineries discharging wastewater in the North Sea (ENDS,1992). It compared the performance of refineries and also set performance improvement targets. The results showed that UK refineries are bad performers.

The environmental controls on products are even more critical to refineries. There is not much flexibility for product innovation (EM1 and EM3, 1995). Therefore, improvements have to be implemented on existing fuels. This demands adaptations of the refining process.

In the past years the major influence on refining technology is the result of environmental controls on fuels (DTI/ETSU,1994).

The changes on product specification because of environmental pollution problems also affects other organizations; for example car manufactures. This generates

conflicts between the oil and the car industry (EM1,1995). Market opportunities are also affected by environmental legislation. It can provide market opportunities but also threats. For example, the marketing of natural gas is an opportunity (EM1 and EA1,1995). The marketing of low benzene petrol is a threat (EA1,1995).

The use of economic instruments to control environmental degradation is also a major concern to oil organizations (ENDS,1993a). For example, the introduction of the carbon tax is in discussion as a way of stabilizing CO_2 emissions in the EU (ENDS,1991a). There is, however, increasing concern that higher taxes on energy may have a wide range of economic and structural effects, or may even jeopardize competition between State Members (Hunt,1991).

5.1.2- Local Community Concerns

The environmental concerns of local communities are considered as an important ecological demand upon oil refineries (EM1 to EM5,1995). They are largely associated with potential risks and nuisance caused because of the refineries' activities (EM1 to EM5,1995).

The degree of pressure from the local community depends on (EM1 to EM5,1995): proximity and location of the local communities relative to the refinery; link of the local community with the refinery; potential benefits the refinery brings to the local community; and level of ecological awareness.

5.1.3- Non-governmental Organizations (green groups) Environmental Concerns

Non-governmental organizations make ecological demands upon oil organizations. However, their direct action upon individual oil refineries in the UK is not so strong (EM1 to EM3 and EM5,1995). The proximity of the refinery to more environmentally sensitive areas is a factor that increases the likelihood of environmental demands from non-governmental organizations (EM2 and EM3,1995). The ecological demands from

non-governmental organizations anticipate the ecological demands of society (EA2,1997). Therefore, their actions and demands are a good indicator of society's ecological demands.

5.1.4- Evidence of Environmental Problems

The physical evidence of the environmental problems as a consequence of the refining activity has direct impacts upon the refineries. First, it increases the concerns of the local community. The local community's major complaints are (EM1 to EM5,1995): flaring, odour from the refining process and effluent treatment plant, leaks from sour gas, plume grounding near the plant, smoke and fallout. Second, it increases the awareness of potential risks and impacts. This is largely due to the occurrence of accidents. For example, Texaco's explosion (ENDS,1994) and Shell's oil spill (ENDS,1989). Depending on the consequences of the accident it also has effects upon other organizations in the oil industry (EM1,1995). Third, it increases the likelihood of fines, for example, the Shell oil spill in 1989 (ENDS,1991b). Lastly, it jeopardizes efforts to promote a green image and leads to an eventual threat to the oil organizations (Hunt,1991).

5.1.5- Environmental Information

Environmental information on refineries' environmental performance is either provided by refineries to environmental authorities (EM1 to EM5,1995), voluntarily published by oil organizations (ENDS, 1992a) or published by other organizations (ENDS,1992). There has been some reluctance to provide environmental information to a public register (EM1 and EM2,1995) and caution on the publication of environmental reports (ENDS,1992a). It has, however, been observed that consistent and reliable information has in fact influenced the attitude from outside interested

groups towards the refineries (EM1, EM2 and EM4, 1995). Nevertheless, it is still a concern (Thomas,1990). Non-governmental groups (EM1,1995) have used the information available in public registers. It has also been used by competitors to establish a comparative environmental performance parameter (EM1,1995).

The improvement of external environmental quality monitoring increases the vulnerability of refineries (EM2 and EM3,1995). For example, the gathering of information about the oil industry pollution effects by the Oslo-Paris Commission has highlighted the poor environmental performance of UK refineries compared to other European refineries (ENDS,1992). Internally environmental information gathering has highlighted cost saving opportunities from both waste minimization and pollution prevention (ENDS,1992a).

5.1.6- Other Stakeholders Demands and Actions

Other ecological demands affecting refineries come from the following stakeholders (EA2,1997): competitors, shareholders, customers and employees.

The bench marking of economic and environmental performance among competitors is a strong pressure influencing oil organizations (EA2, 1997). It triggers competition for innovative solutions, to achieve a better balance between economic and ecological demands. For example some of the parameters used by refineries include: (EM1 to EM5,1995): comparison of emissions results; type of treatment and abatement facilities; and environmental management systems.

Shareholders are increasingly demanding better environmental performance from oil organizations (EA1 and EA2,1997). This, however, is not an exclusive demand upon refineries but is affecting the whole of the oil organizations' activities. For example, the environmental demands of shareholders at Shell's last annual meeting (Corzine and Boulton,1997; Corzine,1997).

The demand from customers is mainly lower prices (EA1 to EA3,1995). However, recently, customers have boycotted oil organizations due to their bad environmental performance (ENDS,1994; Lascelles and Boulton,1995). This has direct effects on the downstream activities of oil organizations, including oil refineries. Shell's products were boycotted as a consequence of the organization's actions in the North Sea. Texaco's products were boycotted because of the organization's actions in Ecuador. The boycott from customers has highlighted to organizations the importance of customers' ecological values (EA2,1997). It provided evidence of the changes in societies' ecological values.

The ecological demands of employees are not very strong (EM1 and EM2,1995). However, oil refineries are increasingly aware that their participation and contribution is essential to their environmental performance (EA2,1997).

5.2 - The Ecological Forces and Environmental Controls affecting the Brazilian Refining Activity

The ecological forces and environmental controls affecting the refining activity of the Brazilian oil organization include the following (content based in interviews of representatives of the Brazilian oil refinery at different levels that took place in 1995):

- environmental legislation;
- environmental management system standards;
- local community concerns;
- non-governmental organizations environmental demands;
- physical evidence of environmental degradation as a consequence of oil refineries' activities;
- environmental information;
- environmental requirements of financiers;
- product substitution;
- customers demands;
- employees demands;

5.2.1- Environmental Legislation

Environmental legislation is considered to be the most significant ecological demand upon the refining activity of the Brazilian oil organization (PE1/13/17/19-23/29-33,1995). Similarly to UK environmental legislation, the Brazilian environmental legislation imposes controls on oil refineries operations and on the quality of oil refineries output (PE1-3/13/17/19-23/39-43,1995).

The existence of environmental legislation in Brazil dates back to 1830 (Guimarães,1991; Fontenelle,1995). The legislation either addressed specific ecological issues or was part of other legal requirements. It was only in the mid-70's that specific environmental controls began to affect Brazilian oil refineries activities. This was a consequence of the creation of the Brazilian Environmental Secretary in 1973 and state environmental agencies (EABR2,1995).

The state environmental agencies aim at controlling the existing environmental problems generated by industries (EABR1-3,1995). It was only at the beginning of the 80's that the state environmental agencies introduced environmental authorization requirements on industries (EABR3,1995). Consequently, enforcement of environmental controls upon industrial activities effectively started in the beginning of the 80's (EABR1,1995). This provoked strong resistance from most of the Brazilian organizations (EABR1-3,1995).

The Brazilian Environmental Policy was defined in 1981 and finally established in 1990. Presently, the environmental legislation in Brazil is divided into: federal, state and county environmental legislation. Refineries have to comply, according to their geographical location, with the strictest among them (PE17,1995), the Brazilian Environmental Legislation is mainly based in USA Environmental Legislation (PE17, 1995). International environmental legislation also has effects in the Brazilian environmental legislation, for the same reasons as presented in section 5.1.1.

The initial changes to the refining activity, as a consequence of environmental controls were end-of-pipe environmental control equipment (PE29, 1995). Followed by changes in the refining process and operational procedures. At this stage the environmental control began to be integrated in the refining process.

Despite knowledge of the environmental impacts of oil products upon the biophysical environment, the environmental controls for cleaner oil products were introduced in Brazil in 1986. In 1986 a government program called PROCONVE* was established. The aim of this program is the control and reduction of vehicular emissions. This program establishes environmental quality standards on transport fuel products and vehicular emissions.

The environmental controls on products are demanding a change in the approach given to environmental management so far. A change from production responsibility to a more strategic approach (Petrobrás,1995c). The main reason for this change is the market opportunities and possible threats in consequence of environmental quality demands on products (PE11,1995). Another requirement as a consequence of air quality deterioration is the use of less polluting fuel during certain times of the year (PE19-23,1995). This is a local requirement set by state environmental authorities. Therefore, it varies from refinery to refinery.

The law requires all the refineries to undertake environmental impact assessment for any new process added to the refining process. One of the states has recently introduced a new procedure (PE20,1995). It is a preliminary report. In this report the refinery has to describe any new process to be added to the current refining process and justify economic and ecological benefits. The researcher had an opportunity of taking part in the elaboration of one preliminary report.

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* PROCONVE - Program on the Control of Vehicular Emissions

5.2.2- Environmental Management System Standards

The organization has had intensive participation in the elaboration of the international environmental management system standard series, ISO 14000 (PE1 and 4,1995). The organization recognizes that compliance with ecological demands is progressively linked to market opportunities and even the survival of the organization (Petrobrás,1995c).

The future certification with an environmental standard is seen as essential by the organization (Petrobras,1995c). Compliance with environmental system standards will demonstrate to others the environmental performance of the organization. This applies mainly to products exported (PE20 and 23,1995).

At the time of this research, the issues related to the ISO 14000 environmental management series standard were still in their preliminary stages (PE1/4/29-33,1995). However, it is considered an issue of high priority among management (PE1,1995).

5.2.3 - The Local Community Ecological Demands

The ecological demands of local communities are an important force affecting refineries (PE19-23/29-33,1995). However, the degrees to which environmental demands of local communities affect refineries vary from refinery to refinery.

Ecological demands for the local communities are not always a high priority (PE9-10/18,1995). Some local communities consider that the environmental issue is among their concerns, but not a priority over social and economic concerns. Ecological demands depend on (PE29-33,1995): economic situation of the local community, geographic position relatively to the refinery, level of education and environmental awareness. The higher the economic situation of the local community the higher the environmental demands upon refineries (PE9-10/34-38,1995).

5.2.4- The Non-Governmental Organizations

The ecological demands of non-governmental organizations on the refining activity varies depending on the geographical location of the refinery (PE1,1995). In some areas around the country the demands of non-governmental organizations have sometimes conflicted with the demands of the local community (PE9-10,1995).

The most significant action of non-governmental organizations upon a refinery was the publication of a list of the worst industrial polluters in the state. This has had a major effect upon refinery management and introduced internal changes in the management of environmental issues (PE1/19/29/39,1995). Another refinery has recently been sued by a non-governmental organization because of non-compliance issues (PE30,1995).

The perception of the organization is that non-governmental organizations are also an indirect force (PE2/7,1995). These organizations act directly upon the government in order to introduce changes to the environmental legislation (PE7,1995).

5.2.5 - Physical Evidence

The physical evidence of environmental pollution is closely monitored by refineries (PE 24-29/29-33,1995). It affects the organization's public image and it can also incur fines.

The local community or members of the public detect some of the pollution impacts caused by the refineries. They complain when abnormalities are suspected or noticed (PE29-33,1995). The complaints of the local community include (PE29-33,1995): accidents, production of smell (form the process or from the wastewater treatment

plant), smoke, fallout, noise, leakage, oil spills and flaring. One of the refineries has had problems as a consequence of underground leakage on to neighbouring farmland (PE30,1995).

5.2.6 - Environmental Information

The increase in environmental information is also considered as a relevant ecological demand upon the refining activity (PE11,1995). It increases the knowledge about the effects of the oil industry upon the biophysical environment. Environmental information increases the demands for better environmental controls on the organization's activities and products (Petrobrás,1995a). It also increases demands for energy alternatives (Petrobrás,1995c).

At a local level there is a lack of environmental information on air quality (EABR1,1995). Environmental agencies do not have enough funds to introduce a monitoring network to assess environmental quality (EABR1-3,1995). Environmental agencies in two different states are considering the possibility of demanding this from local industries (PE19/29/31,1995). Some of the local industries are, however, against this because of the possibility of further controls based on the new information (PE19,1995). Many refineries have already installed meteorological stations, as required by environmental authorities (PE5,1995).

Some state environmental authorities have introduced self-monitoring programs (EABR1-3,1995). The refineries are responsible for sending to the environmental authorities, according to a set schedule, the information on specific parameters (EABR1-3,1995). This includes wastewater emissions, emissions to air and solids disposal. The availability of this information to the public varies according to different states (EABR1-2,1995). Recently, some of this information has been used by a non- governmental organization to demonstrate to the public the bad environmental performance of a refinery (PE19,1995).

5.2.7- Customers Environmental Demands

Customers' environmental demands have been indicated as an ecological demand upon refineries (PE13,1995). Most still see product quality (not including environmental quality) and price as the main determinant of a product's choice by institutional customers (PE2/11/19-23,1995). However, because there is an increasing ecological demand upon institutional customers, this is slowly changing (PE2,1995).

Petrobrás keeps close contacts with customers who use more polluting fuels offering what they claim to be "cleaner products" (Petrobrás,1994b).

5.2.8 - Environmental Requirements of Financiers

International financiers have increasingly been linking their loans to environmental and safety performance. The last refineries built in Brazil between the late 1970's and early 1980's were required to add pollution control equipment to their process (PE1,1995). Recently, the organization has developed a safety and environmental program, including training, in order to comply with requirements of their financiers (PE13,1995).

5.2.9 - Product Substitution

The government aims to increase the participation of natural gas in the Brazilian energy matrix (MME,1994). This increases the pressure on the organization to find alternative uses for their production of fuel oil (Petrobrás,1994b).

The environmental pressure upon other organizations has also contributed to the dislocation of other more polluting energy sources, for example coal. This is an opportunity for the organization to open new markets for some of its products (Petrobrás,1994c).

Brazil uses ethanol as an alternative to transport fuel. The use of ethanol, as a fuel, is considered non-economical compared to petrol (PE2,1995). However, its use is justified, by some, on the social and environmental benefits associated with ethanol use (Petrobrás,1995d; Petrobrás,1995e; Petrobrás,1995f).

Ethanol is also added to the petrol used in Brazil because of environmental legal requirements. The organization supports the use of ethanol as an additive (Petrobrás,1995d). However, not on the basis of the present legislation. The present legislation fixes the quantity of ethanol to be added to petrol. It, therefore, affects the marketing of any other alternative additives (Petrobrás,1995d).

There are strong arguments against the environmental benefits of ethanol use (Petrobrás,1995e; Petrobrás,1995f). First, because of the pollution impacts associated with ethanol production. This includes water pollution, air pollution and disposal of solid wastes (the biomass produced is a potential source of energy but still not economically viable). Second, the destruction of the natural habitat. Third, the demand of water for the production of ethanol. Fourth the pollution effects associated with ethanol use as a fuel (based in the current environmental legislation).

5.2.10 - Employees' Demands

The ecological demands of employees vary depending on their activity and how the refining process affects them (PE44-50,1995). Operators work very closely to the refining process. Consequently, they are more directly affected by it. Their demands are mainly on safety and health issues (PE44-50,1995). However, some of these complaints also have environmental implications (PE44/48,1995). For example, the change in sampling techniques and procedures.

Employees have an informal procedure to improve their working environment. They

demand improvements directly from suppliers which they claim to be effective (PE45/48,1995). The operators participate on the elaboration and improvements of operational procedures, to include environmental issues (PE44-50,1995). However, there is not much participation at the project stage (PE44,1995).

Sometimes, at operational level, there is a strong feeling among operators of contradiction between the organization's environmental goals and effective actions (PE44/46/47,1995). New operators normally have more environmental demands than older operators do (PE44,1995).

5.3- Comparison between Ecological Forces and Environmental Controls affecting the UK and Brazilian Refining Activity

Some differences were found between ecological forces and environmental controls in UK and Brazilian refineries. While in the UK economic instruments, competitors and shareholders were identified as strong ecological forces and environmental controls, in Brazil environmental management systems, demands from financiers and product substitution were identified as having stronger impact upon the refining activity. See summary in table 5.1.

The use of economic instruments has been suggested as an alternative to control pollution problems. While in the EU the introduction of the carbon tax, associated with global warming control, is a concern for organizations, in Brazil this issue is still not a high priority.

Developed countries are major contributors to global air pollution problems. Developed countries are major energy users and fossil fuel CO_2 emitters (IPCC,1996). Although their share of global carbon emissions has been declining (IPCC,1996), less developed countries argue that the "polluters pay" principle should still apply.

Competitors and shareholders are identified as having strong impact upon the refining activity in the UK. It can be suggested that this difference is mostly because in Brazil the oil industry is a state-owned organization and was a monopoly until 1995. However, with the opening of the monopoly the organization is more vulnerable to competition. The financial risks associated with environmental performance will probably increase in relevance.

ECOLOGICAL FORCES AND ENVIRONMENTAL CONTROLS	
UK REFINERIES	BRAZILIAN REFINERIES
Environmental Legislation and Economic Instruments	Environmental Legislation
Local Community Concerns	Local Community Concerns
Non-governmental Organizations	Non-governmental Organizations
Physical Evidence of Environmental Degradation	Physical Evidence of Environmental Degradation
Environmental Information and Awareness	Environmental Information and Awareness
Competitors	-
Shareholders	-
Customers	Customers
Employees	Employees
-	Environmental Management System Standards
-	Environmental Requirements from Financiers
-	Product Substitution

Table 5.1: Ecological Forces and Environmental Controls affecting Oil Refineries. This table shows a summary of the ecological forces affecting UK and Brazilian Refineries. Oil organizations' representatives both in the UK and in Brazil identified the ecological forces and environmental controls affecting the refineries.

Benchmarking to evaluate performance is a common procedure used by UK and Brazilian oil organizations. It is not a direct ecological demand. It is an economic force that leads to performance improvements, which can include environmental performance improvements.

From the research there is no evidence of pressure from financiers upon UK refineries. The demands from financiers increase the link between economic and ecological performance.

The use of ethanol in Brazil was initially an energy solution. However, for the Brazilian oil industry the use of ethanol competes with the marketing of petrol and petrol additives. In the UK this problem does not exist.

In both countries the use of gas is displacing the use of fuel oil; however, in the UK this was not identified as an ecological force. Substitution of products is among the competitive forces suggested by Porter (1980). Substitution of products creates opportunities and threats to oil refineries; for example, the creation of opportunities to substitute more polluting products, such as, coal and threats of product displacement, fuel oil for natural gas.

While the Brazilian oil organization considers environmental management systems a top priority, in the UK most of the refineries are still observing its development. One refinery in the UK has certified with the BS7750, however, all the others still do not see the relevance for their business.

Employees were identified as having significant ecological demands upon Brazilian refineries. Oil refineries in the UK recognize the importance of their participation on the achievement of environmental performance. Some of the organizations interviewed include environmental performance comments as part of their new graduates' brochures. This may suggest that there are demands from potential new employees. The environmental demands of employees are largely linked to safety and health issues at an operational level. The balance between ecological and economic demands seem to become conflicting the closer one works to the refining process.

Environmental and governmental authorities in the UK and Brazil enforce the prevailing environmental legislation.

Organizations' representatives consider the level of enforcement on products strong. Products do not have much flexibility. The product specification is also closely linked to equipment and product use.

The level of enforcement on refinery activities varies from moderate to strong, according to refineries' representatives. In Brazil this depends on the geographical location of the refinery. Each refinery is controlled by independent environmental agencies.

Local communities, both in the UK and Brazil have similar complaints about the pollution problems associated with refineries' activities. However, the pressures from the local communities depend on the factors discussed earlier. It may vary from moderate to strong pressures.

The demand from customers is similar in both countries. Customers' priority is price. However, the boycott of products associated with environmental performance has highlighted to organizations the importance of customers' ecological values.

5.4 - Conclusion

In this chapter the ecological forces, environmental controls and some of the stakeholders considered by the refining activity of oil organizations have been identified.

The ecological forces perceived by organizations' representatives are identified through the ecological demands of stakeholders. Most of the ecological demands of the stakeholders are in accordance with the ecological forces identified by other researchers (see table 2.1). In most of the cases the ecological forces are not linked to a specific demand but a combination of different demands.

The ecological demands of different stakeholders have different impacts upon the refining activity (e.g. changes in operational procedures, changes in the process, changes in products and change in external communication procedures). The dilemma for the refining activity is to decide on how to address the ecological demands before they become an environmental control.

Environmental controls are having significant impact on the refining activity. It was generally recognized that environmental controls (legislation and economic instruments) are not always an effective option to improve environmental quality. However, no other alternative was proposed.

The ecological forces and environmental controls suggested by the interviewees of UK and Brazilian refineries have some similarity as shown in table 5.1. At the time of the interviews the representatives of UK refineries considered that environmental management systems, environmental requirements from financiers and product substitution were not so relevant for the refineries. UK refineries were still observing the need for the implementation of a formal environmental management system. Competitors and shareholders were not found to be relevant by Brazilian refineries' representatives. The Brazilian refineries have been operating under a state monopoly, which was open, while this investigation was taking place. Therefore, some of these differences will inevitably change because of this factor. The need for a more competitive approach was already incipient among few of the interviewees.

The choice of oil organizations on how to respond to the ecological forces and environmental controls affecting them is discussed in the following chapter by answering the second research question *What are an organization's environmental policies?*

CHAPTER 6

OIL ORGANIZATIONS ENVIRONMENTAL POLICIES

The aim of this chapter is answer the second research question; *What are an organization's environmental policies?* This chapter shall establish, through the analysis of environmental policies published by oil organizations (see Appendix 3), the organizations' ecological commitment to green issues affecting the refining activity. For more details on oil organization activities and the impacts on the biophysical environment see Appendix 4.

6.1 - Introduction

The publication of an environmental policy is still voluntary. It may be seen as a modification in an organization's environmental behaviour (see table 3.1). It is a change towards a more open attitude to demonstrate the commitment of organizations to environmental performance improvements.

Environmental management systems standards BS 7750 and ISO 14001 (BSI,1994; BSI,1996) state that environmental policies must contain the commitment of organizations towards the biophysical environment. According to the standards the commitment statement is essential to the implementation of an environmental management system. However, it is acknowledge by the standards that commitment statements or environmental management systems do not determine the actual environmental behaviour of the organization. Nevertheless, it shows oil organizations' efforts to demonstrate their commitment and responsibility to managing the impacts of their activities upon the biophysical environment.

An environmental policy can range from being a mere public relations tool (Ketola,1995) to effectively reflecting the organization's responsibility towards green issues (Gilbert,1993). One way of assessing environmental policies is by comparing them to the organizations' actual actions towards the biophysical environment. Environmental policies can also be assessed by comparing the response of organizations to the ecological demands of stakeholders. Only the former will be investigated in this research.

The first environmental policies were issued by oil organizations in the 1950's. Mobil, for example, published its first environmental policy in 1956, in response to the increasing local ecological pressures affecting refineries since the 1940's (Longsdon,1985).

The increasing political relevance of environmental issues in the late 1960's (Bowlby and Lowe,1992) and the preparation and eventual introduction of environmental legislation in the early 1970's were important issues influencing changes to oil organizations' environmental behaviour (Longsdon,1985; Ketola,1993). This can be shown by: Conoco issued its first environmental policy in 1968, followed by Shell in 1969, Chevron in 1970, Exxon in 1971 and Phillips Petroleum in 1972.

During the oil crisis in the 1970's, with the scare of a possible fuel scarcity, economic and energy problems became the priority over environmental protection (Dunlap and Scarce,1991; Kempton *et al.*,1992). Society's interest in the issue, however, continued. In the late 1980's, ecological concern reemerged and increased in political and social relevance (Bowlby and Lowe,1992).

Consequently, some oil organizations revised their environmental policies (Ketola,1993). An increasing number of oil organizations, that had not yet published environmental policies, also started to publish one. British Petroleum published its

first policy in 1980 (EA1,1997)*. Texaco issued its first environmental policy in 1982 (Longsdon,1985).

The ecological consequences of the use of petroleum and the demand for international responsibility on these issues were further highlighted. For example, with the impact of the Exxon Valdez oil spill in Alaska in 1989 (Buchholz *et al*,1992) and the preparations for the United Nations meeting on the environment, known as The Earth Summit, that took place in Brazil, in 1992 (Brown,1992).

Environmental policies were revised again (Ketola,1993) and more organizations started to publish their environmental policies. Petrobrás published its first policy in 1989, Petrofina in 1991 and Total in 1992. From the research sample, Elf is the only organization that has not yet published an environmental policy and has no future plans to publish one (EM5,1996) **.

The oil organizations used different approaches to the publication of their environmental policies. British Petroleum, Chevron, Petrofina, Phillips Petroleum, Shell, Texaco and Total published a combined environmental, health and safety policy. Conoco and Petrobrás published an environmental policy separately from the organizations' health and safety policy. Exxon issued a separate policy for environmental issues, toxic substances and safety issues. Mobil divided its policy into product safety, environmental protection, minimization of emissions, discharges and wastes, and, employee and facility safety.

Some refineries have issued their own environmental policies (Shell,1995; Texaco,1995; Total/Petrofina,1995). One of the reasons for the publication of separate

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*EA1- British Petroleum Head Office - Health, Safety & Environment,1997;
**Elf Refinery/UK - Environmental Department,1996;

site environmental policies is that the refineries consider the corporate policy too wide to reflect the refineries' actions towards the environment (EM3,1995; EM5,1995). The other reason is that to conform with the requirements of environment management system standards the refineries have to define what specific area is covered by the environmental policy (BSI,1996). Therefore, refineries can restrict the area to be covered by the environmental policy in accordance with their convenience.

An analysis of the contents of oil organizations' corporate environmental policies is presented below. A summary of the content analysis is shown in table 6.1. The focus of the analysis is mainly on environmental issues. However, occasionally, some of the issues discussed may be linked to health and safety issues.

6.2 - Content Analysis of Environmental Policies

The contents of the environmental policies were analyzed according to five main categories. Each category contains themes, which are considered essential elements in environmental management (API,1990; CBI,1992; Sun Company,1992). The categories and themes are as shown in table 6.1. More details on categories and themes are discussed in chapter 4.

6.2.1 - Commitment

All the policies investigated have established that the organizations' missions are to operate and conduct their business with regard to the biophysical environment. Some of the organizations also proposed to become leaders in environmental performance, which suggests some competition among organizations to promote their environmental behaviour and performance. Some examples of these objectives are presented below.

KEY	MANAGEMENT ISSUES	ORGANISATIONS											
Management Issues The themes and categories are selected according to the code procedure shown in Chapter 4 Oil Organisations 1- British Petroleum(93) 2- Chevron(92) 3- Conoco(93) 4- Elf (not published) 5- Exxon (90) 6- Mobil(93) 7- Petrobrás(89) 8- Petrofina(91) 9- Phillips Petroleum(93) 10- Shell(91) 11- Texaco(89) 12- Total(92) () - year of publication or last revision	**Commitment**	1	2	3	4	5	6	7	8	9	10	11	12
	Commitment statement	□	□	□		□	□	□	□	□	□	□	□
	Strategic Planning	□	□	□			□			□	□		□
	Process of improvement			□		□				□	□		
	Sustainable use of natural resources		□	□							□		
	Protection of the Biosphere and Environmental Restoration												
	Energy Conservation	□	□	□						□	□		
	Products and service environmental/ safety aspects			□		□	□			□	□		□
	Work towards the achievement of Sustainable Development												
	Transfer of technology					□	□	□	□		□		
	Strategy Formulation												
	Integrated management	□	□	□		□	□		□	□	□		□
	Precautionary approach (process and products)	□	□	□		□	□	□		□	□	□	□
	Employee education/training			□		□			□		□		□
	Prior assessment		□	□				□		□	□		
	Prevention/Reduction/Elimination of pollution (emissions and discharges, raw material-facilities and operations)	□	□	□			□	□	□	□	□		
	Solid Waste Management (reduce, recycle, re-use and disposal - facilities and operations)	□	□	□			□			□	□		
	Prevent Accidental Emissions/Risk Reduction			□		□		□	□				
	Contingency programs/Procedures for action			□		□		□		□	□	□	□
	Research and development		□	□		□	□	□	□	□	□		
	Participation on the development of environmental policy and environmental programs		□	□		□	□		□		□		□
	Work with others on environmental problems	□	□			□	□						
	Implementation												
	Maintenance and communication of the policy	□		□			□	□	□	□	□		□
	Environmental advice on products	□	□			□			□		□		
	Contractors and suppliers (environmental procedures)	□		□				□	□	□	□		□
	Evaluation												
	Compliance with laws and regulations		□	□		□	□		□	□	□	□	
	Compliance with other requirements	□	□	□		□	□			□	□		
	Audits and reports		□	□		□	□		□	□	□		□
	Feedback												
	Openness to concerns/ Dialogue with interested groups	□	□	□		□	□	□	□	□	□	□	□
	Informing the public	□	□	□		□				□	□		□

TABLE 6.1: Comparison of Environmental Policies. This table shows the results of the content analysis undertaken in the selected oil organisations' environmental policies. The content analysis was undertaken based in the code procedure shown in Chapter 4. The themes used are based in three environmental charters. These charters included ICC (CBI,1992), STEP (API,1990)and CERES (Sun Company,1992).

British Petroleum aims "to be an industry leader in health and safety practices and in environmental standards". Chevron's goal is "to be a leader within the industry by emphasizing innovation and encouraging creative solutions" (this includes environmental issues). Conoco's goal is to demonstrate "our commitment through environmental excellence". Phillips Petroleum's aim is to "be a leader in ethics and environmental stewardship". Shell wants "to be among the leaders" in environmental issues and Texaco aims "to achieve environmental, health and safety excellence".

The environmental charters issued by the International Chamber of Commerce, American Petroleum Institute and Ceres (API,1990; CBI,1992; Sun Company,1992) and the environmental management system standard ISO 14001 (BSI,1996) suggest that organizations should demonstrate their commitment to environmental issues by including them in their organizations' strategic planning and by integrating them to other organizations' policies.

The link of environmental issues with organizations' business goals may be a way of demonstrating an organizations' intentions and commitment to integrate environmental issues as part of their strategies.

British Petroleum and Chevron link environmental performance with the organizations' business performance. British Petroleum considers that good environmental performance "is an integral part of efficient and profitable business management". However, it does not state in its policy how they will integrate economic and ecological objectives. Chevron considers that "innovative and creative solutions" applied to environmental issues "will improve our competitive position", and environmental expenditure should be managed towards this goal.

Conoco, Mobil, Phillips Petroleum and Shell have proposed to include environmental issues in their planning process and organizations' strategies. Total proposes both.

Conoco will address "environmental concerns in all phases of activities". It will commit appropriate means and resources to achieve the organization's environmental goals. Mobil will be guided by their environmental policy "in forming plans, and setting objectives". Phillips Petroleum will " keep environmental considerations as a priority in our planning for all operations and products". Shell will implement the environmental policy "through company strategies and action plans". Total considers that "no economic priority shall overrule considerations of health, safety on the job, and respect for the environment"; environmental issues "shall take precedence in all decisions concerning development projects and the launching of new products".

Only Chevron, Conoco and Phillips Petroleum have committed themselves to provide the necessary financial resources to support environmental management actions.

The commitment to "continual"* improvement of overall environmental performance ("*The process need not take place in all areas of activities simultaneously*")** is proposed in the ISO 14001 (BSI,1996) and is included in 4 of the policies shown in table 6.1. Conoco, Exxon, Phillips Petroleum and Shell. These oil organizations however commit themselves to "continuous"*** or permanent environmental performance improvements. This suggests that the environmental commitment of these oil organizations goes beyond that required by the environmental management system standard. Oil organizations commit themselves to apply their environmental policies to all areas at all times.

