A General Evolutionary Methodology for Sustainable Development

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(ABSTRACT)

In order to determine the dynamic factors inducing the evolution of environmental management strategies in the context of sustainable development, I draw upon theory from the field of general evolutionary sciences (including chaos theory, complexity science, and nonlinear thermodynamics). I translate this emerging theoretical worldview to a *general evolutionary methodology* for the analysis of sustainable development strategies. Application of the methodology to selected case studies indicates that sustainable development strategies *co-evolve* in response to organizational values, technology, and organizational structure inside the firm, and to the *environmental management field* outside the firm. Competing notions of sustainable development influence the politicization process that limits the types of sustainable development strategies chosen and implemented. The evidence also indicates that new pathways of efficiency are emerging in sustainable development based on market driven strategies, institutional partnerships, and the formation of new industries.

The dissertation is based on case study analysis of three sustainable development projects of three different environmental organizations, the International Institute for Energy Conservation, the Environmental Law Institute, and Sanders International. The results have implications for sustainable development theory and practical implications for policy analysts and sustainable development advocates, as well as for a subtler and deeper personal understanding of our place in the world.

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CHAPTER 1

Introduction

The challenge of sustainable development is commonly being interpreted as a need for better knowledge and more control, in short, as a challenge to complete the modern agenda.

Richard B. Norgaard 1994:12

1.1 Introduction

The global initiative, sustainable development, as articulated by the World Commission on Environment and Development and adopted at the 1992 Earth Summit, signals an important response by the global community to reverse current trends of environmental degradation.[1] The concept of sustainable development with its concern for the ecosystem's health, social justice, and ideals of responsibility to future generations, offers hope to the modern environment gone awry. Its wide appeal has attracted a diverse range of advocates. As Serageldin (1994) of the World Bank argues, "without better environmental stewardship, development will be undermined; and without accelerated development in poor countries, environmental policies will fail."

However, for many, sustainable development is not practical, given the current cultural patterns of material and energy consumption in the North, (where one quarter of the people consume three quarters of the world's resources), and the

[1] I will not elaborate on the magnitude of current environmental degradation. The qualitative and quantitative transformation of global environmental changes such as ozone depletion, global warming, loss of biodiversity, deforestation, soil erosion, desertification, water and air pollution are well documented in reports such as the State of the World issued yearly by the World Watch Institute. I assume a priori that a global ecological crisis is well underway.

enormous population growth in the South. It is expected that the 6 billion mark of the world's population will soon be passed, only ten years after we passed the 5 billion mark (Harrison 1992). Limitations of existing institutional environmental management policies and practices further the problem. Lele (1991) points out that the current conception of sustainable development contains some significant problems, which include "incomplete perception of poverty and environmental degradation, and confusion about the role of economic growth and about the concepts of sustainability and participation."

There has been a lack of a clear distinction between the objectives of sustainability, such as the integration of environment and economics in decision making, equitable distribution of resources, quantitative and qualitative growth, and the means for carrying out the objectives. Another source of the problems frequently articulated by the sustainable development researchers is the avoidance of addressing deeper socio-political changes or cultural values that are needed to change current resource consumption patterns. Even though the member states of the international community, UN agencies, the World Bank, governmental institutions, non-governmental organizations, and community groups are adopting sustainable development plans and strategies they are doing so without clear theoretical rigor (Clayton and Radcliffe 1996). As Norgaard (1994:23) argues, "as conventionally understood, sustainable development contests our competence to predict the consequences of our interactions with nature and taxes our capability to control those interruptions so that the old idea of development remains intact yet is sustainable."

In this dissertation, I will argue that the challenge for sustainable development researchers is to *reconstruct* the way the sustainable development problematique is perceived, defined and 'solved', by moving from a static systems perspective to a complex adaptive systems perspective. As Clayton and Radcliffe (1996) argue, "this change must be away from a *closed systems* perspective, in which there are simple definitions, fixed concepts and ultimate solutions, to an *open systems* perspective, in which both problems and solutions are multi-dimensional, dynamic and evolving."

The new science perspective on the general theory of evolution creates a root metaphor for sustainable development and provides a new perspective on the environment-development dynamic. A new framework of thinking for the evolution of large scale systems, such as ecosystems, that synthesizes concrete observation with nonreductionistic ideas, is currently being provided in the study of ecosystems science from the point of view of entropy, emergence, and information (Goerner 1994; Pattee 1982; Swenson 1989; Ulanowicz 1986). Studies that have employed new science concepts to understand sustainable development issues include those of Clayton and Radcliffe (1996), Norgaard (1994), and Uphoff (1996). These studies provide diverse applications of new science concepts to the field of

sustainable development. Few researchers, however, have translated the emerging scientific paradigm to a methodological focus for the analysis of sustainable development case studies. This study aims to fill this gap by developing a general evolutionary methodology for the analysis of sustainable development strategies.

1.2 The Significance of the Study

The purpose of the study is to develop a nonlinear methodology aimed at understanding the emerging sustainable development strategies that could facilitate a transformations of the organizational and institutional systems towards sustainability. This study examines the factors influencing project design, such as personal and organizational values, technology and organizational structure and the project's interaction with the larger institutional field - paradigms of environmental management in development. The study involves the analysis of actors, context, and organizational strategies in cutting edge sustainable development design, as well as the political process influencing the implementation of sustainable development strategies. The research is integrative and interdisciplinary in character drawing upon the dynamic interactions and interdependencies between industrial production and development of environmentally sound markets, eco-technologies, institutional linkages, and environmental impacts.

From a theoretical and methodological point of view, sustainable development strategies represent a class of environmental management strategies which are emergent and evolving. In the context of environment-development dynamics emergent responses that occur as a result of environmental limits are inherently unpredictable (Faber and Proops 1990). Formal modeling, quantitative analysis, as well as mathematical simulations, are strained to the limits when dealing with emergent systems. How are we to analyze a system which in essence cannot be explained mechanistically or functionally due to the emergent property of the system?

This study is based on the premise that sustainable development strategies can be better understood from a general evolutionary perspective. As Uphoff (1996) succinctly argues,

> "There are now other ways to understand the universe which do not posit mechanistic, deterministic causation. There is a valid *post-Newtonian* view of the world that is shaped more by concern with *energization* than with equilibrium, and oriented more toward *evolution* than toward entropy. It frames relationships in terms of *open systems* rather than just closed systems or collapsing ones. It is interested more in promoting *positive-sum* dynamics

than evaluating zero-sum alternatives or, worse still, being fixated on negative-sum outcomes."

The new science perspective provides not only conceptual understanding but also new tools to deal with complex adaptive systems that parallel the design process. [2] The design process in this study is conceived as a creative process which aids in the emergence of appropriate metaphors, patterns and models for sustainable development planning. The logic underlying this premise is that a general evolutionary paradigm can provide insights that embrace personal values and cultural factors as well as interdependent dynamics, emergence, and qualitative change in order to advance scholarly activities in the field of sustainable development.

What I am attempting to *explore* in this dissertation are new types of insights that can be gained from a general evolutionary methodology. This understanding is developed by identifying three major conceptual elements that comprise the general evolutionary paradigm - nonlinear interdependence, self-organization, and qualitative evolution. I have also identified three methodological components based on the three major conceptual elements - structural, process and transformational components for the analysis of case studies. My intent is not to *evaluate* current sustainable development strategies based on generalizations from the general evolutionary paradigm. This dissertation provides an abstract model of the co-evolutionary dynamic between sustainable development strategies and the environmental management field.

1.3 Organization of the Dissertation

The dissertation is comprised of seven chapters. The study is divided broadly into four major sections. The first section, comprising of chapters 1 and 2, initiates the reconstruction of sustainable development from the general evolutionary perspective. Analysis of current issues, problems, various schools of thought and differing paradigms on environment development interaction, and epistemological challenges to sustainable development are discussed.

The second section, comprised of chapters 3 and 4, discusses the development of the postmodern methodological approach for analyzing sustainable development strategies and the research methods used. The general evolutionary methodology

[2] Robert Dyck (1994) states, "there is an important role for design in the scientific analysis, as a necessary means of accommodating the meaning of knowledge in the context of co-evolutionary values, social organization, technology, and the environment." He further states that "design is here generically conceptualized as a process, more than a product, which makes it possible for synergistic compromises to be reached based on use of values and criteria which are informed by 'good practice' and accumulated experience judged to be appropriate to the circumstances."

presented in chapter 3 represents one of the central contributions of this dissertation.

In the third section, comprised of chapters 4 and 5, my research findings are presented. The general evolutionary methodology is applied to three major sustainable development strategies from three environmentally based organizations, the International Institute for Energy Conservation (IIEC), the Environmental Law Institute (ELI), and Sanders International. This analysis presents the co-evolution of organizational strategies and the sustainable development field.

Finally, in the last section, chapter 5, I provide a summary of the research findings, and discuss their theoretical and practical implications as well as needs for further research. A detailed description of each chapter is provided below.

Chapter 2: Reconstructing Sustainable Development. In this chapter I will first deconstruct the epistemological and philosophical foundations of two broad paradigms of thought, the material and the ecological. In the second section of the chapter, I describe the implications of general evolutionary sciences such as chaos theory, self-organization theory, and complexity science for reconstructing sustainable development. In addition to providing a survey of the literature on sustainable development, I have attempted to address epistemological challenges associated with reframing sustainable development issues.

Chapter 3: Development of A General Evolutionary Methodology as a Framework for Analysis. The introduction of a postmodern epistemology for sustainable development necessitates the development of a methodology for data organization and analysis of sustainable development strategies. In my effort to develop a general evolutionary methodology, I relied heavily on three major works by Goerner (1994), Norgaard (1994) and Wilber (1995), which describe the emerging general evolutionary world view from three different disciplinary perspectives. From a theoretical point of view, I saw a close relationship between Goerner's "evolving ecological universe," Norgaard's notion of "co-evolution," and Wilber's "patterns of existence," all current postmodern evolutionary perspectives.

In the process of weaving a theoretical tapestry, a thinking process emerged which emphasized complex causation, emergence, and a process of change, which Goerner calls *ecological thinking*. The parallel process of theoretical synthesis and ecological thinking led me to identify three broad methodological components for the analysis of sustainable development strategies - structural, process, and transformational components each corresponding to the three major conceptual elements: nonlinear interdependence, self-organization, and qualitative evolution. Nonlinear interdependence represents the structural dimension, self-organization represents

the process dimension, and qualitative evolution represents the transformational dimension. This chapter describes these elements in detail.

Chapter 4: Research Design and Method. In this chapter, I present the type of research strategy chosen, the choice of organizations for study, the process of data collection, and the method of analysis. A qualitative method and case study research were employed to describe the emerging trends and approaches of sustainable development strategies from three different environmental organizations. The primary data was collected through in-depth, semi-structured, in-person interviews with project directors. Other data sources include institutional documentation such as project proposals, internal evaluations, progress reports, newsletters and internal memos. The method of data analysis includes descriptive and contextual analysis.

Chapter 5: Descriptive analysis of the Selected Case Studies. In this chapter, I provide a descriptive analysis of the various ways that sustainable development projects are currently being implemented in practice. It provides the first step in the application of a general evolutionary methodology to selected case studies - a description of system characteristics. This chapter examines cutting edge sustainable development strategies in three different organizational settings. It addresses three major questions, "who," "what," and "how," each question corresponding to three major system characteristics of each project - the actors, the context, and the organizational strategies.

Chapter 6: Application of the General Evolutionary Methodology for Contextual Analysis of the Selected Case Studies. In this chapter I provide a contextual analysis of current sustainable development strategies. It provides an empirical analysis of the case studies in the context of general evolutionary concepts. The overall product is an abstract model of the co-evolutionary relationship between sustainable development strategies and the overall environmental management field and the pathways of efficiency within current environmental organizations.

Chapter 7: Summary and Conclusions. This concluding chapter provides the major findings of the research and provides an account of the co-evolution of sustainable development fields outside the organizational context, and strategies inside the organization that go beyond the reductionistic and holistic account of sustainable development. The findings call to attention the relationship between local projects and macro environmental management fields. These findings have some important considerations for sustainable development theory, policy makers, and sustainable development advocates. Finally, I conclude with some deeper considerations that the general evolutionary perspective provides in terms of the understanding of our place in the world and opportunities for future research.

CHAPTER 2

Reconstructing the Concept of Sustainable Development

The real challenge of sustainability is to reframe the challenge.
Richard Norgaard 1994:23

2.1 Introduction

The seminal argument that I make in this dissertation is that an appropriate systems design for sustainable development requires a *conceptual shift* from a static world view to a complex adaptive systems perspective. The conventional point of view on sustainability and environmental management practices has assumed that we have the ability to perceive and control emerging systems. On the contrary, the concept and practice of sustainable development challenges the Newtonian emphasis on prediction and control, and modernism's inherent faith in infinite material growth. In this chapter, I will initiate the reconstruction of sustainable development and the environment-development debate from a general evolutionary perspective. [3] I will address the *epistemological* challenges associated

[3] Various terms could equally apply here such as the nonlinear paradigm or the new sciences which would include chaos theory, the sciences of complexity, dynamical systems, far-from-equilibrium systems, modern nonlinear dynamics and self-organization theory. The term general evolutionary perspective describes a broad cultural and scientific shift taking place currently in the West. See Goerner (1994) for a detailed exploration of the shift in worldview.

in the reconstruction of sustainable development. This will set the stage for the next chapter which will present the methodological elements for analyzing environmental case studies. This is a pioneering attempt at initiating the reconstruction of sustainable development. Rather than just a survey of the burgeoning literature on sustainable development, I have attempted to reframe the challenge by integrating environment-development issues within the context of a general evolutionary perspective. This chapter represents the first part in that process.

The purpose of this chapter is twofold: First, I will deconstruct the epistemological and philosophical foundations of two broad paradigms of thought, the material and ecological, in order to stress the limitation of current paradigms for understanding sustainable development issues. Second, I will describe the potential implications of the New Sciences, such as Chaos Theory, Self-Organization Theory, and Complexity Science to reconcile different schools of philosophical thought in the environment-development debate.

The emphasis on complex process and complex structures rather than prediction and control leads to new challenges for designing sustainable systems. Design, through the means of transdisciplinary analysis, is conceived here as a creative process which aids in the emergence of appropriate metaphors and models for the development of sophisticated environmental planning and policies. In the second section of this chapter, an alternative view of sustainability based on the emerging "New Science" paradigm is presented. Finally, I will present some possible implications for integrated environmental design and planning.

2.2 Sustainable Development

In response to current global ecological concerns, the concept of sustainable development has been put forth as a viable alternative to economic development that incorporates current and future global environmental concerns. This concept gained popular momentum with the report by the United Nation's World Commission on Environment and Development (WCED) entitled "Our Common Future" and has achieved even greater attention since the United Nations Conference on Environment and Development (UNCED), now known as the Earth Summit, held in Rio De Janeiro, Brazil, in 1992. The WCED defines sustainable development as "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). There is growing consensus that if future development is to succeed, it must incorporate both economic and environmental objectives because they are both interdependent and mutually reinforcing (Colby 1989; Reid 1995; Slocombe 1993). However, although the concept has grown in popularity, there has been growing concern that sustainable development lacks conceptual clarity and current

development efforts at the project level suggest a general failure in the implementation of the concept (Lele 1991; Reid 1995)[4].

Part of the reason has been that the concept of sustainable development has meant something different for everyone (Lele 1991; Batie 1989; Norgaard 1994). From a theoretical perspective, it has not yet fully developed into a coherent conceptual framework. From a practical perspective, a wide range of nongovernmental and governmental organizations have embraced the concept. However, as Norgaard (1994) points out, "sustainable development has eluded numerous attempts to give comprehensive, operational definitions" (p.13).

There has been a deeper underlying confusion that different paradigms and various schools of thought have interpreted the concept differently (Batie 1989). Two major paradigms which underlay debate about development and environment can be labeled as “material” and “ecological” paradigms. Their corresponding economic schools of thought are neoclassical economics and ecological economics. The core epistemological and philosophical foundation of these two paradigms and their corresponding economic schools of thought will now be examined.

2.3 Philosophical Foundation of Sustainable Development

2.3.1 The Material Paradigm

Material well-being has always been a very important element of economic development. Development is currently synonymous with material growth and not necessarily with human development pertaining to values, culture, or consciousness (Ornstein and Ehrlich 1989). Sustained economic growth is thought to provide not only a rising standard of living but also peace, equality, and justice. The vision of infinite technological progress and unlimited economic growth as the paradigm for the development of the society has been an approach that has prevailed in the industrialized countries for most of their histories. This paradigm has a benevolent view about the role of technology in increasing the standard of living. In short, the material paradigm has been the modus operandi of Western

[4] The terms sustainable development and sustainability are used interchangeably in the literature. This has lead to some confusion around the concept. Sustainable development refers to the process of development in a sustainable way, integrating economic, social, and ecological objectives. It also connotes the goals and objectives that process will achieve. Sustainability, on the other hand, refers to the state of use in the elements of sustainable development such as economic sustainability or environmental sustainability. Reid (1995) provides broad and comprehensive introduction into the study of sustainable development.

societies since the Age of Enlightenment and more recently in other societies also (Atkinson 1991; Eckersley 1992). The faith in this process has been obvious, given the impressive achievements of modern societies, yet the material paradigm also poses some basic contradictions. Rising standards of living created from economic growth have cured many diseases and have provided many technological breakthroughs, yet the material mode of operation has also increased inequality and depleted natural resources (Botkin 1990; Norgaard 1994).

In this paradigm, there is an inherent faith in infinite material progress aided by technology and information. According to this world view, the relationship between economic growth and the environment is not explicitly drawn out, because natural resources are seen as infinite. With the advent of scarcity of resources, technology and information are thought to facilitate the discovery of new resources, with the market systems adjusting so that optimal use of the resources is ensured. The material paradigm is based on a highly anthropocentric view, where nature is seen as existing for man's instrumental benefit, to be exploited to improve the material quality of human life. Economic growth and the standard of living are driven by one major criteria, efficiency. These attitudes, which are central features of the current industrial culture as a whole, reflect the dominance of material values over ecological values, and are the underlying cause of natural resource degradation. As an elaboration of how the material paradigm has contributed to the degradation of the natural resources, I will examine the predominant school of economic thought reflecting this paradigm, neoclassical economics. Later, I will contrast the neoclassical economic perspective with the emerging discipline of ecological economics.

The Foundation of Neoclassical Economics. The fundamental assumption in neoclassical economics is that substitutions between resources (natural versus man-made capital) are always possible, and therefore relative scarcity only exists between resources whose primary value is the productive input into the economic process. Its ideological foundation is expressed in modern price theory. This view, which dates back to Adam Smith, emphasizes the free pursuit of an individual's self-interest, which leads to an optimal allocation of resources and maximizes social welfare. The operating assumption in the neoclassical economic school is the belief in the power of competitive forces to create appropriate substitution between resources (Underwood and King 1989).

It is assumed that relative price changes provide appropriate signals to guide optimal resource allocation. The price incorporates a set of economic values that are assumed to be consistent, knowable, and "right." Scarce resources are allocated by a rational response to changes in preferences, reflected by the relative price movements in an environment of unregulated and competitive market systems. The economic behavior of a rational individual is such that, within the market economic system, the pursuit of self-interest generates a set of relative price

movements sufficient to produce a pareto optimal or efficient pattern of resource allocation.