Environmental conservation# and preservation+ are issues suggested by the environmental charters and environmental management standard to be included and considered by organizations on the management of environmental issues. The CERES Principles (Sun Company,1992) mentions the sustainable use of renewable natural

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* Continual - describes actions which are repeated over a period of time (LDCE,1991);
** BS EN ISO:1996, pp9;
*** Continuous - describes things and events which continue without interruption (LDCE,1991);
# conserve - saving for (Passmore,1974)
+ preserve - saving from (Passmore,1974)

resources, conservation of non-renewable natural resources, preservation of biodiversity and environmental restoration. The ICC environmental charter (CBI,1992) mentions the sustainable use of renewable natural resources.

British Petroleum states it will reduce the use of energy. Chevron states it will preserve the biophysical environment, conserve natural resources and use energy wisely. Conoco states it will ensure responsible use of energy and natural resources. Phillips Petroleum states it will use energy efficiently. Shell states it will "give proper regard to the conservation of the environment by promoting the efficient use of natural resource and energy".

The environmental aspects and impacts of products and services are part of the full cycle of environmental management considerations of an organization. Conoco, Exxon, Mobil, Phillips Petroleum, Shell and Total's environmental policies include the organizations' concern with the environmental aspects of products.

Transfer or sharing of environmental technology and management methods are suggested by ICC (CBI,1992) and Step (API,1990) as a means to contribute to the improvement of environmental performance throughout the industrial and public sectors. Exxon, Mobil, Petrobrás, Petrofina and Shell have included transfer and/or sharing of technology and/or management practices in their environmental policies.

In summary, as far as commitment is concerned, the environmental policies of oil organizations demonstrated their recognition of their responsibility towards the use of the biophysical environment. Some organizations seem more cautious on the establishment of their commitments towards the biophysical environment (e.g. Texaco compared to Shell). The commitment of organizations to manage green issues is not surprising since they have been under scrutiny since the 1940's. Their commitment has already been acknowledge by other researchers (e.g. Longsdon, 1985; Shrivastava,1992). However, the recognition of the relevance of green issues as

a competitive concern is clearly a demonstration of the change in their attitude towards them and also that green issues are part of organizations' business environment.

6.2.2 - Strategy Formulation

The overall environmental performance of an organization depends on: firstly, the organization's capability of recognizing the environmental requirements of different interested groups; and secondly, the integration and co-ordination of them in the organization's strategies. The environmental policy should provide the "principle of actions" (BSI,1996) for this integration and co-ordination. The principle of actions should define how the organization intends to include environmental issues as part of its management systems.

Two main areas are identified as having environmental requirements: first the environmental requirements on products and second the environmental requirements on the byproducts generated by oil organizations' activities (DTI/ETSU,1994).

Those issues linked to products demand internal integration and co-ordination in order to adapt the refining process to comply with even stricter environmental requirements. The demands on products are very closely linked to organizations' business goals. The ecological impacts of products also increase the demand for better energy policies. This suggests the use of alternative sources of energy, which compete with the use of petroleum.

Those issues linked to the byproducts generated are primarily linked to the organizations' legitimate right to use the biophysical environment. The internal co-ordination and integration of these issues have always been looser and more reactive than for products. The management of by-products generated has normally been associated with costs.

Society's pressure on organizations overall environmental behaviour and the costs associated with by-products' treatment or disposal are important contributors increasing demands upon oil organizations (Steger,1993). The increasing control upon organizations' actions through environmental legislation and regulations is also an important external demand upon organizations (Thomas,1990).

The increasing social, political and economic relevance of environmental issues requires, therefore, better internal integration and co-ordination of both the management of products and also by-products generated.

British Petroleum, Chevron, Conoco, Exxon, Mobil, Petrobrás, Petrofina, Phillips Petroleum, Shell, Texaco and Total proposed to either integrate or apply a precautionary approach in order to include environmental issues as part of organizations' activities (e.g. planning, operations, research and development), including process, products and services. Petrofina proposes to integrate environmental issues by linking the environmental policy to the organization's quality policy.

Employees' environmental training is suggested as an important means to improve environmental performance. (CBI,1992). It provides the means to increase awareness and participation on the integration of environmental issues as part of other management systems.

Environmental training was mentioned in Conoco, Exxon, Petrofina, Shell and Total's environmental policies. Some of the policies mentioned safety training but although there is a relevant link of safety training with the prevention of accidental pollution problems, these policies did not clearly state that environmental training is part of their safety training programs.

Although oil organizations are committed to conduct their business with regard to the

biophysical environment, the use of environmental impact assessment, as suggested in environmental charters, was only included in Chevron, Conoco, Petrobrás, Phillips Petroleum and Shell's environmental policies.

The integration and co-ordination of environmental management programs should take into consideration a full cycle, from the decision on raw material and utilities*, processing, transportation, to the final disposal or recycling of products.

The control of the environmental effects of raw material sourcing is included in Conoco's, Mobil's and Phillips Petroleum's policies. Conoco proposes to "ensuring responsible and efficient use of natural resources" and to "addressing environmental concerns in all phases of activities". Mobil will "handle raw materials in a manner that protects the environment". Phillips Petroleum proposes to conduct and support research on the "environmental effects of raw materials".

The actions proposed by organizations to management emissions and wastes generated in their activities include pollution prevention, minimization of wastes, and even possible elimination of pollutants and wastes.

British Petroleum "will strive for progressive improvement in the environmental performance by reducing emissions, wastes" and "new facilities and plants will apply the best available pollution control techniques that are commercially viable". Chevron will conserve natural resources "by careful management of emissions and discharges, by elimination of unnecessary waste". Conoco will limit "waste generation, discharges and emissions". Mobil proposes "to reduce overall emissions and waste generation from its operation whenever technically and economically feasible" and when possible eliminate the generation of wastes "through source reduction and recycling". Petrobrás will prevent and control the environmental impacts of their activities. Petrofina proposed to develop a "preventive approach". Phillips Petroleum will

* Utilities - water and energy;

"reduce overall emissions and waste generation". Shell will pursue progressive "reductions of emission, effluents and discharges, with the ultimate aim of eliminating them".

Prevention of accidental emissions and contingency programs are also important issues considered by the organizations. They all have health, safety and environmental implications. Both issues are included in the environmental management system standard ISO 14001 (BSI,1996).

To prevent accidental emissions/ risk reduction and contingency programs/ procedures for action may be included either as an environmental or as a safety issue. British Petroleum, Chevron and Mobil omitted all the issues.

Conoco proposes to "reduce the risk of spills, leaks and accidental discharges" and to maintain "emergency preparedness plans". Exxon's goal is "to manage its business with the goal of preventing incidents" and "to respond quickly and effectively to incidents". Petrobrás will provide resources to prevent environmental impact and will maintain contingency plans in order to effectively respond to possible incidents. Petrofina will "take measures to reduce possible risks associated with their activities". Phillips Petroleum proposes "establishing, maintaining emergency readiness plans". Shell develops and maintains contingency procedures. Texaco will "respond quickly and effectively to environmental incidents". Total proposes that "emergency procedures shall be tested, drilled and updated".

Research and development is suggested as a means to prevent, anticipate and improve organizations' environmental performance (API,1990; CBI,1992). The research on environmental issues should include better understanding of the impacts of oil organizations' activities on the environment, methods of environmental protection and improvement of the environmental performance of operations and products.

British Petroleum, Texaco and Total did not include research and development in their environmental policies. Petrobrás will encourage research but only to increase the scientific knowledge on the ecological effects of their activities.

As far as strategy formulation is concerned, the oil organizations propose to apply an integrated and precautionary approach to the management of issues associated with their activities and products. The environmental aspects of different stages of the refining activity are included in the environmental policies.

6.2.3 - Implementation

The environmental policy is a means to communicate internally and to others the organizations' objectives concerning the biophysical environment. Ketola (1995) argues that environmental policies should have a long-term approach. However, the organizations' objectives must be regularly revised to reflect new environmental demands. The ecological demands of stakeholders are not static.

In the sample investigated, Elf is the only organization that does not publish an environmental policy. Elf claims (EM5,1997) firstly that the organization has not identify any need to publish an environmental policy yet. Secondly the information about the environmental performance of the organization in the UK is already available to the public in a public registrar.

Chevron, Exxon, and Texaco did not include any commitment to communicate the policy internally among the organizations' employees.

Refineries in the UK have published their own environmental policies. These policies are written based in the corporate environmental policy but have a narrower scope. This might confirm Ketola's (1995) argument of dual behaviour. The corporate environmental policy should be applicable to every activity within the corporation, no matter its geographical location. For example, Texaco has published a corporate

environmental policy, an UK environmental policy and a refinery environmental policy. Shell and Petrofina have published a separate refinery environmental policy.

The proper use, transportation, storage and disposal of oil organizations' products is part of the life cycle of a product. The provision of proper advice for safe and environmental disposal of the products is a means to comply with legal requirements and also encourage end-users to reduce the impact of oil products upon the biophysical environment. British Petroleum, Chevron, Exxon, Petrofina and Shell will provide information on their product's use, safety and proper disposal.

Some organizations recognize the importance of contractors and suppliers' environmental behaviour to their own environmental performance. British Petroleum and Petrofina will consider the environmental concerns and performance of their suppliers. Conoco will encourage contractors and suppliers to conduct their business with environmental responsibility. Petrobrás, Petrofina, Phillips Petroleum and Shell will encourage contractors to follow their organizations' environmental policies. Total claims to "select its industrial and commercial partners on the basis of their compliance with our rules for health, safety, and environment".

In summary, as far as implementation is concerned, dissemination of the policy and promotion of better environmental behaviour among specified stakeholders are the means proposed to be used by the organizations to demonstrate their concern for the biophysical environment and improve their environmental performance.

6.2.4 - Evaluation

The organizations' environmental compliance commitment must also take into consideration "*some or all the concerns of the other interested parties*" (BSI,1994)* and when possible "*anticipating and responding to their concerns...including those of*

*Environmental Management System Standard, 1994, pp12.

transboundary or global significance" (CBI,1992)**. A commitment to comply with laws and regulations is suggested by environmental management system standards as the minimum limit to be achieved by organizations to demonstrate environmental performance (BSI,1994; BSI,1996).

British Petroleum will assess their environmental performance against their own objectives. However, new facilities and plants "will apply the best available pollution control techniques that are commercially viable". This suggests the organization is committed to comply with environmental legislation, as this is what is required according to the UK Environmental legislation (Gardner,1996). However, this is not explicit in the policy.

Chevron, Conoco, Exxon, Mobil, Phillips Petroleum and Shell state explicitly in their policies that they are committed to comply with environmental requirements set by legislation and regulations and also internal environmental standards set by themselves. The organizations are also committed to introduce controls where these do not exist.

Monitoring is an important means of assessing an organization's environmental performance. British Petroleum, Petrobrás and Texaco did not mention how they will assess their environmental performance. Exxon and Petrobrás will encourage research to increase the scientific knowledge on the ecological impacts of their business on the biophysical environment.

An environmental audit*** is the management tool proposed to be used by Chevron, Conoco, Exxon, Mobil, Petrofina, Phillips Petroleum, Shell and Total in the internal assessment of the organizations' environmental performance.

** International Chamber of Commerce Business Charter for Sustainable Development 1992, pp24.

*** Environmental Audit- a management tool comprising a systematic, documented, periodic and objective evaluation of how well environmental organization, management, and equipment are performing... (ICC,1991, pp3).

As far as evaluation is concerned, most of the oil organizations are committed to comply with the requirements set by environmental legislation and regulations. Some organizations have provided information on the management tool to be used to assess their environmental performance.

6.2.5 - Feedback

All the organizations have proposed to promote dialogue with interested groups. It is reasonable to assume that the interested groups included in the organizations' environmental policies reflect those groups the organizations consider to be their stakeholders. It also represents the groups to whom organizations have environmental responsibilities.

The interested groups and organizations' proposed actions towards them vary from policy to policy. The aim of this research, however, is to identify, independently of the organization, all the possible groups who might have any environmental concern on oil organizations' activities and products.

The groups mentioned in the policies are the following: employees, managers, society, customers, industrial and commercial partners, contractors, local community, suppliers, research groups, industry groups, competitors, shareholders, distributors, emergency services, authorities and government. British Petroleum, Phillips Petroleum and Shell will also work respectively with "relevant bodies", "concerned groups" and "other groups", in environmental issues matters.

For the purpose of this research, the demands of each interested group were identified as follows (based in Ketola,1995):

• employees, managers, suppliers, contractors, distributors, industrial and commercial partners, emergency services and authorities are important "actors" in the achievement of an organizations' environmental performance and maintenance of their "green

image". They are responsible to avoid, reduce or minimize potential impacts linked to the oil organizations activities upon the biophysical environment;

• customers demand low cost and quality of products. Customers are responsible for the final disposal of oil products and the generation of pollutants consequence of the use of oil products;

• society and the local community are the main critics of the organizations' environmental behaviour;

• shareholders' main interest is good return on investments. This is, however, increasingly linked to the organization's environmental performance because of demands on products and increased concern on global warming (BI,1990). Shareholders, therefore, expect organizations to achieve a balance between environmental responsibility and economic performance;

• competitors share technological and management knowledge. Competitors also provide the bench marking that promotes continuous improvement. They co-operate among themselves to protect what they consider to be their legitimate right to use the biophysical environment;

• research groups provide the scientific evidence on the quality of the environment. Research groups also contribute to the development of monitoring and clean technology, which respectively increases the ability, and quality of environmental information. Technological development increases the alternatives to improve the quality of the biophysical environment;

• industry groups, for example API* and ICC**, provide guidelines to encourage a standard environmental behavior within the whole industry, defend the industry's right to use the biophysical environment and undertake research in order to evaluate the

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* API-American Petroleum Institute
** ICC International Chamber of Commerce

impact of the organizations' actions upon the biophysical environment and upon humans;

• government monitors the biophysical environment, and sets and enforces ecological control upon organizations. It balances the ecological demands of different interested groups to set environmental quality specifications. The government also has an interest in organizations economic performance, therefore, different government policies may sometimes be beneficial or even damaging to the biophysical environment. The decision on the balance between ecological, economic and social demands, and environmental quality specifications can therefore be very controversial.

The actions proposed to be taken by oil organizations to the different interested groups include: commitment to operate with due regard to the biophysical environment, provision of information, environmental education, environmental training, open dialogue and discussion on environmental issues linked to the organizations, co-operation among specific organizations, transfer of know-how and management experiences, and participation in the development of appropriate environmental laws and regulations.

The communication of environmental goals and the provision of information on environmental performance results are means of communicating and demonstrating the improvements achieved by organizations in the management of green issues(CBI,1992; Sun Company,1992).

The publication of an organization's environmental performance results allows for the evaluation, by stakeholders, of the organization's environmental performance; allows for the comparison and contrast between environmental performance of peer organizations; encourages customers to contribute to the organization's environmental performance; and provides for the faster development of cleaner technology.

British Petroleum will "communicate openly with those who live or work in the vicinity of our facilities". Chevron will encourage "an open dialogue within the company and with the public". Conoco will develop "dialogue with interested parties". Exxon will "communicate with the public in environmental matters" and will share information on toxic substances with employees, customers, the scientific community, government agencies and the public. Phillips Petroleum will communicate "with concerned groups and regulatory agencies". Shell will "recognize the concerns of shareholders, employees and society". Total will "adopt an attitude of openness and constructive dialogue" with the public authorities and local communities.

As far as feedback is concerned, all organizations intend to have a more open attitude towards the environmental issues associated with their organizations. This may suggest that the promotion of a "green image" is increasing in strategic importance. Organizations have to promote or be more open to defend their right to use the biophysical environment.

Ketola (1993) however has criticized the oil organizations' disregard of environmental pressure groups, media, insurers, financiers, non-governmental organizations and trade unions. Other industries have also not been included in the organizations' environmental policies. Organizations such as British Petroleum, Phillips Petroleum and Shell, however, chose to use a very broad approach to include stakeholders of their concern (e.g. "relevant bodies", concerned groups and other groups"). It is clearly an attempt to avoid such criticism. The evidence of this research (chapter 5) shows that most of these groups are a concern for oil refineries.

6.3 - Comparing Organizations' Environmental Policies

The commitment of oil organizations to work with due regard for the biophysical environment highlights the importance of the latter. However, the definition on the limit on the use of the biophysical environment by organizations is largely affected by:

stakeholders' perceptions of the biophysical environment, environmental impacts caused by the activities of oil organizations, environmental demands and ecological controls affecting them.

Organizations use the biophysical environment both as a source and as a sink. However, the emphasis of the environmental policies is on its use as a sink. To use the biophysical environment as a sink, organizations are committed to address the issues associated with its products and also with the by-products generated.

The organizations are committed to reduce the flow of material and energy from the organization to the biophysical environment and to improve the environmental quality of products and even to eliminate by-products generated. To achieve these goals the organizations have to introduce internal changes to their operational procedures and processes.

None of the organizations have included in their environmental policies the long term impacts resultant from the competition for petroleum exploration and the extensive use of petroleum. The possibility of the use of alternative sources of energy to minimize the impact caused by the use of petroleum is also not considered. Organizations are committed to internal energy conservation. This commitment has environmental and economic benefits. By using energy more effectively the organization reduces wastes generated.

There is not much indication from the environmental polices that the use of anenvironmental impact assessment has any importance on the decision-making process of oil organizations. This issue is omitted by most of the policies as shown in table 6.1. This may suggest that the prior evaluation of the possible impacts which a future activity might cause upon the biophysical environment does not have much influence on the organizations' actions upon it.

None of the policies include any responsibility for the impacts caused as a consequence of past actions upon the biophysical environment. However, this might be considered as part of an organization's commitment to comply with environmental legislation and regulations, which suggests a reactive behaviour in relation to this issue. Environmental restoration is a cost to organizations, however, it is a consequence of their own actions upon the biophysical environment.

Prevention of accidental emissions is also an important issue addressed by organizations' environmental policies as the occurrence of accidents can be very negative to the organization's "green image". It can also result in fines, for example, the Exxon Valdez disaster (Buchholtz *et al*, 1992) and Shell spillage in 1989 in Merseyside in the UK (Fazuy,1993).

Accidents are also a threat to oil organizations as they are a great source of environmental information about the impacts of oil upon the biophysical environment. These can be used by other organizations; for example, by research groups and environmental technology organizations.

The environmental policies state that the impacts caused by oil organizations upon the biophysical environment are to be monitored by the organizations. The generation of environmental information increases the flow of information. However, other stakeholders, for example environmental authorities, research groups or even direct observation, also undertake the monitoring of the biophysical environment by the local community.

Oil organizations argue that environmental legislation and regulation must be based on scientific evidence relating to the impacts caused. Therefore, the organizations need environmental information, to evaluate the impact of their activities and products, and to defend their right to continuing their use of the biophysical environment.

Stakeholders compete among themselves and with oil organizations for the use of the biophysical environment. Oil organizations have included in their policies what they considered to be the stakeholders of their organizations. Organizations do not have any control upon the perceptions of stakeholders and how they use the biophysical environment. However, the organizations are committed to take into consideration the ecological concerns of their stakeholders and communicate with them. The publication of their environmental policies is an example of the organizations' response to stakeholders demands. However, it is not stated in the policies what the ecological concerns of the stakeholders are upon the organizations.

The direct observation of the biophysical environment and the increase in environmental information provides opportunities to the development of environmental technology and affects the ecological demands and controls, upon oil organizations. The environmental controls considered by the policies are environmental legislation and regulation. Compliance with environmental legislation and regulations on their activities and products is a commitment of some of the oil organizations. Oil organizations also propose their own internal control, which suggests that self-regulation could be an alternative to control their actions. However, to achieve self-regulation, organizations must specify and publish their environmental quality goals and this is not included in their policies.

Oil organizations are committed to take part in the environmental legislation and regulations process. This might suggest the organizations' co-operation to provide more effective environmental controls but can also suggest the organizations' attempt to manipulate and control any restraining force upon their activities and products.

There is a flow of material and services from suppliers and contractors to organizations. However, not all organizations consider this as an important contribution to their overall environmental performance.

There is no commitment to encourage energy conservation among customers which

affects the flow of products from the organizations to customers and also affect the flow of by-products generated by the customers. Oil organizations can argue that the by-product generated by customers is not an issue the organizations have control upon. However, they propose to provide advice on the disposal of products.

Changes in customers' consumption behavior can affect oil organizations but they seem to have no interest in reducing consumption as it would be a threat to their economic goals. However, the impacts of such by-products upon the biophysical environment are also a threat to the organizations as it increases the deterioration of the biophysical environment. For example, there is an increasing pressure towards the use of public transport in order to reduce urban air pollution caused by vehicular emissions.

Oil organizations can minimize the impacts of their activities and products upon the biophysical environment and be secretive by not publishing their environmental performance results. The increased demand for the publication of these results with the introduction of legislation (Garner,1996), the increased scientific evidence of the damage caused upon the biophysical environment as a consequence of the use of petroleum (Flavin,1988) and the increase in public awareness through the dissemination of environmental information by the media (Ketola,1995) are, however, constantly affecting the actions of oil organizations.

Oil organizations depend on technological improvements and developments to improve the quality of their products and reduce the by-products generated. Most of the oil organizations recognized the importance of the link of technology with environmental quality improvements. Some organizations are also committed to transfer their know-how. This transfer can either be free or on a commercial basis. This suggests that organizations might have financial opportunities in the development of clean technology.

While internally oil organizations have control over their technological requirements they have no control upon the external development of technology which is undertaken by other organizations. The use of the biophysical environment as a sink and its subsequent deterioration creates a "commodity" for other organizations by providing opportunities for the development of environmental technologies (DTI,1994). These technologies include both cleaner technologies and monitoring technology. Other organizations therefore compete for opportunities provided by the deterioration of the biophysical environment (Porter,1991; DTI,1994).

Physical modification of the biophysical environment as a consequence of technological developments for the use of petroleum, is not included in the environmental policies.

The environmental policies of oil organizations state their commitment to consider the biophysical environment, however, they do not include any commitment to develop or take part in the development of sustainable energy policies. The environmental policies aim at minimizing the impacts of their activities and products upon the biophysical environment. This suggests that the organizations still have a reactive and "end-of-pipe" approach to the pollution problems caused by them. The need of alternative sources of energy is not addressed by the organizations' environmental policies.

There is no indication in the environmental policies of any commitment to environmental programs associated with preservation of biodiversity and environmental remediation. None of the organizations included any proposal to encourage energy conservation among users.

The policies include no commitment towards sustainable development. There is major

controversy around the actual goals of sustainable development (Pearce,1976; McCutcheon,1979; Baroni,1992) and this omission suggests that the organizations are still cautious in committing themselves to this "controversial issue".

Mobil linked the definition of ecological objectives (preservation and conservation) to the government process. In this process a "reasonable balance between ecological goals and those of energy, jobs, and the economy" should be achieved. The achievement of a "reasonable balance" may, however, be a problem "with no possible solution" (Emery and Trist, 1973). The term "reasonable balance" may not have a universally accepted definition.

6.4 - Conclusion

The content analysis undertaken in this chapter has addressed the second research question of this investigation. It has shown the main ecological demands oil organizations have committed themselves to act upon. It has also partly provided some information on how the organizations are to address the issues set out in their policies.

The environmental policies of oil organizations do not follow any exclusive pattern. Most of the principles suggested by the charters are mentioned in the policies. None of the policies has included any themes apart from the ones proposed by the environmental charters. The organizations have also not included all the issues suggested, for example, sustainable development and protection of the biosphere are issues not included in any of the policies.

There is no indication that Petrobrás and Total have used any of the environmental charters used in this research. However, the issues included in their policies are similar to the ones proposed in the charters.

Shell (86%) has included most of the principles, followed by Conoco (82%). Texaco has included the least (5%). Texaco's policy emphasizes safety issues instead of environmental issues. There is no indication that Petrobrás (38%) and Total (45%) follow any of the environmental charters. Although they have included some issues that are similar to the charters.

The environmental policies are not very specific but, in general, they address the ecological forces and environmental controls identified in chapter 5. Some organizations prefer to publish more concise policies than others do. It can be argued that some issues are already implicit in some of the policy statements. Detailed policies increase the likelihood of criticism. For example, there are criticisms against organizations because of their dual behaviour in countries with more lax environmental controls (Ketola,1995; Texaco, 1994; Shell,1995). The publication of leaner policies might be a strategy to avoid criticism of no compliance. On the other hand organizations might also be criticized that their policies do not go far enough. From this research, however, the content of the environmental policies suggests that oil organizations are proposing to manage green issues using the enlightened approach as suggested by Petulla (1987).

The choice on how oil organizations respond to ecological forces and environmental controls and implement their environmental policies is examined in the following chapter.

CHAPTER 7

Organizations' Response to Green Issues

The aim of this chapter is to investigate the third research question, *How are the environmental policies implemented?* The response of oil organizations to green issues is examined through the analysis of the information described by organizations in corporate literature, annual reports and environmental reports*. Interviews with oil organizations' representatives complements the information provided by organizations. There is a wide variation in publications on green issues available by organization. To maintain uniformity among the organizations, other publications containing information on green issues (e.g. technical papers and brochures) published by oil organizations have not been used in this chapter.

7.1 - Introduction

There is an increasing concern among many organizations over the current pressures to disclose corporate environmental information (IISD,1993). The International Institute for Sustainable Development - IISD (1993) has identified some of the reasons influencing organizations to publish their corporate environmental results. These are: new regulations, emerging business requirements and changing public expectations. The publication of corporate environmental information is however still mostly voluntary and does not have a single standardized form.

7.2 - The Response of Oil Organizations to Ecological Demands

Compliance with the commitment statements set by oil organizations in

*A list of corporate literature used in this chapter is provided in Appendix 3.

environmental policies (see chapter 6) depends on how they are integrated and co-ordinated as part of the organizations' decision making process (BSI,1996). It also depends on how they are implemented as part of the organizations' overall management systems (BSI,1996).

A summary of the content analysis of the corporate literature is presented in table 7.1. This analysis follows the same categories suggested in the coding procedures discussed in Chapter 4. A summary of the comparison between environmental policies and corporate literature is shown in table 7.2

7.2.1 - Commitment

From the corporate reports there is evidence that external ecological demands are increasing in strategic importance and influencing organizations decisions on their general goals of profit, growth, stability and long-term survival (Mikdashi,1986). In all of the 12 reports, except that produced by Total, the management of green issues is described to be a business priority by organizations. This repeats the commitment statement of their policies (except Elf that does not publish an environmental policy).

All the environmental reports have highlighted the commitment and responsibility of organizations to green issues, in accordance with the statements of their environmental policies. Some of the organizations are, however, more specific about the extent of their environmental commitment and actions. Some examples of these are presented below.

British Petroleum "favours a balanced approach, one that recognizes that solutions must be based in sound science, accompanied by comprehensive cost benefit analysis and risk assessment that enable priorities to be set and ensure that investments are effective" (BP,1994).

KEY	MANAGEMENT ISSUES	ORGANISATIONS											
	Commitment	1	2	3	4	5	6	7	8	9	10	11	12
Management Issues	Commitment statement	□	□	□	□	□	□	□	□	□	□	□	□
The themes and categories are selected according to the code procedure shown in Chapter 4	Strategic Planning	□	□	□	□	□	□	□	□	□	□	□	□
	Process of improvement	□	□	□	□	□	□	□	v	□	□	□	□
	Sustainable use of natural resources	□	□	□	□	□	□		□	□	□	□	□
	Protection of the Biosphere and Environmental Restoration	□	□	□	□	□	□	□	□	□	□	□	□
	Energy Conservation	□	□	□		□	□			□	□	□	□
Oil Organisations	Products and service environmental/ safety aspects	□	□	□	□	□	□	□	□	□	□	□	□
	Work towards the achievement of Sustainable Development		□								□		
1- British Petroleum (94) [94]	Transfer of technology		□			□	□			□	□	□	
2- Chevron 994) [90]	**Strategy Formulation**												
3- Conoco (94) [94]	Integrated management	□	□	□	□	□	□	□	□	□	□	□	□
4- Elf (94) [not published]	Precautionary approach (process and products)	□	□	□	□	□	□	□	□	□	□	□	□
5- Exxon (94) [90]	Employee education/training		□			□	□	□	□	□	□	□	
6- Mobil (94) [94]	Prior assessment		□	□			□				□		
7- Petrobrás (94) [not published]	Prevention/Reduction/Elimination of pollution (emissions and discharges, raw material- facilities and operations)	□	□	□		□	□	□	□	□	□	□	□
8- Petrofina (94) [95]	Solid Waste Management (reduce, recycle, re-use and disposal - facilities and operations)	□	□	□		□	□		□	□	□	□	□
9- Phillips Petroleum (94) [93]	Prevent Accidental Emissions/Risk Reduction	□	□	□		□	□			□	□	□	
10- Shell (94) [92]	Contingency programs/Procedures for action	□	□	□		□	□			□	□	□	
11- Texaco (94) [94]	Research and development	□	□	□	□	□	□	□	□	□	□	□	□
12- Total (94) [not published]	Participation on the development of environmental policy and environmental programs	□	□							□	□	□	
	Work with others on environmental problems	□	□	□		□	□		□	□	□	□	
	Implementation												
	Maintenance and communication of the policy	□	□	□		□	□	□	□	□	□	□	□
	Environmental advice on products	□				□	□					□	
	Contractors and suppliers (environmental procedures)									□			
	Evaluation												
	Compliance with laws and regulations	□	□	□		□	□		□	□	□	□	
	Compliance with other requirements	□		□			□			□	□		
	Audits and reports	□	□	□		□	□		□	□	□	□	
	Feedback												
( ) - Corporate Annual Report	Openness to concerns/ Dialogue with interested groups	□	□	□				□	□	□	□	□	
[ ] - Corporate Environmental Report	Informing the public	□	□	□	□	□	□		□	□	□	□	□

TABLE 7.1: Comparison of Annual Reports and Environmental Reports. This table shows the results of the content analysis undertaken in the selected oil organisations' environmental policies. The content analysis was undertaken based on the code procedure shown in Chapter 4. The themes used are based in three environmental charters. These charters included ICC (CBI,1992), STEP (API,1990) and CERES (Sun Company,1992).

MANAGEMENT ISSUES (Categories)	ORGANISATIONS											
	1	2	3	4	5	6	7	8	9	10	11	12
Commitment [9]	7(3)	9(4)	7(6)	6(0)	8(4)	8(4)	5(2)	6(2)	8(5)	8(7)	8(1)	7(3)
Strategy Formulation [11]	11(5)	12(8)	9(10)	3(0)	9(8)	10(7)	5(6)	7(6)	10(7)	11(9)	10(2)	5(5)
Implementation [3]	2(3)	1(1)	1(2)	0(0)	2(1)	2(3)	0(0)	1(2)	2(3)	1(3)	2(1)	0(1)
Evaluation [3]	3(1)	2(3)	3(3)	0(0)	2(3)	3(3)	0(0)	2(2)	3(3)	2(3)	3(1)	0(1)
Feedback [2]	2(2)	2(2)	2(2)	1(0)	1(2)	1(1)	1(1)	2(1)	2(2)	2(2)	2(1)	1(2)
TOTAL	25(14)	26(18)	22(23)	10(0)	22(18)	24(18)	11(9)	18(13)	25(20)	24(24)	25(6)	13(12)

Key: [ ] - Total number of themes in each category (according to coding procedures - see chapter 4);
x - Action described by each organization, in their respective corporate literature, related to the management of green issues;
( ) - Themes included in individual organization's environmental policy (from chapter 6);

Organizations:

1- British Petroleum 2- Chevron 3- Conoco 4- Elf 5- Exxon 6- Mobil 7- Petrobrás 8- Petrofina 9- Phillips Petroleum 10- Shell 11- Texaco 12- Total

TABLE 7.2: Implementation of Environmental Policies. This table shows the comparison between the commitment statements established by organizations in their environmental policies and the actions taken by organizations in the management of green issues. The actions taken by organizations were described in the corporate literature. The content analysis of the corporate literature was undertaken using the same procedure used in the analysis of environmental policies.

Chevron claims to be "one of the petroleum industry's most environmentally responsible organizations", however, it believes that "emotion must be balanced with science and reason". Chevron believes that environmental leadership improves opportunities "to explore for oil and gas, run our plants profitably and sell our products competitively (Chevron,1990). Its goal is to be "better than the best" (Chevron,1990). Conoco believes that "responsible environmental performance is essential to strong business performance" (Conoco,1994). Elf considers environmental protection as a continuous activity (Elf,1994). Elf's report presents a very brief note of the organization's efforts in the management of environmental issues and it claims that despite the external economic context environmental protection efforts have not been reduced (Elf,1994). Exxon recognizes "the value and need for operating in a sound manner" (Exxon,1990). It is committed "to meeting the balanced environmental, economic and energy need" (Exxon,1994). Exxon does not guarantee to eliminate all accidents but "will continue to demonstrate our responsibilities to the environment, health and safety" (Exxon,1990). Mobil claims to be "transforming environmental challenges into business opportunities" (Mobil,1994). Petrobrás recognizes that the management of environmental issues requires a more strategic approach (Petrobrás, 1994c; Petrobrás,1995c). Petrofina recognizes the strategic importance of environmental, health and safety issues for their business (Petrofina,1995). Green issues are to be managed "in ways which are both efficiently and economically viable" (Petrofina,1994). Phillips Petroleum considers that "environmental demands is a requirement to be a good corporate citizen" (Phillips Petroleum,1994) and that it "is essential to the organization's financial success" (Price, 1993)*. Its overall performance goals include environmental goals. Shell highlights the importance of finding the right balance between environmental protection and economic development (Shell,1994). Shell suggests that the environmental challenge "requires cooperation between industry, governments, environmental groups and the public to find ways of balancing society's needs and the requirement of environmental protection" and if changes are to be introduced they should "be based on sound

* Phillips Petroleum Annual Report, 1993, pp22

science, well thought and properly planned" (Shell,1992). Texaco recognizes the challenge faced by the oil industry "in seeking efficient, cost-effective, environmentally sound solutions to the world's energy needs" (Texaco,1994) and that oil organizations have a continuous responsibility in ensuring that "petroleum is compatible with a clean environment and also essential to creating a climate of economic expansion and competitiveness that can support responsible stewardship of land, air and water resources" (Texaco,1994). Total claims to have drawn up an environmental plan for the Group's European refineries (Total,1994).

The allocation of financial resources for the management of environmental issues can be a good indication of the increasing priority given to the issue. It may also suggest that the external environmental pressures are significant and affecting organizations' business goals, making organizations spend more in the management of environmental issues.

There, is however, no standard for the publication of environmental expenditure. Environmental expenditure is therefore not a good variable to use for the comparison among organizations' environmental commitments. The information provided by the organizations is normally not very specific or, clearly linked to environmental objectives. In some cases the environmental expenditure might only indicate that organizations have been acting as "free riders" longer than the others; that is, by ignoring the effects of their activities and products on the biophysical environment until forced to do something about them. The possibility of "free riders" is recognized and confirmed by Texaco. The organization highlights that "government granting exception to refiners who have not chosen to make these (environmental investments) commitments may jeopardize the value of these investments".

The organizations have provided information on environmental expenditure of known obligations, however they are not able to estimate any future environmental liability costs linked to present or past actions upon the biophysical environment, and are

uncertain about possible environmental expenditure linked to future environmental laws and regulations requirements.

All of the reports except Petrobrás mentioned the possibility of future environmental liability problems. This would result in an increase in the organizations' environmental expenditure. For example, British Petroleum and Exxon in 1994 were still involved in environmental litigation issues concerning the Exxon Valdez oil spill in Prince William Sound, Alaska in March 1989.

British Petroleum recognizes that environmental expenditure "maintains and improves business performance, and that environmental performance is a part of good business (British Petroleum,1994). However, it also recognizes that the organization directs its environmental investment "in refining locations where we can have, or can achieve, a sustainable competitive advantage" (financially) (British Petroleum,1994). Mobil (Mobil,1994) considers environmental expenditure a significant cost to oil organizations. Texaco (Texaco,1994) acknowledges that future environmental expenditures may certainly be significant but "this will be a cost of doing business that will have to be recovered in the market-place". Texaco also mentioned that the organization's "proactive approach to prevention, detection and remediation of environmental problems gives the company a competitive position in our industry with respect to future environmental costs" (Texaco,1994).

The environmental expenditure mentioned in the reports, including capital and operating expenditure, is used for: air and water emissions prevention, control and possible elimination; environmental research and technology applications; products' environmental quality; waste minimization and handling; clean up programs; and remediation programs. Remediation programs are the only action not mentioned in the organizations' environmental policies.

British Petroleum and Shell are both concerned in recovering the high cost of meeting

society's environmental expectations from consumers "and/or through fiscal incentives offered by governments".

Research shows that the change in internal environmental structure is an indication of the organizations' concern and commitment to environmental issues. It has been suggested that organizations tend to create "boundary-spanning"* (Longsdon,1985) functions within the structure to protect themselves from possible disruptions caused by external forces.

The environmental reports confirm the trend toward the creation of environmental structures and appointment of environmental representatives at a high level of the corporate hierarchy in order to deal with the external ecological pressures affecting them. These demonstrate the pervasiveness and importance of the issue for organizations (Holmes,1978;Longsdon,1985).

British Petroleum (BP,1994a) has established a Health, Safety and Environment Audit Board Committee. Conoco (Conoco,1994a) has an environmental representative taking part of the organization's executive management advisory team, a safety, health and environment (SHE) leadership council and a SHE affairs department. Chevron (Chevron,1990; Chevron,1994) established a permanent Public Policy Committee at board level to monitor and evaluate environmental issues and also has an Environmental Affairs and Services vice-president. Exxon (Exxon,1990; Chevron,1994) has a Public Issues Committee to focus attention on public concerns including environmental issues and also an environment and safety vice-president. Mobil (Mobil,1994a) has established a Corporate Environmental, Health and Safety Department- EHSD that reports to the organization's executive committee. Petrofina

* Boundary-spanning- "It functions to protect the organization by managing relationships with entities outside the organization and by identifying opportunities and threats facing the organization. The goal is to improve the organization's ability to deal with uncertainties generated outside the organization" (Longsdon,1985,pp62)

(Petrofina,1995) has a Health, Safety, Environment and Quality "directeur général" and Phillips Petroleum (Phillips Petroleum,1994) a Health, Environment and Safety vice-president. Shell (Shell,1992) has a Steering Committee for Health, Safety and Environment that is supported by two other interfunctional committees, the Shell Safety and Health Committee and the Shell Product Safety and Environmental Conservation Committee. Texaco (Texaco,1994a) has an Environment, Health and Safety Council that is accountable to the Public Responsibility Committee of the organization's board of directors.

Elf, Petrobrás and Total have also introduced an environmental structure in their organizations. Elf has an environmental department (EM5 and EA3, 1995). Petrobrás has a Corporate Environmental, Quality and Industrial Safety Department (Petrobrás,1994c; PE13,1995). Total has established a Corporate Environment and Safety Functional Division (Total,1996).

The consequence of organizations' past inefficient practices, the present environmental control and the prevention of future environmental impacts are constantly introducing new external environmental limits to organizations' actions. It can affect organizations' overall performance, reputation and efficiency. The balance between environmental demands on its activities and products, and the organizations general business goals is a constant challenge to oil refineries.

There is no clear indication, in the reports, of the criteria and priority given by oil organizations for the integration of environmental issues within the organizations' strategic plans. It can be suggested from the analysis of the reports, that organizations' decisions on environmental issues take into account, primarily: the expected return on investment; followed by environmental liability of past actions (especially in the US) and the extent and pertinence of present external ecological forces to the long term viability of the operations of individual facilities.

It has been acknowledged by British Petroleum (BP,1994) that "there is only limited scope for product differentiation between oil organizations", therefore the main objective of oil refineries is to keep operating costs low, and improve refining efficiency and flexibility. The increase in flexibility and efficiency of the refining process is achieved through the adaptation of the refining process, allowing for the refining of different and cheaper lower-quality types of petroleum, and for the production of high-value products. All the organizations studied as part of this research propose the above. This requires the establishment of mechanisms to assure constant improvements.

From the analysis of the reports there is evidence that organizations have environmental management systems to maintain a continuous process of improvement. This management system is intertwined with other management systems. Only Petrofina (Petrofina,1995) have mentioned that one of its refineries has already been certified with the BS7750. The environmental management system does not cover product environmental quality (Petrofina/ Total,1994).

Sustainable use of renewable natural resources and efficient use of non-renewable natural resources seems to be a concern for all the organizations. The commitment of oil organizations to the sustainable use of natural resources includes the organizations' internal water conservation programs, energy efficiency programs or alternative products to oil products. These are all linked to the organizations' goal of cost reduction.

Shell has addressed the concern over the use of fossil fuel as a source of energy in its report (Shell,1994), but only to justify the continuous use of petroleum as a source of energy. It does not see any cost-effective alternative to oil especially as an energy source for transportation and also as a petrochemical feed stock.

Despite not having included any commitment to alternative sources of energy some of

the organizations are supporting the use of them; for example British Petroleum, Petrofina and Shell. Oil organizations are also proposing new product substitutes in order to reduce vehicular emissions, however, none of the organizations have yet proposed an alternative to fossil fuels to be used as transportation fuel.

Energy conservation programs are among the environmental programs mentioned by organizations. The implementation of energy conservation is included in most of the reports. British Petroleum highlights the relevance of behavioural changes towards energy use, if effective energy conservation is to be achieved (British Petroleum,1994). Chevron has built co-generation units in refineries and includes improvement of energy efficiency as a means to reduce costs (Chevron,1990). Conoco is committed to use energy efficiently through their participation on the STEP* program (Conoco,1994a). Exxon has introduced better process controls, improvements and maintenance, energy systems analysis and products improvement (Exxon,1990). It is also the only organization that claims to encourage energy conservation among their customers. Mobil claims that the organization has introduced efforts to conserve energy, however, the environmental report only mentions the organization's participation on the EPA's "Green Light Program"** (Mobil,1994a). Phillips Petroleum mentions the organization's participation in the EPA's "Green Light Program" (Phillips Petroleum,1993). Shell mentions an integrated system to improve the use of waste energy, co-generation and coal gasification process technology (Shell,1992). Texaco is developing co-generation, gasification to produce electric power and takes part in the EPA's "Green Light Program" (Texaco,1994a). Total is involved in energy conservation projects, including co-generation (Total,1994).

Petrobrás however does not include sustainable use of natural resources in its corporate annual report, although it is part of its business goals (Petrobrás,1994c). The

* STEP- Strategies for Today's Environmental Partnership

** Green Light Program - is a voluntary program introduced by the American Environmental Protection Agency with the aim of encouraging organizations to reduce and optimize their use of electric energy.

organization even has a section which deals exclusively with energy conservation issues (PE4,1995).

The demand for sustainable energy use can be a potential threat to oil organizations' general business goals. The change towards a sustainable energy use will require improvements in energy efficiency, a sustainable mix of energy sources and changes in consumption patterns (Schmidheiny,1992). According to Shell "the future energy mix will be determined by their safety, environmental impact, technical development and price" (Shell,1994).

Protection of the biosphere and environmental restoration are environmental commitments proposed by the CERES Principles (Sun Company,1992). The former is a commitment to reduce environmental damage, safeguard habitats affected by an organization's operations, protect open spaces and wilderness, and preserve biodiversity and the latter is a commitment to clean-up and restore the damage caused to the biophysical environment in consequence of an organization's present and past operations, and waste disposal locations.

Resource conservation programs are voluntary actions while environmental clean-up and restoration are an external demand established through legislation, for example, the Comprehensive Environmental Response, Compensation and Liability Act, commonly referred to as Superfund, enacted in the United States.

Chevron recovered an abandoned wastewater treatment pond (Chevron,1990). Phillips Petroleum (Phillips Petroleum 1993) and Texaco (Texaco,1994a) described their organizations' support to environmental protection programs.

The aim of biosphere protection seems to be a good strategy to promote a good "green image". All of the reports with the exception of Petrofina described their participation in voluntary ecological programs. It is suggested (Amoco,1993) that organizations'

participation in voluntary ecological programs has environmental benefits, improves community relations, benefits the employees and also has cost benefits.

Environmental restoration is described by most of the oil organizations except Conoco and Petrobrás. Texaco mentions their on-going remediation program of waste sites (Texaco,1994a) while all the other oil organizations only mention the remediation actions to explain the possibility of future potential environmental expenditures.

All the oil organizations described the upgrading of their refining process in order to improve and achieve the environmental quality of products required by environmental specifications. Although environmental standards of products vary according to local, national or regional requirements there is a great tendency to stricter standards. In their environmental reports the organizations include the following statements:

British Petroleum recognizes the cradle-to-grave responsibility they have for all their products. Chevron "takes responsibility for how its products affect the biophysical environment". Conoco is committed "to developing new motor fuels that will improve the environment by reducing emitted pollutants. Exxon recognizes that new and better products demand new and more rigorous refining methods. Mobil's research efforts are concentrated in the development of "cleaner-burning fuels at the lowest cost. Phillips Petroleum is involved in research linked to oil products' emissions and promotes the use of alternative fuels. Shell claims to apply cradle-to-grave analysis to their products. Texaco is committed "to help reduce automobile emissions that contribute to air pollution by applying advanced technology to improve gasoline performance". It also promotes the use of alternative fuels.

Some of the changes on products include: low-sulfur diesel, reformulated fuels*, unleaded gasoline and production of oxygenates (gasoline composition), methyl tertiary butyl ether (MTBE) and tertiary methyl ether (TAME).

*reformulated gasoline- gasoline that includes oxygenates and have other composition changes that reduce air toxics and hydrocarbon emissions (Phillips Petroleum, 1993, pp25)

Four of the oil organizations, Mobil, Petrobrás, Texaco and Total have described other efforts to reduce the pollution caused by their products. Mobil is recycling used lubricant oils (Mobil,1994a). Petrobrás advises customers on how to improve the performance of its products (Petrobrás,1994c). Texaco has opened a used oil recycling facility (Texaco,1994). Total (Total,1994a) mentions the organization's program to reduce the pollution caused by the use of petroleum products, by supporting the repair or removal of high pollutant vehicles from the streets.

Sustainable development is not established as a commitment in organizations' environmental policies. British Petroleum (British Petroleum,1994a), however, proposes to contribute to the debate about sustainable development and Shell (Shell,1992) accepts the concept of sustainable development.

British Petroleum and Shell seem to limit the sustainability challenge to the balance between economic and ecological demands. The sustainability challenge for business, however, goes beyond good environmental performance. It should also include social equity, quality of life and values (Elkington and Trisoglio,1996).

From the reports it can be suggested that the production and marketing of clean technology seems to be increasing in strategic importance. The development of clean technology and subsequent marketing of it is associated with the organizations' business goals. There is, however, no clear evidence of the financial contribution of developing and marketing of clean technology to oil organizations' financial performance.

British Petroleum, Exxon, Mobil and Texaco develop and market environmental technology. British Petroleum (British Petroleum,1994a) is involved in research into the production of solar energy. Exxon (Exxon,1990) has developed several processes to reduce emissions that they claim to be licensed to other refineries. It also owns

environmental research companies. Mobil (Mobil,1994a) developed a computerized system to track environmental, health and safety regulations, and established a new subsidiary, Mobil EHS* Inc. This is part of a program to transfer environmental management experience to the Indonesian state-owned gas and oil organization. Mobil (Mobil,1994a) provides the Indonesian state-owned oil organization with environmental training, technology and technical support. Phillips Petroleum (Phillips Petroleu,1994) signed an agreement with the state-owned Mexican oil organization to provide refining "clean technology". Texaco (Texaco,1994a) developed gasification (converts "dirty" fuels into clean synthesis gas) and co-generation technologies that they claim to be licensed to other refineries. Texaco (Texaco,1994a) also completed a program with the US Environmental Protection Agency to demonstrate the feasibility of using the gasification process in soil remediation programs.

As far as commitment is concerned, the information provided by oil organizations shows that, in general, their actions go beyond the environmental commitment established in the environmental policies (see table 7.2).

7.2.2 - Strategy Formulation

It has been suggested that organizations avoid the publication of their strategies for competitive reasons and also to protect themselves in the event of failure to achieve the established objectives (Ross,1987). The organizations did not include any detailed environmental strategy in their reports.

All the organizations investigated are, however, responding to the ecological forces affecting them. They are integrating environmental issues as part of their activities and products. For instance, the adaptation of the refining process to comply with environmental specifications on oil products. They are also applying a precautionary approach to the management of environmental issues. For instance, by reducing or avoiding pollution problems.

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* EHS - Environmental, Health and Safety.

According to the reports, the general environmental goals of oil organizations relate to the management of environmental issues which include: compliance with legal environmental requirements (products and facilities); avoid present and future environmental liability, through waste minimization, emissions reduction and cleaner operations; reduce costs; and improve the organizations' competitive position by increasing the production of value-added products and develop cost-effective clean technology.

There is no indication, however, on how organizations such as British Petroleum, Chevron, Conoco, Phillips Petroleum, Shell and Texaco will achieve the goal of environmental excellence and leadership established in their environmental policies, nor their criteria to define environmental excellence.

Oil organizations claim that environmental performance is the responsibility of every employee at all levels. Environmental training, however, does not seem to be the only means to increase employees' environmental awareness.

Chevron, Exxon, Petrobrás, Petrofina, Phillips Petroleum, Shell and Texaco included employees' environmental training in their environmental reports. None of the organizations, however, have described the content and level of the training programs.

Other alternative ways, suggested by oil organizations, to increase employees' awareness and participation in the organization's environmental performance are to introduce environmental performance assessment as part of employees' annual performance rating (EM2 and EA2,1995), rewards (Conoco,1994a) and to promote internal competitions (EM3,1995).

Environmental impact assessment and ecological risk assessment are described in Chevron, Conoco, Mobil and Shell's environmental reports. The organizations' actions are not voluntary but a response to external ecological pressures and prevention of

future environmental liability, in the case of facility decommissioning and/or leaving a site.

Although not included in Petrobrás' report, the current Brazilian environmental legislation requires the organization to undertake environmental impact assessment to any new facility or even to any modification to the refining process (PE1,1995).

The organizations' environmental reports describe the environmental programs chosen by the organizations relating to the management of environmental issues. These programs are applied in the whole organization and also in individual facilities within the organizations.

The environmental programs introduced by the organizations comprise most of the impacts caused by them on the biophysical environment and are in compliance with the aims established in the environmental policies of oil organizations. These environmental programs demonstrate the organization response to their commitments and also some of the priorities chosen for the management of green issues.

The effectiveness of these programs cannot be evaluated. The organizations, unfortunately, do not provide quantitative information on the actual results achieved. There is some indication, however, that the programs have both economic goals (for example reduction of costs and effective use of petroleum) and ecological goals (for example compliance with legislation and regulations, reduction of future environmental liability).

British Petroleum (British Petroleum,1994a) describes programs on the prevention, control, abatement or elimination of air, water and solid waste. It also mentions the operation of new effluent treatment facilities. Chevron (Chevron,1994) describes programs to control air emissions, water discharges and waste handling. Elf (Elf,1994) has launched a program on volatile organic compound emissions. Exxon

(Exxon,1994) mentions the progress of the organization's waste reduction program. Mobil (Mobil,1994a) describes the progress of the organization's waste recycling program. Petrobrás (Petrobrás,1994) describes the organization's efforts to minimize oil spills in terminals and refineries. Petrofina (Petrofina,1995) has introduced a new waste water unit in one of its refineries, and also initiatives to recover hydrocarbon vapors and to improve waste management. Phillips Petroleum (Phillips Petroleum,1994) describes the improvement of a wastewater treatment plant and describes the progress on the organization's waste reduction program. Shell (Shell,1994) describes the organization's efforts to limit or monitor hazardous substances or pollutants and also new "greenfield" projects. Texaco (Texaco,1994a) describes air, water and solid waste management programs, energy efficiency improvement through cogeneration and gasification. Total (Total,1994) describes the improvement of a wastewater treatment plant and the refinery drainage system, and also the implementation of a waste management program. The areas targeted by the organization's environmental plan also include SO_2 emissions, hydrocarbon vapor recovery and quality improvement of discharged water.

Other objectives described in the environmental reports include: to recycle wastes and reduce hazardous wastes generated; to increase use of non- toxic alternatives for materials and processes; to improve the efficiency of resource usage; to apply a multi media approach to pollution reduction and control; to devise safer operating procedures and contingency programs; to use risk assessment in order to investigate and analyze potential risks; to undertake environmental impact assessment and life cycle analysis in the development of products; to develop new clean technology; to encourage and provide the means to final product recycling or disposal; to undertake soil restoration and remediation programs; and to monitor environmental quality.

Elf (EM5,1995) and Petrobrás (PE1,1995) have introduced more environmental programs than those described in the reports.

The implementation of contingency programs in order to control and reduce the environmental impact consequence of any possible incident related to organizations' activities, is recommended by the ICC (CBI,1992) and the CERES Principles (Sun Company,1992) environmental charters.

Most of the oil organizations have described their efforts to prevent accidental emissions, reduce risk and the introduction of contingency programs. Elf (EM5,1997), Petrobrás (PE1,1995), Petrofina and Total's (EM4,1994) actions are similar to the other organizations, although not described in their reports.

Research and development is a means to address and incorporate environmental issues in organizations' products and activities. The importance of research and development is highlighted by all the oil organizations. From the reports it is clear that economic and ecological demands are driving organizations to develop more cost-effective technology in order to comply with environmental demands and improve their overall economic and environmental performance. For example, the research programs mentioned in the reports (annual and environmental) include: products environmental quality, through refining process modification and change of product composition; development of new cleaner products; waste disposal; soil regeneration; monitoring of environmental quality; recycling alternatives; toxicology; reduction of water consumption; wastewater treatment and air emissions reductions; increase of energy efficiency through the upgrade of the refining process; increase in the production of high value products; co-generation and gasification technology; bioremediation treatment; investigation of the effects of fuel composition on engine emissions; new products, such as additives, detergents and motor oil, to improve and reduce emissions; fuel blends, for example diesel and rape seed methyl ether; and products to minimize the impact of oil spills, for example detergents to remove hydrocarbon residues from birds caught in oil spills.

There is great concern over the rigid and prescriptive approach used in environmental legislation (BP,1993; Shell,1993). Shell suggests that the development of European

environmental policy still lacks an appreciation of the wider impacts an environmental policy can cause to organizations (Shell,1993) and Texaco (1994) suggests that "environmental legislation in the US has grown to the point where its costs and rigidity are stunting the country's economic growth".

The concern on environmental controls seems to have increased the participation of organizations with government and others on the debate on environmental issues. The interest of organizations in the development of legislation seems to be an attempt to have some control on the policy development process by highlighting the wider impacts an environmental policy can cause for businesses. However, despite organizations' concerns and reaction to the prescriptive approach used, the control upon them is continuously increasing, thereby demanding more operational and capital environmental expenditure as mentioned in all the reports.

British Petroleum (British Petroleum,1994a) is working with policy makers to develop workable climate change strategies. Chevron (Chevron,1990) recognizes that a "balanced legislation is needed". Chevron is "eager to contribute sound, scientific data to discussions on legislation that will affect its business" (especially in issues associated with products). Phillips Petroleum states in its corporate report (1994) that they take part in the development of environmental regulations and legislation. Shell (Shell,1992) aims to contribute to the formulation of national, regional and international standards. Texaco (1994a) mentioned the organization's participation in the public debate on environmental issues in order to assure that the design of laws and regulations enhance environmental quality and preserve economic vitality.

Phillips Petroleum highlights that "we've noted that mounting environmental regulation often costs more than it contributes and is a particular burden to oil organizations". Shell proposes that "governments should aim to encourage the creativity and ingenuity of industry since self-regulation and market instruments are likely to be more effective than legislation and regulation".

Texaco proposes to "maintain a leadership position in the public debate over the development of laws and regulations that protect the environment on a cost-effective basis". It also recognizes the importance of a co-operative approach among oil organizations in this matter.

Petrobrás takes part in a technical committee nominated by the government to discuss environmental legislation (Petrobras,1995; PE1/PE2/PE13,1995).

The refineries do not have a direct participation in the development of environmental legislation (EM1-5,1995; PE1-2). They take part in technical committees co-ordinated by the United Kingdom Petroleum Industry Association- UKPIA in the UK and internal committees organized in Petrobrás. In the UK, UKPIA is in most cases the link between the organizations and the government in discussions of green issues (UKPIA1,1995).

The participation of organizations in discussions or programs related to the environmental issues related to their activities and products is proposed by the Step (API,1990) and ICC (CBI,1992) environmental charters as a demonstration of organizations commitment to improve environmental quality. Oil organizations are working closely with other organizations in order to understand, reduce or solve the environmental problems related to oil refineries' products and operations.

British Petroleum (British Petroleum,1994a) supports the European tripartite initiative on air quality, emissions, fuel and engine technology involving the automobile industry, oil industry and the European Commission. It also contributes to a similar auto-oil initiative in the US, takes part on the debate on global warming, and co-sponsor the Massachusetts Institute of Technology Joint Program on the Science and Policy of Global Change. Chevron (Chevron,1990) conducts and supports research into automobile fuels and fuel systems, initiated a joint industry/government study of

methanol production, supported Stanford University to develop a hybrid motor vehicle using electricity and conventional fuels, supports air quality monitoring studies and helped to create the Petroleum Environmental Research Forum. Conoco (Conoco,1994a) supports environmental research through a fellowship research program. Exxon (Exxon,1990) helped to establish and fund private research organizations that work in finding solutions to environmental problems. It also supports environmental groups involved with scientific environmental research, development of sound policy and environmental preservation and participates in joint industry/government research program to evaluate the impact of certain gases on the atmosphere. Mobil (Mobil,1994a) takes part in the American joint Auto-Oil industry research program to develop data on fuels and vehicles as a system. Mobil also supports research on environmental monitoring, preservation and atmospheric studies, and the development of recommendations for working in ecologically sensitive areas. Phillips Petroleum (Phillips Petroleum,1993) is a member of a research group developing solutions to shared environmental problems, supports research programs in different research organizations and takes part of the Auto/Oil Air Quality Improvement Research Program. Shell (Shell,1992) supports biodiversity and climate change research programs. Texaco (Texaco,1994a) supports research in climate change, air quality modeling and biodiversity. It participates in two voluntary programs, EPA's "Waste Wi$e" and the "Office Paper Recycling Project". It also works in partnership in the Global Climate Coalition and International Chamber of Commerce.

Some organizations described their support and participation in research programs undertaken by business associations such as the API*, CONCAWE** and IPIECA***

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* API - American Petroleum Institute

** CONCAWE - Conservation of Clean Air and Water Europe, recently changed to The Oil Companies' European Organization for Environment, Health and Safety.

*** IPIECA - International Petroleum Industry Environmental Conservation Association

Petrobrás provides technical support and works together with different groups, including universities, in order to improve the knowledge about the effects of its activities and products upon the biophysical environment (Petrobrás,1994).

As far as the strategy formulation commitment statements are concerned, in general, the oil organizations do more than is stated in their environmental policies (see table 7.2).

7.2.3 - Implementation

Elf is the only organization not to publish an environmental policy. However, from the research it may be suggested that this organization does not have much option but, at least, to comply with environmental legislation. Compliance with environmental legislation is a goal in Elf's UK refinery (EM5,1995). This suggests that green issues are inevitably part of the organization's decision-making process.

Petrobrás has published an environmental policy, however, the organization has a different internal environmental policy (see chapter 8). Shell (Shell,1995), Texaco (Texaco, 1995) and Total (Total,1992) publish a separate environmental policy in the UK. Some of the UK refineries also publish their own site environmental policies (Total/Petrofina,1994; Texaco,1995a; Shell,1995)

All of the reports except for Petrofina, describe the provision of safety information of products. However, only British Petroleum (British Petroleum, 1994a), Exxon (Exxon,1994), Mobil (Mobil,1994a) and Texaco (Texaco,1994a) claim to provide customers with advice on the environmental aspects of products. For example, information on: the disposal of lubricant oil; provision of information about regulations affecting oil products; and the environmental benefits of reduced-emissions petrol and performance-improving motor oils.

Only Phillips Petroleum (Phillips Petroleum,1993) describes environmental assessment of contractors environmental management aspects. None of the reports include any action concerning suppliers' environmental behaviour.

As far as implementation is concerned, the organizations do not publish enough information on all the commitment statements stated in the organizations' environmental policies (see table 7.2).

7.2.4 - Evaluation

Although compliance with environmental legislation may seem a good and reliable way of comparing organizations' environmental performance and commitment, legislation frequently varies widely among countries and even between areas within the same country. Consequently, compliance with environmental legislation is too limited to establish a good comparison of organizations' environmental performance.

For organizations, compliance with environmental legislation, however, is a means of promoting their commitment to operate in regard to the biophysical environment and to demonstrate their improvement in environmental performance. It may also help create a corporate "green image" or even be used as a bench marking parameter (EA1,1995).

British Petroleum (British Petroleum ,1994) intends to ensure "that we comply with environmental and product quality regulations". It also recognizes that compliance with environmental regulations protects their "license to operate" and "can also provide a commercial return". Chevron (Chevron,1990) considers that compliance with legislation is as a "moving target" and "keeping up environmental legislation and laws is getting tougher". Its objective is to comply with environmental laws (Chevron,1994). Exxon (Exxon,1994) set a very open and general commitment to "meeting the balanced environmental, economic and energy needs of the communities

in which it operates". Petrofina's (Petrofina,1994) objectives include "compliance with environmental quality of products".

Conoco (Conoco,1994), Mobil (Mobil,1994), Phillips Petroleum (1994), Shell (Shell,1994) and Texaco (Texaco,1994) reinforce their policy commitment to comply with environmental legislation. Elf (EM5,1995), Petrobrás (Petrobrás,1994) and Petrofina/Total (EM4,1995) also stated that compliance with environmental legislation and regulation is among their objectives.

Organizations claim to set themselves environmental objectives that are tougher than the legislation. However, complaints on different environmental performance standards of oil organizations raise doubts on these claims (Ketola,1995). Organizations also take part in voluntary emissions reduction programs (mainly in the US).

The ICC and the CERES environmental charters (CBI,1992; Sun Company,1992) suggest that organizations should monitor their environmental performance through environmental audits. The use of environmental audits seems to be the management tool used by organizations to monitor the progress of their environmental performance.

British Petroleum (British Petroleum,1994a) Chevron (Chevron,1990), Conoco (Conoco,1994a), Mobil (Mobil,1994a), Phillips Petroleum (Phillips Petroleum,1993), Shell (Shell,1992) and Texaco (Texaco,1994a) highlighted the importance of environmental auditing as an internal management tool to provide the assessment of the organizations' environmental performance and guide to future organizations' improvement. Petrofina has just started to implement a systematic monitoring system.

Petrobrás has undertaken its first corporate environmental audit in 1995 (PE23,1995). During the research this researcher observed the preparations for the audit. Elf (EM5,1995) and Petrofina/Total (EM4,1995) claim that they undertake internal environmental audits.

Some organizations have also described their participation in monitoring programs in order to provide scientific evidence of the impact caused by their activities and products (EM1,1995; PE1/PE13,1995).

As far as evaluation is concerned, most of the organizations comply with the commitments set out in their policies. Some of the organizations provided information on their compliance results, despite not having this as a commitment in the environmental policy (see table 7.2).

7.2.5 - Feed-back

The increased scrutiny and pressures on oil organizations' ecological issues are reflected in the ecological concerns of different interest groups. Organizations have to identify the relevant interest groups and determine their environmental concerns on the organization's activities and products. This is similar to the business environment framework proposed by Hannan and Freeman (1977), but in this case the stakeholders' interest is mainly the organization's environmental performance. The stakeholders other interests in the organization's overall performance are not necessarily exclusive between one another.

Chevron's community-awareness efforts include: visits to their facilities, educational videos, telephone line to respond to neighbours' inquiries, open discussions with the community and environmental organizations. Conoco (Conoco,1994a) supports the creation of citizen advisory councils "to monitor environmental performance and blow the whistle if the organization does not perform". Phillips Petroleum (Phillips Petroleum,1993) set up Community Awareness and Emergency Response Centres, supports Community Advisory Centres, participates in a multi-company panel involving plant managers and community leaders. It develops employees as community relations' co-ordinators. Petrobrás (Petrobrás,1994; PE34-38,1995) and

Petrofina (Petrofina,1994) mentions dialogue with interested groups. Petrofina supports Community Advisory Groups, internal publications, presentations and training sessions. Petrobrás promotes dialogue and supports environmental agencies, universities and non-government environmental organizations (Petrobrás,1994). Texaco (Texaco,1994) is concerned in meeting customers demands for "plentiful, affordable energy with heightened expectations that we will be effective stewards of the environment". Shell (Shell,1994) proposes that it is "the prerogative and responsibility of society to decide how best to reconcile economic growth and environmental protection".