The degradation of soil resources, for example, signals the price of agricultural commodities to eventually rise because of the decrease in crop yields and increase in input costs such as fertilizers. A rise in prices, which leads to a reduction in the demand for agricultural commodities, stimulates the farmers to adopt soil conserving techniques, such as minimum tillage or utilizing cover crops, to increase agricultural yield. The "invisible hand" thus secures the sustainability of both soil resources and the economic system.

Natural resource degradation is viewed as a process external to the market trading process. In neoclassical economics, the market is assumed to generate a set of relative price movements to internalize these externalities given clear property rights for the resource in question. Given "perfect" market conditions, which implies perfect information and that no one producer can affect prices, individuals are assumed to have the necessary capabilities to create new institutions so that gains from trade are possible. The level of social welfare is raised by internalizing social costs in production and consumption activities. The policy implications are thus to define property rights and channel resources to induce resource conserving technological innovations.

In this perspective, market distortions such as agricultural credit and tax and subsidy policies create price distortions that do not reflect natural resource scarcity, therefore hindering the incentive of the resource users to utilize available conservation methods. Policies that fail to supply the needed finances, or that artificially increase or decrease the profitability of resource intensive activities, can result in increased natural resource degradation. Repetto (1989), for example, points out that in the context of soil erosion, policies which favor urban consumers through food subsidies depress agricultural profitability through food price distortions. Such distortions reduce the demand for farmland, labor, and other inputs in agriculture. In general, depressed agricultural prices lower the farmers' incentives to practice soil conservation.

Market failure, on the other hand, is distinctively different from market distortion. Market distortion refers to internal distortion in the value of a particular natural resource, whereas market failure refers to external distortion in the value of a resource which lies outside the market process. Market failure is due to external effects of an economic activity which cannot be internalized by individual decision makers and leads to reductions in social welfare. Pearce and Turner (1990) state that externalities or external costs are created when the following conditions prevail: 1) an economic activity by one agent causes a loss of welfare to another individual and 2) the loss of welfare is uncompensated. In the case of soil erosion, external costs are created because agricultural activities create erosion which causes external effects of

production such as flooding, loss of storage capacity of dams, and loss of navigability of waterways. The downstream effects of soil erosion are "external" because they are social costs which the farmer does not consider when making production decisions.

The primary research concern in this paradigm of thought is to determine the optimal rate of consumption or depletion of the natural resource in question. The optimal level of natural resource degradation occurs when marginal costs equal the marginal benefits of conservation. Assuming that resource users (e.g. industries, agricultural producers) behave as profit maximizers, the optimal level of production occurs when the sum of private benefits minus the sum of private costs is maximized. Given the assumption that the aim of society is one of maximizing the sum of benefits minus the sum of costs, the optimal level of economic activity for the society occurs when marginal social benefits equal marginal social costs.

When market failure occurs, government intervention is necessary to equate marginal costs of environmental conservation with marginal social benefits. Research is carried out to try to measure these costs and benefits through linear and nonlinear independent dynamic mathematical programming models.[5] When market distortions occur, research is conducted to identify policies that indirectly cause resource depletion and policies which can provide incentives to the resource users. Credit policies, subsidies on inputs to production, pricing policies, and exchange rate policies can all have the effect of depressing the real value of prices. Identifying and removing these barriers represents a primary research concern for neoclassical economists.

The Newtonian world view is dominant in the material paradigm. The market in the neoclassical economic paradigm functions much like the Newtonian pendulum, free from the bondage of time or any biophysical constraints. As Batie (1989: 1094) states, "mechanistic systems, so predominant in neoclassical economics, are suitable for stable predictable systems ... the neoclassical perspective, in general, maintains the assumption of a stable and reversible process." The neoclassical model is mechanistic in the assumption that the economic system can operate in equilibrium at any position along a continuum and move back and forth between positions (Norgaard 1985).

Also, the assumption of reversible process implies the fact that time is neutral; the past and future play identical roles in the neoclassical economic school of thought.

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[5] Both linear and nonlinear independent methods are approachable via calculus-based methods, the dominant tools in neoclassical economics. This set of tools, however, frames the interaction of economic and environmental systems as static, as a set of *independent* variables. As I will elaborate further in Chapter 3, real world systems are *nonlinear interdependent systems*, unapproachable via calculus-based methods. One of the revolutionary points about the science of Chaos is that it provides mathematical tools for dealing with real world systems.

Furthermore, the relationship between man and nature is anthropocentric, that is, nature is seen as existing for man's benefit to be used and exploited for its resources.

The material paradigm, with its emphasis on unlimited growth, technological optimism, and Newtonian mechanics, has come under severe criticism in recent years. As a result, an alternative paradigm, the ecological paradigm, has gained some prominence as an alternative perspective to development (Costanza 1991; Daly 1991; Norgaard 1994; Rees 1995). As we shall see, this paradigm has some important environmental policy implications but requires significant conceptual evolution to deal effectively with the question of sustainable development.

2.3.2 The Ecological Paradigm

The epistemological foundation of the ecological paradigm is the belief that there are limits to which natural resources can be replaced by man-made capital. The main assumption in this paradigm is that there is absolute scarcity and not relative scarcity in the natural environment (Underwood and King 1989; Norgaard 1994; Daly 1987). Absolute scarcity refers to the limits posed by the global environment, such as the limited capacity of the environment to absorb pollution from economic activities as evidenced by global warming and ozone depletion. Biophysical constraints and ecological laws arguably limit economic growth. The cosmological foundation of the biophysical limit to growth is based on the laws of thermodynamics. Biophysical analysts argue that neither basic physical nor ecological laws are reflected in the neoclassical economic models. Therefore, they posit that changes need to be made in how we perceive the economic model itself in order to address current global environmental problems. A predominant school of economic thought reflecting the ecological paradigm is ecological economics.

The Foundation of Ecological Economics. As its name suggests, ecological economics incorporates ecological dimensions in the conventional neoclassical model. The ecological economic view contrasts with the neoclassical economic view. This perspective has been influenced by Georgescu-Roegon (1971), Kenneth Boulding (1966), Herman Daly (1987), Costanza (1991), Pearce (1987), and others. It differs from the neoclassical circular flow model of economic production by incorporating an entropic perspective to production and environment. Entropy is a measure of the amount of energy no longer capable of conversion into ‘work.’ From an entropic perspective, pollution is a form of energy no longer capable of work. Pollution, therefore, is the sum total of all of the available energy in the world that has been transformed into unavailable energy.

Economic production requires a continuous flow of energy and physical resources from the natural environment to drive both the economic production process and the 'circular flow' between households and firms. In the production process, high

quality/low entropy physical resources and energy enter the economic system and then leave the system as low quality/high entropy pollution. The economy is driven by the inputs of high quality/low entropy energy sources such as fossil fuel which return to the ecosystem after having performed their economic function as low-quality/high entropy heat and matter. The open relationship between the environment and economic production, which is nonexistent in the neoclassical economic model, is explicitly incorporated in the ecological economic model.

Ecological economists argue that because economic production requires a continuous flow of energy matter inputs, which are governed by the irreversible entropic process, there are limits to economic growth. Boulding (1966) was one of the first economists to note that the economic process may be limited by the laws of thermodynamics. He argued that the total economic system or the "econosphere" involves inputs of available energy in the form of some energy material input, but this input is by its nature exhaustible in accordance with the second law of thermodynamics. It is argued, therefore, that natural resource use should be minimized. The criteria for measuring the success of the economic system is based not on the total amount of production and consumption but on the nature, extent, and quality of the total natural capital stock.

In recent years, Daly (1991; 1990; 1987) has taken the basics of the laws of thermodynamics to criticize the neoclassical economic model. He argues that the "standard circular flow model" incorporates the first law of thermodynamics but not the second. In the neoclassical economic model, time is reversible, that is, "the circular flow has no beginning and no end, no points of contact with anything outside itself. Therefore, it cannot possibly register the costs of depletion and pollution, nor the irreversible historical effects induced by the entropic nature of the throughput" (Daly 1990:6).

Daly (1987), argues that in the normal economic process, the capacity to rearrange matter is used up by low-entropy energy. The available energy is degraded into unavailable energy; therefore, the market cannot, and does not, function in an entropic vacuum. In reality, the economic process does not act according to the circular flow paradigm; instead there is a one-way, linear entropic flow (throughput) from the environment (depletion), through the economy (production and depreciation), and back to the environment in the form of pollution. The circular flow economic model is therefore inappropriate for modeling sustainable development because of its failure to incorporate this biophysical reality.

The implication of utilizing the laws of thermodynamics as the meta-economic principle is that entropic laws ultimately limit economic growth (Underwood and King 1989). Furthermore, there is the reality of absolute scarcity rather than relative scarcity, or limited substitution rather than unlimited substitution between resources. Due to the entropic nature of the universe, future productive potential of

the biosphere is always less than the present productive potential. Under such biospheric constraints, simple price changes cannot generate a welfare-maximizing resource allocation. Daly (1990) argues further that the market can generate pareto optimality (optimal allocation) but cannot find optimal scale across generations due to entropic laws. Daly (1990:2-3) states that "a boat that tries to carry too much weight will still sink even if that weight is optimally allocated. Allocation is one thing, scale is something else."

Concerning resource depletion, the primary policy implication from this school of thought is to find optimal scale in economic production. The allocation problem has been addressed by neoclassical economics, but the question of optimal scale in production has not. The optimal development path is to limit the scale of economic production so that the production process does not deplete the ability of natural resources to regenerate themselves. The intrinsic value of natural resources would also be recognized independent of their instrumental use or value to human beings. Rather than a strong anthropocentric view, there is a recognition of the interdependence between human activities and the ecosystem. The focus is on conservation rather than depletion. The logical policy implications are: 1) to impose a limit on the scale of global economic process; 2) to induce technological shifts to efficiency-increasing rather than throughput-increasing; 3) to exploit renewable resources on a profit-maximizing sustained yield basis; and 4) to exploit nonrenewable resources at a rate equal to the creation of renewable substitutes occurring outside the economic system but not outside the ecosystem as a whole (Daly 1991).

Questions of population growth, attention to ecological feedback, and valuation of non-market goods are critical to the implementation of sustainability goals in the ecological economic paradigm. The ecological economic approach expands the equilibrium approach of neoclassical economics and expands economic analysis by the inclusion of the ecosystem. The model of the closed economic system is replaced with the biophysical economics model of a thermodynamically constrained economy.

Both neoclassical and ecological economic thought have important policy contributions to make in regards to the environment and development. There has been some question, however, regarding the basic premise of these schools which has contributed to a strong deterministic outlook depending on the assumptions and the epistemological foundations chosen (Norgaard 1994; Daly and Cobb 1989). Regarding ecological economic thought, the appropriateness of the use of the second law of thermodynamics as the sole meta-economic principle has been questioned. One of the crucial implications of utilizing the entropic law as a meta-economic principle for environment and development issues is that entropic determinism was based upon an ideal physical system which is closed or nearly

closed; there was no exchange of energy outside the system. This issue is elaborated further in the next subsection.

The Appropriateness of the Entropic Perspective. From a pure entropic perspective, the concept of sustainable development seems self-contradictory since no system can be sustained on the earth according to the law of entropy. The law of entropy, formulated by Clausius in the nineteenth century, was developed in an isolated system which exchanged neither energy nor matter with the outside world. Entropic determinism was derived from an ideal system which was closed or nearly closed. Von Bertalanffy (1949) makes the following distinction between closed and open systems. An open system is a system that interchanges energy with its outside environment. A closed system is a system that is self-contained and only minimally responds to outside influences. However, no system exists in the real world that is totally closed to outside influences for an indefinite period of time.

The earth is a closed system in relation to the solar system with regard to matter, but it is an open system in relation to energy. The earth exchanges energy with the sun but does not exchange matter with the rest of the solar system. Therefore, the earth is neither totally open nor totally closed. Also, with advancements in space technology, the earth has the potential to exchange matter with the solar system. Therefore, the earth is by no means a completely closed system.

The laws of entropy also may not be directly applicable to analyzing the economic growth process because they apply only to physical systems. Boulding (1966) distinguishes three important classes of inputs and outputs in economic production: matter, energy and information (knowledge). The relationship between matter and energy is accounted for by the law of entropy. However, the relationship between energy and information is not clear. The economic system is open to all three of these inputs and outputs. Boulding states that inputs and outputs of information "are more subtle and harder to trace but represent an open system related to but not totally dependent on matter and energy." Human knowledge, therefore, exhibits a sort of "negative entropy" or the capacity to "self organize" and seems contradictory to the laws of thermodynamics.

An important point is that it may not be possible to conclude definitively that the economic system is locked in a closed system bounded by entropic laws. Boulding (1991) acknowledges the problem of defining sustainable development solely in terms of entropy, because entropic determinism does not account for the potential of social, economic and human systems to evolve and develop in higher order and complexity. Given these limitations, what is needed is the exploration of alternatives and the search for new insights incorporating assumptions that are appropriate to fostering sustainable development objectives.

I will argue in the next section that the inherent contradictions that exist in the deterministic paradigm of entropy may be resolved when we approach the issue of environment and development from a co-evolutionary or non-linear thermodynamic perspective. From the recent developments in the disciplines referred to here as the new sciences, such as the theory of dissipative structures, an evolutionary view within the cosmological reality of entropy may be possible. Such developments allow for the possibility of emergence, not toward a deterministic outcome of disorder, but rather toward the possibility for evolution and reframing the concept of development.

2.4 The Nonlinear Paradigm

Many have argued that a new scientific paradigm is emerging (Grene 1985; Kiel 1991; Mannermaa 1991; Van Steenbergen 1990). Within this paradigm, an interesting new scientific development that has the potential for helping to shape new models for sustainable development is the behavior of nonlinear thermodynamic systems also known as far-from-equilibrium systems.[6] A particular theory from the non-linear paradigm that is valuable in the environment and development debate can be found in the work of Nobel laureate chemist Ilya Prigogine, who advanced the theory of dissipative structures and the self-organizing universe (Prigogine and Stenger 1984).

In this theory, one starts with an open system rather than with a closed system. This open system (dissipative structure) imports energy from outside the system and has the possibility of maintaining structure and order rather than disorder or chaos. In what Prigogine calls a “far-from-equilibrium” world, a system behaves in a way that seems contradictory both to the second law of thermodynamics and classical physics. A small change in existing variables in the system may cause a random fluctuation, driving the system toward the brink of irreversible structural change. This critical juncture is referred to as the "bifurcation point.” At this point, the symmetry of the system breaks down and a new structure evolves. The process is random in that it is inherently impossible to determine the direction of change that the system will take, either to a chaotic state or to a higher level of order or organization (Prigogine and Stenger 1984). Additional information, regardless of the degree of precision, cannot predict which of the evolutionary pathways will be selected. Evolution of a system, therefore, seems to be the interplay of both chance and determinism.

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[6] Although nonlinear thermodynamic systems constitute only one element of the general evolutionary perspective, I have specifically utilized this example because it reveals new dynamics within the context of energy flow and entropy. We will come back to this theme later in chapter 3 in a more general way.

Nonlinear or nonequilibrium dynamic systems describe a condition in which small changes in the relationship between the variables often have large and dramatic consequences. Depending on the initial condition, the outcome can lead to a variety of qualitatively different outcomes. The collection of evidence for self-organization ranges from economics to evolutionary biology and reflects a shift in paradigm (Allen 1982; Anderson, Arrow, Pines 1988; Arthur 1988; Cambel 1993; Lewin 1992 and others) and worldview (Goerner, 1994). At the heart of the new paradigm is the study of emergent systems.

Emergent systems are evidenced by the development of a global system which arises from the interaction of the elemental constituent parts in which nonlinearity, unequal proportionality between cause and effect, plays a significant role. Emergent systems are unpredictable in the sense that the outcome from the dynamics and the relationship between the variables composing the system can take on a variety of possibilities. In emergent systems, a small change in the initial condition or a small fluctuation in the system can generate positive feedback, self-organization, or amplification responses which cause structural and functional change throughout the whole global system. This process can create new ordered states which include more orderly and complex structures, or more random and chaotic structures. Self-organization is one of the characteristics in emergent phenomena. Waldrop (1992:33-34) describes simple examples of self-organizing systems, including a laser beam, a hurricane, and a living cell. He states the following:

> " a laser is a self-organizing system in which particles of light, photons, can spontaneously group themselves into a single powerful beam that has every photon moving in lockstep. A hurricane is a self-organizing system powered by the steady stream of energy coming in from the sun, which drives the winds and draws rainwater from the ocean. A living cell - although much too complicated to analyze mathematically - is a self-organizing system that survives by taking in energy in the form of food and excreting energy in the form of heat and waste."

The New Science perspective, with its emphasis on process, dynamics and relationships, has important implications for social sciences (Kiel 1991). The very nature of social systems incorporates new scientific concepts of complexity, nonlinearity, and emergence. Many researchers dealing with environment and development issues have noted the potential importance of this new paradigm for dealing with sustainable development issues (Hersperger 1994; Schneider and Kay 1994; Slocombe 1993; Zimmerer 1994).

2.5 Sustainable Development: Implications from a General Evolutionary Perspective

The foregoing discussion represents an example of an important conceptual shift taking place based on the recent discoveries in sciences that are spilling over to a broad cultural shift. In this section, I will outline some important implications for the evolution of society, the development of a sustainable society.

From the general evolutionary point of view, human systems, economic systems, social systems, and political systems, are essentially systems existing in states of thermodynamic non-equilibrium where the relationships between variables are unstable and dynamic (Mannermaa 1991; Kiel 1991). This new cosmology enlarges the scope from which meta-principles for sustainable development can be based.

One of the primary implications of the nonlinear paradigm for the future evolution of society is the premise that societies are dynamic and exist in far-from thermodynamic equilibrium. Rather than looking at the economic system as existing in equilibrium conditions that are stable and predictable, the focus should shift to understanding the diverse sets of changes that can have unpredictable and massive effects on the society. Mannermaa (1991:358) postulates that "the evolution of societal systems consists of stable evolutionary epochs with some degree of predictability, and breaks or chaos phases, the outcomes of which are unpredictable and consisting of a variety of possibilities for different development paths in the future."

Furthermore, the ideas of complexity, change, and randomness emphasize the need for wholistic thinking rather than reductionist thinking (Mannermaa 1991; Norgaard 1985; Van Steenbergen 1990). Wholistic thinking becomes a necessary condition, rather than a sufficient condition, for understanding the complex issues in the environment-development problematique. Van Steenbergen (1990) argues in this new paradigm that there is an emphasis placed on harmony rather than an emphasis on conflict. Van Steenbergen (1990:1078) describes the approach in this manner:

> "Typical dialectics is the unity of opposites. Marxism emphasizes the notion of opposites and the unity is projected somewhere in the far future..... In the new paradigm, the emphasis is on unity and opposite energies contribute permanently to the creation of that unity."

The dialectic of the new paradigm emphasizes a positive sum game where there are "win-win" situations in response to conflict rather than a negative sum game where there is a clear winner and a clear loser.

For Norgaard (1988), the policy challenge in the new paradigm is finding a path towards identifying new modes of technology, new institutions, values systems, and the knowledge base for 'co-evolutionary' development between social and ecological systems. He argues that human beings have always been active agents in

the evolution of the ecosystem, though largely destructive agents, since the shift from the renewable resource system management to the hydrocarbon based system during the past century. Botkin (1990), in order to develop a way forward, argues that we must first become conscious of the mechanistic assumptions that we have made about nature and man while building on the new scientific developments of the wholistic understanding of nature and ecosystems.