The publication of environmental policies, the inclusion of environmental information in organization's corporate annual reports and the publication of environmental reports demonstrate the response of the organizations to external demands for more environmental information.

The publication of annual reports is a legal requirement to disclose organizations' financial information but it also provides voluntary information that reflects the organization's views and their own assessment of their performance in several other areas. This includes information on the organization's environmental performance.

Within the reports investigated, the information on green issues varies considerably as there is no statutory specification of the information to be provided. Oil organizations began to provide environmental information in their corporate annual reports in the 1940's in response to the external demands on the organizations' environmental performance (Longsdon,1985).

Some organizations chose to include whole exclusive sections of the report to communicate on the organization's environmental performance while others provided the information according to different activities and some only describe the organization's environment programs. The information available in the reports is,

however, easily compared because of the similarity in activities, products, byproducts and effects upon the biophysical environment.

The publication of environmental reports is a means of communication used by oil organizations; however, this is still a voluntary initiative of organizations. The contents of the reports vary among oil organizations and it seems that they are still cautious on the environmental information provided. An attempt to provide a guide for the publication of environmental reports has been suggested with the proposal of the PERI Guidelines* (PERI,1994). The PERI guideline is a voluntary action by organizations to establish a standard in environmental reporting but it also gives organizations some control over the information provided as they standardize the format and information to be included in the reports. British Petroleum, Conoco, Phillips Petroleum and Texaco have produced their corporate environmental reports according to this guideline.

After the oil spill in Alaska in March 1989, oil organizations "have been subjected to closer scrutiny and tighter regulatory controls than ever before" (Chevron, 1990, pp3). This was probably a strong contributing factor to organizations' openness, with the publication of environmental reports to protect their own "green image".

From the sample selected Mobil, Chevron, Exxon and Texaco were the first oil organizations to publish environmental reports in 1990. British Petroleum published its first report in 1992 followed by Phillips Petroleum in 1993 and Conoco in 1994. Shell published a report providing details of the organization's environmental management programs in 1992. Total published a brochure in 1992 giving general information about actions taken to reduce the pollution effects of the oil industry. Petrofina's first environmental report was published in 1995. Elf, Petrobrás and Total have not yet published an environmental report.

* PERI Guidelines- The Public Environmental Reporting Initiative

British Petroleum recognizes that the publication of environmental performance results can be misinterpreted and misused but it is also essential to respond to general ecological concerns upon organizations. Phillips Petroleum points out that the information provided by organizations can be "constructed by others to promote their own special agendas". Petrofina recognizes that communication in environmental issues is crucial but also complex, not easily understood and occasionally misused by others. Chevron, Shell, Texaco and Petrofina seem to protect themselves against probable criticism, by recognizing that they are managing the environmental impact of their activities and products; however, they emphasize that there are still areas in their organizations that need improvement.

Other means described by organizations that are used to communicate the environmental issues related to their organizations, promote the organizations' "green image" and to increase public awareness on the issue are through environmental education programs.

Despite the similarity on their emissions, the publication of the environmental performance results does not follow a standard procedure and shows global results only. It is difficult, therefore, to evaluate any discrepancy in environmental management procedures and performance results among organizations, or even between individual facilities within the same organization.

Most of the environmental information provided by oil organizations includes the results of voluntary environmental programs and in some cases the information required by legislation.

The type of environmental performance information provided by the organizations include: Toxic Release Inventory (TRI) data (obligatory), US Environmental Protection Agency's industrial toxic emissions program, known as "33/50 Program"

(voluntary), Superfund Amendments and Reauthorization Act (SARA 313) (obligatory), discharges to water, including oil and grease, sulfides, ammonia, phenols, total suspended solids and chemical oxygen demand, atmospheric emissions, including sulfur dioxide emissions, nitrogen oxide and volatile organic compounds, notices of violation, including oil spill, flaring and non-compliance incidents, and fines paid.

As far as feedback is concerned, oil organizations are promoting dialogue with certain interested groups and they are slowly providing more information on their performance. The information provided is, however, still not enough for a thorough and comprehensive assessment of the organizations' environmental performance (see table 7.2).

7.3 - Discussion

The publication of information on green issues is still voluntary therefore organizations decide on what details they will publish. Most of the information provided tends to be very descriptive. There is not enough to establish a quantitative comparison of organizations' environmental performance.

Green issues associated with products are mostly described in the organizations' annual reports, while the green issues associated with the operation of the refining activity are mostly described in the organizations' environmental report.

The organizations have described more than the commitment statements of their environmental policies (see table 7.2). Conoco is the only organization where the actions described are less than the commitments proposed in the organization's environmental policy. Shell has an equal number. All the other organizations described more than was set out in their policies. The issues described by the organizations are not always the same ones defined in their policies.

The actions described by the organizations are very similar, depending on the geographical location of the refineries. Compliance with product environmental quality is a general concern. The trend shows a move towards stricter limits. The US is still the strictest, followed by the EU and Brazil. Refineries in the US seem very concerned with energy conservation and clean up issues. Participation in voluntary environmental programs launched by environmental authorities is also on the agenda of US refineries. Refineries in the UK are concerned with wastewater treatment. Refineries in Brazil do not follow a general pattern as the legislation varies in each state. However, compliance with legislation and avoidance of nuisance to local communities are top priorities.

This investigation has shown that ecological demands upon oil refineries are affecting most of their products and operations. Therefore, it can be suggested that the management of environmental issues is integrated and co-ordinated as part of the refining activity decision making. It can also be suggested that the management of environmental issues is intertwined in most of the activities of the refinery. However, the level of integration and co-ordination could not be defined in this analysis.

7.4 - Conclusion

The content analysis of the information provided by organizations in corporate literature, annual reports and environmental reports has addressed the third research question of this investigation. The analysis showed the main areas the organizations act upon, their environmental programs, internal organizational changes in consequence of ecological demands and the interaction the organizations have with different stakeholders.

The information provided by oil organizations indicated that they are implementing their environmental policies (chapter 6) and are addressing most of the ecological forces and environmental controls identified in chapter 5. However, the oil refineries'

behaviour varies depending on the control system in place. Environmental policies do not establish quantitative goals therefore it was not possible to establish a quantitative assessment between the environmental policies and their level of implementation.

The content analysis undertaken in this chapter suggests that ecological demands have become a variable part of organizations' economic process. Organizations are under constant pressure to achieve their business goals and respond to ecological demands of different stakeholders.

The effect of the environmental policy upon the refining activity of an organization is investigated in the next chapter.

CHAPTER 8

Green Issues and the Refining Activity - A Case Study

The aim of this chapter is to answer the following research question: *How is the environmental policy linked to strategy?*

A case study of the refining activity of an oil organization is presented in order to investigate the effect of the organization's environmental policy upon this activity.

8.1 - The Oil Organization

Petrobrás - Petroléo Brasileiro SA is a mixed capital organization (51.5% of the total shares are held by the Federal Union), being the executor of the state oil monopoly* from 1953 (Dias *et al*,1993) until 1995 (Magalhães,1995). Its activities are organized into upstream and downstream oil operations. It also operates in the natural gas segment, petrochemicals and fertilizers.

The mission of Petrobrás is (Petrobrás, 1997):

> "*Guarantee domestic suppliers of oil, natural gas and oil products, through the activities defined in the Brazilian Constitution and under Law no. 2004/53 (the establishment of Petrobrás as a state oil monopoly), and profitability at lowest costs to society, thereby contributing to Brazilian development*". (Petrobrás, 1977, pp8)

The organization has a functional structure where tasks are divided into functional activities. This includes: exploration & production, downstream, services, regional offices and special divisions. The functional units are integrated through a corporate strategic plan (Petrobrás,1994c). The organizational chart is shown in figure 8.1.

*Initially the monopoly was on exploration, production, refining and transport. Later it included marketing and importing of petroleum, and, importing and exporting of products (Dias *et al*,1993). Despite the monopoly on refining the government authorized the maintenance of two small private refineries.

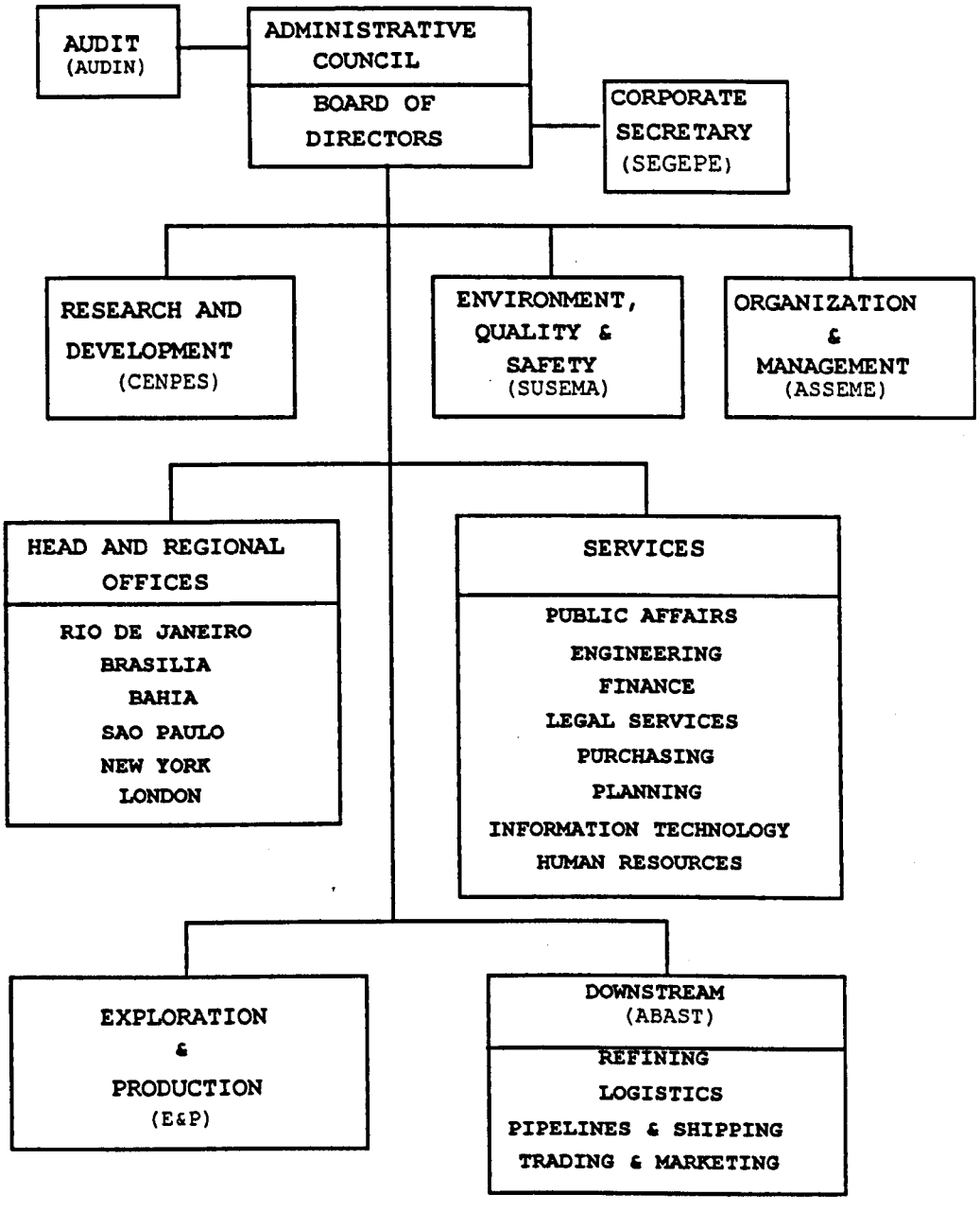

Figure 8.1: Organizational Chart of Petrobrás. This figure shows the organizational structure of Petrobrás. It is a functional structure. (Source: Petrobrás Annual Report 1996, 1997)

The strategic guidelines of the corporate strategic plan include: consolidation and strengthening of the domestic market; expansion of international activities; and integration, competitiveness and excellence of its business (Petrobrás, 1994c). The strategic directions set out in the plan are put into practice through the establishment of corporate goals, corporate projects and functional activities strategies (Petrobrás, 1994c).

8.2 - Petrobrás and Green Issues

Petrobrás has recognized that there is an increasing trend to stricter demands on environmental quality and product quality upon oil organizations (Petrobrás,1995a). The organization also recognizes that these issues are increasingly more associated with the organization's overall performance (PE1 and PE13,1995). The evolution of environmental, quality and safety demands are, however, uncertain to Petrobrás because of the characteristics of the oil industry (P1 and P11,1995). This constant uncertainty requires a permanent worldwide monitoring of environmental and quality demands upon oil organizations. This monitoring is done by Petrobrás' planning service and further integrated into Petrobrás' strategies (P11,1995; Petrobrás, 1995a). The effect of the increasing environmental pressures upon oil organizations, including Petrobrás, is reflected in Petrobrás' organizational structure, corporate objectives and internal environmental policy.

8.2.1 - The Environmental Organizational Structure of Petrobrás

The organization has had a corporate environmental, and safety and quality (only included in 1991) special division since the mid-1970's, formed in response to the increased relevance of environmental issues at that time (Petrobrás,1991) (see organizational chart in figure 8.1).

The corporate environmental, safety and quality special division co-ordinates and integrates environmental management issues within the organization. It is responsible to establish the corporate environmental policy and corporate environmental objectives. These apply to the whole organization (P13,1995). The effective management of green issues within the organizations is the responsibility of each functional unit (P13, 1995).

Different functional units have their own environmental and safety internal structure. The functional units however do not have a standardized environmental structure (P1-P3,1995). It generally includes a central representative in the head office and representatives in each different facility (P1-P3,1995). The management of quality issues is not part of the same structure in the functional units (P1-P3 and P13,1995).

The central representative is responsible for managing green issues at corporate level. She/he integrates with other functional units and co-ordinates the activities within the functional unit (P1-P3,1995). The facilities' representatives are responsible to co-ordinate environmental issues at operational level; however, their tasks are not standardized through the organization (P24-P28,1995).

There are also employees working in environmental management in the planning department, legal affairs, R&D, engineering and public affairs (P1,1995).

8.2.2 - Petrobrás Corporate Environmental Objectives

> The organization's corporate objectives, long and medium term, associated with green issues, provide the scope of the organization's environmental management. The objectives are, respectively (Petrobrás,1991):
>
> "*to preserve and respect the biophysical environment in areas the organization operates and in the quality of its products*"; and, "*to minimize the impact upon the biophysical environment*".

The organization also sets short term environmental objectives which are revised on a yearly basis (Petrobrás,1994c).

The corporate environmental objectives are complemented by the environmental, quality and safety corporate policy set out by the Environmental, Safety and Quality special division (Petrobrás,1991).

While the corporate objectives set the general goals for the organization, the internal environmental policy provides the strategic direction for action.

8.2.3 - Petrobrás Internal Environmental Policy

The organization previously published an environmental policy in 1989 (Petrobrás,1989). This policy was discussed in chapter 6. The internal policy is not available to the public.

From the research it can be suggested that the emphasis of the two policies are different. While the first policy is a means of communication with society, the internal policy provides guidelines for action within the organization.

The internal policy is a combined environmental, quality and safety policy. It complements the corporate environmental objectives. The aim of this combined policy is:

> "*to allow Petrobrás to demonstrate to society its distinguished performance in the management of the above issues*" (see 8.2.2 - Petrobrás Corporate Environmental Objectives) (Petrobrás,1991).

The policies' principles for action are the following (Petrobrás,1991):

> - *to integrate environment, quality and safety in Petrobrás' mission and in every activity undertaken by the organization;*
>
> - *the implementation of the corporate objectives and policy, is the responsibility of every employee. Each manager is responsible for the overall results;*
>
> - *to continuously improve the environmental, quality and safety performance of any of Petrobrás' activities and products in order to satisfy the requirements in each one of the above areas. This includes internal policies, operational procedures, facilities, products and*

services. Contractors should also be required to comply with the organization's principles on the above issues;

- to include environmental, quality and safety considerations in Petrobrás' decision-making process. This should consider the requirement of interested parts and potential opportunities along the whole life cycle of each project. This includes: assurance that the organization's activities do not deteriorate the quality of life of local communities, use of appropriate technology taking into consideration environmental, quality and safety issues and appropriate resources to prevent and control possible incidents;

- to encourage employees to have a preventative and proactive approach in relation to environmental, quality and safety issues. To include these issues in Petrobrás' training programs and continuously develop employees' capability;

- to continuously seek the satisfaction of interested parts, internal and external, and also customers of Petrobrás' products and services;

- to integrate with suppliers in order to assure the quality of products and services;

- to minimize any potential risks upon employees and contractors;

- *to inform the local community about potential risks consequence of the organization's activities and existing contingency plan; to increase local community awareness and encourage their participation in contingent events;*

The above policy suggests that the organization proposes to manage environmental, quality and safety issues with the same level of priority. The policy takes into consideration general internal matters that are applicable to all three issues. It highlights specific matters that are separately applicable to each of one of the above issues. The environmental policy also covers all the ecological forces and environmental controls identified in chapter 5.

The above policy includes several issues suggested in environmental management charters (CBI,1992; API,1990; Sun Company,1992). There is also a similarity with policies of other oil organizations (see chapter 6).

The combination of quality with the other two issues is, however, unique to Petrobrás when compared to the policies published by other oil organizations investigated in this research (see chapter 6).

8.2.4 - Short Term Environmental Objectives

To achieve the corporate long and medium term environmental objectives and also comply with the organization's policy, short-term objectives are proposed by the functional units. The definition of the short-term objectives are also set by the Corporate Environmental, Quality and Safety Office (Petrobrás,1995c).

While the organization's corporate policy integrates environmental, quality and safety issues, the short-term objectives are considered separately. The environmental objectives set for the whole organization by the end of 1995 include the following issues (Petrobrás,1995c): ISO 14000 environmental standard series; improvement of environmental index; environmental auditing; contingency plans; external communication; environmental training; use of natural gas; clean technology; environmental performance information; environmental quality of products; environmental performance of contractors.

There is an overlap in some of the objectives set by the organization. For example, while compliance with environmental requirements of diesel is only part of the quality objectives, quality of products is included both in quality and environmental objectives. Contingency plans are also part of safety and environmental objectives.

8.2.5 - Environmental Expenditure of Petrobrás

The environmental expenditure of Petrobrás is shown in table 8.1. The figures shown in the table are only part of the total amount spent by the organization in the environmental area. The organization claims that part of its environmental expenditure is recorded elsewhere (Petrobrás,1996). It is not explicit but the organization claims that it is included as part of investments in property, plant and equipment.

Year	1993	1994	1995	1996
Consolidated Capital Expenditure US$M/year	2,298	2,414	3,297	3,368
Environmental Expenditure* US$M/year	20	NA**	33.27	35.68
%	0.9	-	1.0	1.0

Note: * - Environmental expenditure for the whole organization. Environmental expenditure is also included as part of investments in property, plant and equipment (Petrobrás,1996). The total amount, however, is not explicit for all years.
** - Not available

Table 8.1: Environmental expenditure of Petrobrás. This table shows the amounts spent by Petrobrás in the environmental area, in relation to the organization's consolidated capital expenditure (Source: Petrobrás Annual Reports: 1993, 1994, 1996).

Each functional unit has to propose, on a yearly basis, the financial resources necessary to comply with their respective environmental objectives (Petrobrás,1995c). These objectives are decided based on the corporate environmental goals, internal environmental policy and short term objectives (Petrobrás,1994b).

In 1993 the organization claims to have spent US$M150, in total, in the environmental area (Petrobrás,1994). From this amount US$M20 was used to minimize the effect of oil spills, personnel training and installation of special equipment in platforms and terminals, as shown in table 8.1. According to the 1993

annual report the total investment was equivalent to 7% of its overall investments (Petrobrás,1993).

In 1994 Petrobrás reported (Petrobrás,1995) that the total environmental expenditure was equivalent to 7 to 10% of its total capital expenditure. While the environmental programs were the same as in 1993, there is no indication of the amount spent in these programs only.

In 1995 and 1996 Petrobrás did not report the total environmental expenditure (Petrobrás,1997). The environmental programs were developed at the organization's operation facilities and headquarters. They emphasized environmental impact evaluations, management of dangerous residues, protection of maritime resources and training of corporate environmental auditors.

8.3 - The Refining Activity

The refining functional unit comprises a central office which co-ordinates the activity of 10 oil refineries, 1 asphalt plant and 2 fertilizer plants. The refineries have a rated refining capacity of 1,540 Mbpd with an average daily output of 1,308 Mbpd (Petrobrás,1997). The products from the refining activity are mainly consumed in the internal market but some is also exported (Petrobrás,1994c). Petrobrás' trade strategy follows the organization's mission. It is directed to ensure the domestic demand for crude oil, oil products, alcohol and natural gas is at the lowest possible cost for the Brazilian population (Petrobrás,1994c).

8.3.1 - The Refining Activity Objectives

The main objective of the refining activity derives from the corporate objectives (P1/P4,1995). The corporate objectives, specially those related to the refining activity,

include (Petrobrás,1994c): to develop the processing of oil and natural gas and to improve the quality of Petrobrás' products and services to comply with customers' demands.

The refining activity's main objective is as follows (Petrobrás,1994c):

> *"to manage the facilities, within the refining functional unit, producing oil products, within management standards of performance, technology, quality, environmental and safety requirements that are similar to the refining activity of other oil organizations, and, contributing for the development of Petrobrás".*

While the main objective establishes the global strategic scope for the refining activity, other objectives have been established to complement and provide a more specific strategic direction. All the objectives are for the period 1991-2000 (Petrobrás,1994a).

The complementary objectives are grouped into four strategic areas. They are (Petrobrás,1994c): technology; efficiency and effectiveness; growth; and, the biophysical environment and the human being. The main emphasis is on the improvement of quality of products and services, and operational performance.

In 1992 the strategic plan for the refining activity was revised and a new strategic approach was adopted (Petrobrás,1994c). This new approach integrates all the downstream activities. It includes the refining activity, transportation and marketing sectors, and customer service.

8.3.2 - The Refining Activity Performance Index

The refining activity has established a performance index, which is monitored by all the refineries. The performance index in 1994 included 11 different parameters

(Petrobrás,1994c) as shown in table 8.2. In 1995 (at the time of this research) a change to the performance index was proposed. The parameters to be measured were kept the same while the index was divided into autonomous and dependent indexes (Petrobrás,1995c). The aim of this change was to optmize the evaluation and use of results, based on previous years' experience.

The autonomous index evaluates the results which are exclusively dependent on each refinery activity and one technical area in the head office. The dependent index evaluates the results, which depend on each refinery activity and several technical areas in the head office. The refining activity also evaluates the quality performance of each product, operational performance and suppliers' quality performance. The decision on the performance index was not yet finalized by the end of 1995.

The quality performance provides an indication of various specific parameters of each individual product. These parameters are, in most cases, established in standards set by the Brazilian Minister of Energy, through the Fuel Department-DNC (Petrobrás,1994c). Petrobrás also establishes its own standards when required. These standards can be more rigid than the ones set by the government. Stricter standards are introduced to respond to customers' demands (Petrobrás,1994c; PE19-23) and also to increase the marketing opportunities of products (Petrobrás,1994c). For example, the reduction in benzene content in commercial hexane has allowed this product to be used by the food industry (Petrobrás,1994c).

Operational performance evaluates the operational performance of the refining activity, which allows for comparison with other organizations. The operational performance evaluation includes the following parameters (Petrobrás,1994c): refinery crude oil throughput; total refining cost; refining margin (difference between total sales and costs of production); distillation and cracking units' production lost; comparative evolution of products production; refining utilization rate; return on investment; and a comparative evolution of refining capacity, processed load and national products' demand.

Index	Objective	Method of Calculation
Internal Operational Factor - FOI	Measure the utilization rate of a refinery	FOI =reference load (m^3/month)- lost because of internal factors (m^3/month)/reference load (m^3/month)
Refining Cost - CR	Indicates the average specific processing cost of each refinery and the refining activity	CR= Direct Costs (US$)/ volume of load processed (bbl)
Specific Energy Consumption - CEF	Indicates the specific energy consumption taking into consideration the refinery's process complexity	CEF= Total consumption of energy (m^3 OCPE)/ {volume of load processed (m^3) x complexity factor} *100
Number of employees and contractors	Provides a quantitative monitoring of number of people working	Number of employees Number of Permanent contractors Number of Temporary contractors
Rate of accident frequency - FCA	Indicates the number of accidents with lost time per million of hours worked	FCA= Number of employees not working due to accident *10^6/employee- working hours exposed to risk
Discharge of pollutants to water receptor- PFH	Indicates the quantity of pollutants discharged in the water receptor	PFH= Chemical Demand of Oxygen (gm/m^3) * volume of effluent (m^3)/specific load (10^3 bbl) * 159
Material in stock	Indicates the quantity of any material stocked by each refinery	Number of items
Average Stock Coverage - MF	Indicates the average time material is kept in stock	MF= Value of Average Stock (R$)/ Value of Average Monthly consumption (R$/month)
Realization of costs budget - ROC	Monitors the performance of costs budget in relation to costs budget prediction	ROC= Realized cost budget (US$) *100/ Predicted Costs Budget (US$)
Paraffin Production	Indicates the production of paraffin in RLAM and REDUC	Production of paraffin in tones
Energy Index - IE	Indicates the specific energy consumption in each refinery, without the complexity factor	IE= Total Energy Used (m^3 OCPE) *100/ load processed (m^3)

Note: m^3 - cubic meter; bbl- barrel
US$ - U.S. Dollar; gm/m^3- gram per cubic meter
m^3 OCPE - fuel oil petroleum equivalent; R$ - Real

Table 8.2. Petrobrás Performance Index. This table shows the 11 parameters used by the refining function of Petrobrás to evaluate its performance. (Source: translated from "Relatório de Auto-Avaliação", Petrobrás,1994c).

In 1995 Petrobrás has commissioned a comparative study of its refining activity and other international organizations which uses some of the above parameters and the parameters specified in the performance index (Petrobrás,1994c). The benchmarking is in line with the organization's strategic guidelines presented in section 8.1.

Suppliers' quality performance includes the monitoring of sulphur content and specific gravity of petroleum processed, quality of welding, and delay on materials delivery.

The first two parameters provide an indication of the possible demands upon the refining process. The sulphur content is linked to environmental demands upon products. The specific gravity indicates the yield of products to be expected. Depending on product demand this also provide an indication of possible necessary adaptations to the refining process. For example (Petrobrás,1994c): the increased processing of Brazilian petroleum (medium sulphur content and heavier crude) allows Brazilian refineries more flexibility to comply with environmental demands on products. The "bottom of the barrel"* upgrading processes, introduced in the 80's in Petrobrás, allows the refineries to produce more lighter products, such as petrol and diesel.

8.3.3 - The Refining Activity and Green Issues

The identification of how green issues affects the refining activity is based in the new integrated approach mentioned in the previous section (section 8.3.1). Green issues have been identified as an external force affecting the refining activity (PE1/4/11/13/19-23,1995). It is considered as a threat to the organization and also as a social responsibility (Petrobrás,1994c).

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*Bottom of the barrel - The decline in heavy fuel oil and the increased demand for lighter products required oil refineries worldwide to adapt the refining process in order to convert heavy fractions of the crude into lighter products (IP,1994a).

The increasing environmental demands on products through legislation, scrutiny of refineries activities and potential product substitution, on environmental grounds, are the threats identified to affect the refining activity (Petrobrás,1994c).

The priority given to the protection of the biophysical environment and prevention of impacts of activities and products are considered part of the refining activities' social responsibility (Petrobrás,1994c). Green issues are also closely related to competitiveness and public image (PE19-23,1995).

Oil refineries are part of a commodity industry where there is not much scope for differentiation. A low cost strategy relative to competitors often prevails, though other areas such as quality and service cannot be ignored (Porter,1980). Environmental costs are therefore among negative factors for refinery profitability, affecting competitiveness (Mohnfled,1994).

Oil organizations are constantly competing to develop technology or improve the existing technology at the lowest possible costs. Ecological demands have been a major influence on refinery technology during the past years (DTI/ETSU,1994). This is a constant concern for Petrobrás (Petrobrás, 1994c; Petrobrás, 1995h).

Although environmental controls upon products are increasing, they are not uniform (Mohnfeld,1994). The refining activity capability and flexibility to comply with stricter environmental demands upon products at low cost increases market opportunities, affecting competitiveness (P20-23,1995).

The evidence of environmental impacts (for example: accidents, oil spill, production of smoke and smell and no compliance with environmental legislation) is an important contributor to decrease public credibility on the organization's environmental behaviour (P1-3 and P19-23,1995). It affects any attempt to promote a "green image".

8.3.3.1 - The Refining Activity Environmental Structure

In the organization's head office the refining activity has an environmental and safety adviser and an environmental and safety office (P1,1995). The environmental structure of some refineries were under re-structuring during the time of this research (P25-28,1995).

Four out of five of the refineries, studied in the research, have a similar structure. They have just integrated the institutional issues of environment and safety, while the operational aspects of environmental management are the responsibility of operational units. The environmental and safety unit is under the responsibility of the site manager. One of the above refineries also has allocated an environmental and safety technician in each one of the operational units (P25 and P30,1995). However, within the operational units, these technicians are normally diverted to do other jobs (P30,1995). At the time of this research the managers of the new integrated units were still not sure of their responsibilities (P25-28,1995).

The last refinery has separate environmental and safety units. The environmental unit is under the responsibility of the engineering manager (P29,1995). At the time of the research there were no plans for future changes in this structure (P39,1995).

The refineries have a minimum contact with the environmental, quality and safety special division (P29-33,1995). Their main contact with head office is through the refining activity environmental office. These contacts are normally restricted to issues that have corporate implications (P29 and 30,1995). Otherwise environmental management in refineries is very decentralized (P19-23,1995).

Refineries also have close contact with the research and development special division (P29,1995). The support from the research and development special division is, for

example, for issues such as (P29-33,1995) wastewater treatment, oil sludge treatment, landfarming and bioremediation.

The implementation of environmental programs involving the local community is the responsibility of the refinery's public affair representative (P19-23, 34-38,1995). The environmental and safety unit is responsible for any other external contact relating to environmental issues associated with the refining activity at local level (P24-28,1995). This is the same for all the refineries.

Process managers are responsible for the management of environmental issues associated with products (P2,3,39-43,1995). They normally liaise with specific technical groups in the head office, research and development centre and other refineries.

The negotiation of environmental legislation with relevant authorities is co-ordinated by the head office (P1,1995; Petrobrás,1994a). Technical committees are formed involving representatives of different areas within the organization. Petrobrás takes part in the process of environmental legislation development; however, it has little control over its final outcomes (P17,1995).

8.3.3.2 - The Refining Activity Environmental Objectives

The refining activity has included the corporate environmental objective in its main objective (presented in section 8.2.2). Environmental considerations are also included in the strategic areas identified by the refining activity (section 8.2.2).

The inclusion of environmental parameters on products' quality assessment is an objective of the refining activity (Petrobrás,1994c). The environmental requirements on products are inserted into the first three strategic areas of the refining activity. This includes respectively (Petrobrás,1994c): increase technological capability; improve

product quality and operational performance; and changes to the refining process to achieve products' quality and quantity requirements for the stated period.

The environmental impacts of products and of the refining process are inserted into the last strategic area (the biophysical environment and the human being). It aims to minimize the impact of the refining activity and products upon the biophysical environment (Petrobrás,1994c).

Among Petrobrás' corporate strategic goals is (Petrobrás,1994c) *"to contribute to national economic development through its activities"*. Therefore, the balance between society's ecological demands and the country's economic development determine the limit of the refining activity actions towards the biophysical environment (Petrobrás,1994c).