The question of ethics, values, and institutions which help to organize society plays a critical role in addressing this question (Beatley 1994). Value systems evolve over time in response to changes in social and natural systems and the technologies that transform them (Norgaard 1988). In this paradigm, the institutional structures emphasize flexibility, creativity, and diversity rather than efficiency and homogeneity. The value systems reflect a strong sense of sharing, equitable distribution, and harmony. Two major institutions, the market and the state, which will play an important role in securing the stability and the sustainability between the social and ecological systems, are described further below.

Buchanan and Vanberg (1991) argue that the coordinative properties of the market, with its emphasis on the creativity of human choice, plays an important function in organizing society. The market has the ability to evolve because its inputs are based on a creative process. The teleological conception of the market (i.e. an allocative or discovery process) is still valid, but what makes the market a more effective form of social organization, as opposed to centralized planning, is that the market has the ability to co-evolve with social systems. Since the future is not predictable, Buchanan and Vanberg (1991) argue that the market should be conceived as a creative process rather than just a mechanism that allocates resources.

In an open-ended, evolving universe where the future is not predetermined, the spontaneous ordering properties of the market with their emphasis on choice will be an important organizing structure. Furthermore, from the evolutionary perspective, the emphasis should not be placed on the organizational structure alone, but on the value systems which help guide the evolution of choices. The value system of a society, therefore, is critical to the question of sustainability (Beatley 1994).

A society based on assumptions of unlimited material growth creates a human perception of reality which is constrained to the material world. In such societies, creative capacity in human beings is often detached from a meaningful societal or cultural context. Fragmentation becomes an inherent characteristic, where the search for meaning is almost exclusively in the material realm of human existence (Berman 1981; Gare 1995). The "Good Life" is associated with an ever increasing supply of goods and services produced by the institutions of the society. Jones (1990:111) states:

> "Consumption becomes an end, rather than a means, and ties consumers not just to their possessions, but also to the virtually unconscious ideology of consumerism upon which the very existence of advanced industrial society depends. Such a society is dynamically unstable. It is organized for indefinite expansion and the concurrent unlimited creation of new needs which in an industrial environment soon become basic necessities."

The breakdown of community structures as a result of materialism means that individual decisions can no longer be made with reference to the totality of social life. A social system which is oriented toward a single-minded pursuit of material progress has no place for a rationality which takes the overall interest of humanity into account (Daly and Cobb 1989). The rise of "formal" rationality thus automatically devalues the aesthetic, moral and spiritual dimensions of human existence and introduces a destabilizing force into the culture as a whole.

In an evolutionary framework, the tensions between rights and responsibilities and between the market and democracy give the whole process an impetus for change and development. Sustainable development is the struggle for balance rather than the struggle for right or wrong. This notion of struggle for balance for the citizenry among competing notions of what is "good" has been addressed by political theorists such as Galston (1991) and Pincoffs (1991). They conceive government not only as the provider or guarantor of the infrastructure fostering freedom of individual choice but also as a "nurturer of choosers." What is argued by Galston is not that the state should enforce a set of arbitrary morals and ethics, but that the state should incorporate diversity of human virtues. Rather than being defined as acculturating its citizens with certain basic virtues, the state should be developing consensus through the process of dialogue itself, where tolerance and an opportunity of equality are important and widely shared tenets.

From a general evolutionary perspective, diversity and flexibility play an important role in sustaining society. Therefore, moral and ethical values require supporting tenets of citizen behavior such as dialogue, tolerance, and consensus. Galston (1988) argues that any viable defense of liberalism must rely on some substantive conception of what is good for human beings. His theory of liberalism begins from the premise that human beings have "special insight into their own good." He is arguing for a more enlightened view of liberalism, perhaps a more humanistic and wholistic approach to the conception of liberalism. He argues that "liberalism is committed to equality but it needs excellence, it is committed to freedom but it needs virtue." Galston's outlook is better situated to an evolutionary perspective than an equilibrium perspective because the point of view is holistic both in its methodology and its outlook on human potential. Resolving disputes through open discussions and confronting social imperfections through a public appeal are necessary conditions that have the potential to lead to a shared perception of a duty to the environment and a movement toward a more sustainable society.

In the context of sustainable development, environmental conflict resolution has emerged as an important discipline for resolving natural resource conflicts and also as an alternative form of formulation and implementation of environmental planning policies.[7] In the following section, I will discuss the field of environmental conflict resolution in detail. The following section will reveal how new science perspectives can aid in the development of new environmental conflict resolution methods. Also, the analysis of environmental conflict resolution methods provides us with better understanding of the dynamics inherent in environmental problem-solving and gives us the context for the analysis of the selected case studies in later chapters.

2.6 Environmental Conflict Resolution

Environmental mediation proposes an alternative method of problem solving based on consensus building for successful environmental policies. Environmental problems refer not only to the degradation of the physical resources but also the conflict surrounding those who want to utilize the natural resource for their own benefit. Environmental conflict resolution, therefore, does not solely depend on technical data and scientific information but also on the cooperation of the various interest groups involved. Environmental mediation is the process of combining conflicting points of view into a single decision. Problem solving is not only a process of education and discovery but also a process of managing a variety of different self-interests (Fisher, Ury and Patton 1991).

Negotiation around environmental issues often deals with conflicts surrounding not only man versus nature, but man versus man, and society versus society. Thus, environmental mediation has evolved not only to deal with conflicts arising from various interests at stake in natural resource use, but also in developing environmental policies. At the global level, Zartman (1993) notes that

[7] Many scholars suggest environmental change and scarcity of renewable resources are going to cause major regional conflicts in the future (Homer-Dixon, Boutwell, and Rathjens 1993; Homer-Dixon 1991). Homer-Dixon, Boutwell and Rathjens (1993) relate that the Middle East, a region already affected by political instability, will further experience instability due to scarcity of water sources. Hommer-Dixon (1991) note that Turkey and Syria have exchanged angry threats over a dam that Turkey plans to build on the Euphrates River which supplies vital water to Syria. Hommer-Dixon cites four major factors inherent in natural resource scarcity that could lead to regional conflicts: 1) Resource scarcities often have a powerful dynamic effect; 2) Resource consumption has reached gigantic proportions due to the increase in global population; 3) Much of the regional environmental degradation occurs in developing countries which lack capital and resources to respond to these problems; 4) The resource scarcity has the potential effect of making social and political institutions unstable and thereby destabilize market mechanisms which could allow technological ingenuity to help change these problems. Given this projected outlook, a means of resolving environmental disputes will be vital not only for the management of resources, but also for developing a cooperative means of diffusing regional conflicts and thereby avoiding a new class of conflict in the twenty-first century.

environmental mediation is often a problem-solving method because the conflict is inherent in the existence of the environmental problem itself.

Cormick (1980)[8] defines mediation as "a voluntary process in which those involved in a dispute jointly explore and reconcile their differences." The dispute is settled when the parties themselves reach what they consider to be a workable solution. Negotiation, on the other hand, is characterized not by the use of a mutual mediator or parties of mediators but by the principal parties themselves. Cormick defines negotiation as:

> "a means of striking bargains where the parties meet face to face to settle issues in which there is a disagreement. There is a mutual commitment by the parties to seek a mutually acceptable solution by which they are bound."

Techniques such as principle negotiations and interest analysis are often involved. Principle negotiations involve looking behind the positions often taken by the participants in negotiation to find common interests and developing methods and means for mutual gain within the context of a set of agreed upon objective criteria (Fisher, Ury and Patton 1991). Interest analysis is important since it can expedite the negotiation process as follows: starting out with small and obvious salient issues, stressing win-win solutions and then developing more commonly agreed-upon interest for all parties.

Third parties are often critical to the successful outcome of the process (Rubin 1993). Diagnosing and offering solutions can emerge from the negotiators themselves rather than solely from a neutral mediator. The third party, in this respect, is much like a mediator who suggests both substantive and process mechanisms to help the parties identify the issues, the possibility for settlement, and also help participants to engage in a positive dialogue that can bring about a win-win situation. Rubin (1993) points out that the pre-negotiation phase of the process is an important period for the mediators to minimize barriers that might arise in the negotiating process. Strategies that can be utilized by the third party include increasing the parties' motivation to reach agreement and making suggestions for modification of both the content and the context of the dialogue. The third party can modify time limits, have access to communications, determine the number of parties in the exchange, and form sub-groups to encourage an appropriate process that can facilitate a

[8] Gerald Cormick (1980) wrote one of the first papers on theories and practice of environmental mediation. It proposed the working definition for negotiation and mediation. He provides a series of questions which parallels Susskin and Weinstein's (1980) nine steps to ensure effective resolution as well as identifying various stages in the conflict process such as the conflict pre-emergence stage, the building power and influence stage, the initial skirmish stage, the third party review stage and the stalemate stage. These stages are necessary before the mediation process can occur. He concludes that conflict is the very basis for change in a democratic society and that it provides the opportunity for social participation.

reasonable agreement.

The successes of environmental conflict resolution methods have been quite well documented (Bingham 1986).[9] They have successfully been applied in writing environmental legislation (Sneider and Tohn 1985; Levinson 1988), in water resource projects (Priscoli 1987), in managing forests (Gaffney and Loeffler 1991), in international contexts (Susskind 1994), and others.[10]

Characteristics of Environmental Conflict Resolution. Environmental mediation, unlike mediation of trade or labor disputes, is distinctively different in both the context and the content of the issues. (Faure and Rubin 1993; MacDonnell 1988).[11] Negotiations of the environment have eight attributes that make them distinctively different from other negotiation cases. They include:

1. Multiple parties and multiple roles which include not only different nations but a multitude of actors within each nation and the multiple roles they play.

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[9]Bingham (1986) has documented successes of the mediation process in settling environmental disputes. The author cites that in more than 160 environmental disputes, agreements were reached in 78% of the cases. The authors cite that private corporations and environmental groups were at the table only 33% of the time but that federal, state and local agencies were at the table 81% of the time. Local citizen groups were involved in 44% of the cases. Bingham and Haygood (1986) note that the willingness of the parties to negotiate was a major factor in the success of the environmental conflict resolution process.

[10] Environmental negotiations at the international level have mostly been utilized for treaty making as a part of the evolutionary development of international regimes. Therefore, unlike at the national level where a legal context already exists, at the international level there are no governing international bodies to exercise jurisdiction over the compliance with agreements, conventions and declarations. The process of agreement often involves a general agreement to observe the conditions inherent in a specific environmental issue and also includes the drafting of protocols or treaties that contain required compliance on a specific environmental matter (Kremenyuk and Lang, 1993). The environmental negotiation approach has been successfully utilized to develop international treaties on numerous global environmental problems. Environmental negotiation has played a major role in treaty making for legally binding rules, development of guidelines, declarations, conclusions and principles which are not legally binding on a variety of global and transboundary environmental problems (Sjostedt, 1993). There have been, however, only a few cases where mediation has been used to settle disputes in a site-specific transboundary setting. One example has been applied in a transboundary dispute between the city of Seattle and the Province of British Columbia. The dispute concerned the development of a dam on the Skagit river. The process was mediated under the auspices of the United States / Canadian joint commission and an agreement was reached in 1984 (Dryzek and Hunter, 1987).

[11]Lawrence McDonald (1988) provides a very nice overview of environmental dispute mediation over the past two decades that coincides with Susskins and Weinstein's (1980) article. They state that sources and types of conflict in natural resources occur due to: differences in factual interpretation of environmental matters among the various parties, different views of the future, different values placed on the environment, and different uses of resources. They may involve two parties or a number of parties including the government. Environmental dispute mediation represents a voluntary non-legal approach, whereas the decisions created legislatively by a political body, administratively by an agency or judicially by the courts represent traditional approaches.

Multiple issues often include economic, social and political implications;

2. Lack of geographic boundaries - many global environmental problems involve transboundary solutions, therefore, although the solution may be complex, it enforces the interdependence of one country to another to act cooperatively to solve national impacts of a particular transnational boundary issues;

3. Technical and scientific uncertainty - environmental disputes are filled with technical difficulties as to the cause and the effects and solutions to the problem. Most people do not commonly agree on the causes of some of the environmental problems, let alone on the solutions to effectively deal with them;

4. Power asymmetry - this refers not only to the differences in political and economic power among various groups but also to the underlying difference of power among various governments;

5. Negative perceptions of immediate outcomes - short run solutions tend to be filled with perceptions of high costs relative to the benefits;

6. Long time frame - many of the current global environmental problems may not be solved within this generation;

7. Changing actors - there are many different actors involved in the overall negotiation process. Different political ideology may also shape the negotiation outcome due to the constant changing nature of the global political environment;

8. The development of new regimes and rules - new international organizations may be needed to carry out the rules to support new forms of behavior needed to meet the conditions necessary to improve the quality of the environment (Faure and Rubin 1993).

For these reasons, the process is often very complex, and it is difficult to achieve common solutions. In an international context, Dryzek and Hunter (1987) point out that environmental mediation offers one of the few methods for dealing with international environmental issues (such as localized trans-boundary problems and global environmental problems) due essentially to the decentralized character of the international political system. Environmental mediation methodology has the potential of becoming an integral instrument to the development of international regimes that can cope with international environmental problems.

Dryzek and Hunter (1987) argue that environmental mediation can play three essential roles in this regard: it can function as a decision making component, as an

instrumental component in creating international regimes, and to maintain and reinforce the voluntary process which is at the foundation of such regimes. These authors relate the following benefits of environmental mediation: it can settle disputes and generate outcomes at lower transactional cost than alternative forms of international decision-making processes such as coercive decision-making; it can facilitate pareto-better (win-win) situations for the participants involved; it can deal with situations involving different values and interpretations; it can also promote dialogue that transcends particular interest to generalizable interests of all actors involved, (i.e. the survivability of the human species); and facilitate processes involved in mediation to provide a means of producing optimal outcomes. The mediation process, however, is also filled with numerous barriers.

Potential Barriers. There are several potential barriers to the mediation process. The most important of these is an imbalance of power. Imbalance of power can arise from unequal access to the mediation process and differences in resources, money, and capital among various interest groups. One of the major concerns when an imbalance of power exists is that the mediation process can lead to an unfair concession by one of the participating groups (Amy 1983). Environmental mediation may even legitimize imbalances in power by introducing mediation as a voluntary process. There may also be other pitfalls, such as the equitable selection of representatives. Rabe (1988) has also criticized the limitations of the current environmental mediation process. The basic argument has been that the nature of the current mediation process assumes that the economy and society are in conflict; therefore, the decision making process often assumes a confrontational style rather than a voluntary style.

In his observation of the recent Earth Summit, Sachs (1993:13) states the following:

> "The rhetoric which ornaments conferences and conventions, ritually calls for a new global ethic but the reality at the negotiating tables suggests a different logic. There, for the most part, one sees diplomats engaged in the familiar game of accumulating advantages for their counties, eager to out-maneuver their opponents, shrewdly tailoring environmental concerns to the interests dictated by their nation's economic position. Their parameters of action are bounded by the need to extend their nation's space for 'development'; therefore in their hands environmental concerns turn into bargaining chips in the struggle of interests. In that respect, the thrust of UNCED'S (United Nation's conference on Environment and Development, commonly known as the Earth Summit) negotiation was no different from the thrust of previous negotiations about the law of the Sea, the Antarctic, or the Montreal protocol on the reduction on CFC's."

In the international context, Dryzek and Hunter (1987) offer two factors which may hinder a successful outcome when using the mediation approach. The prime

concern is that the diversity of the international actors hinders the ability to implement decision outcomes. The second concern involves resolving values and epistemological differences inherent in a cross cultural dialogue.

Another primary issue that must be considered at the international level is the north-south issue. Benedick (1993) states that global environmental issues "can be resolved only if the wealthier countries acknowledge the responsibility to aid the south by compensation for the cost of adopting environmentally benign policies and by furnishing the relevant technology on a fair term." Hettwer (1991) argues that methods for moving beyond existing methods of environmental negotiations should include a new conception of progress, growth, and balance of wealth from north to south through concessions, technological transfers and information exchanges. He states that the negotiation process should aim at the "protection of the biological foundation of human life and improvement of the environment through international cooperation."

Furthermore, little has been done to place environmental conflict resolution research within an established theoretical framework for long-term analysis. Current theories and conceptual frameworks which have been proposed do not take the need for the change in the social, economic, environmental, and cultural context into account. The mediation process needs to be looked at in the light of social and economic inequalities and ideology inherent in society rather than seeing it as a solely voluntary and neutral process that exists in an ideological vacuum.

Lessons from the New Science Paradigm. Emerging concepts from the modern evolutionary sciences (new scientific paradigm) may better deal with the issue of developing new sets of environmental institutional regimes for one primary reason, its contribution towards modeling the ecosystem from a nonlinear perspective.

Traditionally, the ecosystem has been described in terms of its elements such as the volume of water, the carrying capacity of the arid land, and the size of the population. By focusing on various parts of the ecosystem rather than looking at the interaction of the physical and social elements of it, we get a very static picture of the conditions in the environment. As Kiel (1991:436) states:

> "The static nature of linear and deterministic models reveals that these efforts provide at best a "snapshot" of reality with, most likely, only short-term relevance. The determinism generally embedded in traditional linear models inhibits dynamics that may arise over time. This can result in native extrapolation based on assumptions of static relationships between relevant variables."

The mechanistic paradigm of scientific thought may be inappropriate to deal with

global ecological problems. The environment is complex not only due to the multiple effects of the physical elemental level of the ecosystem, but also due to the evolutionary tendency of the ecosystem to become more complex and dynamic. Painter (1988) argues that the evolutionary momentum is irreversible in that it produces a more highly structured informational content being. Also, in an epistemological context, the environment has an analogue character. This means that the environment cannot be perceived solely from a binary or linear perspective. Changes in the environment are dynamic and nonlinear in character. Environmental effects are also logarithmic in that small changes to the system can have dramatic and far reaching consequences.

The new scientific paradigm, with its emphasis on emergence, nonlinearity, and positive feedback has an important role to play in providing data in the conflict resolution process. In the new scientific paradigm, the emergent condition that arises from the various parts of the global system is the driving force behind evolution. Minor changes in the overall interaction between the elements can have some dramatic effects. This understanding emphasizes the importance of nonlinearity, and nonequilibrium in the ecosystem. Current data about the ecosystem needs to integrate a conceptual base that can address the complex non-linear, non-reversible, and dissipative nature of the eco-system (Painter 1988). The elements of competition, cooperation, and evolution, manifested in the cultural use of an environment need to be incorporated into the dialogue in environmental conflict resolution. The co-evolutionary theoretical framework proposed by Norgaard (1994) which looks at the interaction between values, technology, knowledge and the environment in an evolutionary framework, will also be helpful in this regard.

There is a need for international cooperation on the establishment of new international institutions and organizations to help deal with conflicts that arise from environmental problems (Young, 1989). International regimes are basically social institutions based on "constellations of rights and rules that govern interactions among the occupants of recognizable roles defined with reference to more or less distinct issue areas" (Young, 1993). International regimes include the Barcelona Convention for the Protection of the Mediterranean Sea, the Vienna convention for the Protection of the Ozone layer and the Geneva Convention on Transboundary Air Pollution. International organizations, on the other hand, include organizations such as UNEP or ECE (Economic Commission for Europe). They are physical entities that play a significant role in the bargaining process, implementing and administering the enjoining of contracts which give rise to environmental regimes. International organizations play a vital role in the development of international regimes through coordination of environmental negotiations and provision of leadership.

Young (1993) concludes that our best hope for survival lies in international

cooperation to preserve the natural basis of life on this planet. In the future, environmental conflict resolution needs to be inclusive, dynamic, appropriate to the place, neutral, and involving. Environmental conflict resolution has the potential to incorporate the evolutionary dimension of environmental and human systems and avoid the deterministic methodology of each discipline of the involved groups. The process also needs to be reflexive where it allows the participants to reflect on their own assumptions and limited self-interest to educate and develop respect for others self-interest, value systems and ways of knowing. Cooperative decision making in the 21st century will need to be more wholistic, encompassing different cultural value systems and knowledge bases in order to successfully address the diversity of actors involved in global environmental regime development.

Addressing the ontological and epistemological dimensions of how we perceive the reality, in this case the environment, is critical. We need to develop an approach better informed by theories which take into account the nonlinear dynamic nature of the environment explicitly and conflict resolution methods which can incorporate a more wholistic approach. In the cross-cultural context, we are dealing with the differences in people's linguistic patterns, their perceptual context, and cognitive processes. For example, scientific facts about the environment cannot replace rational values that some cultures might view as being sacred. There may not be a price that could estimate the value of such resources. We need to move away from decisions based solely on disciplinary analyses where scientists only see technical fixes, lawyers see law, and politicians see only in terms of power to a more wholistic system of thought and universal values systems. This may best be accomplished through the new science perspective and the dialogue process.

2.7 Implications for Environmental Planning

There is considerable intuitive and practical appeal from the theories of new sciences for integrated environment and development planning. The concept of wholism and the perspective of looking at possibilities rather than predictability are important in developing creative and innovative approaches for current cultural and social problems. Within the context of integrated environmental and development planning, new sciences expand the traditional understanding of change in the biophysical systems and also provide renewed impetus for community-based development.

The rise of new metaphors from emerging disciplines in the new sciences signals important theoretical and empirical advancements (Zimmerer 1994). The Ecosystems approach (Slocombe 1993) and Landscape Ecology (Hersperger 1994) are two examples of recent integration of the new science paradigm in environmental planning. These planning approaches integrate natural, physical, and biological dimensions with historical, cultural, and socioeconomic aspects. Both the

ecosystems approach and landscape ecology are planning models which signify the advancement from a general systems ecological framework. The systems approach stresses temporal and spatial homogeneity. The new science paradigm, on the other hand, arises out of the nonlinear interdependent framework and emphasizes environmental heterogeneity, diverse spatial patterns, nonequilibrium, and self organization (Slocombe 1993; Zimmerer 1994). Furthermore, the concepts of change, risk, and uncertainty emerge as important variables for effective integrated environment and development planning.

The new sciences, specifically complexity science and chaos theory, provide a more intricate understanding of ecosystems. From this perspective, the ecosystem does not behave in just simple chaotic, random, or unpredictable ways but exhibits complex dynamics, unpredictability, and the potential for rapid change. One of the primary goals of environmental planning and management is to maintain ecological integrity. Ecological integrity takes on a deeper significance within the self-organizational point of view. Schneider and Kay (1994) state:

> "The challenge facing the practice of environmental management is to learn how to work with these self-organizing processes in a way which allows us to meet our species needs, while still preserving the integrity of ecosystems, that is to say the integrity of self-organizing processes. Only by acknowledging that the essence of ecosystem is self-organization, and our responsibility for maintaining these self-organizing processes, will we ensure our species a sustainable niche in the biosphere." (P.644)

The new sciences have a more integrated understanding of humans and nature. One of the key aspects of new environmental planning approaches is not to separate humans and nature. From a new science perspective, the basic mechanism for the emergence of organized behavior accounts for the evolutionary tendencies not only in ecosystems and in socioeconomic systems, but also in life itself. Thus, the preservation of ecological integrity means the preservation of not only species and eco-diversity but the preservation of a process which allows for the emergence of life itself, the preservation of *evolutionary integrity*.

From a social organizational perspective, the shift from a mechanistic to an ecological worldview would include movements away from the top-down, centralized, hierarchical development models to a decentralized, people-centered organization based on communitarian philosophies (Korten 1990). Plans of economic diversification include local control of resources and the means of production, formation of voluntary and people's organizations, open and locally acceptable government, emphasis on small and intermediate scale of production, strong local educational programs which build local capacity, and acceptance of shared responsibility for all members of community (Dyck 1995). Zimmerer (1994:118) states in the context of the implication for Human geography:

> "Having recognized the limitations of top-down development models, human geographers are examining anew the socio-economic empowerment of local people through democratic participation, decentralized decision-making, and economic growth based on local resources, skills, and knowledge. And when local participator development is united with environmental conservation under the management guidelines of "new ecology" [variance of New Science], local inhabitants are, in many cases most able to identify the spatial and temporal heterogeneity's of the biophysical environments and to help plan accordingly."

In the context of planning for sustainable communities, emphasis would be placed on ecological limits, equity, integrated and wholistic approaches, ethics, and a sense of community. Plans would include consideration of ecological limits and environmental impacts to geographical, temporal and biological dimensions, compact urban forms, sustainable modes of urban transportation, and full cost accounting strategies (Beatley, 1995). The emerging new paradigm of sustainable communities also reflects the emerging new paradigm of planning theory of "communicative action" where planners are conceived not only as objective, neutral observers but also as critical and ethical actors (Fisher and Forester 1993; Innes 1995; Dyck 1995).

2.8 Towards an Integrated Environmental Design and Planning

The transdisciplinary approach has important implications for current social and environmental dilemmas. The development of consciousness is central to this process. Many researchers have stressed the importance of learning in an organizational and institutional context to deal with various complex issues (Michael 1993; Senge 1992). The same can be said for changes in the way we perceive environmental problems, more specifically about how we design environmental models or metaphors (Botkin 1990; Lyle 1994).

Metaphorical implications from the new sciences with concepts such as evolutionary dynamics, chaotic fluctuations, autonomy, and spontaneous adjustments are replacing models which emphasize stability, control, and homeostasis in policy context (Dobuzinskis 1992). Metaphors represent a primary mode of apprehending the world (Questel 1994). Lakoff and Johnson (1980) state that "our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature." The very recognition that we think in terms of metaphors is an important development for communicating across disciplines as well as changing our current mode of operation. However, what may sustain this process of awareness through the use of metaphors is rarely addressed.

The Question of Epistemology. In recent years, many researchers have argued for the need to look at the very fabric from which our thoughts and actions derive. Some have called this the epistemological issue and have termed this the meta issue in development (Norgaard 1994; Merchant 1989). These researchers point out that institutions, policies, and our world view have been derived from principles which date back in the Western societies to the Age of Enlightenment. Norgaard (1994), for example, states in response to the deterministic paradigm surrounding our perception of the environment that "inadequate metaphors and models have gotten us into the environmental and social difficulties we now experience and continue to impede the development of more sophisticated policies" (p. 213).

Gore (1992: 216) states the following:

> "At the heart of every human society is a web of stories that attempt to answer our most basic questions: Who are we, and why are we here? But as the destructive pattern of our relationship to the natural world becomes increasingly clear, we begin to wonder if our old stories still make sense and sometimes have gone so far as to devise entirely new stories about the meaning and purpose of human civilization."

What are our old stories? The basic principles, which represent the lines in our stories, can be briefly summarized as atomism, mechanism, and objectivism. Atomism is the premise that systems consist of parts to which the total is equal without being greater than the sum of its parts. Society, for example, can be viewed as a system composed of the sum of the individuals. Mechanism is the premise that systems are composed of interchangeable parts and that the system's natural tendency is to remain in an equilibrium state. Objectivism basically means that the observer can be separated from that which he or she is observing. The extension of this concept has also been thought to separate humans and nature (Norgaard 1994; Berman 1981).

Furthermore, scientific rationalism views the acquisition of knowledge as having universal implications. The mind is thought of as an independent entity that perceives and interprets. It is assumed, in this view, that natural and social systems consist of unchanging parts and relations, and knowledge is thought to be constant over time, place, and culture (Norgaard 1988). In the scientific rationalistic paradigm, underlying universal thoughts are assumed to be maintained across diverse environments and cultures. This is predominantly a "northern" (i.e., developed countries) point of view. As Norgaard (1994) points out, the "southern" point of view on man and nature is quite varied. For example, indigenous peoples tend to equate land with life and spirituality and a wholistic view of people and the environment, rather than with political power or economic productivity. Marxist and neoclassical points of view in these geographical regions see it in terms of

power and productivity. Any comprehensive view for the next century, given our global interconnectedness, needs to address these divergent view points.

For Norgaard (1994), Western epistemological principles represent broader philosophical interpretations of modernism, and it is these basic principles which have led to the degradation of environmental and cultural systems. Atkinson (1991) also traces much of our current environmental and cultural malaise and, therefore, the conflict between development and environment, back to the principles inherent since the Age of Enlightenment. Atkinson (1991:126) states the following concerning these epistemological premises:

> "They represent a concept which is, in general, highly valued by our society. And yet each of these possesses a substantial content of ideas and related activity which ecologists see as highly problematic, directly contributing to the lethal trajectory of our society."

Norgaard (1988) gives four main reasons why there are problems associated with an atomistic view of knowledge: 1) the problem of complexity (i.e., ecosystems are dynamic and not easily accessible through atomistic methodology), 2) the concept of evolution precludes universal principles of predictability, 3) learning changes knowledge and how people interact with nature, 4) knowledge is intertwined with social organization, technology, and values of particular people, times, and places, and cannot exist on its own, contrary to the scientific rationalistic paradigm.

For Norgaard (1988), development has been unsustainable because the value system and the knowledge system have been reduced to a Western understanding of what development is. For example, our value system and knowledge system have evolved to fit a hydrocarbon culture which developed from our exploitation of fossil fuels. The hydrocarbon culture has replaced natural nutrient cycles of climate and plant-to-plant interactions with fossil fuel energy, irrigation, man-made pesticides, and specialized mono-culture of genetic hybrid crops. While this has led to significant increases in world food output, the hydrocarbon culture has also led to significant environmental pollution.

Furthermore, the epistemological issues are problematic because the Western philosophical principles are often hidden in the way we perceive our institutions and our world in general. Milbrath (1994: 118) states:

> "Every person functions day by day using an unspoken set of premises about how the world works: they are essential just for getting though the day. Most people simply accept the premises that are handed to them by the culture; they do not question them and they do not observe others questioning them".

He defines paradigms as "epistemological systems for interpreting reality that ground their picture of reality in their own construction" (p.117). The problem is that society as a whole may be manifesting a collective unconsciousness that is reflected in how we manage social change. The question we need to ask ourselves is not whether or not these epistemological and ontological premises are right or wrong, but, rather given current environmental conditions, are these premises appropriate to guide our societies to a sustainable future? One way to resolve this issue may be through the development of an epistemology of complementarity.

An Epistemology of Complementarity. An epistemology of complementarity or "diversity in unity" comes from the occidental scientific contribution of new science and various oriental philosophies. This has given rise to a scientific paradigm which has the potential means of addressing complex issues such as sustainable development and the evolution of consciousness (Bohm 1980; Rash 1994a; Zohar and Marshall 1994). At the foundation of this epistemology is an ontological starting condition of unity or implicate order. An epistemology of complementarity would emphasize process thinking as a necessary means in the revelatory process of becoming conscious of and understanding the 'hidden' dimensions in research (as in re-search meaning “to search again”) process. Emphasis on the previously dominant paradigm of positivism, with its ontological starting condition of atomism and its concern for objectivity and reason, is changed by the concern for integrating the observer with the observed, subjective experience, and process thinking. There are various supporting terms for complementarity, as Bouratinos (1994) describes, "within and without", or as Zohar and Marshall (1994) describe as "both/and" ways of thinking.

Traditionally, positivism has assumed the separation of the observer from the observed. Emilios Bouratinos (1994) states the following concerning this subject:

> "Scientists first adopt the accepted scientific approach on account of its conventional rationality. Then they use the approach for checking forms of knowledge or occurrences other than those amenable to conventional rational apprehension- naturally finding these forms or occurrences to be lacking in rationality. For them all validity is derived from this conventional approach- because they know it leads to valid results. Also, this type of thinking reflects a naive approach to what may be considered as existent. Because one system for reaching scientific knowledge works, this in no way implies that for which it doesn't work, also doesn't exist. As Abraham Maslow once remarked: 'If the only tool you have is a hammer, you tend to treat everything as if it were a nail.'" (p. 8)

In an evolutionary framework, what may be needed is the development of complementarity thinking not only to deal with the changing epistemological context in the postmodern world but also to develop creative and innovative

thinking. The process of dialogue may be one means of developing complementary thinking within the general evolutionary framework.

Dialogue. Dialogue comes from the root word in Greek dialogos, dia means “through”, and logos means “meaning”, suggesting that dialogue is "meaning passing through.” Instead of the argumentation process, which is primarily having your own views prevail, dialogue is a means of understanding the dynamics of the various levels of communication processes which take place. Issacs (1992) defines dialogue as "sustained collective inquiry into the process, assumptions, and certainties that compose everyday experience." In previous learning approaches, the education process afforded a generalized picture of the phenomenon examined. In this approach, instead of a single frame, not only is the process being examined, but the ways in which meaning is generated from the collective participation between the learner and the subject matter are also examined.

The essence of this approach is process thinking. As Combs (1994: 1) describes process thinking, "it sees reality as flux, a flow of events in which stationary patterns arise as secondary phenomena." Collective thinking unfolds rather than just develops. It emerges and the whole process is dynamic. The potential is already there, but the patterns of meaning unfold as underlying motives, assumptions, and beliefs are examined. As Bohm, Factor, and Garrett (1994:1-3) state:

> "In Dialogue a group of people can explore the individual and collective presuppositions, ideas, beliefs and feelings that subtly control their interactions. It provides an opportunity for them to participate in a process that displays their successes and failures of communication and it can reveal the often puzzling patterns of incoherence that often leads them to avoid certain issues or, on the other hand, to insist, against all reason, on standing and defending their opinions about them."

They further state:

> "As a microcosm of the larger culture Dialogue allows a wide spectrum of possible relationships to be revealed. It can disclose the impact of society on the individual and the individual's impact on society. It can display how power is assumed or given away and how pervasive are the generally unnoticed rules of the system that constitutes our culture. But it is most deeply concerned with understanding the dynamics of how thought conceives such connections. It is not concerned with deliberately trying to alter or change behavior nor to get the participants to move toward a predetermined goal. Any such attempt would distort and obscure the processes that the Dialogue has set out to explore. Nevertheless, changes do occur because observed thought behaves differently from unobserved thought. Dialogue can thus become an opportunity for thought and feeling to

> play freely in a continuously engaging movement. Topics of a specific or personal nature will become entwined with areas of deeper or more general meaning. Any subject can be included and no content is excluded. Such an activity is very rare in our culture."

Therefore, from an evolutionary framework, where process and a wholistic stance between the learner and the subject is stressed, the dialogue approach may lead to some differences in perception and outcome. Dialogue is not proposed as an alternative to current practices. Only when process and wholistic stance are stressed, dialogue may present an important alternative. Furthermore, what will inform the evolution within the dialogue process is the consciousness of the individual as well as the consciousness of the collective. Bouratinos (1994: 5) states the following:

> "If the observer is part of the observed, it becomes necessary to draw the capabilities, qualities, limitations, tendencies and capacity for self-knowledge of the observer into the picture as well.... The observer of nature is in turn observed with the same intensity (and to the same extent) as that which he observed. This will enable the observer to see what is actually there, without being unaware of what he projects onto it from the store of his mind. He will test the new techniques, data, insights and theories. He will avoid the present tendency of getting stuck on the type of thought, evaluation or research they require."

Therefore, while dialogue may be an important tool in the development of the observer, it is not the only tool. The science of consciousness is needed not only to inform the observer but also to inform the evolution consciousness itself. Such a process of will require implicit use of the epistemology of "diversity in unity" or complementarity (Rash 1983).

2.9 Towards a Transdisciplinary Synthesis

Sustaining awareness is in itself the question of consciousness. How do we stay conscious? What informs learning? What informs the observer? What informs the use of metaphor? The answers to these questions may lie in understanding consciousness itself.

Transdisciplinary synthesis can be one possible mean for this task. The essence of the complementarity approach would be to seek balance between the known and the unknown, the seen and the unseen, the finite and the infinite expression. Its object would be to achieve balance and harmony within the ontology of unity or implicate order which changes to fit according to the needs presented: the needs of time, the participant, the place, and the circumstance. The crossing place between the known and the unknown has been the place of various wisdom traditions. These wisdom

traditions have always sought to seek this balance through seeing the "otherness" and "self-ness" (Rash 1994a).

Consciousness itself speaks of movement and process and not as an object to be sought. Permanent objectification, fragmentation of the whole without its reference to the whole, becomes a barrier to awareness. Therefore, transdisciplinary analysis here would seek not only the physical and biological explanation of consciousness but also the means or the ways in which our consciousness becomes refined and evolves. Traditionally, stories, myths, symbols, metaphors, rituals, and dialogue have been utilized to 'inform' the observer to the realities of "otherness" and to circumvent the shortcomings of permanent objectification (Bouratinos 1993). These methods are still utilized today in various wisdom traditions (Shaw 1968). These methods show the ability to bridge the virtual and real transitions (in quantum language), between predictability and possibility in the evolution of consciousness. J.E. Rash (1994b: 1) summarizes it this way:

> "It is the nature of new sciences to be ever changing. The changes are an integral factor in utilizing quantum thinking. So the epistemology (of complementarity) exists and is emerging much like a piece of sculpture emerges from the rock, given the observation of the sculptor. At the same time, it changes. It changes according to where it is being observed, who is observing it, under what conditions it is being observed, and how it is being observed. We must, therefore, take into account culture and social conditioning. This paradigm lends itself to creativity and intuition. The time, place, people and the circumstance that they are involved in have special relevancy. New science is human centered and is a totally different way of thinking. So we have to speak not only of predictability, we have to talk about possibility and potentiality. The key aspect of this field lies in being able to seize the moment and bring one's experience and knowledge to the moment, instead of relying on previous models to have replicable results. New science must investigate intuition, creativity and culture to fulfill its espoused intention."

In the context of sustainable development, the communication dilemma that we often see in the issues and the assumptions within each discipline can be attributed to the discrepancy between permanent objectification and reality as experienced. Therefore, the current inability to resolve environmental crisis can be viewed as a crisis in consciousness. Sustainable development, in short, will require the evolution of consciousness, being able to transcend the limitations of cultural patterns to a transcultural view (Rash 1994a; Weber 1989). One of the means for this process could be transdisciplinary analyses within the epistemology of complementarity and the ontology of Unity.

2.10 Conclusion

In this chapter, I have explored new insights and alternative epistemologies that can initiate reconstructing the concept of sustainable development. The general evolutionary paradigm provides alternative metaprinciples from which to grasp better understanding of the environment-development problematique. It is better equipped to deal with the complexity and the dynamics of societal and environmental change. Consequences for implementing policies and actions from the evolutionary paradigm should play an important role in the development of a more sustainable society. The emerging evolutionary paradigm should significantly contribute to the theoretical foundation necessary to address how sustainable development is to be achieved.