Other specific objectives have also been set by the refining activity. These include (Petrobrás,1994a): to undertake risk analysis on every new project and to comply with environmental legislation.

8.3.3.3 - The Refining Activity Environmental Expenditure

The decision on environmental expenditure for the refining activity as a whole is divided into two areas (P8,1995). The first area includes those issues linked to products. The second area includes those issues linked to the refining process.

The decision on the financial resources for the former area depends on several factors (Petrobrás,1995a): international changes in product specification; demands from institutional customers; Brazilian environmental legislation; problems in product usage; result of internal performance tests of products; internal demands from refineries; cost analysis. The decision on the financial resources for the latter depends on external demands, mainly environmental legislation (P8,1995). The refineries also

have their own separate budget where environmental expenditure is included as part of operational expenditure (P19,29,1995).

The refining activity expenditure on environmental, quality and safety issues for the period 1989 to 1993 was equivalent to US$M 135.61 (Petrobrás,1994c). In 1993 it spent US$M 27.11. This is equivalent to 18% of the Petrobrás total environmental expenditure in the same year. The environmental expenditure for other years was not available at the time of this research.

8.3.3.4 - The Refining Activity Environmental Index

Out of 11 parameters part of the refining activity performance index (see table 8.2) only one is exclusively to monitoring of environmental issues. The environmental index gives an indication of the pollutant load discharged (Petrobrás,1994c) as shown in table 8.2.

Some refineries questioned this index (P29,33 and 42,1995). These refineries consider that this index is not representative of the environmental performance of refineries. First, it does not consider all the environmental impacts of the refineries. Therefore, it is not representative of the refinery's overall environmental performance. Second, the number of samples collected is not standardized. This affects the calculation of the index. A new environmental index for one of the refineries is under study (P32 and 49,1995). This will probably include: use of water; catalyst lost; efficiency of the sulphur recuperation unit and efficiency of the CO* boiler.

Non-compliance with legislation and number of complaints also indicate environmental performance (Petrobrás,1994c; Petrobrás,1995i). These two parameters are complementary to the environmental index but are not used in the refineries' performance assessment.

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* CO - carbon monoxide

The increasing internationalization and globalization of green issues, associated with the wide use of all fossil fuels, and, the similarity of environmental impacts, all contribute to the increasing concern for its use and the impacts caused. The information on the impacts of the oil industry generated in other countries is a source of environmental quality reference. Petrobrás the monitors environmental quality information of other countries (Petrobrás,1994b; Petrobrás,1994c; Petrobrás,1995a). It anticipates future demands upon the refining activity (Petrobrás,1994c).

8.3.3.5 - The Environmental Demands of Stakeholders

The refining activity has identified its main stakeholders (Petrobrás,1994c). It divides them into internal and external. The internal stakeholders are (Petrobrás,1994c): board of directors; managers and technical staff of the refining activity; other functional units; all the other employees; and contractors. The external stakeholders are (Petrobrás,1994c): government; Brazilian Fuel Standard Control Department, local communities, society, unions, environmental authorities, institutional customers, distributing organizations, solvent distributing organizations, product importers, petrochemical industry, ethanol producers, suppliers and national and international financiers. The environmental demands of the above stakeholders are (P1-3 and 19-23,1995): quality of products (this includes environmental issues), reduction of pollution problems, internally and locally, and improvement of environmental performance.

The refining activity has intensified its contacts with different stakeholders in order to address their demands (Petrobrás,1994a; P19-23,1995). It participates in the development of environmental legislation (Petrobrás,1994c). It supports customers in order to improve their environmental performance or improve the environmental quality of products (Petrobrás,1994c). All the operational procedures have to be periodically revised to include environmental management issues (Petrobrás,1995i). For example, a refinery has designed a specific internal procedure to respond to any

environmental concern of the local community (Petrobrás,1994e). It participates and supports environmental monitoring programs (Petrobrás,1994c). Refineries support schools on the development of environmental education programs (P34-38,1995). Refineries provide basic environmental awareness training for new employees (Petrobrás,1994c) and external environmental training for technical staff (P19,1995). The refining activity participates in different internal environmental committees (Petrobrás,1994c). The refining activity has just started to undertake corporate environmental audits* (P23,1995). The refining activity takes part in joint technological research with stakeholders (Petrobrás,1994c). Refineries have commissioned surveys to identify the concerns of local communities (P37-38,1995). Refineries promote visits and talks with the local communities (P34-38,1995). It promotes voluntary environmental protection programs (P9-10 and 34-38,1995). One of the refineries has designated an area for a natural reserve with the support of the Brazilian Environmental Agency. (The researcher visited the area) Refineries have introduced internal recycling programs (P29,34 and 38, 1995). Petrobrás sponsors environmental conservation programs (P9-10,1995; Petrobrás, 1995)

8.4 - The Refineries and Green Issues

The achievement of environmental objectives set out in the corporate and refining activity strategic plan depend on the how they are translated into programs and implemented at refinery level. Refineries are responsible for manufacturing products, both in the quality and volume required, and to minimize the impacts of their activities upon the biophysical environment. Petrobrás has establish strategic corporate projects in order to prioritize some of its strategic objectives (Petrobrás,1994). None of these programs are specifically related to green issues; however, green issues are part of them (P3,1995).

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* This researcher had opportunity to observe the final planning arrangements of the corporate environment audit.

Among these strategic corporate projects is "*to upgrade and modernize the refinery facilities*" (Petrobrás,1994). The goal of this project is to propose a low cost alternative to modernize and to adapt each refinery (P41-43,1995).

The eventual changes to each refinery take into consideration the following issues (Petrobrás,1995h): future demands on quality of products; the evolution of the refining activity of the oil industry for the next decade; the regional and national product demand; minimization of environmental impacts; and maximization of effectiveness and safety.

The Brazilian environmental legislation affects the refining process at every stage (depending on the environmental authority), from the proposal of new projects up to the specification of emission quality (P17,1995). Any change to the refining process is therefore increasingly being required to justify its environmental benefits (P19,29,31,41,32 and 42,1995).

The promotion of public image is among the strategic corporate projects of Petrobrás (Petrobrás,1994). The pressures that led to the breakup of the oil monopoly in 1995 increased the pressure upon the organization to promote its public image (Petrobrás,1995) and intervene in the setting of future controls on the oil business in Brazil (Petrobrás, 1994f; Petrobrás,1995g).

The refineries have introduced several programs to promote their image (P34-38,1995). These include environmental projects (see section 8.3.3.5). The environmental projects are divided into corporate and refineries' projects (P9,10 and 34-38,1995).

Depending on the local community some of the projects have a more social than environmental objective (P38,1995). For example, Petrobrás has an institutional program that promotes the creation of vegetable gardens in local communities around

its operational units. The objective of the program is twofold (P9/10/25/37). First, environmental education and, second, to provide food and income to local communities. One of the refineries allows the local community to sell the vegetables in the refinery's social club (P24,1995).

The refineries are responsible for setting their immediate operational environmental objectives (P39-43,1995). These objectives are directly associated with the refining process. The critical sources of pollution problems are identified and the refinery aims to improve its operational efficiency and reliability (Petrobrás,1995i).

The refineries also set their operational environmental index (Petrobrás,1995i). The index is divided into control and verification parameters. The index includes (Petrobrás,1995i): wastewater quality; number of complaints; flaring and smoke; management of landfills; processing of oil residue; and operation of specific equipment.

The refineries have operational environmental monitoring programs (P29-33,1995). These include monitoring of water discharges, emissions, solid waste treatment facilities and quantity of oil residue (P29-33,1995). Some of the monitoring is used for internal control purposes and some is required by legislation. Some refineries also undertake external (outside the refineries physical boundaries) monitoring of air quality (P29-33,1995). This is mainly to be used in case of possible dispute over the refineries' emissions.

The perception of environmental quality by stakeholders is undertaken through direct observation or spot-checking by environmental authorities (P29-33,1995). The Brazilian environmental authorities do not have a good air quality-monitoring network yet (EABR1-3,1995).

8.5 - The Effects of Green Issues upon the Refining Activity

Environmental demands, especially environmental legislation are introducing changes to the refining activity. The organization recognizes the need to protect the biophysical environment and also the strategic importance of integrating green issues as part of its strategies (P1,4-7 and 19-23,1995).

The response to environmental demands is not a voluntary action but is a consequence of external demands (Petrobrás,1994). The organization's pledge to protect the biophysical environment is demonstrated in its corporate objectives and internal policies (see section 8.2.2 and 8.2.3). The corporate objectives and the internal policies address the impacts of both the organization's products and activities.

The increased environmental demands on the refining activity have introduced changes to its organizational structure as shown in figure 8.1 and section 8.2.1. It has affected the way green issues are dealt with in Petrobrás. This researcher had the opportunity to observe that there is an informal environmental management system in place.

Green issues linked to products require more integration and co-ordination among different functional areas and departments. For example, the integration and co-ordination between different operations which are part of the downstream activity, with the creation of a division named Integrated Operational Logistics (Petrobrás,1997) (see figure 8.1). This allows Petrobrás to use its refineries more effectively by linking issues such as petroleum availability, process, product demand, and product quality demands (including environmental quality demands).

The management of the impacts associated with each refinery is decentralized as shown in section 8.3.3.1. The refineries liase with other departments or services when required.

Refineries have the responsibility to monitor their environmental performance according to internal objectives, to comply with local community demands and also comply with demands set by environmental legislation. For this they have (P29-33 and P44-50,1995) set their own internal objectives, introduced new internal operational procedures or included green issues as part of old ones, launched local environmental programs, set and improved operational monitoring programs, demand environmental improvements from suppliers (changes in packing), and introduced internal procedures for contractors working in the refineries (depends on constant enforcement).

Environmental requirements on products affect the refining activity technology. It is recognized that refineries need to adapt its process to comply with national environmental legislation requirements and also upgrade the refining process to keep pace with stricter environmental demands of other countries (Petrobrás,1994c).

The modernization and upgrading of refineries increases the organizational capability to comply with environmental legislation requirements and also provide market opportunities for the refining activity (Petrobrás,1994a; P21,1995; Petrobrás,1995a). For example (Petrobrás,1997): the production and exportation of MTBE*, improvements in diesel quality (reduction of sulphur emissions), increased production of petrol and gas, through optimization of heavy streams, and possibilities for product substitution (coal for fuel oil and more use of gas).

The allocation of financial resources for the refining activity was equivalent to 10% of the Petrobrás consolidated capital expenditure (see table 6.1) in 1993 (Petrobrás,1994). It decreased slightly to 8.7% in 1994 (Petrobrás,1995) and has been progressively increasing since 1994. It was 13.9% in 1995 and 20.3% in 1996 (Petrobrás,1997).

* MTBE- Methyl Tertiary Butyl Ether- it is an oxygenated product used to boost octane and cut pollutants.

According to Petrobrás' financial investment plan (Petrobrás,1994c), financial resources are used to increase the refining capacity, to adjust the production structure, to adapt the refining activity to comply with products' quality demands (including environmental standards) and to allow for the production of special products such as MTBE.

The above suggests that green issues are economically affecting the refining activity. This is very similar to the trend observed in the refining activity of other organizations in other countries (Brunnet,1994a; Brunet,1994b; Mohnfeld,1994).

Physical evidence of environmental impact results in possible fines (P29-33,1995) and affects the organization's public image (P34-38). Refineries' aims are to continuously comply with environmental legislation and avoid environmental impacts that might affect local communities. However, they do not comply with these aims all the time (P29-33,1995).

8.6 - Conclusion

The research shows that the ecological constraints, mainly through environmental legislation upon products and the refineries' activities, have affected Petrobrás' behaviour concerning green issues. By interviewing people at different levels within then organization it was possible to gather evidence that green issues are intertwined in every level of activity and decisions within the refining activity. Direct observation of daily activities has improved the understanding of the refining activity's management of green issues.

Green issues have become an issue of strategic importance for Petrobrás. The refineries' survival depends on their capability to adapt the refining process to comply with ecological demands, at low cost. This capability is linked to the profitability and competitiveness of refineries.

The investigation of Petrobrás has shown that the organization has two different environmental policies. The policy that is available to the public is very general while the internal policy is more specific to the issues affecting the organization. From the issues covered by the policy it can be suggested that its aim is to provide the framework for making decisions in environmental issues.

The organization has established environmental goals at different levels: at corporate, refining activity and refinery levels. Corporate environmental goals are very wide and demonstrate the general response of the organization towards environmental issues. The refining activity has a quantitative performance index which is too weak to demonstrate all the environmental issues affecting the refineries. The refineries set the short term quantitative environmental goals to be achieved.

The break up of the monopoly will probably bring more challenges for the refining activity, which at the time of this research was just starting.

Based on the discussions of chapter 5, 6, 7 and 8 the social process associated with ecological forces and environmental controls upon the refining activity is discussed in the next chapter.

CHAPTER 9

Discussion: The Ecological Complex Framework

The aim of this chapter is to expand and adapt the ecological complex framework (see chapter 3), to represent the on-going social process associated with the relationship of an organization with the biophysical environment. The evidence gathered in chapters 5,6,7 and 8 were used in the development of the ecological complex framework.

9.1 - Introduction

Environmental management system standards such as BS7750 (BSI,1994) and ISO14001 (BSI,1996) propose that an initial review of the green issues affecting an organization should be undertaken to assess the position of the organization in relation to them. The ecological complex framework proposed by Duncan (1959) (discussed in chapter 3) is a general representation of the social links between elements of the process of human adaptation to the biophysical environment. In this research Duncan's framework was modified and expanded as an attempt to develop a systematic framework that can represent the process associated with the management of green issues affecting an organization. This framework was expanded and adapted using the results of the empirical investigation of the relationship between an organization and the biophysical environment presented in chapters 5,6,7 and 8.

While Duncan's framework provided the theoretical structure for the investigation, the examination of the interaction between an organization (the refining activity in this case) and the biophysical environment, provided an insight into the mechanism associated with the management of green issues. The previous experience of this researcher in the management of green issues is also a valuable contribution to the discussion.

9.2 - A New Representation of the Ecological Complex Framework

Duncan assumes that the social process of human adaptation to the biophysical environment can be represented by four main elements that are interconnected by social links. Duncan's ecological complex framework is depicted in figure 3.1.

As discussed in chapter 3, Duncan's ecological framework was restricted to the representation of the social environment and the social links between elements of the social process.

In this research, the environment shown in figure 3.1 is the biophysical environment. The other elements of the ecological complex are part of the social environment. The organization is the refining activity. The social environment for the purpose of this research is, first, restricted to the environment of the refining activity. Second, the environment comprises the elements identified to affect the refining activity's management of green issues.

Organizations have economic and social responsibility towards their own stakeholders. The economic and social issues of interest in this research are those linked to the management of green issues. Economic issues represent the economic aspects related to ecological demands. Organizations' social responsibility is restricted to the organizations' attitude towards the biophysical environment and behaviour in the management of green issues. The refining activity of oil organizations is the focus of this research.

Andrews (1980) proposed that the environment of an organization is composed of five factors: economic, political, social, technological and ecological (see chapter 3). While technology is already represented as an element in the ecological complex framework the other factors are not so clearly represented.

Ecological factors are not directly represented by an element but by the changes

induced in other elements. The first component of ecological factors represents the changes of the biophysical environment as a consequence of an organization's activities and products. The second component is the changes to part of the environment of the refining activity (political, economic, technological and social) as a consequence of stakeholders' ecological values. Different ecological values and environmental concerns trigger changes in the attitude towards the biophysical environment. It affects the socially constructed limits for the use of the biophysical environment (limit between the human system and the biophysical environment in figure 2.1).

Population represents the stakeholders of the biophysical environment. Stakeholders are groups that compete for their legitimate right to use the biophysical environment. These include society and organizations (except the organizations that are the focus of the research). Their individual actions continuously impact the biophysical environment, to various degrees. The continuous deterioration of the biophysical environment affects both organizations and other stakeholders. These two groups are not mutually exclusive. However, for the purpose of this research population is divided into three major groups which are associated with Andrews' social, economic and political factors.

Following Duncan's ecological complex framework, all the elements are interrelated. In this research each one of the elements represents issues affecting the refining activity. However, differently from Duncan, the links between the elements may be a flow of matter, energy and/or information.

As discussed in chapter 2 there is also a flow of services between organizations and customers. However, the main focus of this research is the relationship between the refining activity and the biophysical environment. Only the impacts that services (provided to the refining activity) may cause upon the biophysical environment are therefore relevant to this research.

A representation of the expanded theoretical ecological complex framework is shown in figure 9.1. The interactions between the elements of the framework and the components of each element are discussed further in this chapter. It is however beyond the scope of this research to identify all the variables in each one of the links.

9.3 - The Refining Activity and the Modified Ecological Complex Framework

As discussed previously in chapter 2 the definition of the environment and environmental problems is very complex as it depends on individual ecological values and concerns. The empirical research has shown that the perception of ecological forces and environmental controls vary from organization to organization, refineries within the same organization and different individuals within the same refinery. None of the interviewees have demonstrated to have a complete perception of the issues associated with the management of green issues. The variation in individuals' perceptions of the environment have already been reported by other researchers (Duncan,1972). Different interviewees have identified the issues more closely associated with their activities. Therefore, for the identification of the whole process associated with the issues affecting the refining activity the use of various interviewees and source of information were necessary.

9.3.1 - The Biophysical Environment

There is a circular flow of material between the biophysical environment and oil refineries. Oil refineries take material and energy from the biophysical environment, either directly or indirectly, through suppliers.

Petroleum is explored for and produced by the upstream activities of the oil industry in several different countries. The petroleum produced by different organizations is transported to oil refineries to be processed into final products and petrochemical feedstock. The final products and petrochemical feedstock are transported to distributors and petrochemical activities. The products of oil refineries are used by refineries themselves and by customers.

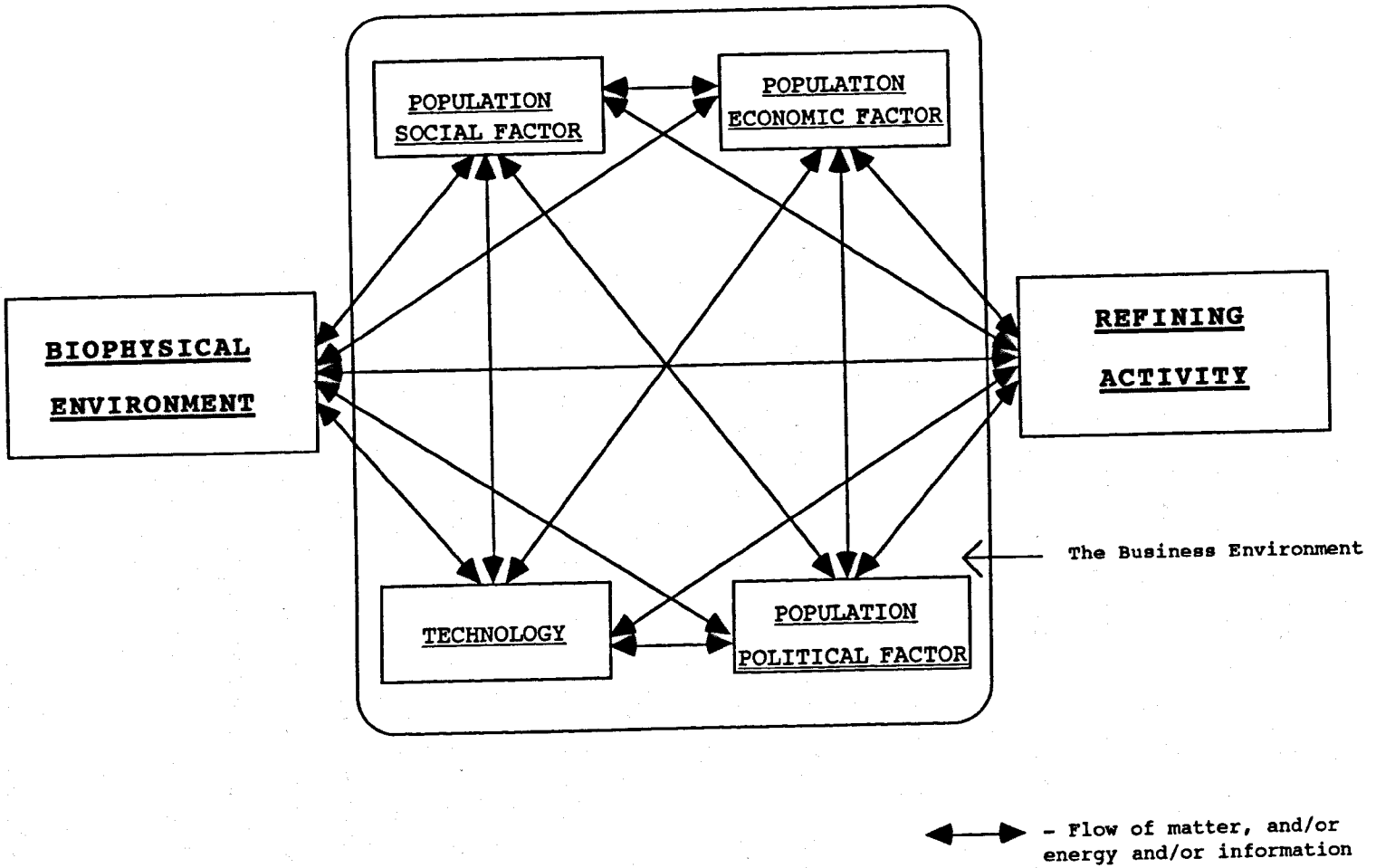

FIGURE 9.1: The Ecological Complex Framework Modified. The above figure shows the elements that influence the relationship between an oil refinery and the biophysical environment. The elements are interconnected by a flow of either matter, energy or information. The elements of the social environment are outlined.

From production to final product use there is generation of by-products. The by-products can either be recycled, treated before final disposal, or be directly disposed back into the biophysical environment (see Appendix 4).

The control of the flow of material and energy from the biophysical environment, within the human system and back to the biophysical environment depends on objectives and needs of different groups within the human system. These include individual and collective objectives. Economic objectives of oil refineries are individual objectives (the organization), while environmental protection objectives of various stakeholders are collective objectives (the biophysical environment).

The biophysical environment does not have any control over human actions upon it. It is a limited "common property", where any action upon it is limited by its carrying and depurative capacity. There is great dispute on the definition of the capacity of the biophysical environment and the "real value" of a natural resource (Roome,1992; Mather and Chapman,1995). The definition of usefulness and "value" varies among different users (Firey,1960; Simmons, 1981; Pitt and Zube,1987; Dryzek,1987; O'Riordan,1991; Kempton,1992; Roome,1992); and they are constantly changing.

The environmental problems associated with oil refineries are very complex. First, because petroleum is a fossil fuel, most of the air pollution problems are the same independently of the source of fossil fuel. Second, pollution problems associated with the use of products depend on individual choices. Individual actions upon the biophysical environment have collective consequences that affect different "users". Third the predominant use of petroleum as a source of energy has created a technological dependence.

The impacts of refining activity upon the biophysical environment can be classified into three different categories. The categories are divided according to monitoring objectives as follows: direct monitoring; legal monitoring; and scientific monitoring.

Groups directly affected by the refining activities undertake the direct monitoring. From the empirical research (chapter 5) the issues addressed by oil refineries as a result of direct monitoring are smell, fall out, smoke, flaring and potential accidents.

The legal monitoring is the monitoring that is either undertaken by the refineries themselves, to comply with legal requirements, or undertaken directly by environmental authorities. The aim of this monitoring is to assure that environmental quality or emissions are in compliance with those specified by standards. The items monitored by refineries include three categories: solid wastes; water pollution; air pollution. Specific authorities monitor the effects on health. However, these were not considered in this research.

Environmental quality of products is also a legal requirement. Environmental quality of products is more rigorously monitored by refineries. No compliance with environmental quality specifications has financial and market implications for refineries (Petrobrás, 1994c; PE19-PE23,1995).

International agreements do not set legal environment standards. However, they are a commitment agreed between the countries, therefore they can be assumed to be under the legal monitoring category. One example is monitoring of maritime pollution.

Research groups normally undertake scientific monitoring. These groups are supported by government, by oil organizations, by green groups or by environmental technology organizations. The aim of scientific monitoring is to investigate the stress inflicted upon the biophysical environment. Scientific monitoring does not exclusively monitor the effects of the refining activity. Therefore, its results may also affect other organizations. Some of the scientific evidence on the deterioration of the biophysical environment caused by oil refineries' management of green issues is (Miller,1980; ENDS Report 1985-1996): climate change; damage to the ozone layer; urban air pollution; and acid rain.

Petroleum is a non-renewable resource. The physical limit of petroleum is a major concern for oil organizations. None of the oil organizations are concerned, however, with the depletion of the natural resource. Oil organizations are concerned with the development of technology for the acquisition of more oil reserves to reduce their business vulnerability. From the information provided in oil organizations' annual reports, it is evident that the acquisition of more petroleum reserves is a business priority. This shows the organizations' technocratic behaviour as described by O'Riordan (1977); and it also shows the differences between the economic process and the biophysical environment as identified in table 2.2.

Other changes to the biophysical environmental are the facilities built to explore, manufacture and transport oil and oil products. For example, oil refineries, oil-rigs, ducts, petrol-stations and storage facilities.

A summary of the ecological issues and impacts found to be the result of the oil industry activity upon the biophysical environment is shown in figure 9.2a. The evidence of ecological issues and impacts provoke the "action" of the biophysical environment upon different stakeholders. The links between elements of the ecological framework shall be discussed later in this chapter.

9.3.2 - Population

As suggested by Freeman (1984) the identification of stakeholders and their respective concerns can be very complex. Everyone is a stakeholder of the biophysical environment. Every individual has a legitimate right to use the biophysical environment. The ecological value, ecological demands and ecological behaviour depend on how each individual uses the biophysical environment. However, research shows that many people do not associate their own actions with impacts upon the biophysical environment (Kempton,1993).

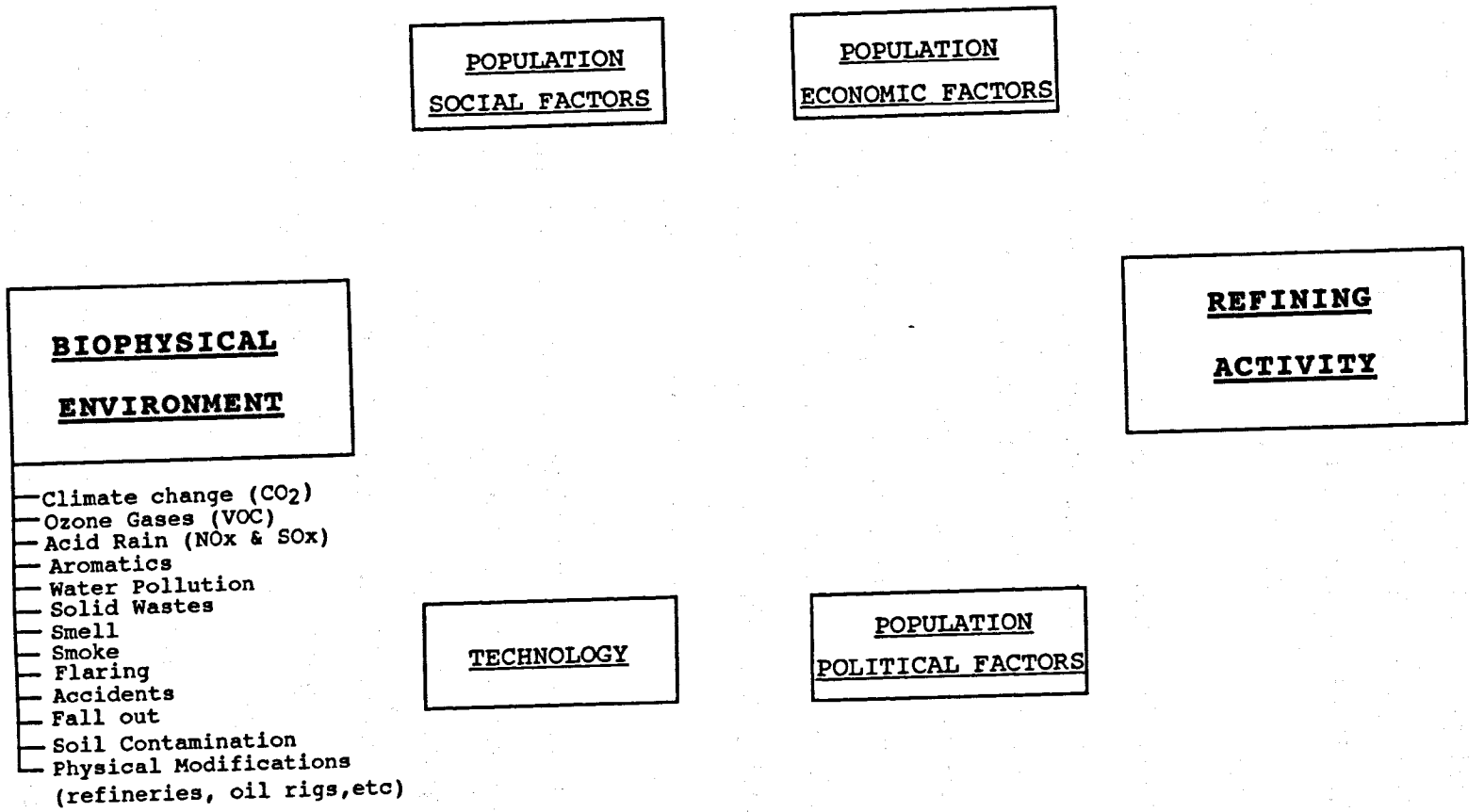

FIGURE 9.2a: The Ecological Complex Framework Modified and the Refining Activity - The Biophysical Environment. The above shows the ecological issues and impacts identified in this research that affect the refining activity.

Some organizations define general stakeholders, for example, "relevant bodies", "concerned groups" and "other groups" (section 6.2.5). However, previous researchers (Throop,1993; Ketola,1995) have identified stakeholders having ecological demands upon organizations. Most of the stakeholders identified previously have also been identified in this research. Ketola (1995) classified the stakeholders of oil organizations according to Andrews' five factors (1980). Her classification was however slightly changed for the purpose of this research.

The stakeholders identified in this research are as follows (from chapters 5,6,7,and 8): local community; government (including environmental authorities and emergency services) non-governmental organizations; competitors; shareholders; customers; managers; employees; financiers; society; industrial and commercial partners; contractors; suppliers; research groups; distributors; and industry groups. Similarly to Ketola (1995) insurers were not found to be relevant stakeholders of oil organizations. On the other hand trade unions and media were not identified by Ketola but were identified as a relevant stakeholder in this research.

It was observed during the research in Petrobrás that they constantly monitor any information published about the organization in the media. Petrobrás also employs an organization to undertake a daily survey of several Brazilian newspapers for any information about green issues. This is internally available to employees. The trade union is described among the stakeholders of Petrobrás (1995c).

The media is an important means of dissemination of information about green issues, including the organization's ecological behaviour. The occurrence of any incident is a source of sensationalist reports that are damaging to the organization's public image. It also contributes to increasing the ecological awareness of the population, and exposes the organization to external criticism about their environmental performance.

The increased public interest in green issues and wider availability of information on green issues confirms Emery and Trist's (1973) prediction that green issues and information would be a source of further uncertainty for organizations.

Following Andrews (1980) the stakeholders (population) identified in the research were divided into three major groups according to economic, political and social factors as shown in figure 9.2b.

9.3.2.1 - Population and Social Factors

Under social factors were considered the groups that provide and disseminate information about green issues. These are non-governmental organizations (green groups), media, trade unions, research groups; and also groups that are affected by pollution problems caused by the oil industry and are constantly demanding changes from them. Theses groups are the local, national and international community.

9.3.2.2 - Population and Political Factors

According to this research the major external demand considered to affect oil refineries is environmental control. Government is responsible for introducing and enforcing environmental control and policies to protect the biophysical environment. These should attend the demands of various stakeholders. Government in this research shall therefore represent the political factors in the management of green issues. Government includes any local, state, national and international government authorities dealing with green issues affecting organizations.

Petroleum is a commodity internationally intertwined with national strategies, global politics and power (Yergin,1991). Therefore, there may be conflicts between different governmental departments. However, this issue is beyond the scope of this research.

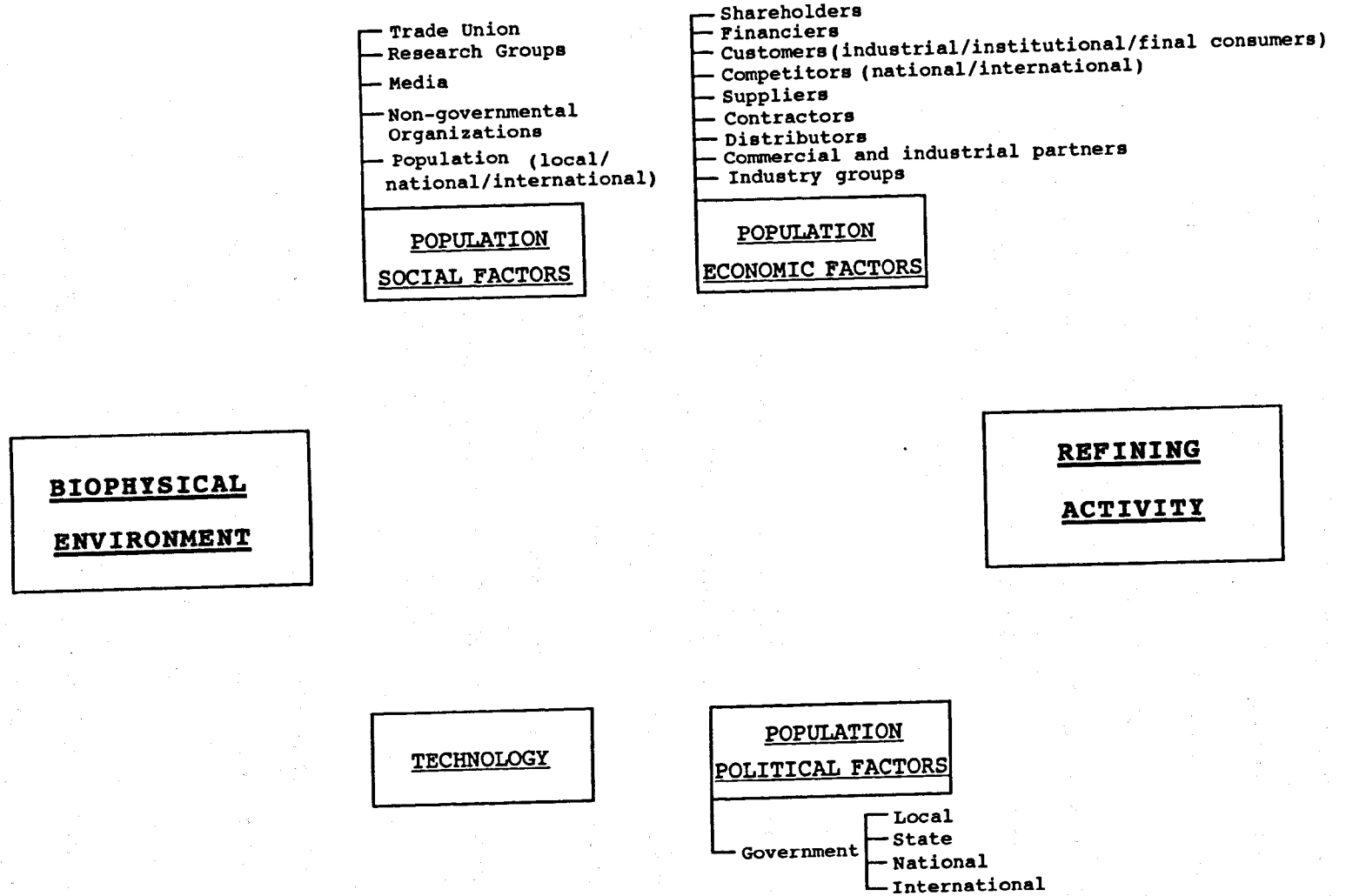

FIGURE 9.2b: The Ecological Complex Framework Modified and the Refining Activity - Population. The above figure shows the stakeholders who represent political, economic and social factors that were identified to affect the the refining activity.

9.3.2.3 - Population and Economic Factors

Groups economically affected by an organization's performance (economic and environmental) or that can affect an organization's environmental performance were classified under economic factors. These groups are respectively: shareholders, financiers, customers (industrial/institutional/final consumers), competitors (national/international) and commercial and industrial partners; suppliers, contractors, distributors. Industry groups are also classified under economic factors because they are sponsored by oil organizations and in most cases act as their representatives.

9.3.3 - Technology

Technology has been identified as an important element in the process of human adaptation to the biophysical environment. Technological developments however always have side effects that may improve as knowledge increases. The technology associated with the use of petroleum, from its discovery until its final use, has gone through several modifications over the years. For example, various respondents have recognized that environmental controls lead to technological improvement and development of the whole industry.

Although the ethical aspects of technological developments are relevant to the social process of human adaptation to the biophysical environment, the issue is complex and has not been addressed in the context of this research.

As shown in figure 9.2c the technological factors identified in this research (chapter 5,6,7 and 8) that are linked to the refining activity include: monitoring technology; process/clean technology; treatment technology; and product technology (new products and use of product).

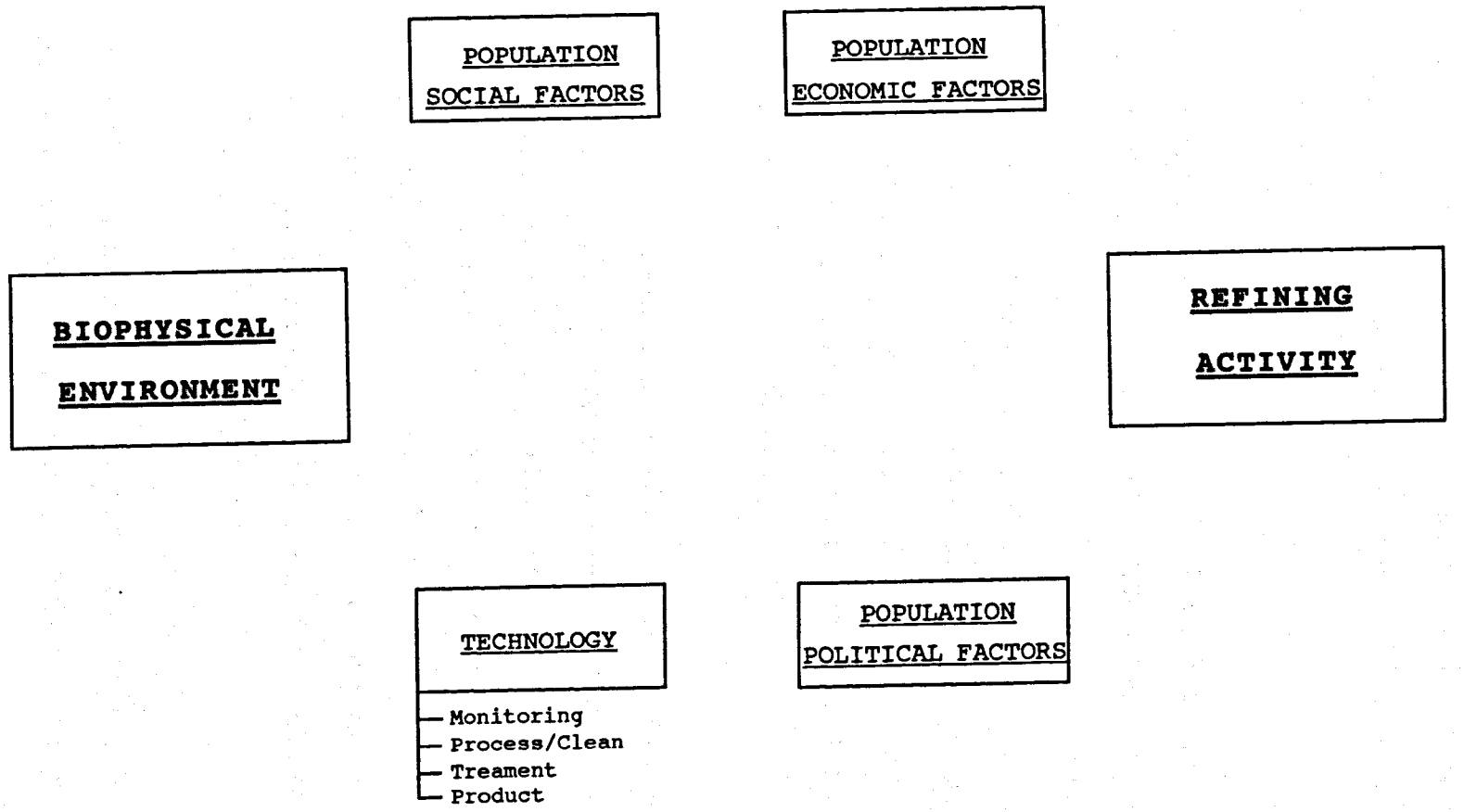

FIGURE 9.2c: The Ecological Complex Framework Modified and the Refining Activity - Technology. The above figure shows the technological factors identified to affect the refining activity.

9.3.4 - Refining Activity

The demands for ecological performance improvements set limits for oil refineries' actions upon the biophysical environment. These limits are defined in environmental legislation, which set controls on product quality, emissions, biophysical environment quality and effects on health.

Green issues are part of the decision process at all levels within the organization (EM1-EM5,1995; EA1-EA3,1995; PE1/PE13/PE14-16/PE19-23,1995). The research has shown that the management of green issues is increasingly relevant to the oil refining activity. The balance between ecological and economic demands is undoubtedly a major challenge. At the head office, however, the impacts of the refining activity upon the biophysical environment are considered in a more abstract way. The actions in the head office are largely strategic and predominantly focused on the long-term profitability goals of the organization.

The refineries have a more short-term approach to their decisions compared to that of the head office. Refineries design and implement programs to achieve the corporate goals. It has been found in the empirical research that the management of green issues is included in these programs, but considers a shorter time frame (see chapter 8). The impacts of the refining activity upon the biophysical environment are very concrete. Refineries are responsible for the short-term management of the pollution resulting from the refining process; and they are also responsible for the compliance with the immediate environmental quality standards of products.

The responsibility of environmental managers varies from refinery to refinery. Therefore, their perception of the issues associated with the management of green issues varies. None of the environmental managers have a complete perception of the all the issues linked to the management of environmental issues. While Ketola (1995)

found that site managers are not fully aware of the green issues affecting the refineries, in this research the refineries site managers were found to have a comprehensive perception of the green issues affecting the refinery. They bring together the strategic approach of the head office with the operational needs of the refineries

The level of external ecological forces and environmental controls affecting each refinery at the time of the research was different. Site and environmental managers also pointed out that the demands upon refineries vary with time and therefore their priorities change accordingly.

Each different processing unit within a refinery has responsibility for the operational aspects of environmental management of its process. This includes the green issues related to the refining process and products. The management of green issues is part of their daily activities.

The oil industry follows a low cost strategy pattern (Porter,1980). Oil refineries have very limited scope for product differentiation (British Petroleum,1993) and do not have much flexibility in complying with environmental quality requirements on products. The competition among refineries and market opportunities depend therefore on refineries ability to manufacture products within volume and quality and at competitive cost (PE19-23,1995).

Compliance with environmental requirements has both quality and economic implications for refineries. The environmental legislation compliance commitment, set in the environmental policies of most of the oil organizations (included in the research) is therefore linked to an organization's economic objectives.

It is suggested (Oil and Energy Trend,1994b; Mohnfeld,1994) that ecological demands affect and may weaken refineries' profitability. However, the real financial

implications for refineries are still a controversial issue between oil organizations, government and other interested groups.

It has been found that there is an increasing pressure on organizations to disclose how environmental compliance may affect their capital expenditure, earnings and competitive position (IISD,1993). Oil organizations are responding to this pressure by publishing the organizations' environmental expenditure in their annual reports. However, despite evidence that the management of green issues has financial implication for the refineries the information provided is not enough to evaluate the degree it affects oil refineries' profitability.

First, depending on the geographical location of the refinery, the environmental controls are different. Second, oil organizations tend to publish the environmental expenditure for the whole organization. Third, the publication of environmental expenditure still does not have a standardized procedure to allow for comparison. Fourth, it is difficult to quantify environmental expenditure with economic and ecological benefits.

The demand of oil products depends on (IP,1994b; Oil and Energy Trends,1994a; Oil Organizations' Annual Reports, 1994): weather condition, countries' economic condition, energy conservation programs, and availability of other energy sources. These are variables that oil refineries do not have much control upon.

For the refining activity, the uncertainty in demand and capacity levels has always been a strategic issue. Green issues and the refining of heavier petroleum have been added to the refining activity agenda. Both demand adaptation of the refining process. The combination of unknown demand levels with known environmental expenditure is therefore a constant dilemma to the definition of a strategy for refining activity.

The environmental strategy used was not very clear from the information provided by oil organizations. However, the investigation of the case organization has shown that the environmental strategy of the refining activity is split in three major areas. These are products, by-products generated (including decommissioning of old facilities) and pollution issues in consequence of past actions.

The environmental goals range from qualitative objectives (coordinated by the head office) to quantitative objectives (coordinated by refineries). Most of the environmental goals are set according to external environmental controls.

Environmental legislation is an important variable in the definition of the strategic options chosen by refineries. The strategic importance of green issues increases with stricter environmental legislation, especially environmental controls upon products.

Compliance with environmental requirements upon refineries operations is not so strict compared to compliance with environmental quality requirements on products. Compliance with environmental requirements on products is very closely associated with the organizations' business goals. It requires planning and is intertwined in all levels of the decision making process. From the decision of the type of petroleum used to the suitable market (PE11/PE19-23,1995; Petrobrás,1995a).

The response of oil organizations to improve the competitive position of their oil refineries are similar and include the following strategic options (Oil Organizations Annual Reports,1994; Petrobrás,1994c; Petrobrás,1995b): to increase the refining processes' flexibility to process heavier petroleum; to optimize the process to produce more value-added products; to optimize the use of energy; to improve the quality of products; to reduce the size of the refining system; to concentrate on specific marketing regions; to develop improvements in alternative energy technology; and to reduce operational costs.

The marketing of oil products plays a major part in oil organizations' competition. The marketing of oil products is however not part of a refineries' responsibility. It is therefore not addressed by this research.

The research shows that oil organizations prioritize local green issues related to the operation of refineries depending on the degree of the external demands. These include demands from environmental authorities and local communities. Concerning ecological forces and environmental controls on by-products generated and past pollution problems the environmental strategy is of compliance and prevention.

Following Petulla's (1987) environmental strategy categories (see table 3.1) oil organizations range from cost-oriented to the enlightened category. It can be suggested from the research that the behaviour of oil organizations towards green issues does not follow a rigid pattern. It varies from a conflicting behaviour to a more cooperative behaviour. It depends on the issue in question. Their attitude to green issues in the refining activity range from compliance to innovation within a cost-effective framework. This can vary within a refinery. In the case study investigation it was found that within the same organization individuals' attitude towards green issues can be of denial where it is assumed that the refinery causes no harm to the biophysical environment. However, this was found in only one refinery.

Most of the organizations have published an environmental policy or have their internal environmental policies. Previous research (Ketola,1995) has shown that the environmental policies are not fully integrated in other organizational strategies. However, this research shows that the published environmental policy does not cover all the ecological issues addressed by the organizations (see chapter 7). The case study has also shown that an organization may have an external and an internal policy. The internal policy provides the guidance to the management of green issues and integration with other management systems.

Oil organizations have established environmental units both at head office and refinery level. However, during the field research it was observed that management of green issues is not an activity exclusive to the environmental units. Environmental units do not have any operational responsibility over green issues. The operational responsibility over green issues is split within operational units accordingly.

The environmental behaviour of oil organizations as a whole is increasingly affecting their public image. This has financial implications for the organizations. For example, both Shell and Texaco had their products boycotted because of their actions towards the biophysical environment. The Exxon Valdez disaster has affected Exxon's share price (Piesse,1992). At local level refineries have increased their contact with the local communities.

Oil organizations are providing more information on green issues. The organizations are voluntary publishing environmental reports. There is no standard on the information published in the reports. Therefore, it is not possible to compare and evaluate organizations' environmental performance through the information provided.

Oil organizations are participating more on green issues debate and the setting of environmental controls. There is also some evidence of environmental training and education within organizations. However, not all the organizations have included environmental training as a means to achieve environmental performance (chapter 6).

The refining activity takes part of internal research of green issues and oil organizations support research on green issues affecting the whole organization. Oil organizations argue that the setting of environmental controls must be based in scientific evidence. Therefore, their participation on green issues debate demands good knowledge of the green issues affecting the organizations.

In summary green issues are part of the refining activity strategy. The main objectives of the refining activity are profitability and public image. Both provide the guide to the setting of environmental goals. See figure 9.2d.

9.3.5 - The Refining Activity and the other Elements of the Framework

In this research the aim was to identify the mechanism of the social process associated with the relationship of the refining activity with the biophysical environment. Similarly to Duncan's framework this mechanism is described by showing the existing links between the refining activity and the other elements of the framework. Because of the exploratory and phenomenological approach of the research there was not an attempt to quantify the links. The links were identified based in information of primary and secondary sources used in the research. Some of the links between the different elements of the framework were not identified in the research. The effect of those links upon the refining activity requires further investigation that was beyond the scope of this research.

Environmental managers are the communication channel between the refinery and other groups. For example, they promote the link between the refinery and the local community, the local and state environmental authorities, local business organizations, media, non-governmental groups, and competitors (in the UK- directly or through the business association).

In Brazil the representatives of the head office are the communication channel for issues that may affect the whole organization. The head office also co-ordinates internal technical committees to deal with specific green issues. These committees bring together representatives of different functional units within the organization. These committees promote the contact with relevant interested groups. In Brazil the communication with outside groups and internal promotion of environmental awareness is also the responsibility of the public relations representatives.

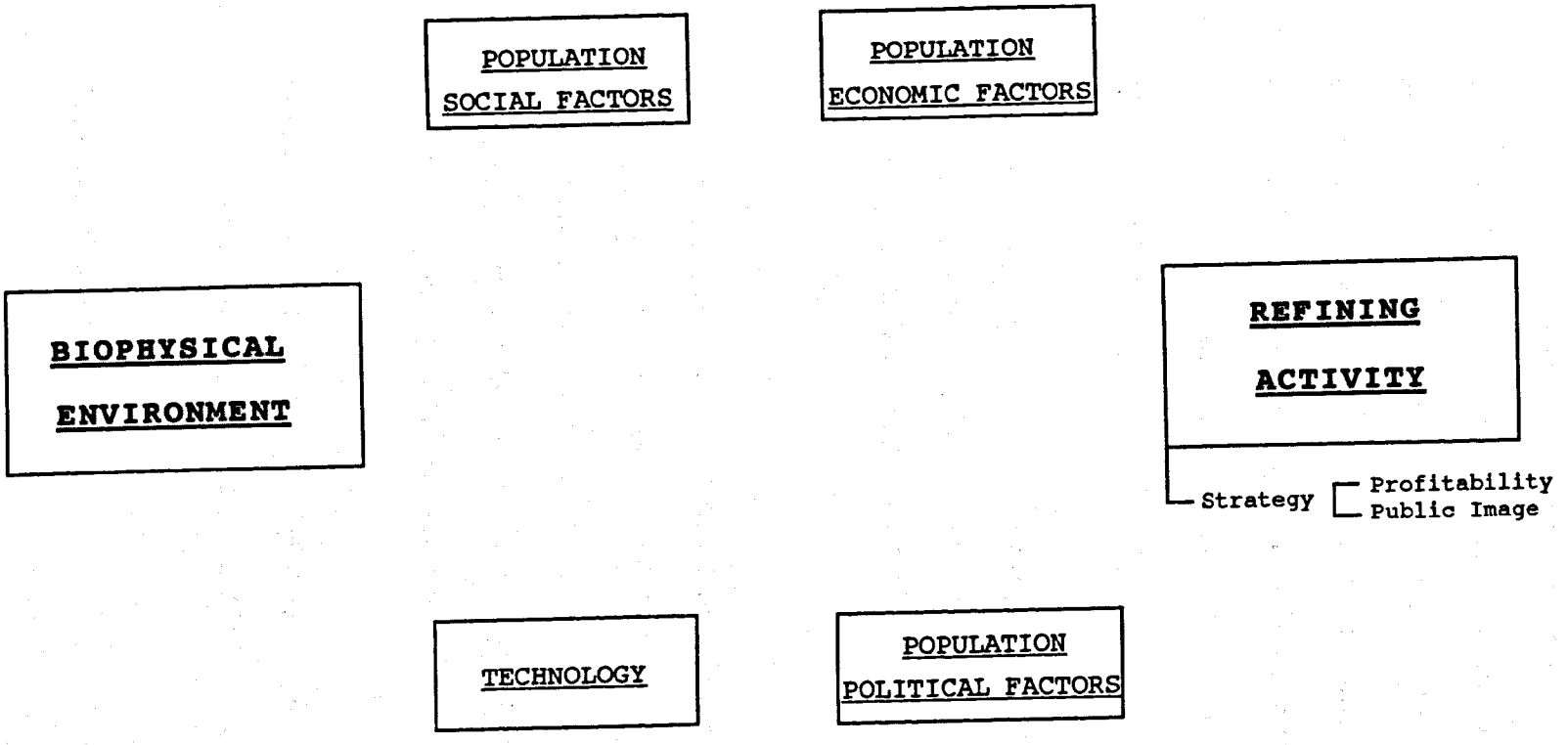

FIGURE 9.2d: The Ecological Complex Framework Modified and the Refining Activity - The Refining Activity. The above figure shows the main objectives of the refining activity that are linked to the management of green issues. This figure summarizes the findings of the empirical research.

9.3.5.1 - Biophysical Environment

As discussed in chapter 2 the biophysical environment is the source of material goods and commodities, source of services such as pleasure and enjoyment and source of life-supporting systems. It is also used as a sink for wastes generated by any system within the ecological system. There is a constant flow of energy and material from and to the biophysical environment. For simplification the flow of material and energy is not represented in the ecological complex framework. This flow is represented by the effects of the refining activity and the use of its products upon the biophysical environment. (as shown in figure 9.2a).

The biophysical environment "acts" upon every human through individual perceptions. Humans "react" individually or collectively in order to satisfy their needs and wants. These "reactions" can have predictable and unpredictable implications for the interest of others.

In this research the refining activity ("reaction" of oil organizations) transforms a natural resource into useful products. The impacts of the refining activity and its products upon the biophysical environment are the "action" of the biophysical environment upon different users. The "action" of the biophysical environment upon different users (limited to the human system) is represented in figure 9.3a.

The physical evidence of the impacts of the refining activity have been identified as an ecological force affecting oil refineries both in the UK and in Brazil (chapter 5).

9.3.5.2 - Population - Social Factors

The increasing concern about the consequences of the impacts of the refining activity

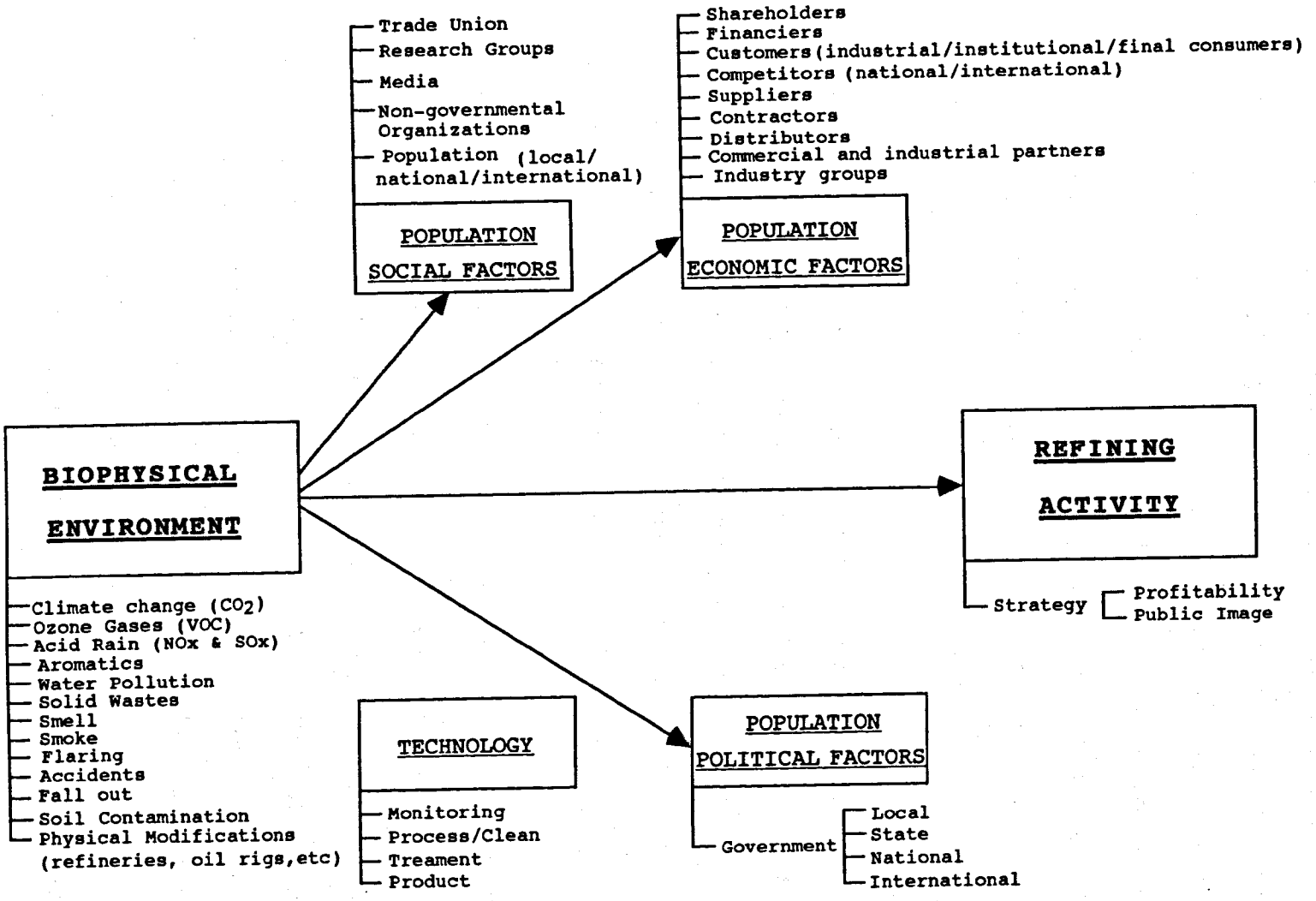

FIGURE 9.3a: The Ecological Complex Framework Modified and the Refining Activity - The Biophysical Environment. The above figure shows the "action" of the biophysical environment upon different stakeholders.

and the increasing interest of research groups, government and organizations on these impacts generate the demand of information on the quality of the biophysical environment and on the environmental performance of organizations. This demand has been observed at local, national and international level. The direct effects of pollution caused by the refining activity operations causes concerns at local level. The use of oil products causes concerns from a local to international level. The global concern with the impacts of the use of fossil fuels upon the biophysical environment directly affects the oil industry and consequently oil refineries. The dissemination of environmental information, especially by the media and by green groups increases the public awareness on the issue.

The demand and generation of environmental information and the increased awareness on the impacts of the refining activity increase demands upon oil refineries to improve their performance; increase the demands upon governments to set policies to control the impacts; create the demand for the development of environmental technology; increase the economic relevance of environmental performance.

The pressure from national and international population through their support to non-governmental organizations normally affects the ecological behaviour of the oil organization as a whole. These groups therefore indirectly affect the refining activity. Non- governmental organizations represent the demands of a certain group of the population. The demands of non-governmental organizations can, first, be very localized, having specific demands on specific refineries. Second, the demands can apply to the ecological behaviour of the organization as a whole. Non-governmental organizations have been considered by oil organizations as a good indicator of future ecological demands of the population.

The stakeholders representing social factors affect the refining activity. From the

research there is evidence that the refining activity has increased its communication with different groups and is providing more information on their environmental performance. Therefore, there is an ecological force from the groups representing the social factors that are affecting the refining activity. The refining activity is responding to those groups. This is represented in figure 9.3b.

The research has also shown that there is strong similarity between refineries within the same country and refineries from a different country. The ecological demands upon them, however, are not exactly the same. Some refineries are under more scrutiny then others. However, according to refineries' representatives these differences are only a matter of time.

9.3.5.3 - Population - Economic Factors

The stakeholders classified under economic factors may have financial interest in the environmental performance of the refining activity and/or contribute, through their actions, to an organization's environmental performance.

The economic issues, linked to green issues, affecting the refining activity are included in Porter's (1980) competitive forces. Green issues have introduced new constraints and opportunities to organizations.

Environmental quality demands upon oil refineries affect the competition between them. First, because refineries need time to adapt the refining process to be able to comply with the demands. Second, it increases refining costs. The challenge for refineries is to be able to comply with environmental demands at the lowest possible cost. Third, depending on the environmental constraints required it can affect marketing opportunities.

Benchmarking to evaluate performance is a very common procedure used by UK and

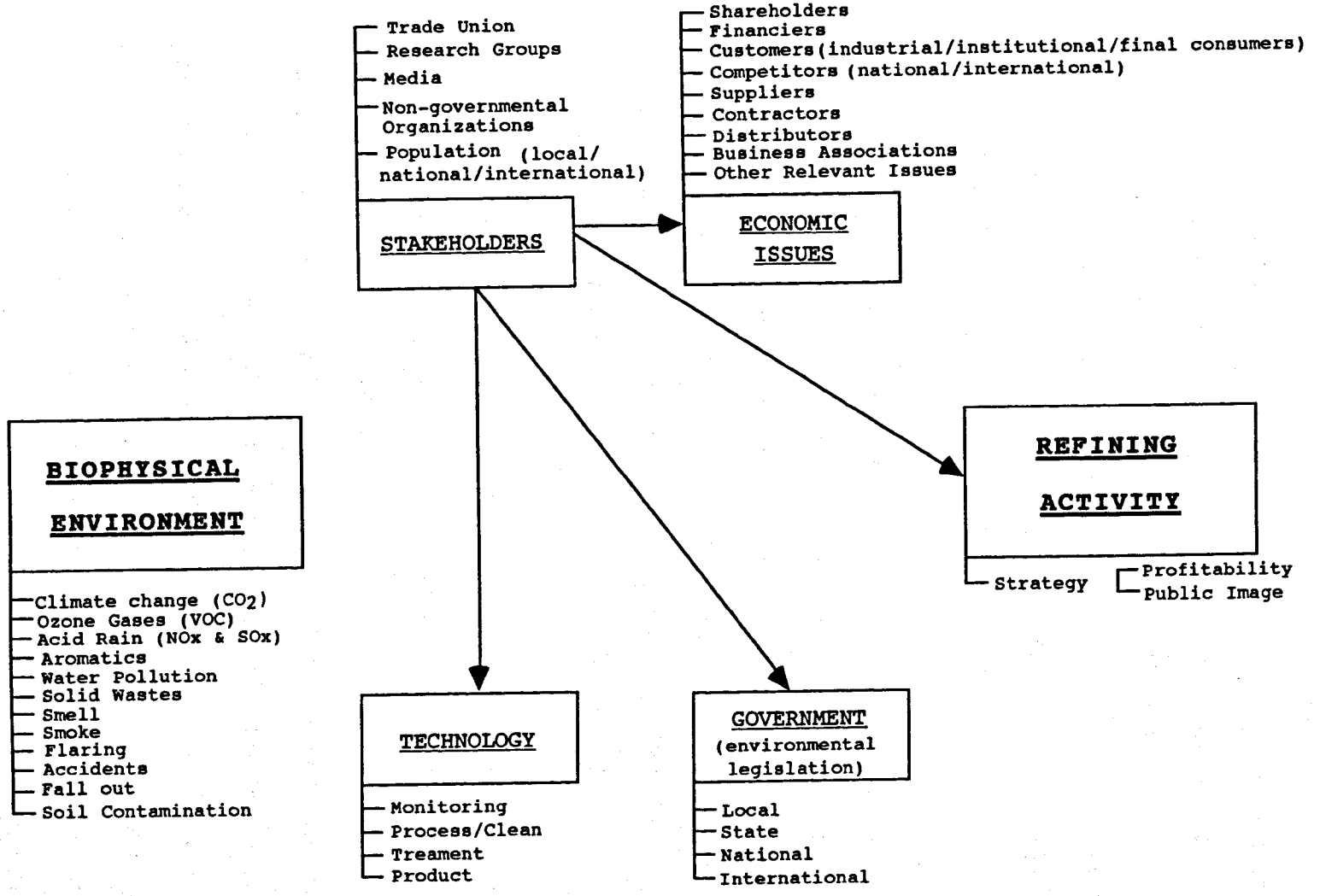

FIGURE 9.3b: The Ecological Complex Framework Modified and the Refining Activity - Population: social factors. The above figure shows the effects of the groups representing social factors upon the other elements. This figure summarizes the findings of the empirical research.