Furthermore, in this chapter, I have attempted to apply the evolutionary framework to the issue of environmental design and planning. The integration requires an alternative view. The new science perspective has some important contributions to make in this regard. The development of wholistic thought or what Laughlin and Richardson (1986) call "global abstract thought" - the ability of a person to process information about any aspect of reality, external or internal to their being, whether physical, social or moral, at a uniformly abstract level, will be a key task in the evolutionary framework.

Thus, the process of reframing sustainability brings forth a new set of challenges. The epistemological challenge was addressed in this chapter. In the next chapter, I will address the methodological implications of the general evolutionary perspective. I will describe three major methodological elements that emerge, *nonlinearity, emergence,* and *qualitative evolution*. In chapters 5 and 6, three environmental case studies will be analyzed based on the methodological developments to gain an understanding of current sustainable development practices.

CHAPTER 3

Development of A General Evolutionary Methodology as a Framework for Analysis

We are not masters of the universe nor accidents of the universe. We are part of an ongoing unfolding process that is the quintessential creative process. We co-create this unfolding along with all other elements of the world.

Sally J. Goerner 1994: 9

3.1 Introduction

It was pointed out in Chapter 2 that an appropriate system's design for sustainable development requires a conceptual shift from a static, Newtonian world view to a general evolutionary perspective. The previous chapter addressed the *epistemological* challenges associated with the reconstruction of sustainable development. In this chapter, I will outline three *methodological* elements derived from the general evolutionary perspective. They will provide the framework for data organization and analysis of the environmental case studies.

The purpose of this chapter is twofold: first, I will describe the three major elements which comprise the emerging general evolutionary worldview, the vision of an evolving ecological universe (Goerner 1994). The three major elements are nonlinear interdependence, self-organization, and qualitative evolution. I will describe the range of intellectual contributions from various different fields ranging from chaos, complexity science, nonlinear systems dynamics, and self-organization theory. Second, I will outline conceptual elements that explicitly guide the search for nonlinear, self-organization, and qualitative evolutionary characteristics in environmental case studies.

As earlier discussed, some of the fields in environmental planning, such as ecosystem planning, landscape ecology, and new human geography, have recently attempted to integrate some of the elements of new science with environmental planning. These fields look directly at the physical ecosystem and have attempted to apply the physical understanding derived from the new science literature to the physical systems. The current task is different in that I have tried to tie new science concepts, which predominately come from the physical sciences, to the analysis of sustainable development strategies, which are at the social sciences level. By applying the new science concepts to the human level I am attempting to describe new systems which may be emerging, utilizing physical science attributes.

The field of general evolutionary sciences (new sciences) is very broad. It incorporates chaos theory, complexity science, nonlinear equilibrium systems, dissipative systems, far-from-equilibrium systems, self-organization theory, fractals, and quantum mechanics. Few researchers have articulated how the general evolutionary sciences are combining to transform the world view of Western civilization. My current task is specialized in that I am attempting to develop a methodology for case study analysis based on a broad synthesis achieved by these researchers. I have relied heavily on three major works by Goerner (1994), Norgaard (1995) and Wilber (1995) for the development of a general evolutionary methodology. The three works stem from the different disciplines of psychology, development studies, and philosophy. They provide, for the first time, a coherent picture of the cultural and scientific shift currently taking place. The focus on mechanistic themes, material reality, and logical lawfulness, which have been central to all areas of human endeavor since the Enlightenment is shifting to include ecological images and an intricately interconnected, interdependent world. It is a view of the world which is complexly interconnected, rapidly unfolding, and self-organizing.

In the process of weaving a theoretical tapestry, a thinking process emerges which focuses on complex causation, emergence, and process of change. Goerner (1994) calls this ecological thinking. The parallel process of theoretical synthesis and ecological thinking lead me to identify three broad methodological components - *structural, process* and *transformational* components. Each corresponds in turn to three distinct conceptual elements of the general evolutionary sciences, nonlinear interdependence, self-organization, and qualitative evolution. Nonlinear interdependence represents the *structural* dimension. The second aspect, self organization, represent the *process* dimension. The third aspect, qualitative evolution represents the *transformational* dimension. Figure 3.1 describes the relationship between the general evolutionary elements and their methodological dimensions. The rest of the chapter will explain each of these elements in detail. In the following sections, I will also discuss the breadth and depth of the general evolutionary paradigm.

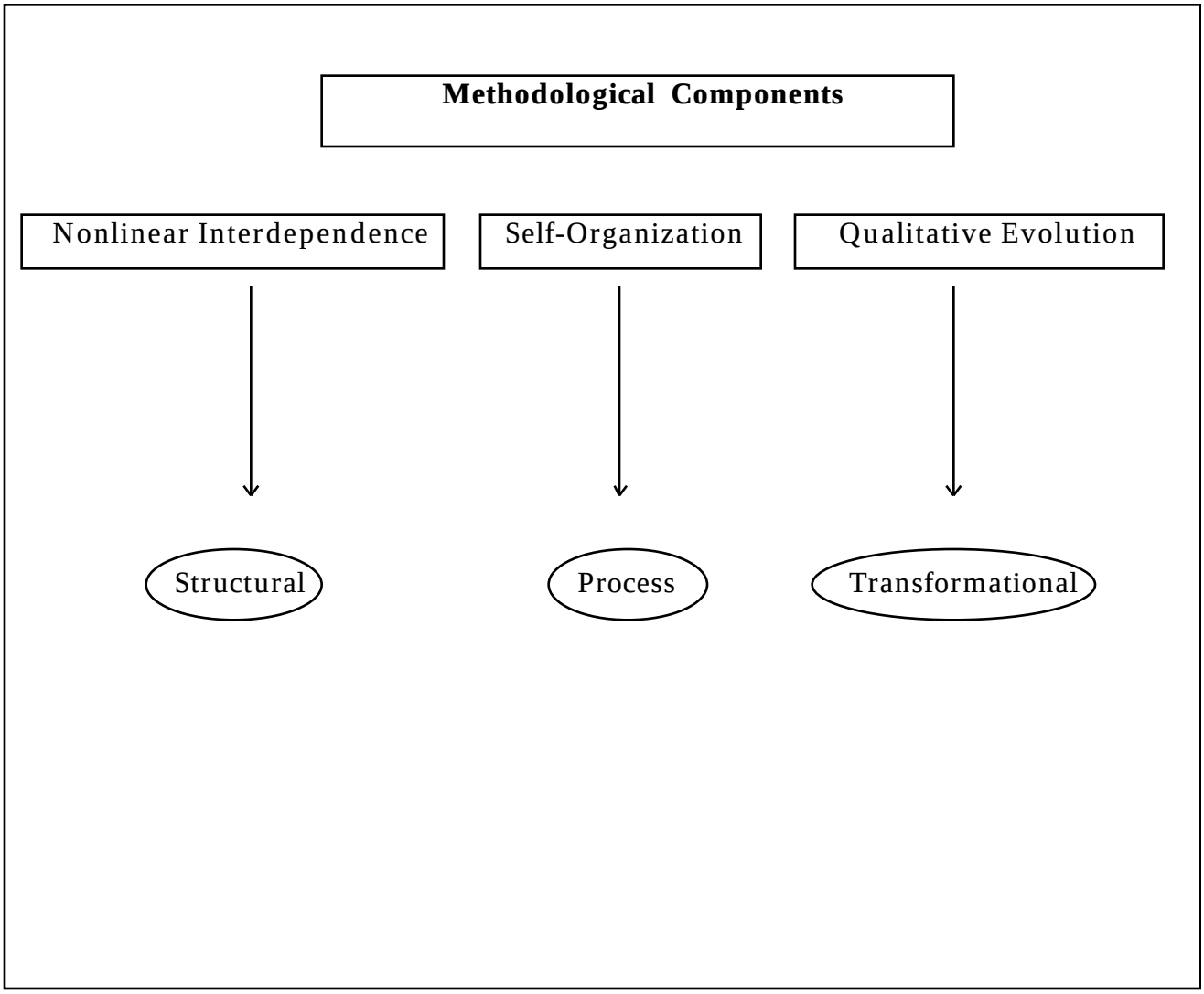

Figure 3.1 General Evolutionary Elements

3.2 Implications and Overview

The current cultural and scientific shift that is taking place is not to be considered as a mere paradigm shift in the Kuhnsian sense. Kuhn's (1972) notion of a paradigm shift is a shift in the conceptual framework shared by a community of scientists that provides them with an overview of a common set of problems and solutions. The current shift is considered a shift in worldview, or more specifically, a change in world hypothesis: it is a change in the tacitly held model of how the world works. The world hypothesis is broader than a paradigm in that it encompasses not only the models held by the scientific community but also other members of society, perhaps the entire culture. The world hypothesis provides a tacit conceptual model or root metaphor for understanding reality (Pepper 1946). For example, Goerner (1994: 4) notes the following distinction between mechanism and organicism as two distinct models of the world:

> "One might tacitly hold a model of the world as a machine, very lawful, logical and knowable. Or one might see the world as an unfolding organism, developing through various stages of history and having an overall coherence to it."

Furthermore, she expands the importance of world hypothesis to creating a unified view:

> "World hypotheses are deep-seated, tacitly held models of how the world works that powerfully shape how their owners see and consequently how they act in the world. Often seeming to be only what's 'obvious' or 'reasonable,' world hypotheses have also been a major source of division in human knowledge systems. And yet they are very powerful vehicles for navigating the world, for organizing experience, for communicating with fellows, for coordinating efforts. World hypotheses are tacit mental models, no more, no less. They aid vision and they create conflicts." (p.6)

The current transformation in worldview contains two distinct aspects: an evolutionary dimension and a revolutionary aspect (Goerner 1994). "The evolutionary dimension" means that the current development of new tools provides a new and more subtler understanding of how things work, how process proceeds, the relationship between things and process, and the relationship between the observation of phenomena and the process of observing. Thus, it significantly departs from the mechanistic vision which is a material hypothesis, but incorporates it as well.

This transformation in worldview also has a revolutionary component which arises from the physical understanding of how things can "self-organize." One of the most

important aspects of this transformation has to do with reconciling various world hypotheses by showing how their differing observations fit together. The modernist dualities such as holism / reductionism, mind / body, and physical / spiritual begin to be reconciled under the new vision of an evolving ecological world view. An ecological world view includes the mechanistic approach but looks at it from a more inclusive point of view. It is a process of reframing and renewal. The possibility of reframing sustainable development falls under this realm.

The ecological vision shows how simple relations can be hidden in a complex system and how they are bound by networks of mutual causal effects, where no one component is separated and where simple "cause and effect" relations do not make sense. Ecological thinking is built on the notion that the whole is built of diverse elements, inherent notions of interdependence, patterns which are hidden, complex causation, and ongoing change (Goerner 1994).

The revolutionary vision expands to include human-centered discourse. It is a human-centered vision. In a sense, mechanism seemed unable to address the human aspects of humanity, such as the topics of meaning and morality, spirituality and wisdom. More specifically there is a shift in the scientific frame of reference, in physical terms, from linearity to nonlinearity and from independence to interdependence. It also includes the understanding of spontaneous ordering in the physical world and ends with a transformed understanding of evolution. Evolution becomes an all-encompassing physical process, an order-producing process in which we are the co-participants.

Again, as Goerner (1994) states:

> "A civilization whose physical conceptualization is irreconcilable with so many fundamentally important life concepts is of necessity split within itself and split off from the world. Consonance between science and life-centered discourse creates the possibility of vastly less schizophrenic understanding of what it means to be human in a physically real world. This is a fundamental change." (p.10)

3.3 General Evolutionary Methodology

Before I outline the methodology for the analysis of environmental case studies, let me discuss briefly the issues of management and control.
The recent developments in general evolutionary science clearly represent sophisticated methods for the study of complex systems. However, there has been some recent criticism of the methods. The major criticism is that the emphasis is still on management and control (Shackley, Wynne, Waterton, 1996). The argument, so far, has been that alternative methodologies and conceptual tools are

required to capture the dynamic inherent in complex systems such as the nervous system, ecological, and environmental systems, which exhibit a significant difference in complexity and uncertainty. Thus, more powerful methods mean better understanding of the system and better management and control. Recent simulations of the behavior of deterministic non-linear systems are being utilized for the explanation of business cycles, economic systems, and ecological systems. In these simulated models, the concerns of evolutionary dynamics, the adaptive and structural changes occur internally. The internal characteristics of the actors change endogenously and new variables and new dynamics occur spontaneously from within the system itself.[12]

As Shackley, Wynne and Waterton (1996: 205) argue:

> "In short, in its more naive realist versions, complexity may come to imply no more than the substitution of one set of methods, now seen to be inadequate, with another more sophisticated set, with no consequent change in existing practices and institutions".

Their concern is that the new development for probing complex systems stays consistent with its tenets (Shackley, Wynne and Waterton 1996: 220):

> "If as we argue, the key defining feature of the complexity problematique is indeterminacy, then any complexity 'tool' must always also be more than a mere tool, since its use must build in the very indeterminacy which it claims to be addressing when it addresses complexity. Otherwise it is indulging in the same, but even more pretentious, kind of misbegotten control-oriented myth-making which we would suggest has characterized much of modern science-for-policy."

This is what Wilber (1995) calls subtle reductionism. The implication is that the challenge for institutions lies not only in understanding and managing the qualitatively new concept called complexity but also in acknowledging the need to move away from the aim of control and prediction. This sort of subtle reductionism adds to the epistemological complexity addressed in chapter 2. The organization's need for stability will require some degree of control and management and the ability to navigate in a constantly changing environment.

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[12] Faber and Proops (1990) have set out a seminal framework for ecological economics in which the emergence of novelty, structural change, new concepts of evolution, and time-irreversibility are incorporated in a method of simulating the long-run interaction of consumption, capital accumulation, resource use, and pollution. Allen (1994) has explored the behaviors of systems with endogenously generated innovations and selections for a business firm. The concept of "possibility space" is used, which represents the range of different techniques and behavior that could potentially arise from different types of firms. The mathematical model presents a picture of a landscape of emergent co-evolution of behaviors.

The methodology that I propose is a nonreductionistic methodology. Its focus is not on prediction and control but rather on understanding patterns of interaction and emergence. It addresses the major research question in this study - how do the sustainable development strategies and methods currently being utilized by selected environmental organizations reflect the general evolutionary perspective?

The methodology is elaborated below. In chapters five and six, case studies will be analyzed using these attributes to gain a better understanding of the path towards sustainability.

3.3.1 Structural Component

The proceeding discussion of chaos theory, nonlinear interdependence, and geometry of behavior and attractors can be synthesized to provide the first step in data organization and analysis. It provides the structural component of the methodology. This methodology is oriented toward developing insight into environmental case studies in the context of sustainability as the predetermined management goal.

This methodology is developed for the purpose of this study, although it may have ramifications for other subject matters. The first part of the methodology follows closely the general framework proposed to analyze the negotiation process (Faure and Rubin 1993) and nonequilibrium system's methodology (Slocombe, 1990) with special emphasis on the system's characteristics and nonlinear interdependent dynamics. I have defined it as structural methodology since, as we will see in the following discussions, it is the structural nonlinear interdependent component that runs across the general theory of evolution.

The first step in the methodology is to identify the systems characteristics. It describes project level characteristics in detail. It identifies actors, context and organizational strategies. Actors include those who participate as well as those who may have influence and interest within the identified project. Context refers to the set of constraints within which the project takes place, such as the number of parties, distribution of power, time frame, location, and communication process. Organizational strategies describe the general orientation of the action to be taken to achieve set goals. In chapter 5, for each case study, I describe how these variables have played out in more detail. Figure 3.2 identifies the interacting systems characteristics which need to be described.

The second step includes identifying chaos characteristics such as nonlinear interdependent variables and micro attractors. The term "attractor" is a key concept in chaos that describes a mathematical model of hidden patterns in interactive chaos. I am using the term "attractor" quite broadly here to describe a particular

form that a dynamic system may be drawn towards. As Goerner (1994:39) articulates, " a system's behavior can be thought of as being drawn toward the attractor's form." I am using the term micro attractor to describe a generalized pattern that a project is moving towards. Micro-project attractors refer to project states. They describe the forms that have emerged from the project.

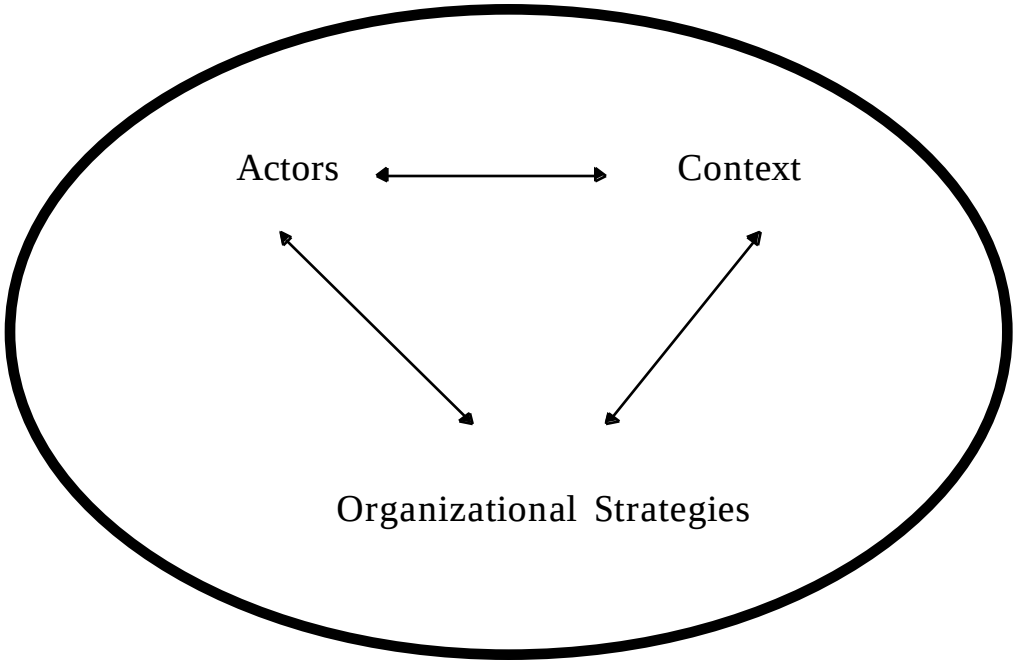

Figure 3.2 Schematic of the Structural Component: System Characteristics

I will identify the coevolving variables which underlie interactions at the project level. These variables shape the behavior and patterns of micro-project attractors. Macro-attractors refer to environmental management fields which exist outside the micro-project attractors and describe the macro level environment. I will identify important actions, events, and ideals and look for small-scale nondirectional changes, qualitatively new organizations, alignments, and relationships being developed. Figure 3.3 describes the schematic of the micro-project attractor and nonlinear interdependent variables.

3.3.2 Process Component

The process component deals with the emergent behavior in the system. It describes the internally generated order-building process. Internal configuration of the project is only one level of organizational action, the macro environment can exert significant pressure on the development of the micro-project attractor. Therefore, it is important to describe the overall macro field and its relationship with the micro attractor. Here, I will look for dynamics in the case studies such as growth in complexity and the pace of change. I will examine the selected case studies for symmetry-breaking processes, emerging fields, and what is sustaining the processes as well as factors which bring about the collapse of the micro attractors. I will also

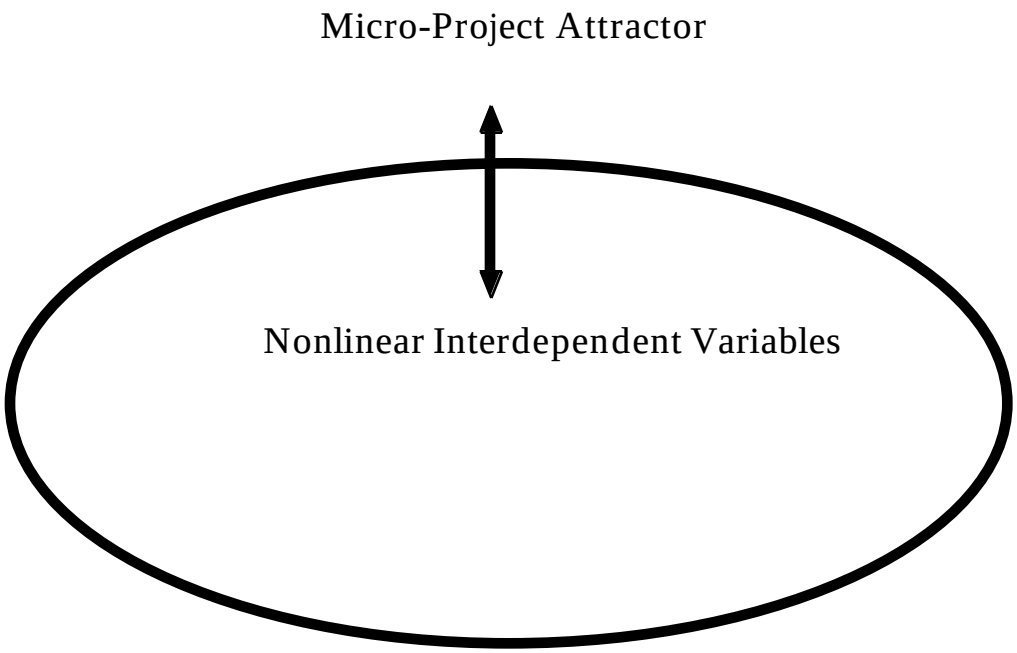

Figure 3.3 Schematic of the Structural Component: Micro Attractor

identify barriers, internal and external factors that provide destabilizing forces. Figure 3.4 describes the schematic relationship between the micro and macro attractors.

3.3.3 Transformational Component

The transformational component deals with new types of gradient that may be emerging. Here, I will search for new levels of independence from previous levels and assess the probabilities and possibilities for change, planning, and understanding in the micro-project attractors. This is a qualitative empirical task based on characteristics of the emergent attractors. I will look for coevolutionary relationships between the institutional field and the type of gradient which may be driving the process as well as potential planning implications. The characteristics include networks and coupling processes, the selection process, energy flows, pathways of efficiency, new levels of complexity, and new conditions of possibilities. I will also search for characteristics such as semantic closure, types of unfolding and learning, translating elements, transforming elements, creativity, and novelty in the system. In this section, I am attempting to describe evolutionary characteristics such as increasing complexity, differentiation, integration, increasing organization and structuration, and increasing autonomy, that

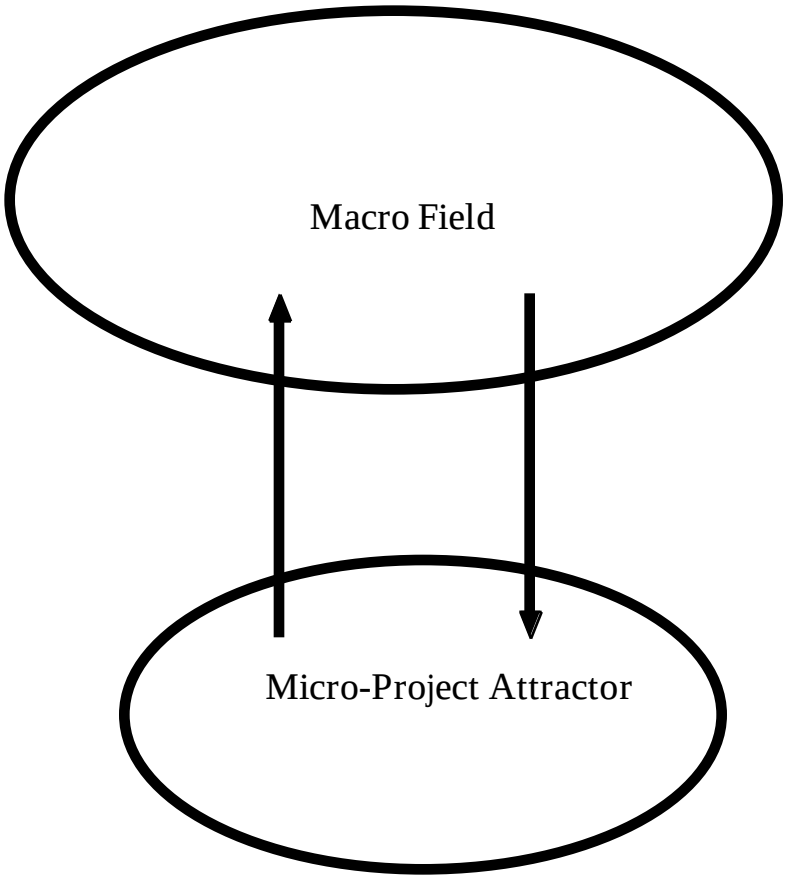

Figure 3.4 Schematic of the Process Component: Relationship between Micro Attractor and Macro Field

may be in operation. Figure 3.5 describes the pathways of efficiencies that are resulting from the co-evolutionary dynamic between micro attractor and macro fields.

3.4 Building Elements of the General Theory of Evolution

Having described the three separate components in the general evolutionary methodology, I will describe in detail the corresponding conceptual elements of the general evolutionary sciences from which the methodology is derived: nonlinear interdependence, self-organization, and qualitative evolution.

3.4.1 Nonlinear Interdependence

Nonlinear interdependence, or chaos, has come to represent the study of complex dynamic systems including fractals, attractors and multi-dimensional systems. Chaos is the study of nonlinear interdependent relationships, hence the terms nonlinear dynamics, complexity, and also the metaphor of ecology. Contrary to its name, chaos as a mathematical tool describes complex systems through simple sets of relationships. One of the interesting findings in chaos is that simple relationships, or, more precisely nonlinear interdependent relationships, can drive a system towards

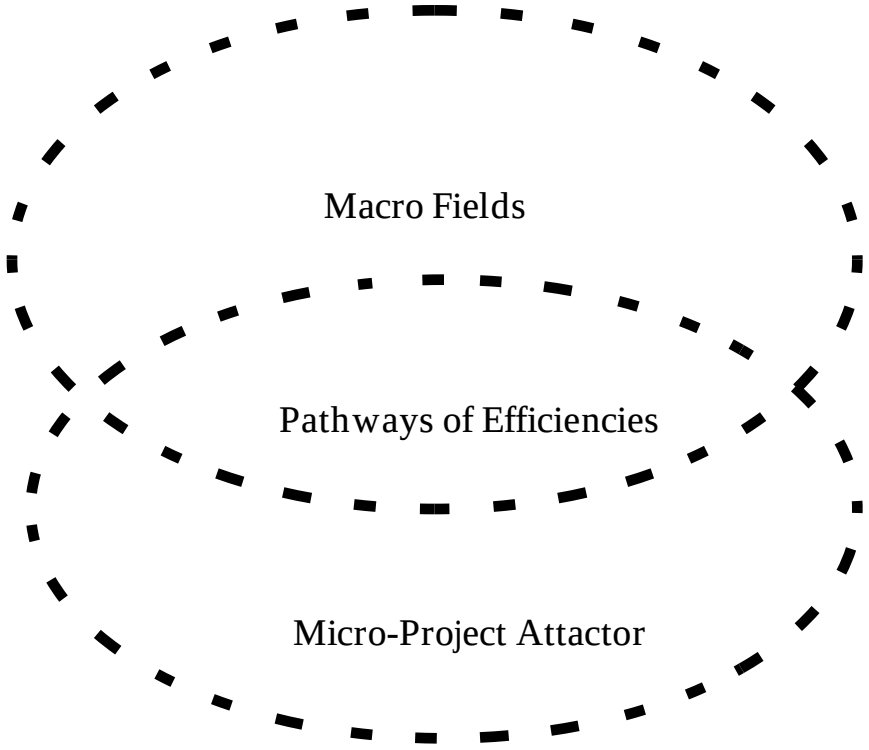

Figure 3.5 Schematic of Transformational Component

complexity. Complex interdependence is found in examples such as weather, the brain, and ecology. The reason for the current novelty in chaos is that it provides a new mathematical tool for the study of systems which are part of every day life.

The term *nonlinear* simply describes a relationship where the input is not proportional to its output, such as $Y = X^2$. The term *interdependence* describes a condition where the variables mutually affect and are affected by one another, a condition known as complex causality. For example, environmental degradation is often cited as a function of population, consumption levels, and technology as described by the following equation: $E = f(p, c, t)$ where the level of environmental degradation E is a dependent variable and is a function of the independent variables *p = population, c = consumption, and t= levels of technology*. Contrary to the simplified model, these variables are not *independent* of each other. These variables mutually affect one another. For example, population growth is affected by levels of technology and the consumption level is also affected by the levels of technology and vice versa.

Peter Senge (1992: 71) describes in another real world example, a view of the arms race between the United States and the Soviet Union during the cold war.

> " The systems view of the arms race shows a perpetual cycle of aggression. The United States responds to a perceived threat to Americans by increasing US arms, which increases the threat to the Soviets, which leads to more Soviet arms, which increase the threat to the United States, which leads to more US arms, which increases the threat to the Soviets, which ... and so on, and so on."

In this very real and potentially catastrophic interaction, both sides mutually affect one another, and as Senge notes, the simple conclusion of "doing the obvious thing does not produce the obvious, desired outcome." The real aggression in this case is caused by the failure to see the inseparability or interdependence of each others' action. Interaction effects are nondecomposable and cannot be separated at each level.

Interdependence describes a relationship where the variables affect and are affected by each other in complex causality. In most real world examples, there is no such thing as an "independent" variable per se, because one cannot separate the two variables. The equation described above is not only unrealistic, but misleading because it assumes that the complex nonlinear interdependent dynamic can be described in a linear fashion; it cannot.

The nonlinear interdependent relationships describe just about all relationships in the universe. The systems that are actually rare are linear and nonlinear *independent* relationships, which Newtonian calculus and other approximation methods are able to solve. Nonlinear independent systems can be described by equations which are nonlinear but have only one variable. Newton's foundational model for science was derived using a calculus-based approximation method.

In the Newtonian mechanistic model of a given system, whether it is the solar system or an urban system, the model is constructed from the causal relations that exist between the components of the system for a particular time and space. If you can describe the behavior of the system for a particular moment through a series of equations, they will describe the system in the future and in the past, given that the starting conditions are known. In human systems, the added assumption that is attached with the initial condition is that the system runs towards an equilibrium (Allen 1994). [13]

Chaos has introduced a new quantitative method for the analysis of complex dynamic systems which were not approachable via calculus-based methods. What new method was introduced? The new method provides the overall *pattern* of the system's flow, and it maps the *geometry of behavior* (Goerner 1994). [14] A good example that expresses geometry of behavior is known as phase space. The phase diagram maps out the entire range of behavior between speed and direction and describes the pattern of the system's flow. Attractors and bifurcation diagrams are further examples of patterned maps that provide the geometry of behavior.[15] Cohen and Stewart (1994: 200) describe the geometry of behavior in this way:

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[13] Furthermore, as Wilber (1995; 48) states, "Let me note in passing that this means *all* sciences are fundamentally *reconstructive sciences*. That is, we never know, and never can know, exactly what any holon will do tomorrow (we might know broad outlines and probabilities, based on past observations, but self-transcendent emergence always means, to some degree: surprise!). We have to wait and see and from that, after the fact, we reconstruct a knowledge system. *However*, when a holon's self-transcendence approaches zero (when its creativity is utterly minimal), then the *reconstructive sciences* collapse into the *predictive sciences*. Historically, the empirical sciences got their start by studying precisely those holons that show minimal creativity. In fact, they basically studied nothing but a bunch of *rocks* in motion (mass moving through space over time), and thus mistook the nature of science to be essentially predictive.

[14] The attribution of the development of visual systems that allows for the study of dynamical systems is contributed to Henri Poincaré.

[15] The classic example from biology is Volterra's model which describes the dynamical relationship between predator and prey to combine a phase space diagram that shows the changes in population values through time. Similarly, the Lorenz attractor describes a weather modeling system graphed in three-dimensional phase space. This type of attractor is known as a strange attractor. The point is that nonlinear interdependent relationships can be described via chaos methods, which help us understand patterns and structures of behavior.

> "The geometry of dynamical systems takes place in a mental space, known as phase space. It's very different from ordinary physical space. Phase space contains not just what happens but what might happen under different circumstances. It's the space of the possible."

Thus, the geometry of behavior describes the space of the possible - the description of its states for a dynamic system and the things that are happening to the system as a whole.

The point to remember here is that nonlinear interdependent relationships can be described via chaos' methods and provide the quantitative means to understand patterns and structures of behavior. Goerner (1994) explains the difference between chaos and calculus-based methods this way:

> "They allow empiricism to enter realms that are provably unbroachable via analytic methods. The approaches are just different. Specifically, they focus on the geometry of behavior; they help us predict and verify patterns and transformations between patterns instead of focusing us on predicting specific events."

An *attractor* describes a particular form of behavior which changes or evolves in the same system or the same equation. Thus complex systems with multiple possibilities or states can be described through a very simple equation with few dimensions. A dynamical system can have just one attractor or many. Changes in the system portrayed by different attractors provide a map of the qualitative change in the dynamics brought about by changes in the variables via interdependent effects. These qualitative changes are known as bifurcations. One of the important implications of bifurcation is that macro qualitative changes in the system can come suddenly to a qualitatively different form of behavior from the same interaction of variables. Small changes in the control variables can have massive effects, producing qualitatively different forms of behavior and thus new attractors. [16]

Complexity comes from the consequence of the relationship between simple elements at each level through the enormous potential of possibilities accompanied by simple laws. The combination of letters within the context of grammatical guidelines produces the enormous possibilities that can be expressed through the written word for a shared meaning in a culture.

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[16] See Cohen and Stewart (1994: 210) for examples of attractors related to beetle population. Roger Lewin(1992: 44-62) describes an example of an evolutionary shift that provided the Pre-Cambrian explosion. Other environmental examples may be global warming, currently caused by changes in the carbon emission from industrial production. It can produce a different climatic attractor with few degree changes in the earth, which can have massive effects on the global dynamical system.

Attractors not only represent the form of interactive dynamics, but also the pulling of the behavior towards this pattern. This type of pattern can have structural stability and is said to be self-stabilizing. When instability results, it can lead to a qualitatively different form, or different attractor, and all can come from the same nonlinear interdependent effects in the system. These "chaotic" structures can further exhibit sensitive dependence on initial conditions, a process known affectionately as the "butterfly effect" because very small changes in the initial conditions can lead to very different forms and patterns. Thus, even if the equation is known, due to the butterfly effect, chaotic systems are unpredictable. Chaotic systems are said to be lawful, orderly, deterministic, and unpredictable (Çambel, 1993).

Order has a special meaning in this context. Order, or simplicity, can be hidden in randomness, and simple equations can generate complexity. Complex local behavior can be a part of a simple ordered global system. From the interactive dynamics, order emerges from the system's internal dynamics rather than being enforced from the outside, and is said to be "self-generated behavior." Specifically, global order can arise from local behavior which seems chaotic, and, due to the "affecting and being affected" principle, global order affects local behavior, and local behavior in turn affects the global pattern, or attractor. In the case of whirlpools, for example, the whirlpool form represents the order behavior in the global system, while the water molecules which are in chaotic interaction at the local level help pull new molecules into their pattern flow, and it in turn affects the interaction at the local level.

This type of positive feedback is one of the essential features in Arthur's (1988) economic model of the nonlinear behavior of increasing returns. Conventional neoclassical economic theory is built mainly on the assumption of diminishing returns on the margin or local negative feedback. In the theory of increasing returns, however, the economy is viewed also as the working of increasing returns (positive feedback). Emergence takes place within the market system through initial market changes and interactions among the variable components such as the level of technology, marketing, consumer behavior, and "chance." [17]

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[17] Waldrop (1992: 40) provides a practical example in the case of the development of an internal combustion engine. When the automotive industry was in its infancy, gasoline was considered the least promising power source. At the time, Steam technology was ahead of gasoline. It was considered safer than the dangerously explosive and noisy gasoline. However, in the late 19th and 20th century North America, a series of historical accidents involving an outbreak of hoof and mouth disease allowed gasoline power to be a quick lock in. This was due to the withdrawal of horse troughs, which were the only place where steam cars could fill up with water. Another example he describes is the history of the standard QWERTY keyboard layout, which is on virtually every typewriter and computer keyboard in the Western World (the name QWERTY spells out the first six letters of the keyboard). Is this the most efficient way to arrange keys on the typewriter? No. As the story goes, "An engineer named Christopher Scholes designed the QWERTY layout in 1873 specifically to slow typists down; the typewriting machines of the day tended to jam if the typist went too fast. But then Remington

There is a meta dimension to the concept of nonlinear interdependence. It connotes not only the linkage with the variables but also a micro-macro linkage or local-global relationship. As Cohen and Stewart (1994: 220) articulate, "the term 'reductionism' carries the connotation that complexity on one level is reduced to simplicity on another level." Chaos proves that this is not the case. In a sense, local behavior can only be understood through its global outcome. One does not exist without the other, and the ultimate causality is neither from below or above. Neither reductionism nor holism are the answer, and the effects come from neither here nor there. This type of perception, as I have pointed out in chapter 2, requires the epistemology of complementarity.

Chaos theory, with its concepts and tools, has brought forth into the foreground the principle notion of complex causality. Causality is not just complex, it is irreducibly so. It cannot be broken down into independent elements. Study of chaotic systems thus expands the Newtonian framework and changes the way we think and the way we question things by changing the framing of questions from "either/or" to "both/and" (Zohar and Marshall, 1994). It brings forth the notion of an ecological dynamic with internally generated order, interdependence, sensitive relationships, and micro-macro linkage. In short, it brings forth the beginning exploration of an evolutionary vision of possibilities.

3.4.2 Self-Organization

Chaos provides an understanding of ordered structure - attractors with patterns and forms derived from the internal dynamics of nonlinear interdependence. Another important branch of the nonlinear revolution is the theory of self-organization, particularly in the context of far-from-equilibrium energy flow. The theory provides an understanding of why ordered structure emerges at all. This section provides an understanding of what I would describe as the process character in nonlinear revolution. I will first discuss the subject of energy flow and the concept of self-organization.