Brazilian oil organizations. It is an economic force that leads to performance improvements and technological developments. This includes environmental performance, mainly environmental quality of products.

Organizations agree that market forces encourage environmental performance improvements. However, it can be argued that this is only valid as long as there are environmental controls. Environmental legislation and enforcement upon oil refineries are not uniform. The stricter the environmental controls, the higher the costs to manage green issues. Therefore, the competitive conditions are not equal among refineries. The difference in environmental controls encourages free riding.

The oil industry competes for its share of the energy market. Therefore, the competition between the oil industry and other energy organizations also affects oil refineries. The effects upon refineries can be either positive, for example, the displacement of coal and wood for fuel oil, the production of MTBE and the marketing of alternative fuels, or negative, through the displacement of oil products, for example, the use of ethanol in Brazil and the increasing use of gas.

Customers demands upon the organizations are quality and price of products. Green issues do seem to be among the priorities of some of the final consumers. The stricter environmental controls upon consumer organizations is increasing their interest on alternative sources of energy. However, the use of alternative energy sources depends on the balance between the risks of non-compliance and the costs of adapting their process to use cleaner fuel. The increased control on vehicular emissions has encouraged cooperation among institutional customers such as the car manufactures and the oil industry. Some of the oil organizations have described in their environmental reports their participation in joint research programs, including the government (both in the US and the EU) and car manufactures. The aim of these programs is to investigate better alternatives to reduce emissions.

The pollution impacts on final consumers is reduced by product quality improvements, technological improvements in equipment and reduction in consumption. While the former options demand changes from organizations, the latter demand change from final customers. Oil organizations have no interest in reducing consumption of products. The most they are doing is to encourage final users to recycle lubricant oil.

Suppliers (not including petroleum suppliers) provide the materials used in the refining process. Most of the materials once used have to be disposed of back in the biophysical environment. The impact of these materials upon the biophysical environment is the refineries' responsibility. Refineries have acted upon suppliers to reduce the impacts caused. For example, chemicals used in water treatment have been substituted (elimination of chromium discharges), and changes in packing have been required.

Porter (1991) points out that there is a link between tougher environmental legislation and improvement in country's environmental technology market. Suppliers of environmental technology have not been considered as an ecological force affecting the refining activity. It is suggested however that suppliers of environmental technology have economic interest in stricter legislation (Porter,1991; DTI,1994). Their need for tougher environmental controls are very likely to affect refineries. Two respondents pointed out the importance of the direct action of suppliers upon government to make environmental legislation stricter.

Business associations play an important part in the negotiations of environmental standards. They also promote improvements among oil organizations by setting their own environmental code of practice, to be followed by members. The role of business organizations is important in the UK. The co-operation of oil organizations through the business association strengthens their negotiation position. In Brazil Petrobrás and representatives of two small refineries negotiate green issues directly with relevant authorities.

Oil organizations have contributed on the development of environmental management systems standards. The implementation of environmental management systems is among the strategic objectives of Petrobrás.

Depending on the legislation in practice, oil refineries are becoming increasingly liable to environmental impacts caused by contractors. Consequently, refineries are becoming more concerned about contractors' ecological behaviour. Demands on the environmental performance of contractors was observed during the empirical research. Organizations also have described the increased auditing of contractors' environmental performance.

The delivery of oil products to customers is either direct to the customers or through distributors. The verification of the quality of products delivered is the responsibility of both refineries and distributors. The demand for quality is constantly increasing, including stricter environmental quality requirements. Organizations do not have much choice but to comply with quality requirements. Distributors are also under pressure to reduce emissions and improve environmental performance. During the empirical research it was observed that distributors worked together with refineries on the improvement of operational procedures involving both activities, monitoring of product quality and communication with customers.

Financiers are introducing environmental protection requirements as part of their loan agreement. This was observed in Petrobrás. Oil organizations in the UK have identified the demands from their shareholders. In both cases these demands affect the oil organization as a whole, not only the refining activity.

Sustainable development is an issue that has been addressed by some of the oil organizations. Organizations agree that they have to take part in the debate. This is a complex issue to be addressed by governments, business and society. Refineries, however, do not take part in this debate directly.

The issues to be addressed are various. First, the balance between ecological, energy and economic demands. The balance between individual and collective goals may be a problem with no solution as suggested by Emery and Trist (1973). Second, countries, dependence on petroleum as a main source of energy. Hence, individual economic interests of oil organizations becomes confused with a country's economic interest. Pollution issues associated with petroleum use are therefore solved in a piecemeal approach, applying end-of-pipe solutions. Third, society's consumption behaviour. The relative satisfaction of individual wants and needs is endless. This may lead to the tragedy of the commons described by Hardin (1968).

The stakeholders representing economic factors affect the refining activity, government and technology. This is shown in figure 9.3c.

9.3.5.4 - Population - Political Factors

The control on pollution problems caused by refining activity began in the 1940's. The continuous search to increase the knowledge about the effects upon health and upon the biophysical environment is invariably introducing stricter controls.

Despite a similarity of pollution problems, the environmental control upon refineries is not homogeneous. They have a tendency to become similar but with a certain timelag between countries and between states within the same country. This difference also applies to different local councils within the same state, for example, the use of unleaded petrol and the sulphur content of diesel.

The same way that environmental legislation is different, enforcement of environmental legislation among countries is also different. However, the globalization of pollution problems and the internationalization of environmental legislation are contributing to reduce these differences, for example, the control of pollution of the North Sea.

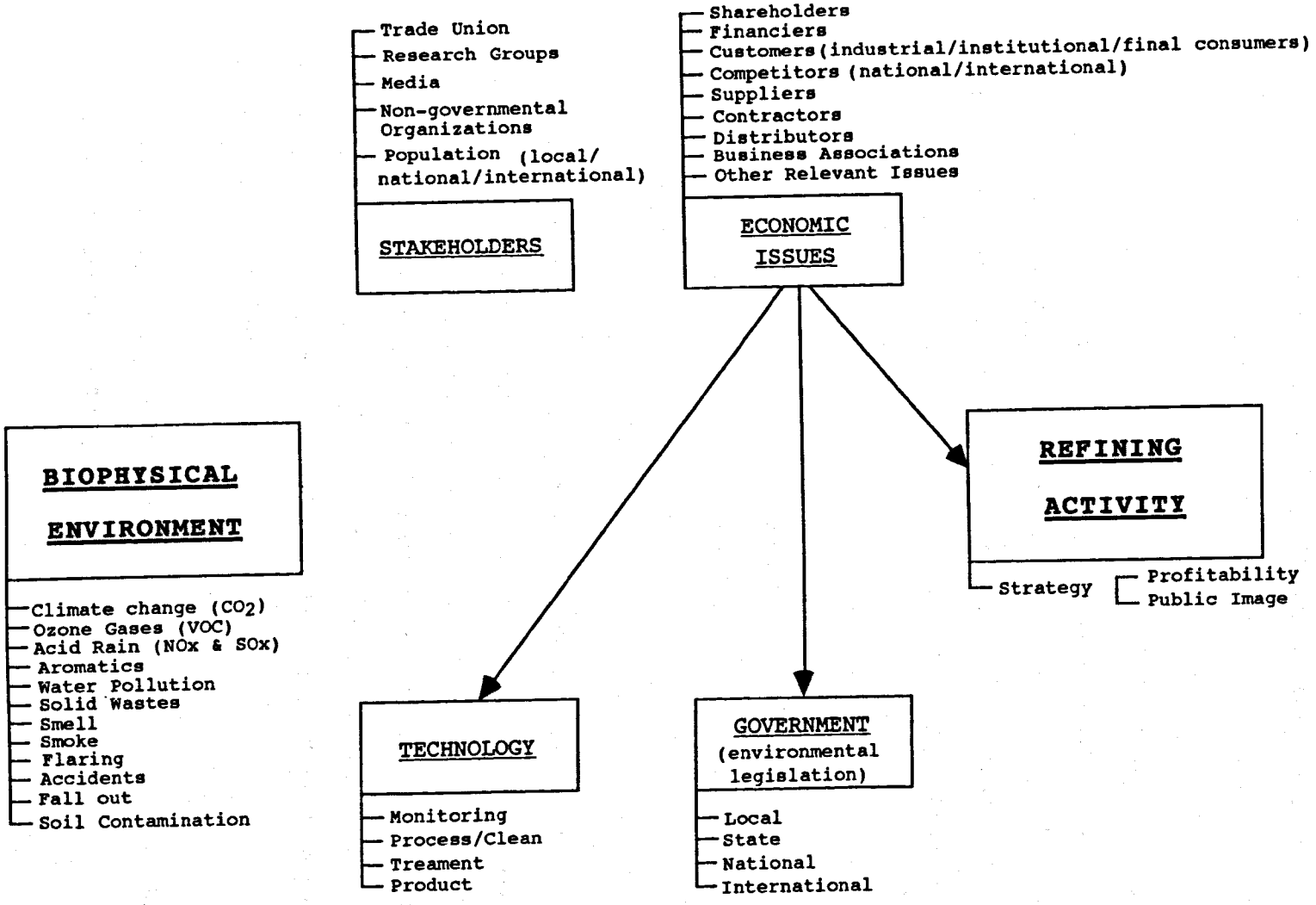

FIGURE 9.3c: The Ecological Complex Framework Modified and the Refining Activity - Population: economic factors. The above figure shows the effects of the groups representing economic factors upon the other elements. This figure summarizes the findings of the empirical research.

One of the refineries, in Brazil, has highlighted the negative effects on product quality caused as a consequence of different local and state environmental legislation. The legislation can generate costs to refineries and no environmental benefit. This is caused because of the marketing of the product. There is no incentive for the use of a more expensive cleaner product at local level. The refinery is working closely with the local authorities to restrict the marketing of the cleaner products to the local market.

Porter (1991) argues that tougher environmental legislation provides opportunities for organizations by triggering innovation and upgrading. However, as Porter emphasizes, this depends on the establishment of the right kind of legislation, with emphasis on "pollution prevention rather than abatement and cleanup". In the case of petroleum use, pollution prevention is not the approach chosen. Pollution prevention in the case of energy use (including petroleum) must have a much wider approach.

The oil industry has intensified its participation in the development of environmental legislation. The regulatory-negotiation approach seems a common practice in the USA, UK and in Brazil.

In the UK environmental managers are responsible for the monitoring of environmental legislation affecting refineries. The contact with the government is mostly through the oil organizations' business association. Representatives of Brazilian refineries take part in the development of local and state environmental legislation. They have the support of the head office when required. In Brazil, representatives of the head office (refining activity and others) take part in the development of national legislation.

Participation in the development of international legislation is done either through the participation or support of research groups.

Economic instruments are an important environmental control that may affect refineries, for example, the increase in fuel taxes and the introduction of CO_2 tax. It is

believed that environmental taxes will keep increasing (Oil and Energy Trends,1994b). However, there is increasing concern that environmental taxes are mainly attributed to fiscal pressures on governments (Mohnfeld,1994). The oil refineries in the UK are more concerned with the possibility of CO_2 tax than the Brazilian refineries.

The introduction of environmental controls affects the refining activity, technology and stakeholders representing social and economic factors. This is shown in figure 9.3d.

9.3.5.5 - Technology

The economic pressures upon refineries to process heavier petroleum has demanded changes in the refining process to allow for its processing. Changes in a product's demand pattern is also a constant demand for technological changes. For instance, the increased demand for distillate products and decrease in demand of heavy fuel oil. Economic competition among oil organizations also demands process improvements to increase productivity. However, it is recognized that over the past years the major influence upon refining technology has been a consequence of environmental constraints.

The quality and yield of products depends on the petroleum processed and on the process of each refinery. Oil organizations do not provide detailed information on their research and development programs, for competitive reasons. Differences in the refining process and differences in environmental controls affect refineries competitive positions.

It is suggested that most of the technology necessary to comply with environmental demands is available (DTI/ETSU,1994). However, the main argument is the investment necessary for such modifications. Oil organizations have published estimates of the costs to adapt American and European refineries to comply with environmental demands. However, these estimates have to be considered with caution.

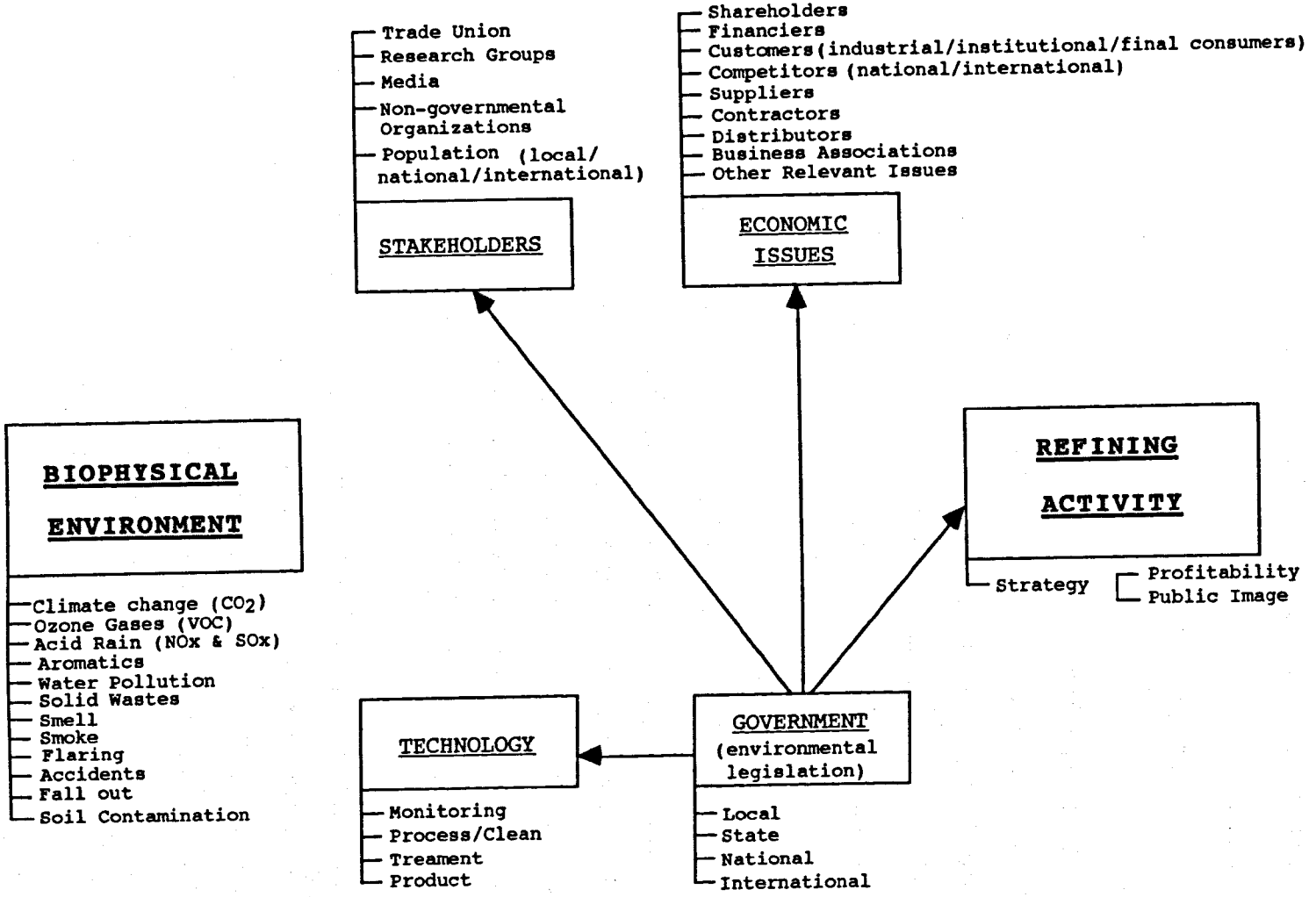

FIGURE 9.3d: The Ecological Complex Framework Modified and the Refining Activity - Population: political factors. The above figure shows the effects of political factors upon the other groups. This figure summarizes the findings of the empirical research.

They have overestimated environmental expenditure in the past (Oil and Energy Trends,1994b).

The development of technology to treat the discharges produced by oil refineries includes landfarming, bioremediation, incineration, processing of refinery oil sludge, tertiary water treatment. Treatment technology can reduce costs and also increase the refineries' flexibility to comply with environmental requirements.

The decision on treatment technology must take a long-term approach. This sometimes goes against short-term economic objectives. However, the more the biophysical environment is burdened with emissions and wastes, the more green issues increase in importance and controls become stricter. Organizations are increasingly having to deal with their past pollution problems. Some respondents call past pollution problems "environmental debit"*.

Oil organizations have always reacted against environmental controls arguing that they were not based on scientific evidence. However, scientific interest in the impacts upon the biophysical environment is producing the scientific evidence. This not only provides the evidence for the introduction of environmental controls but also triggers the development of more research and also the development of monitoring technology. Monitoring technology is a growing market (DTI,1994).

Monitoring technology has three purposes. The first is the monitoring of the process. The second is the monitoring of environmental quality, for compliance and research reasons. The third is the monitoring of the impact on health. Refineries do not develop monitoring technology. They are consumers of monitoring technology. The refining activity generates the "raw material" (for example emissions, wastewater; and wastes) and the demand for monitoring technology.

Environmental controls affect three main product groups petrol, diesel and fuel oil.

*Environmental Debit- translated from Portuguese- "Passivo Ambiental"

The pressure on petrol includes the reduction in benzene, sulphur, aromatics, olefins and vapour pressure. The pressure on diesel includes the reduction in sulphur and cetane number*. The pressure in fuel oil includes the reduction in sulphur.

Environmental controls have generated opportunities for the development of new products and the marketing of alternative fuels, for example, the use of MTBE and the marketing of methanol, ethanol and natural gas as alternative fuels.

Oil organizations are creating companies to develop and market environmental technology (monitoring and clean technology). Therefore, the environmental pressures upon them have also created new business opportunities. Oil organizations are also investing in research and marketing alternative sources of energy. For example, solar energy.

Technology acts upon the refining activity and stakeholders representing social, political and economic issues. The refining activity develops new environmental technology. This is shown in figure 9.3e. A complete ecological complex framework result of this research is shown in figure 9.3f.

9.4 - Conclusion

The ecological complex framework proved to be instrumental in demonstrating that the relationship between an organization and the biophysical environment can not be considered in isolation. It is part of a much greater process where different elements are interrelated and therefore affected by any of the organization's actions.

The research has shown that green issues are part of the refining activity's environment and included in its decisions. The challenges for strategic managers are therefore, first,

* Cetane number - a measure of the ease with which a diesel fuel will ignite (COD,1990)

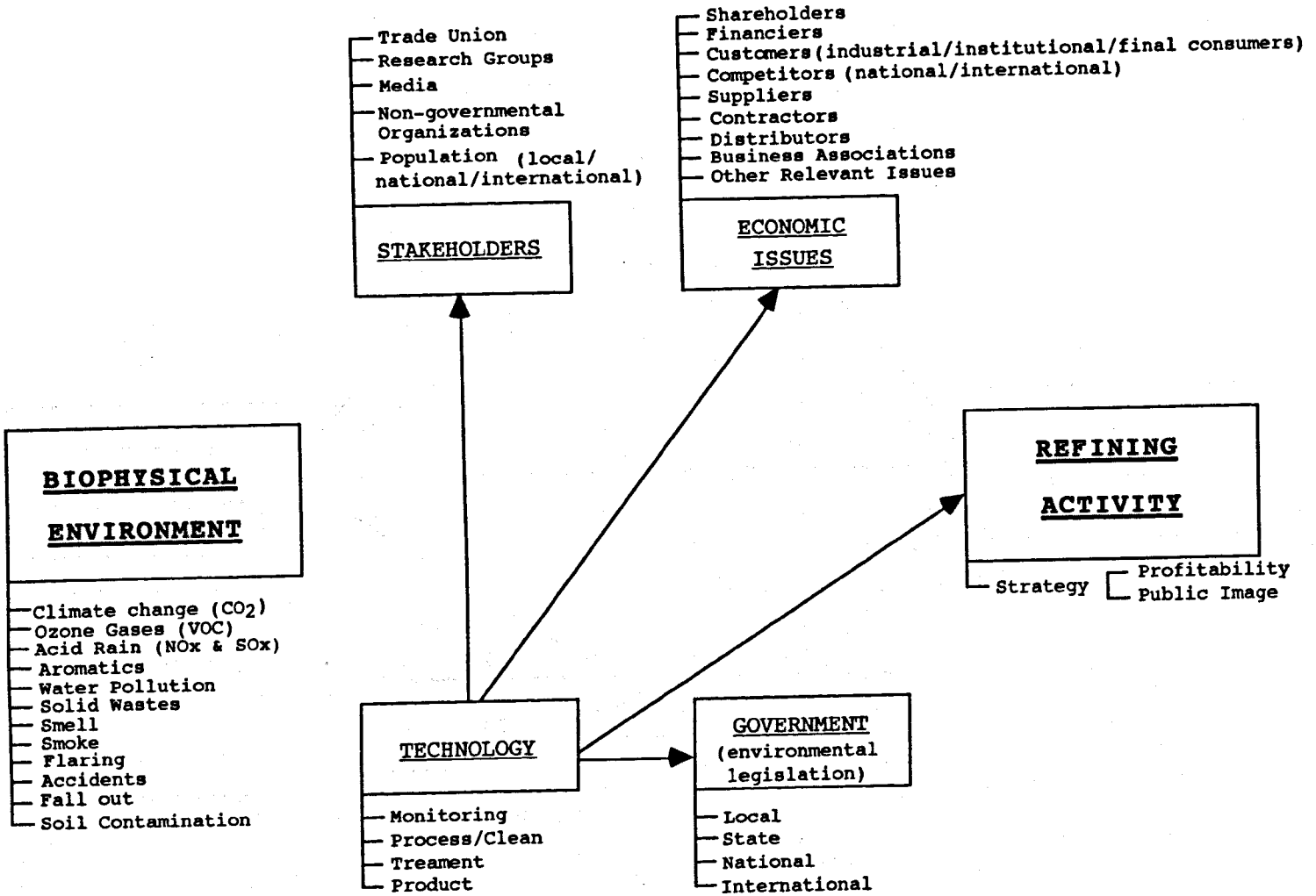

FIGURE 9.3e: The Ecological Complex Framework Modified and the Refining Activity - Technology. The above figure shows the effect of technological factors upon the other elements. This figure summarizes the findings of the empirical research.

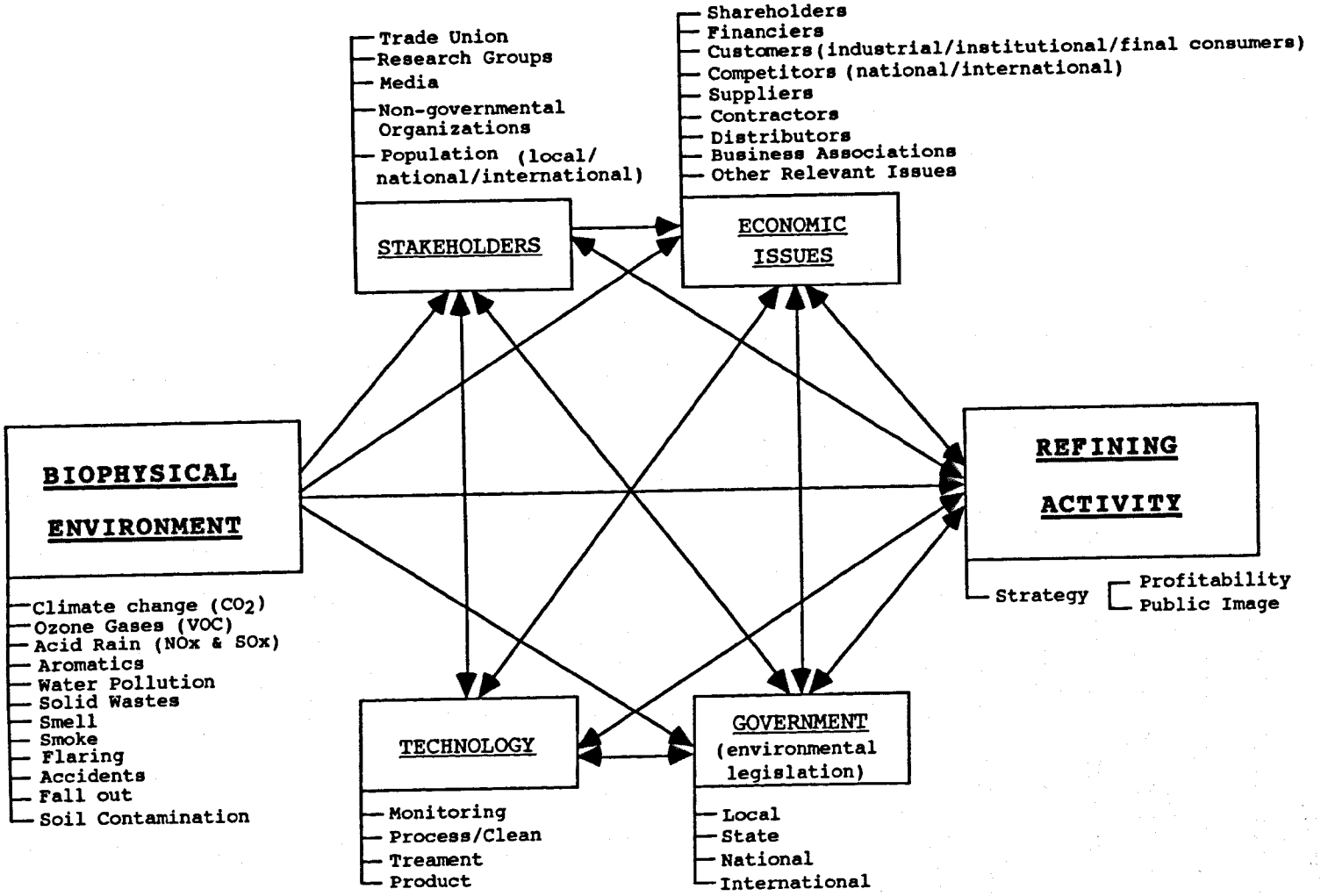

FIGURE 9.3f: The Ecological Complex Framework Modified and the Refining Activity - The Complete Framework. The above figure shows the elements that influence the relationship between an oil refinery and the biophysical environment. Each element comprises different issues. For simplification the flow of matter and energy is not represented in this figure. This figure summarizes the findings of the empirical research.

to be able to identify the component parts of each element. Second, to perceive how they are interconnected. Third, to identify the relevance to their organization's strategies.

The ecological complex framework discussed in this chapter represents an initial attempt to demonstrate the systematic approach required to the management of green issues. None of the interviewees had a comprehensive perception of all the issues related to the management of green issues. Therefore, the importance of such a framework is that it provides an easier visualization of the complexity behind the management of green issues. It shows the various elements, and respective components, that may affect an organization. Although this framework was designed for the refining activity, it seems generalizable to other organizations. However, further research is needed to investigate the links not identified in this research.

The caveats associated with the research, conclusions and suggestions to develop further the research ideas are discussed in the next chapter.

CHAPTER 10

CONCLUSIONS

10.1 - The Research Problem

The increased deterioration of the biophysical environment is affecting people's ecological values. The change in ecological values increased the social and political importance of green issues. These changes are constantly affecting ecological forces and introducing new environmental controls. Environmental control, such as environmental legislation, affects the social constructed limits for the use of the biophysical environment. Consequently, the new social constructed limits are affecting the actions of any individual or group of individuals within the human system.

Increased ecological forces and environmental controls are forcing organizations to re-examine their relationship with the biophysical environment. In this research the main subject of study was to investigate this relationship. The main focus was the refining activity of the oil industry.

Previous research has shown that oil organizations have been dealing with green issues since the 1940's. However, the increased internationalization and globalization of green issues are demanding a more strategic and systematic approach to manage green issues.

This research has confirmed that oil organizations have introduced several organizational changes because of ecological forces and environmental controls. The research also showed that ecological forces and environmental controls are responsible for major technological changes in refineries. The management of green issues has become part of organizations' decisions and strategies.

The first research question sought to establish how organizations perceive ecological forces and environmental controls. It also wanted to compare the differences among the perceptions of representatives of UK and Brazilian oil refineries.

The increased awareness and dissemination of information on the effects of the refining activity are similarly affecting refineries both in the UK and in Brazil. The representatives of refineries identified specific stakeholders as the ecological forces affecting them. It was found that there is a slight difference in stakeholders identified by the representatives of UK and Brazilian refineries. It is expected, however, that the recent opening of the state oil monopoly in Brazil will eventually affect this. For example, the management of green issues by competitors and the ecological demands of shareholders were considered of major importance for UK refineries, while the ecological demands of financiers were more relevant in Brazilian refineries. In Brazil the use of ethanol as a fuel and as an additive increased the relevance of product substitution for the refining activity. Environmental management systems were found to be an important ecological force for the refining activity in Brazil but not in the UK. However, as the issues related to environmental management systems were still in their preliminary stages there is not much evidence of its significance as an ecological force for oil refineries.

The second research question sought to determine the green issues proposed to be addressed by oil organizations. The empirical research showed that oil organizations are committed to work with due regard to the biophysical environment. The organizations are committed to reduce the flow of material and energy from the organizations to the biophysical environment. The environmental policies of oil organizations, in general, addressed the ecological forces and environmental controls identified in chapter 5. Most of the oil organizations seemed to follow the guidelines

proposed by business associations. However, despite similarity in operations and products there is no uniformity on the commitments set by the organizations. The lack of quantitative ecological goals suggests that, despite the publication of the policies, organizations are still uncertain about the publication of fixed ecological goals. None of the organizations have proposed actions towards the long term impact resultant from the competition from petroleum exploration and the extensive use of petroleum.

The third research question dealt with the level of implementation of the environmental policies of oil organizations. The empirical research showed that oil organizations are implementing their environmental policies. The management of green issues seems to be intertwined in other existing management systems. However, the implementation of the environmental policy does not seem to be uniform among refineries belonging to the same organization. The organizations are still not providing enough quantitative environmental goals. Therefore, a quantitative assessment between environmental policies and level of implementation was not undertaken. The actions of the refining activity towards the biophysical environment vary depending on external ecological forces and environmental controls.

The fourth research question concerned the extent to which green issues are intertwined with an organization's business goals, management systems and strategies. The case study showed that the importance of green issues for the refining activity has increased dramatically with stricter environmental controls upon products. These controls are strongly affecting the refining activity at all levels. The research showed that the green issues are integrated in the strategic planning of the case study organization, from the petroleum selection to the distribution of the final products. The management of green issues is linked to two main strategic issues. They are profitability and public image. The effect of green issues upon profitability affects not only the refining activity but the oil organization as a whole. The effect of green

issues on the organization's public image is largely dependent on the scale of the impact of any of its action upon the biophysical environment.

Researchers, for example, Throop (1993), Shrivastava(1994) and Ketola (1995) have argued that the business environment was too limited to represent the biophysical environment. By focusing the research on the relationship between an organization and the biophysical environment this was not confirmed. Ecological forces and environmental controls have already become part of the business environment. They are affecting social, economic, political and technological factors of the business environment. However, as shown in the ecological complex framework in figure 9.4f, the addition of the biophysical environment to the business environment provided a better perception of the "action" it causes upon the business environment.