In the theory of self-organization, the concept of attractors is expanded to include flows of energy, and more specifically, attractors which pull energy. The theory of self-organization incorporates the science of energy - thermodynamics to describe the internally generated order producing process, hence the term self-organization.[18]

Sewing Machine Company mass-produced a typewriter using the QWERTY keyboard, which meant that lots of typists began to learn the system, which meant that other typewriter companies began to offer the QWERTY keyboard, which meant that still more typist began to learn it..." (Waldrop, 1992: 35). As we can see, this type of positive feedback, or increasing returns, is evident throughout the economic system.

[18] This section is important, as pointed out in chapter 2, since it is on thermodynamics that recent variants of ecological economics have based their analysis of sustainable development. The new

Emergent forms describes not only physical processes such as hurricanes but social processes as well. It is an approach that begins to describe the general theory of evolution.

The first aspect of the theory describes the flow of energy. The flow of energy depends on the relationships between various concentrations. "Far-from equilibrium" is a specific condition of varied energy concentrations which force the energy to flow in a nonequilibrium manner (Prigogine and Stengers 1984). An emerging attractor is derived from a self-generated dynamic. It is the configuration, or the relationship, of the system's energy that makes energy flow. Nonlinear interdependence is inherent in this theory, as it is in chaos theory.

What drives the system is not an exogenous energy source outside but an uneven internal distribution of energy, known as field potential. Field potential becomes the force which drives energy flow. The configuration of the system also becomes a primitive form of self-selection. Flow and force are parts of an interdependent system in which they "affect and are affected" by one another. Self-organization results from nonlinear interdependent dynamics of flow and force. A dissipative system basically adds energy dimension to this (Jantsch 1980; Prigogine and Stengers 1984; Prigogine 1985). The important message of the self-organization theory is that the possibility for *order exists from within*. In a closed system, the flow would eventually recede and the system would reach a local equilibrium point. From an information perspective, such a system is considered "informationally dead" in which "creativity is utterly minimal" (Wilber 1995: 48). In an open system where the energy ecology continues to be dynamic, the most efficient path is selected. This selection forms a system of positive feedback loops (self-feeding cycle) which pulls in energy faster and generates more flow, so the path becomes more efficient and generates new information.

Within the internal field, the attractor contains what Swenson (1989) calls an on-board potential, from which the energy is transferred. An efficient path for the energy emerges. As more energy is transferred along this path and the motion becomes accelerated, the self-selection process creates a positive feedback cycle or amplification effect. In an open system, these fluctuations, which Prigogine and Stenger (1984) call "order through fluctuation" lead to a "far-from-equilibrium system."[19] Under critical conditions, small fluctuations can lead to a bifurcation

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understanding has the potential to expand recent approaches. See Funtowicz and Ravetz (1994) for more detailed analysis.

[19] Prigogine and Stenger (1984: 141) describe a far-from-equilibrium condition as follows:

"In some cases, the analysis leads to the conclusion that a state is 'unstable' - in such a state, certain fluctuations, instead of regressing, may be amplified and invade the entire system, compelling it to evolve toward a new regime that may be qualitatively quite different from the stationary states

point and the emergence of a new attractor. This is a self-organizing ecology because the emergent organization system maintains its structural stability, due to its ability to exchange its energy with its field. These small, critical fluctuations can also lead to the collapse of attractors. Self-organizing ecological systems are said to be on the edge of chaos and order (Waldrop 1992). A dynamic entity is a particular matter/energy configuration that exists in a particular point in time and space. It is a self-organizing ecology of on-board potential, flow, and matter all existing in an interdependent relationship, again the theme of nonlinear interdependence.

From this ecological point of view, there is no such thing as a "thing" per se and no such process as "process" per se. From a physical point of view, a molecule is not a thing but a dynamic system of atoms organized in a self-organizing ecology. Cells are dynamic systems of molecules, organs are dynamic systems of cells, individuals are dynamic systems of organs, and societies are dynamic systems of individuals. Furthermore, these entities are wholes that are part of other wholes, as Wilber (1995: 35) concludes in the new scientific conception of *reality*.

> "*Reality is composed not of things or processes but of holons*. Composed, that is, of wholes that are simultaneously parts of other wholes, with no upward or downward limit. To say that holons are processes instead of things is in some ways true, but misses the essential point that processes themselves exist only within other processes. There are no things or processes, only holons.

Examples of such dynamical systems can be found in hydrodynamic fluids such as Bénard Cells, tornadoes, autocatalytic chemical reactions, and in ecosystems (Schneider and Kay 1994). In Bénard cells, when the temperature gradient increases to a bifurcation point, highly organized hexagonal cell structures emerge.[20] The transformation between molecules randomly colliding in a non-coherent fashion from heat transfer to a self-organizing emergent structure results in 10^{22} molecules stabilizing in organized matter. The tornado, another highly organized structure, has the ability of 10^{23} molecules through a dissipating gradient to bring together this macroscopic, organized structure.

In chemistry, the self-feeding mechanism is known as an autocatalytic reaction. It differs from the self-organization processes found in Bénard cells and hurricanes. Autocatalytic reactions produce an intermediary product and an end product, which become parts of the self-feeding mechanism. They represent a self-generating, self-

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corresponding to minimum entropy production. Thermodynamics lead to an initial general conclusion concerning systems that are liable to escape the type of order governing equilibrium. These systems have to be 'far from equilibrium.' In cases where instability is possible, we have to ascertain the threshold, the distance from equilibrium, at which fluctuations may lead to new behavior, different from the 'normal' stable behavior characteristic of equilibrium or near-equilibrium systems."

[20] Bénard cells represent a hydrodynamic experimentation that shows repeatable spontaneous emergence of a coherent state in a viscous fluid at a far-from-equilibrium condition.

organizing ecology. Autocatalytic reactions add the extra dimension of cycles and networks. In chemical kinetics, nonlinear interdependent networks produce self-feeding reactions which form a network of networks. These reaction networks provide more efficient use of energy, faster flow of energy, and more stability than those found in hydrodynamic fluids. In reactions such as the Kreb cycle, vital for biological oxidation-burning of foods, stability is vital and becomes its own form of self-selection. Thus, an autocatalytic reaction produces more complex and more stable dynamical organization. It represents a spontaneous reproductive organization which emerges through self-organizing ecology. It not only involves the energy ecology, but also the emergence of chemical networks, which proceed through their own reproductive chemical networks (Csanyi, 1989). The self-organizing theory reveals that the concepts of selection, stability, and reproduction exist not only in living systems but are evident in systems which are precursors to life itself (Csanyi 1989).

What I have described so far is an emergence of autonomous organization in relatively isolated situations such as fluid flow, hydrodynamics, and chemical instabilities. We have seen so far that the spontaneous emergence of dynamical entities is possible from the perspective of self-organizing ecology. How are living systems linked with the laws of thermodynamics? Are similar processes at work in living systems such as the ecosystem? In the following argument, I will introduce the emerging theories with some broad empirical data that critically link concepts of emergence, complexity, increasing efficiency, and the acceleration of change to form the general theory of evolution.

Erwin Schrödinger was one of the first theorists to try to link the fundamental processes found in biology, to chemistry and physics. He observed that one of the fundamental processes of life involves order emerging from disorder. Schneider and Kay (1994: 629) summarize his efforts in the following way:

> "He noted that at first glance, living systems seem to defy the second law of thermodynamics which insists that, within closed systems, entropy should be maximized and disorder should reign. Living systems, however, are the antithesis of such disorder. They display marvelous levels of order created from disorder. For instance, plants are highly ordered structures, which are synthesized from disordered atoms and molecules found in atmospheric gases and soil. Schrödinger solved this dilemma by turning to non-equilibrium thermodynamics, where he recognized that living systems exist in a world of energy and material fluxes. An organism stays alive in its highly organized state by taking energy from outside itself, from a larger encompassing system, and processing it to produce, within itself, a lower entropy, more organized state. Schrödinger recognized that life is a far from equilibrium system that maintains its local level of organization at the expense of the larger global entropy budget. He proposed that to study living

> systems from a non-equilibrium perspective would reconcile biological self-organization and thermodynamics."

Entropy is usually associated with the creation of disorder. However, as Bohm(1980) notes, the concept is more closely defined by *randomness* rather than disorder. This conceptual shift is important, since randomness is tied to the concept of complexity and links with the nonlinear observations. The general trend in evolution, the movement toward order and complexity, is at absolute odds with the second law of thermodynamics, the production of maximum randomness, or maximum entropy production (Swenson 1989). But perhaps with these two concepts being at such extremes, they are much closer than previously thought. The key lies in the far-from-equilibrium condition. In equilibrium or near equilibrium conditions, spontaneous order is infinitely improbable, and maximum randomness, infinitely probable. However, in far-from-equilibrium conditions or "on-the-edge of order and chaos," evolution becomes infinitely inexorable (Goerner 1994; Swenson 1989).

Goerner (1994: 78) articulates the relationship between evolution and the second law of thermodynamics in the following:

> "Three things become linked - the growth of complexity, increasing efficiency, and the acceleration of change. These elements form the basis of a general theory of evolution, from molecules to civilizations, as one overall process that exhibits isomorphic patterns of change. The message: evolution is inexorable, not improbable; it includes more than just species and it is going on right now."

Swenson (1989) has utilized the connection between the far-from-equilibrium condition and entropy to provide a plausible thermodynamic story of evolution. In Swenson's theory, entropy not only increases with acceleration of energy flow, but under far-from-equilibrium conditions, it flows at the maximum rate. This is a theory of Maximum Entropy Production (MEP). MEP's perspective reinforces the notion of self-organizing ecology by including the relationship between the field and order with the rate of energy flow. The overall field seeks orderly flow because order is a most efficient[21] way of producing entropy. Coherent structure provides a faster flow of energy than incoherent structure. A self-organized state provides the most efficient path of producing maximum entropy at the given time-space constraint and in turn provides new dissipative surfaces, new levels of complexity. The generation of complexity is an important prerequisite for new levels of efficiency in flows of energy.

[21] Efficiency is "measured in nonlinear systems by the effectiveness of that attractor's internal amplifier." (Swenson 1989: 195)

Increase in the production of entropy provides seeds of complexity and diversity such as cycles, networks, and coupling,[22] which produces new forms of organization such as the coupling of single cell organisms to form multi-cellular organisms. It also provides new forms of fluctuation from the internal dynamics, setting the possibility for symmetry breaking points in the new system. Generally speaking, the possibilities set the conditions for probabilities and probabilities set the condition for possibilities.

For Swenson (1989: 187), physical evolution is:

> "The time-dependent attraction of matter away from equilibrium to time-independent limit sets from spontaneous symmetry-breaking events that have brought and continue to bring the visible universe, including the consciousness with which it contemplates itself, into being."

In summary, Swenson (1989: 195) states about the principle of Maximum Entropy Production:

> "The law of maximum entropy production provides a cornerstone to a comprehensive theory of general evolution within which biological and cultural evolution are shown to be special cases, e.g., information is differentially retained that maximizes the space-time expansion of a field's dissipative surfaces. It provides a causal explanation for the universality of the spontaneous destabilization of homogeneous states and the emergence of new, irreducible levels of dynamical space-time behavior."

Molecules, for example, emerge from dynamic interaction between atoms, providing the field with the most efficient flow of energy. Under far-from-equilibrium conditions, time-space constraints are broken- incoherent to coherent transformation, and new form or attractors emerge into being.

Schneider and Kay (1994) and Holling (1994) have recently proposed applying a thermodynamic paradigm for the study of ecosystems. Ecosystems are viewed as non-equilibrium structures and processes, open to material and energy flows. Schneider and Kay (1994: 633) argue:

> "Living systems in this biosphere, having evolved in accordance with the second law, decrease the overall ability of incoming energy to establish energy gradients and thus disequilibrium. This is accomplished by increasing

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[22] Also known as Autopoiesis - the ability to generate itself (Maturana and Varela 1992).

throughput and degrading the excergy[23] content of the mass and energy flow through the system."

Schneider and Kay (1994) provide evidence from recent empirical data that shows ecosystems degrade energy gradients more effectively as the ecosystem evolves. Evidence from the NASA thermal infrared multispectal scanner suggests that the more developed the ecosystem, the faster its ability to degrade energy. The technology assesses the energy budgets of terrestrial landscapes. It suggests that ecosystems develop structure and function in order to assist energy degradation more effectively. Satellite-derived Earth radiation data also suggests that more developed ecosystems such as tropical rainforests with their coupled cloud systems degrade solar gradients more than terrestrial ecosystems. As the principle of Maximum Entropy Production suggests, the more evolved the ecosystem, the faster the rate of energy flow.

3.4.3 Qualitative Evolution

The acceleration of change, increasing complexity, and increasing levels of efficiency (maximum entropy production) all interact interdependently in a constantly fluctuating field[24] to provide a vision of unfolding dances which we call evolution. The notion of energy flow with the concept of attractors at far-from-equilibrium conditions provides the conceptual basis for understanding how order arises. Order becomes the natural state of an entropy-producing universe through its relationship with efficiency. Higher order is produced by higher efficiency, and higher efficiency produces higher order. All are interconnected. The important part of the story is that not only do new attractors emerge from the energy gradients, but more refined gradients such as information and meaning also emerge from this process, setting the possibility for qualitative evolution.

Living systems respond not just to local gradients but also to their external environment. Living systems are not slaves of the energy gradient. In the example of a whirlpool, if you turn off the faucet (the local energy gradient), the whirlpool ceases to exist. The emergent, self-organized system collapses. A basic life form such as a bacterium, on the other hand, increases its activity when its local gradient ceases. It gets "hungry" and seeks to satisfy its "appetite." It transcends its local field potential (mass-driving gradient) and responds to the environment in a functional

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[23] Excergy measures the available work content of energy. It measures the ability of energy to drive the system away from equilibrium. It is also related to the quality of energy. The higher the quality of energy, the greater the gradients.

[24] This is comparable to the concept of morphogenic field introduced by Rupert Sheldrake (1981). Morphogenic field describes a hierarchically organized system, *holons* ranging from atoms to societies. At each level, the field works by ordering processes that are interconnected to higher ordered levels.

way. It responds to non-local potentials, information-based gradients known as kinematics. How is this type of autonomy and control accessed?

For living systems, autonomy and control seem to be gained from a process called semantic closure (symbol-matter system). Pattee (1982) points out that replication, metabolism and function, the basic functions of life, require a semantic closure of symbol and matter as a highly refined coupled self-organized system to preserve functional information, e.g., the "programming" inside the bacterium. In other words, the DNA, which carries the program or code, and the RNA, which reads the code, the reader, and the interaction between the two, comprise a single, inseparable, *interdependent* system. This semantic closure arises from the necessity that the reader and the code effect and affect one another and provides a new type of gradient that brings forth life. As Pattee (1982: 333) states:

> "We can say that the molecular strings of the genes only become symbolic representations if the physical symbol tokens are, at some stage of string processing, directly recognized by translation molecules (tRNA's and synthetases) which thereupon execute specific but arbitrary action (protein synthesis). The semantic closure arises from the necessity that the translation molecules are themselves referent of the gene strings."

The origin of life in energy flow terms seems to suggest that independence from mass-driving gradients, which can produce molecular compounds such as DNA and RNA through biological/chemical processes such as autopieosis and autocatalysis, was achieved through the addition of rate-independent constraints to flow (Swenson 1989).

From the point of view of efficiency, the new attractor (symbol-matter configuration) is selected since it pulls more energy and continues to do so over its life cycle. Replicative activity is "selected" because of its autocatalytic nature, where output becomes the input in its own system. The result is that life and its relationships with information based fields *co-evolved*. Systems become favored, which become efficient within the information-based gradient. Systems are not just efficient in their relationships with the mass- based gradient, but are systems which learn. Emergence of culture, language, meaning, and symbols can be seen as an examples of second-order semantic closure. They represent emergent attractors that break their driving gradients (information in these cases). Cultures and their relationships to meaning-based gradients co-evolve. Those cultures *can*[25] become

[25] I say "can" because I am now describing a system which I am part of and in which I am part of the unfolding. The ideas that I put forth to the community of learners can enhance the possibility of this unfolding or aid in the collapse of this emergent attractor. The concepts of intentionality, awareness, and consciousness become important factors at this level. Methods, actions, and criteria by which we

favored that are efficient, learn, and display wisdom. The interdependence of efficiency, learning, and wisdom can become the criteria for evolutionary selection. As the opening quotation suggests, qualitative evolution puts a different understanding of our role in the process of evolution. We are not passive participants nor masters. We co-create the unfolding where *learning* becomes the quintessential act.

Goerner (1994:116) summarizes the path that the learning universe, so far, has traversed in the following:

> "Humankind's more conscious learning and planful activity is the latest result of the learning process. In first-order flows, such as the Bénard cell, learning involves re-configuration at the level of bulk-mass geometry. Since learning is embodied in structure, learning is limited by the system's general physical shape. The emergence of first-and second-order kinematics flows represents a dramatic increase in efficiency whereby more and more mass is driven by finer and finer flows. In second-order flows, such as bacteria, reconfiguration produces tighter coupling internally and a different kind of coupling externally. Learning accumulates faster as systems extend over time and over more complex fields. In third-order flows, such as culture and science, the flows turn back on the field. Learning moves beyond the individual's life time and is turned back on the environment. What is learned is how to restructure environment itself. And in the process, the field's differentiated aspects (human beings) have become more intentional and planful, i.e., rational."

The story describes the unfolding of the universe, which is the same from atoms to civilizations; an isomorphic pattern emerges.

Let me conclude this section with a quote from Wilber (1995: 73), a glimpse of what the learning universe implies for us.

> "Each discovery of a new and deeper context and meaning is a discovery of a new *therapia*, a new therapy, namely: we *must shift our perspectives, deepen our perception*, often against a great deal of *resistance*, to embrace the deeper and wider context. The self is situated in contexts within contexts within contexts, and each shift in context is an often painful process of growth, of death to a shallow context and rebirth to a deeper one. But for just that reason, each time we identify a deeper context, our relative autonomy actually increases, because in identifying with a deeper perception, we have found a wider freedom".

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aid the development of cultures, and reexamine the process by which we may have been destroying the fabric of cultures, become an important area of study.

3.5 Conclusion

In this chapter, as a way of transdisciplinary synthesis, I have presented the concepts of nonlinear interdependence, self-organization, and qualitative evolution that functions as an interpretive framework for analysis of selected case studies. More importantly, I have translated the general evolutionary paradigm to a methodological focus, identifying three methodological components - *structural*, *process* and *transformational* components. The following chapters present the results of the research analysis.

CHAPTER 4

Research Design and Methods

*You can look at the "insides" all you want and you will never see an **interior**, because whereas surfaces or exteriors can be seen, interiors must be **interpreted.***
Ken Wilber 1995: 134

4.1 Introduction

In this chapter, the research process and the method of analysis are identified and discussed. In the previous chapter, I presented a *methodological framework* for the study derived from the general evolutionary sciences. In this chapter I will discuss the research method itself. I will discuss the type of research strategy chosen, the organizations under study, the process of data collection, and the method of analysis. I employ a qualitative method and case study as a research strategy (Yin 1994).[26] A qualitative method and case study research are employed because I am attempting to *describe* the emerging trends and approaches of environmental management practices in the *context* of sustainable development as a management goal. Yin (1994) defines a case study as an "empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident."