The biophysical environment is a common property therefore there is constant competition between different users for their individual and collective objectives. The competition of different users for the biophysical environment was not included in previous representations of the business environment. The diversity of objectives makes this competition very complex. Strategic management researchers may choose to ignore it, however, organizations are among the competitors. Organizations' individual economic objectives compete with other users' individual objectives and collective objectives, such as environmental quality.

The publication of environmental policies is an example of the change in organizations' ecological behaviour, in response to ecological forces. However, environmental policies without specific goals are a mere public relations tool.

The environmental policies of oil organizations tend to set very general objectives. In comparison to environmental management codes of practice, they range from very

comprehensive to very lean. Oil refineries in the UK are publishing site policies that are more specific to their activities and comply with the requirements of environmental management standards, such as, ISO 14001.

In the case study it was observed that the published environmental policy is different from the internal environmental policy. It was also observed that the refining activity was already engaged in environmental management before the environmental policy was written. The environmental policy has provided a better framework for action. However, the objectives established by the organization or by specific refineries are the main drive for action.

The publication of environmental expenditure is another change in organizations' behaviour. However, the published environmental expenditure is meaningless information on its own. Environmental expenditure must be justified against the established objectives. Environmental expenditure can have negative or positive financial implications for organizations. The negative implications are making organizations reduce their emissions and wastes. The positive implications are the creation of market opportunities.

In the case study it was observed the behaviour of the refining activity on green issues is still reactive towards new environmental controls. However, this behaviour becomes proactive in the identification of market opportunities, generated because of ecological forces and environmental controls (for example the use of unleaded petrol). Both economic and ecological forces and environmental controls squeeze oil refineries. Therefore, the balance of economic and ecological demands is not considered separately in their strategies.

Ketola (1995) found that environmental policies of oil organizations are not fully integrated into their management systems. This investigation suggests that they are integrated. Oil refineries cannot afford to ignore ecological forces and environmental

controls. They are intertwined with costs and quality objectives. Environmental policies, however, still do not reflect the demands of all users of the biophysical environment.

Environmental legislation plays a major part in the changes of organizations' ecological behaviour. It was found to be the major environmental control affecting refineries. There is an increasing trend towards the use of economic instruments. This will certainly affect the economic relevance of pollution generated by oil refineries. Stricter environmental legislation upon refinery operations affects refineries at local level. However, stricter environmental legislation upon products affects the refining activity as whole.

Compliance with environmental legislation is a goal established by oil organizations. Compliance with environmental legislation is the least expected from oil organizations. It protects their legitimate right to operate. It also allows them to market their products. Occasionally the refining activity may pre-empt environmental controls but this was not found to be the usual attitude among oil refineries.

Compliance with legislation is a very general goal. The monitoring of environmental legislation affecting other countries, even if presently not affecting the refining activity of a certain organization, is used to identify market opportunities and constraints.

Some organizations proposed that self-regulation would be the best way to improve environmental performance. However, despite the similarity of products and emissions, oil refineries tend to comply with the minimum required by environmental legislation in place. Oil refineries' ecological behavior varies according to external controls. This suggests that self-regulation alone, is not enough to control refineries ecological behaviour.

Oil organizations have increased their participation in the development of environmental legislation. However, environmental legislation depends on issues such as: the continuous deterioration of the biophysical environment, technological developments, other users of the biophysical environment, economic interests of other groups, and knowledge about the impacts upon the biophysical environment. Oil organizations do not have much control over these issues.

The stakeholders identified in this research were slightly different from those identified by Ketola (1995) in her investigation of oil refineries in the UK. The comparison with Brazilian refineries has shown that financiers, trade unions and media are also stakeholders considered by the refining activity. The difference found in stakeholders identified is probably because Ketola's research did not include state owned oil organizations.

The immediate physical effect of oil refineries operations upon the biophysical environmental was identified as an ecological force affecting oil refineries. However, the constant deterioration of the biophysical environment was not identified as an ecological force. Organizations' own actions upon the biophysical environment provide the "raw material" to research groups and environmental technology organizations. The constant search for a definition of environmental quality should be seen as a permanent ecological force affecting organizations.

Demands for environmental quality have affected oil refineries' market opportunities. The environmental quality of oil refineries' activities and products are constantly restricting oil refineries' actions upon the biophysical environment. This constant change in environmental demands affects oil refineries' competitive ability.

The ecological complex framework developed in this research (figure 9.3f) is an

attempt to demonstrate the systematic approach needed to the management of green issues. It also aimed at demonstrating that the relationship between an organization and its environment goes beyond the business environment of strategic management research. It must also consider the biophysical environment. Others (Shrivastava, 1992; Throop,1993; Dodge,1995; Ketola, 1995) have observed that an organization's actions are not restricted to a business environment, they also affect the biophysical environment. The changes in the biophysical environment affect other users. These users affect the social environment and consequently affect organizations. It is a continuous process where the production process has to constantly comply with stricter environmental quality demands.

Duncan's ecological complex framework proved to be too general to represent the social process associated with the management of green issues. The original framework was adapted by comparing it with the other forces (social, political, economic, technological) in the business environment, as suggested by Andrews (1980). The results of the empirical research were then used to construct the modified ecological complex framework.

One of the oil organizations used in this research has very recently introduced a more systematic and integrated approach on the management of social, ecological and economic demands which is in accordance with the ecological framework proposed in this research (Shell,1998). This organization is presently seeking to identify the expectations of different stakeholders.

10.2 - The Methodology

The method adopted in this inquiry was largely dictated by the nature of the research problem. The research aimed at investigating the relationship of an organization with the biophysical environment in the context of a social life process. The emphasis was on investigating the process aimed at reflecting the reality of every day management of green issues.

The phenomenological and exploratory approach used in this research proved to be very useful. It unveiled the interconnecting events associated with environmental management on the basis of people's real experience. It achieved the aim of reflecting and synthesizing subjects' perceptions about issues relevant to management of green issues under a theoretical framework.

The flexibility and lack of structure characteristic of the research strategy chosen gave opportunities to discover unexpected issues about the management of green issues. For example, the informal procedures and actions taken to solve immediate problems. Research questions and a theoretical structure were used to focus the investigation on such unstructured complexity of social reality.

In this research, theory has emerged from data. It allowed for the generation of a theoretical framework more meaningful to the subjects of the research as it was developed based in their own experiences. The aim of the investigation was to discover theory and not to verify theory. This relationship between theory and data is formulated in terms of grounded theory. The use of multiple sources allowed for triangulation of evidence, which strengthens grounding of theory. The use of previous literature (e.g. environmental charters) and independent assessors were useful to reduce research bias in the interpretation of information.

The choice of concentrating the research in a specific activity was useful. The similarity of the activity provided a more homogeneous set of experiences, which allowed a better comparison between different subjects' experiences. It also provided a more comprehensive understanding of issues associated with environmental management in oil refineries and in the refining activity as a whole.

Generalization is often a drawback of qualitative research. In this research a "typical cluster" of characteristics was selected. Different people and organizations were examined. The data were then integrated in a theoretical context. The aim of this

investigation was therefore not to enumerate frequencies but to expand and generalize a theoretical proposition (Yin,1994). Other researchers can examine comparable cases and, generalizations may be extracted as evidence is accumulated.

Previous experience of this researcher in the management of green issues combined with the theoretical background of social science research were essential for the development of this investigation.

Interpretation of data is another drawback of qualitative research. Therefore, the use of only one researcher was a limitation of this investigation. The use of multiple sources of information and development of a standard helped to reduce the exposure to bias. The results of the content analysis were checked by independent assessors to reduce research bias and hidden assumptions. This procedure has previously used by other researchers (Bryman,1989). Researchers' claims to neutrality, objectivity, descriptive faithfulness, or benign intent is a matter of perspectives (Freeman,1993).

Accessibility to subjects was a major problem faced by this researcher. However, persistence proved to be the right tactic to get a reasonable research sample.

Environmental managers were appointed by oil organizations as their representatives. Ketola (1995) suggested, in her research, that environmental managers were involved with most issues related to management of green issues. However, the empirical research showed that site managers have a much better global view of the issues affecting refineries. Environmental managers are, in general, more involved with issues affecting the refinery at local level (this does not include green issues affecting products). Unfortunately, not all site managers could be interviewed.

10.3 - Suggestions for Future Research

It is acknowledged that research on green issues is still underdeveloped

(Gladwin,1993) and the inclusion of green issues in strategy theories have been problematic because of the economic interpretation given to the business environment (McCloskey and Smith, 1995). However, as organizations cannot afford to neglect the management of green issues any longer, researchers must update their research agendas to include those factors which can present opportunities and/or threats to organizations.

In this research the elements affecting the relationship between an organization and the biophysical environment were identified. Further research is required to examine how each element is affected by the organization. This could then be compared to how organizations perceive and respond to each element.

The identification of the variables in each one of the proposed links and the understanding of how the interconnections between different elements affect the subject organization also requires further research. This also applies for conflicts between stakeholders of the same element. For example, how does the conflict between governments and within government departments affect an organization?

The relationship of other organizations with the biophysical environment should be investigated and compared to the ecological complex framework proposed in this research. This will probably unveil other elements not identified in this research.

Competition for the use of the biophysical environment is affecting oil refineries. How our understanding of competitors' behaviour can be amended to represent this is a challenge for future strategic management researchers.

Ecological forces promote the creation of new organizations and an environmental market. Researchers in population ecology of organizations should investigate what are these organizations? What is the effect of these organizations upon the subject

organization? Strategic management researchers should ask how environmental organizations affect an organization's business environment?

The aim of this research was to investigate the impact of ecological concerns upon organizations. This study has attempted to advance our understanding of this complex problem. The author is aware that the research into such a contemporary topic is far from complete and no doubt future research will present new evidence and provide the opportunity to further develop the ideas presented here.

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APPENDIX 1

List of Interviewees

1- Oil refineries and Head Office Environmental Advisors in the UK

- Environmental Managers (05) [EM1 to EM5]*
- Environmental Advisors (03) [EA1 to EA3]

2- Brazilian Petroleum Organization [PE1 to PE50]

Head Office:

- Refining activity:
  Head Office Advisors- Health, Environment and Safety; Product Quality Control; Process (03);
  Environmental and Safety Department Representatives - (03 Management & 01 Technology);
  Financial Representative (01);

- Corporate Public Relations (02);

- Planning Department (01);

- Research & Development -Environmental Advisor (01);

- Corporate Quality, Environmental and Safety Superintendence -Environmental Advisor (01);

- E&P, Transport and Engineering Corporate Departments -Environmental Advisor (03);

- Legal Department (01);

- Project & Engineering - Environmental Advisor (01);

Refineries:

Site Managers (05);
Environmental, Health and Safety Managers or equivalent (05);
Environmental Representatives (05);
Public Relations (05);
Process Managers (05);
Operators Supervisors (in some refineries) (07);

3- Others

Environmental Authorities

UK - NRA (03), HMIP (01), Local Council (01); [EAUK1 to EAUK5]
Brazil - State Environmental Agencies (03); [EABR 1 to EABR3]

UKPIA - United Kingdom Petroleum Industry Association (01); [UKPIA1]

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* [ ] - Reference code

APPENDIX 2

Research Guide

1.0- Introduction

a) Note the time (begin and end).
b) Confirm confidentiality.
c) Explain the objective and relevance of the research.
d) Starting question: Can you describe the progressing of environmental management activities in this refinery and the current environmental management system? For example, ecological forces, structural changes, your main responsibilities, internal pressures, environmental programs, recent investments linked to environmental issues.
e) Describe interviewee's behavior and anything displayed that is linked to environmental issues.

2.0- Guiding Questions and Objectives

- Can you briefly describe your main activities?
Objective: Understand the internal and external links concerning the management of environmental issues.

- What are the ecological forces affecting the refinery?
Objective: Determine stakeholders and their respective ecological concerns. (population, government, other organizations)

- Can you describe the main environmental programs that you have implemented in the refineries recently?
Objective: Determine the issues, which have priority for the refinery and link them to the stakeholders' ecological concern.

- Can you describe in more detail your contact and work with government at all levels?
Objective: Define the refineries' links and behavior with the government. (government)

- What are the means to know and monitor the stakeholders' reactions to possible impacts of your activities upon the biophysical environment, including human beings?
Objective: Find out the trigger of ecological concerns on oil refineries' activities and products, and possibly environmental index of performance. (monitoring and observation)

- Can you describe the environmental information either provided by you or obtained by you?
Objective: Understand the flow, type and importance of environmental information to refineries. (information)

- In your opinion how do you contribute to the development of clean and monitoring technology? How are you affected by it?
Objective: To understand refineries participation in the development and implementation of technology (clean and monitoring technology).

3.0 - Strategic Elements and Interactions

Biophysical environment
Stakeholders
Government
Other Organizations (linked to the flow of petroleum)
Technology
Economic Issues

APPENDIX 3

List of Corporate Literature

Publication (Year) / Organization	Annual Report (1)	Environmental Report (2)	Environmental Policy (3)
British Petroleum	1994	1994a {3}	1993 [1980]*
Chevron	1994	1990 {1}	1992 [1970]**
Conoco	1994	1994a {1}	1993 [1968]***
Elf	1994	-	-
Exxon	1994	1990 {1}	1990 [1971]**
Mobil	1994	1994a {5}	1993 [1956]**
Petrobrás	1994	-	1989 [1989]
Petrofina	1994	1995 {1}	1991 [1991]
Phillips Petroleum	1994	1993 {1}	1993 [1972]**
Shell	1994	*1992 {1}*	*1991 [1969]***
Texaco	1994	1994a {3}(**)	1989 [1982]**
Total	1994	-	1992 [1992]

(1) - Financial year 1993;
(2) - reports available in 1994, except Petrofina; (**) Texaco's report is published biannually;
(3) - year of publication or last revision available in 1994;
{ } - report number;
[ ] - publication of first environmental policy;

TABLE A-3: LIST OF CORPORATE LITERATURE USED IN THE STUDY. Corporate Annual Reports refer to the financial year 1993. Environmental Reports include the reports provided by organizations in 1994, except Elf, Petrobrás, Petrofina and Total. Petrofina published its first report with reference to year 1994 in 1995. Petrobrás was not planning to publish an environmental report in the foreseeable future as by Dec 1995 (end of fieldwork). Elf and Total did not publish an environmental report by Dec 1996. Environmental policies refer to the year of publication or the latest revision available in 1994. Elf did not publish an environmental policy by Dec 1996. (Source:* BP-personal communication, 1997; ** Longsdon,1985; *** provided in the environmental policy)

APPENDIX 4

ENERGY AS AN INTERMEDIARY BETWEEN THE HUMAN SYSTEM AND THE ECOLOGICAL SYSTEM

A4.1 - Energy

Energy is probably the best workable intermediary between ecological, social and economic demands (Odum and Odum,1981) for the following reasons: energy is essential for all the subsystems part of the ecological system but it is only in the human system that it is a commodity which can be bought and sold (Simmons,1981); it is essential for the development and growth of the human system (Odum and Odum,1981) it has great influence and changed the way humans interact with the biophysical environment (Schumacher,1985). Deevey (1971) and Commoner (1971) have suggested that the use of energy is one of the main causes of environmental pathologies.

The utilization of energy by the human system has changed over the years. At first energy requirement was only from solar energy through food and natural climate requirements but with the human expansion of knowledge and social behaviour the consumption of energy has changed both in quality and quantity used (Cook,1975). The human system has been transformed in an "energy intensive society" (Cook,1971).

The different sources of energy presently available to be used by the humans are depicted in figure A4.1. However, the use of these energy sources depends on: knowledge to convert the energy available into heat and work (Miller,1980); the energetic quality of the source (Simmons,1981); the availability of the source (Mather and Chapman,1995); the economic relevance of the energy source (Eden et al.,1981); and the development of energy policies (Cook and Suny,1977).

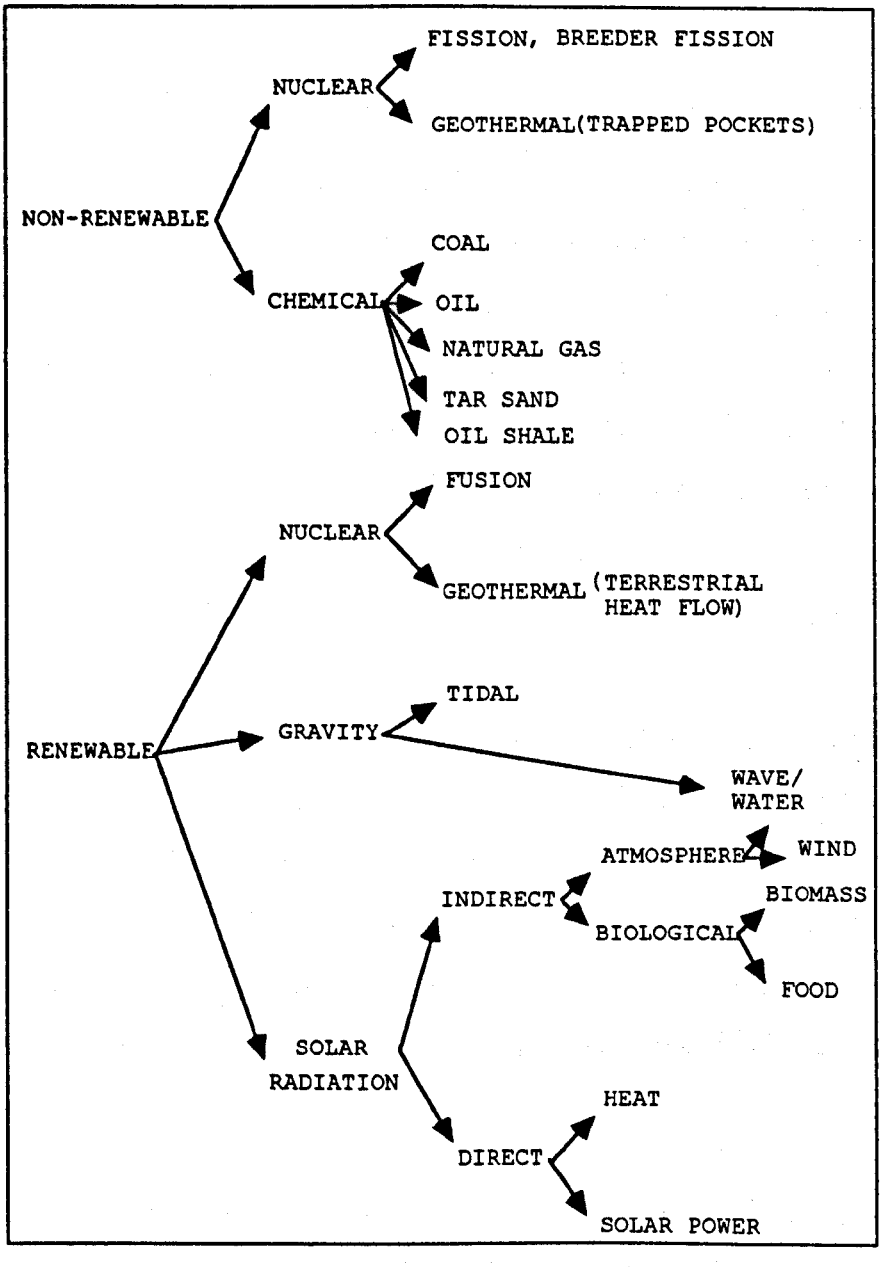

FIGURE A4.1:- The Different Primary Energy Sources. These energy sources have been classified according to their physical limits. Fusion can also be classified as non-renewable (Source: Miller, 1980, Mather and Chapman,1995).

Energy is an essential element in national power and economies or countries, world economics, a critical point for wars and conflict and crucial in international affairs (Yergin,1991). Although there is a strong link between the sources and quantity of energy used by a country and its stage of economic development (Holdren,1990; WEC,1993) Simmons (1981) has suggested that the main issues in the development

and implementation of energy policies are not economic or even technological but ethical and social.

The average consumption of energy world-wide is still increasing (ETSU,1994), however, the energy demand is considered to be stable in developed countries with the growth in demand ranging from 1 to 2% per year of the world demand of energy while in developing and emergent market economy countries the increase is much higher (BP,1995). The variation in the demand of energy and the use of different sources of energy between countries depends on variables such as: a country's energy policy; economic development; population growth; geographic and climatic factors (ETSU,1994; Yergin,1991).

At present, it is estimated that almost 80% of the world's consumption of primary energy derives from non-renewable energy sources (WEC,1993). Economic growth is in fact associated with the increased demand of coal, petroleum and natural gas (Mather and Chapman, 1995) where petroleum is the most widely used (BP,1995). For example a comparison between the world's energy use by source, with the energy use of a developed country and an emergent market economy is illustrated in table A4.1.

The intensive production, processing and use of any of the different sources of energy can cause stress and possible shocks on the ecological system (Miller,1980). Although energy is used for electricity, households and services, industry and transport, there is some evidence that different users of energy still do not associate the use of energy sources with the possible ecological consequences (Kempton,1992) and in the use of energy the "common's dilemma" is observed, where individual decisions can conflict with the collective goal of ecological quality demands; for instance individual choices on transportation.

However, the human system's dependence and extensive consumption of fossil fuels is increasing the ecological concerns on the long term consequences of fossil fuels use upon the ecological system (Flavin,1988).

SOURCE/PLACE	WORLD (WEC,1993) %	BRAZIL (MME,1994) %	UK (DTI,1994) %
Oil	31,8	32,0	35,7
Coal	26,1	5,4	23,9
Natural Gas	19,3	2,5	29,7***
Nuclear	4,5	-	9,8****
Hydro	5,7	34,9	0,2
Traditional	10,3**	13,3*	-
New Renewable	2,3	1,3	-
Alcohol	-	10,6	-
Others	-	-	0,7
TOTAL	**100,0**	**100,0**	**100,0**

* - Alcohol not included; ** - all biomass energy sources
*** - Includes renewable sources; **** - includes colliery smelters, landfill gas and sewage gas

TABLE A4.1: Distribution of Energy Sources Use. The use of different sources of energy varies among countries. The consumption of fossil fuels is greater in the UK than in Brazil. (Source: WEC,1993; MME.1994; DTI,1994a). The UK is a developed country and Brazil an emergent economy. This allows for a comparison of ecological demands in two different economic conditions.

For example some of the concerns associated with the use of fossil fuels are (Miller,1980): fossil fuels are non-renewable and limited; the unlimited approach applied to the use of natural resources has contributed to little conservation and limited use of alternative sources; high net energy yields at relatively low cost has contributed to the increased demand since the 1950's; and fossil fuels prices have been kept at artificially low levels not including ecological, health and social costs, stimulating higher use and waste.

At present there is a great and growing demand for governments to adopt policies that are consistent not only with the countries' economic development but also with the sustainability proposals of balancing economic, social and ecological demands (WCED,1987). Geographical and political issues, the biophysical environment, social and political pressures are pushing towards a more balanced use of different energy sources that will certainly affect most governments and energy organizations (Flavin and Lessen,1991).

A4.2 - Petroleum

Petroleum is a relevant source of primary energy for the human system with recognized importance for countries' economic development. The consequences of its use upon the ecological system range from the local to global level and the ecological concerns on the use of petroleum is the increasing of ecological pressures affecting organizations within the oil industry.

Petroleum, known as crude oil, is a chemical source of energy, which can be found in sedimentary basins that normally contain saline waters, natural gas and oil. It is a complex mixture of gas, liquids and solids. The main components of petroleum are hydrocarbons and impurities, such as sulfur, nitrogen, chlorine and traces of vanadium, nickel, chrome, lead and arsenic (Miller,1980). This mixture is further processed or "broken up" into usable products. Depending on the petroleum's physical and chemical characteristics, the refining technology required to process it and the economic value of the crude oil can vary.

The petroleum industry activities interact among themselves and can be divided into upstream activities that involve exploration and production and downstream activities involving refining, transporting and marketing.

A4.2.1 - The Use of Petroleum

Despite previous uses of fossil fuels, it was only in the late 18th century that petroleum was discovered and began to be considered as a commodity that was processed and its products used commercially.

The first use of a petroleum product was kerosene for lighting and with further technological developments, for instance, the internal combustion engine, petrol started to be used as fuel. Petrol was previously considered a by-product that was mainly discharged.

It was only after the 2nd World War that the use of petroleum products increased substantially in world-wide demand not only as a transport fuel, and source of domestic and illuminant energy, but also as raw materials in the manufacturing of most of the industrial chemicals, such as: fertilizers, pesticides, plastics, synthetic fabrics, medicine and other products (Miller,1980; Yergin,1991).

Although there is a dependence of oil importing countries on oil exporting countries the oil market involves a complex combination of political and economic issues that are very linked to the historical control power associated with the industry (Yergin,1991). These issues and the geographical and physical limits have influence in the oil price's definition.

From 1900 until 1970 the price of oil was very stable; however, after the 1970's it is characterized by fluctuations (BP,1995). The production and price of oil seems to vary depending on the economic interest of producing countries and major oil organizations (Yergin, 1991). The producing countries own the natural resource and the major oil organizations want to achieve their business goal of long term survival. There seems to be a "balance" between production rate and price (Rosa, 1994).

Petroleum represents almost 40% of the total world primary energy demand (BP,1995). The market for petroleum is still growing, but at a lower rate than expected (BP,1995). This increases the competition among oil organizations. The use of petroleum has created an interdependent technological network. Therefore, the high dependence of most countries in oil, makes oil price fluctuations affect the whole economic process, having serious social and economic consequences.

Although the implementation or change of countries' energy policies depends on a complexity of ethical and political issues (Schmidheiny,1992) the definition of a sustainable energy matrix, using alternative sources of energy and energy conservation can, however, be options adopted by countries. The adoption of such options can be conflicting with oil producing countries and oil organizations' economic interests.

In summary, petroleum is a commodity internationally intertwined with national strategies, global politics and power (Yergin,1991) and because of its intensive use, it is also a threat to a possible environmental crisis (Commoner,1972; Metcalf,1977).

A4.3 - The Petroleum Industry and the Biophysical Environment

The oil industry uses the biophysical environment as a source of raw material, petroleum, and as a sink to the wastes generated during all the activities involved in petroleum's exploration, processing and distribution. The biophysical environment is also a sink to the wastes generated after the use of petroleum products. In both cases, as a source or as a sink, the use of the biophysical environment has ecological implications.

Petroleum is a limited or non-renewable natural resource. The intensive use of petroleum can lead to petroleum scarcity, however, a clear definition of oil reserves capacity is controversial. In 1992 it was estimated that the world oil reserves

contained around $1x10^9$ barrels of oil with a world annual production of $23.7x10^6$ barrels. This results in an average of 43 years of production (BP,1995; Petrobrás,1995g), however, the capacity of oil reserves vary.

Among the 50 largest oil reserves, that represent 86% of the total world reserves and 65% of the world's production, the average production is estimated to last 56 years at their 1992 production rate. Within these large oil reserves 81% represent state owned reserves and can last an average of 74 years, and 5% privately owned reserves that can last for an average of 11 years (Petrobrás,1995g).

If the level of consumption is kept the same as 1992 the smaller reserves will be used up, so the other reserves will have to increase their production in order to maintain the production rate. Otherwise further technology developments will have to provide for the discovery of new commercially potential reserves and improve the use of the present ones.

Although the biophysical environment does not depend on petroleum, presently the human system depends on it as a major source of energy. The geographical location of oil reserves and both state or privately owned oil reserves' limits can give rise to great vulnerability for the human system.

Consequently the physical limits of this natural resource can introduce several changes and conflicts within the human system reinforcing and demonstrating the interdependence among technological, economic, political and social forces within the human system with the ecological system.

The use of the biophysical environment as a sink of the wastes generated from both the oil industry activities, upstream and downstream, and final products use can affect other living systems within the ecological system, and also the naturally occurring ecological system purification process.

The environmental problems associated with the oil industry are mainly: safety and health hazards, water pollution, maritime pollution, land use, contamination and siting impact, solid waste disposal, hazardous air pollutants, noise, visual, thermal, acid deposition, stratospheric ozone depletion and global climate change (Miller,1980).

For the ecological system as a whole the changes introduced will eventually result in a new ecological equilibrium. Any living system within the ecological system including the human system is affected by ecological degradation. Each one of the oil industry activities' environmental, safety and health issues can, therefore, influence and give rise to ecological concerns within the human system.

Some of the environmental impacts caused by the oil industry activities and products use are easily noticed and require immediate action from oil organizations, especially at local level, or as a result of an accident with ecological consequences. The hidden and unnoticed cumulative environmental effects over time, that are not widely known and not easily detected, are open to debate over the long term consequences of them upon the ecological system.

The ecological impacts upon the ecological system are introducing constraints and possible long-term survival threats to the human system. The extent of the constraints on the human system, as a consequence of ecological degradation, is yet not fully understood and requires advances in scientific knowledge and monitoring technology.

The same way the physical limit of petroleum introduces changes within the human system, the consequence of environmental degradation are also observed in the changes introduced in the social, political, economic, technological and ecological forces, that constitute the social environment of the human system. These changes affect the whole of the human system.

Although the external ecological pressures can affect all the activities within the oil

industry, from well to petrol pump and final products use, the refining activity seems to be the activity under more pressure as most of the above ecological pressures can affect it.

A4.4 - The Refining Activity

The main objective of oil refining is to convert petroleum into intermediates for the petrochemical industry and useful products such as: gasoline, gasoil, fuel oil and kerosene. The refining process can be very complex and involves different processing stages.

A4.4.1 - The Refining Process

Crude oil is initially heated and "desalted" to separate impurities. Then the desalted crude oil goes through distillation, conversion processes, extraction processes and special treatments. All the stages involve the use of intense heat and pressure. Each refinery, however, can to some extent, decide the processes to be used according to the final products desired.

The distillation is a physical separation of the crude oil into various fractions that will be further processed to final products. The type of petroleum determined the amount of each fraction and the composition of the residue produced. After the distillation the oil fractions go through conversion processes where a chemical change in hydrocarbon composition takes place or go through extraction processes where separation of the required hydrocarbons takes place. Finally, before the products are ready to be used and marketed, they are treated in order to remove unwanted impurities.

The whole of the refining activity causes impacts on the biophysical environment. The extent of these impacts can vary from the local level , such as photochemical smog

and water contamination, to the global level, such as global warming. Some of the main releases, wastes, possible contamination and impacts associated with the refining activity, and its products are depicted in table A4.2.

REFINING ACTIVITY	Air	SO_X, CO, CO_2, NO_X, VOC, H_2S, Particulate, mercaptans;
	Water	oil, phenols, ammonia, cyanide, chlorides, sulfide, nitrogen phosphates oil spills, leaks of storage tanks, chemicals from cooling water system, diethanol amine, spent naphthenic caustics, suspended and dissolved solids, trace of metals, contaminated tank water, desalter water, storm water runoff;
	Land	catalysts (FCC and others), tank sludge, wastewater treatment sludge, oil spills, leaks of storage tanks, other wastes, heavy metals, coke fines, sludge from heat exchanger tube bundle cleaning, cooling tower treatment sludge, API separator sludge, DAF unit sludge, slop oil emulsion solids, miscellaneous wastes;
	Others	water requirements, smell, noise, thermal pollution, risk of fire or explosion, black smoke, flaring, ugliness, loss of amenity, use of wilderness areas, potential health and safety impacts;
PRODUCT	Air, water, land and others	Benzene, CO_2, VOC, SO_X, NO_X, particulate, leaks of storage tanks, possible spills, disposal of used products, potential health and safety impacts

TABLE A4.2 - The Main Environmental Impacts of Oil Refineries. Oil refineries' activities and products have chemical and physical impacts on air, water and soil (Chandler,1973; Hetcoat,1990; Amoco,1993; Miller,1980)

A4.4.2 - The Ecological Demands on Oil Refineries

Presently, the ecological demands upon the refining activity include (ETSU,1994): pressure for cleaner products and increased scrutiny of the refineries' environmental performance. These demands are linked to local but mainly to the global effects of the use of petroleum upon the biophysical environment.