In this study, three sustainable development projects are analyzed from three

[26] Yin (1994) argues that case study is not just a method for data collection nor just a design feature, it is a comprehensive research strategy which connects empirical data with research questions, and to its conclusions.

different environmental organizations to capture the diverse emerging sustainable development strategies. I am attempting to broadly *interpret* current *events* and their *contextual* conditions. Case study research is ideally suited for this task. Yin (1994) also argues that the case study approach is particularly appropriate when questions are being asked about a contemporary set of events over which the investigator has little or no control. The current case studies can be descriptive, exploratory, and explanatory. I have employed a descriptive case study. How do we go from description to interpretation, as the opening quote suggests? My approach for this study has been to utilize the descriptive approach via the methodological framework proposed in chapter 3.

The overall goal of my research is predominantly theoretical, to understand current environmental management practices under the rubric of sustainable development in relation to the general evolutionary science perspective. This dissertation seeks to explore the emerging trends and approaches of environmental management practices to sustainable development through a general evolutionary methodology. This chapter begins with the discussion of the distinction between qualitative and quantitative methods and then moves on to the research process, interviews, data, and the method of analysis.

4.2 Quantitative and Qualitative Methods

Currently, social science research has been derived primarily from two broad epistemological systems, positivism and phenomenology. The techniques and practices that have been used in the research process have broadly been divided into quantitative and qualitative methods. There has been a tendency to confuse the philosophical issue with the technical issue (Bryman, 1984; Glassner and Moreno, eds., 1989). The philosophical issue relates to epistemology, the means by which society validates the development of knowledge base. Over the years, confusion has risen due to the fact that epistemological issues and technical issues have often been treated simultaneously. Even the language has been confusing. Methodology has often been used at philosophical and technical levels.

Positivism, within the methodological context, focuses on objectivity, causality, and validity. Quantitative methods are usually thought to accompany this philosophical approach. In social science research, survey methods are seen as the preferred instrument in the positivistic framework. Here, there is an inherent position, though often not explicitly acknowledged, of the separation between the observer and the observed. This separation is thought to be a necessary condition for objectivity. Causality is developed through regression analysis and other related techniques.

Phenomenology, on the other hand, focuses on subjectivity and reliability in the foreground while emphasizing objectivity, causality and validity in the background.

The emphasis is placed on rendering the viewpoint of the subject. Therefore, understanding the *context* to discover the *meaning* presented by the subject is an important element, to *interpret* the *interior* as Wilber (1995) suggests. Qualitative methods, including participant observation, unstructured interviews, personal narratives, document analysis, and other related techniques, are often utilized. Phenomenological research may also involve a combination of quantitative and qualitative methods.

The common foundation in qualitative research is the construction of meaning. Daly (1992) notes, "qualitative methods are suited to understanding the meanings, interpretations and subjective experiences." Construction of meaning means gaining insights about ourselves and the world which are often 'hidden' or 'veiled'. A derivation of a phenomenological epistemology is the feminist epistemology. Fonow and Cook (1991) argue that a feminist epistemology can be used to gain a creative insight "that is generated by experiencing contradictions." This is because part of feminist epistemology is based on the concept of reflexivity, "that is, the tendency of feminists to reflect upon, examine critically and explore analytically the nature of the research process." This process, therefore, engages us to look for the meaning behind a set of social norms and assumptions and engages us to dive deeper into understanding the social, political, and psychological forces governing our perception of 'reality.'

Reflexivity is an element, perhaps, of utmost importance in doing qualitative research because the reality of the subject studied is interacted with and clouded by the researcher's limited states and experiences. Hewitt (1992) points out to us that we do not always look for those areas which are at odds with us, and thus we miss out on obtaining nonbiased results due to our conditioning. She states that, "we all contain within ourselves multiple, sometimes contradictory, elements which we have, if we are lucky, fused into some whole that works for us." Therefore, what she is pointing out is that reality is perceived differently by different people and also perceived differently by the same person at different times. Therefore, for the purpose of developing knowledge and gaining insights about the world around us, we must be reflexive and have open possibilities for 'multiple truths' and 'multiple points of discovery' rather than 'partial truths' or 'polarized truths'. Jarrett (1992) informs us that qualitative data can generate new theories or inform us of existing theories embedded in the experiences of the people that one is researching.

Qualitative research data can generate theories that more closely approximate social realities than can be provided by quantitative research methodology. It can also be used to get into the hidden dimensions of social realities (Jarrett 1992; Allen and Walker 1992). Allen and Walker (1992) have gone a step further in their research in using qualitative methods to reveal the underlying meanings in the relationships between mothers and daughters in elderly care. They ground their research methods in the principle of self-reflective procedures. Reflexivity allows the reader

to understand how the researcher's perspective aids in understanding the phenomena being studied.
I have utilized qualitative research methods grounded in a self-reflexivity in the dissertation.

4.3 Research Design

Preliminary Research.

I began my research process with "insider's knowledge," an important tool of qualitative methods (Allen 1989; Daly 1992). I utilized my working experience with a nonprofit organization, Legacy International,[27] which has initiated leading innovative projects in the area of sustainable development, to gain access to organizations and project directors. I used my contact with the President and the Executive Director of Legacy International, as well as the senior partner for Pacific Basin Corp., a strategic group, to identify projects or organizations that they considered to be on the cutting edge of sustainable development. I also carried out some preliminary research and interviews with the President of Legacy International, the Executive Director, and the senior partner for Pacific Basin Partners, Inc. I used these interviews to explore in greater detail how various practitioners in the field are attempting to integrate environmental concerns with economic development objectives, improving our current understanding of sustainable issues and developing new management approaches and strategies for implementation. These interviews were audiotaped and transcribed verbatim. I did not collect data for use in the study, but rather used the situations for understanding the issues in the management of sustainable development and to gain knowledge from experts in the field. These interviews with experienced leaders were

[27] Legacy International is a non-profit organization affiliated with the United Nations Department of Public Information as a Non-Governmental organization. Legacy has broad experience in fostering environmentally sound development. Central to Legacy's program is its emphasis on cross-cultural dialogue. Sustainable Development programs in the organization have included corporate-community environmental forum bringing together leaders of corporations, governments, environmental organizations and educational institutions to discuss sustainable development issues.

important in becoming theoretically and empirically sensitized to the issues and as a way of further refining research design through the case study approach.

I provided a letter explaining my aims and purpose of the research, and through a series of telephone calls and e-mail messages, I obtained permission to interview project directors. The original contacts included the Environmental Law Institute, Environs International Inc., ESSA Technologies, the International Conservation Union, Organizing for Development, the International Institute for Energy Conservation, Overseas Private Investment Corporation, Sanders International, World Bank, and the World Wild Life Fund. I narrowed my preliminary interviews to five organizations. The criterion for selection at this stage was accessibility of data and fit. This type of sampling is called purposeful sampling (Maxwell 1996). Maxwell (1996) points out that purposeful sampling can be used to deliberately select cases in qualitative research that are critical for the theories that one begins the study with or that one has subsequently developed.

In June and July of 1996, I interviewed project directors at the following organizations: the World Bank, the International Institute for Energy Conservation, Sanders International, Inc., Environmental Law Institute, and Environs Corporation. At the World Bank, I spoke with a project director about the Bank's renewable energy projects in Eastern Europe. At IIEC, a nonprofit organization, I spoke with the President about the private sector initiative program developing markets for energy-efficiency products and services in Latin America and Asia. At Environs corp., a private environmental consulting company focusing on business development, I spoke with the principal director about his work on pollution clean-ups. All the projects were being carried out under the rubric of sustainable development.

My basic intention was to gain an understanding of currently emerging trends in the area of environmental management in the context of sustainable development. I designed an open-ended interview with the following topical questions:

- What innovative methods are currently taking place in integrating environmental concerns with economic development objectives?

- How has the structure, strategy, and the process of environmental problem solving developed in response to the issue of sustainability?

- What are some of the emerging conceptual sustainable design approaches?

These interviews were audiotaped and transcribed verbatim. I looked for common emerging themes and concepts in them. To become more "theoretically sensitized" I also had extensive discussions about the New Science paradigm and its implications with Mr. J. E. Rash, founder and President of Legacy International,

who has done extensive work and given lectures on the relationship between new sciences, changing world view, and sustainable development. I also spoke with Danah Zohar, author of two books on the implication of the quantum science paradigm on social change and social relations. I observed her workshop in Chicago in July 1996, presented to mid-level managers at Motorola Inc. about translating ideas from the new science paradigm to management innovations in the corporate setting. These conversations were also audiotaped and transcribed verbatim.

Two major conclusions emerged from my preliminary research. One was that what seems to be evolving in the environmental management field is the use of *cooperative decision-making processes* as a means of implementing sustainable development. The cooperative decision-making process in the environmental context is broadly defined here as part of a larger process of institutional relations capable of changing relationships among the stake holders through cooperation and joint problem solving. William Rees (1989) offers a broad working definition of sustainable development on a society-wide basis:

> "Sustainable development is positive socioeconomic change that does not undermine the ecological and social systems upon which communities and society are dependent. Its successful implementation requires integrated policy, planning, and social learning processes; its political viability depends on the full support of the people it affects through their government, their social institutions, and their private activities."

I also learned that in the previous construction of the research design, I had depended too heavily on the use of the "new science theory" to try to explain what was going on in the field. I had imposed the theory on the study and limited questions, methods, and data. New science serves the function of providing a way of thinking, or a point of view for exploring an area of inquiry rather than as a functional matrix for explaining a phenomenon. I have already developed this point in the theoretical discussion section in chapter 3. I had confused the issue between the research issue and practical issue. Maxwell (1996) defines the research issue as what the researcher wants to understand by doing the study and the practical issue as what the researcher wants to accomplish. Previous research questions reflected why I wanted to do the study but not necessarily what I would learn as a result of the study.

These early interviews were important because they provided a way of refining the research questions. I became more sensitive to the issues, and the interviews established further categories for data collection. Based on the preliminary research, I developed the following research questions.

Research Questions

The major research questions that now guided the exploration were:

- What are the sustainable development strategies and methods currently being utilized by the leading environmental organizations?

- How do these strategies and methods reflect the general evolutionary perspective?

- Based on this analysis, what implications does the general evolutionary perspective provide for sustainable development planning?

Research Sites, Interviews and Data

The preliminary research helped me to narrow the study down to three major organizations and three different environmental management approaches to "sustainable development." The organizations were: the Environmental Law Institute, the International Institute for Energy Conservation, and Sanders International, Inc. The Environmental Law Institute is an independent, nonprofit research organization. The International Institute for Energy Conservation is an international nonprofit organization specializing in the adoption of energy-efficient policies, technologies, and practices in developing countries. Sanders International is a private environmental consulting company focusing on business development. These organizations were chosen because they represented a diverse set of institutions and provided access to the needed data. These organizations were also chosen due to their close proximity. They were all located in Washington, D.C., and minimized travel costs.

I collected data through in-depth, semi-structured, face to face interviews with project directors. I first met with the heads, or the division heads, of the organizations to establish a sense of trust for the research. They then recommended a particular project for the research within the organization that seemed suited to the research.

I interviewed the primary director of each project. I spoke with each at least twice on the phone in the late summer of 1996 to develop a working relationship with them. Each agreed to participate in the research and provided me with various documents to review before the interview. I asked for and obtained institutional documentation such as communiqués (letters or memos), written reports of the projects, newsletters, internal evaluations, and progress reports. These documents, along with interview transcripts and my notes with observations, represent primary sources of data. From there, I developed a research protocol.

The interviews with project leaders consisted of a series of questions and follow-up reflections designed to encourage respondents to reflect and reconstruct each project. The areas of inquiry included actors and major parties involved in the project; economic, social and cultural constraints in the cooperative decision-making process; implicit and explicit goals of the project; processes by which they moved towards those goals; significant barriers in the processes; and the end results, such as the quality of outcomes, types of relationships built, and the degree of success. Each project director was asked similar questions so that comparable data could be accessed across cases. The semi-structured and open format also allowed the project directors to express their own opinions on the project without necessarily following the company line. Each interview lasted about 2 hours. Each interview was recorded and transcribed verbatim.

4.4 Analysis

The case study analysis consisted of two major tasks: descriptive analysis and contextual analysis. The first task was case description. The data was identified, collected, and categorized according to the following elements: actors, context and organizational strategies. The case description addresses the first research question.

4.4.1 Case Description

Descriptive analysis is similar to categorizing strategies. It involves coding and thematic analysis. Descriptive analysis provides the means to make ideas and analysis visible and facilitate thinking about relationships between concepts (Maxwell 1996). I listened to the interview tapes first, prior to transcription. I compared my interview notes and began developing concept maps illustrating the relationship between various categories, dividing the data according to the elements. I also began writing memos to myself during this process to develop my analytical thinking about the data, developing themes and issues from the interviews. Once the interviews were transcribed, I analyzed the institutional documents including proposals, evaluation reports, and newsletters and I began conceptualizing different dimensions in each of the categories described earlier. I refined my concept maps (based on the analysis of the interviews), institutional documents, my observation notes, and memos. Concept or network maps were very helpful in identifying patterns, comparison, trends, and paradoxes among the case studies. The findings are reported in chapter 5.

4.4.2 Contextual Analysis.

The second strategy employed in this study is contextual analysis. Contextual strategies operate differently from descriptive analysis. Instead of dividing the

initial text into discrete elements and re-sorting it into categories, contextualizing analysis attempts to understand the data in context (Maxwell 1996). As Maxwell (1996: 79) suggests, contextual analyses:

> "do not focus primarily on relationships of similarity that can be used to sort data into categories independently of context but instead look for relationships that connect statements and events within a context into a coherent whole."

This strategy also relies on ways to identify relationships among the different elements of the data but within a context.

I started out with general evolutionary science concepts of nonlinear interdependence, self-organization, and qualitative evolution. I began looking for the attributes in the data. The methodology was elaborated in chapter 3. I began developing concept maps of the attributes found in the data through a series of questions and inquiries. The questions can be found in the case study protocol. I found that there were three major coevolving elements operating within the project cases: values, technology, and organization structure. They were helping to shape a particular configuration in the sustainable development field. They included strategic initiative, policy formulation, and development of a new industry. I also began to develop new flows and efficiencies such as market driven approaches, partnerships, and the formation of new industries. After I identified and developed these categories, I began reviewing these classifications through multiple reading of the data and developing new memos and concept maps for each case. What I have attempted to do is to try to build a logical chain of evidence and to construct a theoretically and conceptually coherent understanding of the emerging sustainable development field. Utilizing this process, what I hope to accomplish is to show how the new science perspective provides the possibility for the evolution of environmental management in the context of sustainable development.

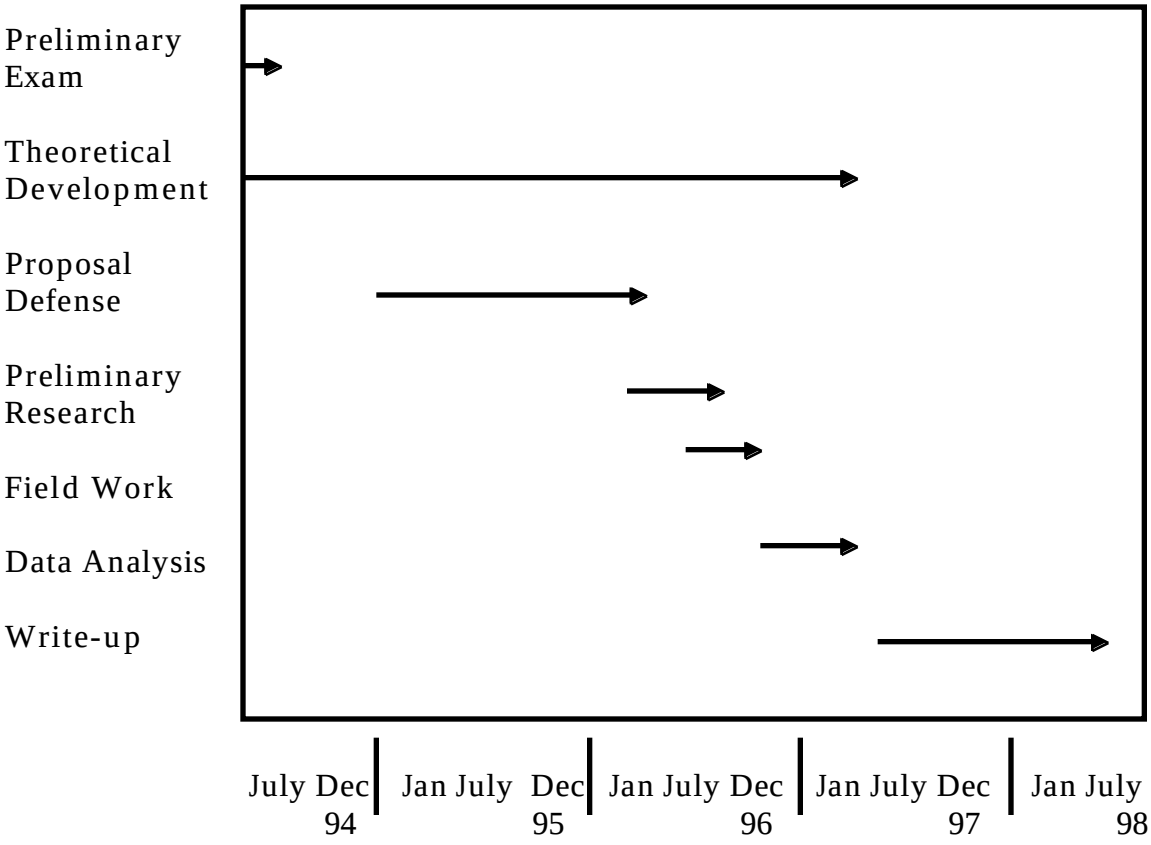
4.5 Validation

Validation of data is achieved by triangulation of methods through the interviews, documents, and analytical methods. Theoretical validation was achieved by periodic discussion of emerging conclusions with Mr. J.E. Rash, who is familiar with the application of the emerging world view. Further validation was achieved by comparing my analysis with the notes and workshop documents presented by Donah Zohar, who is an expert in the area of new science, though she has not applied this work specifically to the environmental area.

4.6 Timetable

The time table for the research is provided in table 4.1. This research has been conducted over the past four years, commencing with the approval of the preliminary examination in September 1994. Theoretical development started with the epistemological process, and the work was published in the *Journal of Planning Literature,* entitled "The Implications of the Nonlinear Paradigm for Integrated Environmental Design and Planning." Chapter 2 represents part of the article. The formal research activities took place in the summer of 1996, with the write-up during the summer of 1997 through the summer of 1998.

Table 4.1 Timetable for Research



CHAPTER 5

Descriptive Analysis of the Selected Case Studies

The question being asked is no longer "Do development and environmental concerns contradict each other?" but "How can sustainable development be achieved?"

Lélé 1991: 607

5.1 Introduction

This chapter provides a description of the selected cases under study. It provides the first step in the application of the general evolutionary methodology to the selected case studies - description of system characteristics. I will deconstruct various ways in which sustainable development projects are currently being implemented into practice. The purpose of this chapter is two fold: one, it offers an opportunity to examine cutting edge sustainable development designs in three different organizational setting; two, the chapter provides a description of system characteristics in terms of several key elements: actors, contexts, and organizational strategies. "Actors" describes the various participants in the project, their motivations, and role in the project. It describes their interest in the project, and their ability to influence its outcome. "Context" describes the set of constraints within which the project takes place. It addresses the physical, social, and cultural constraints and the opportunities which shape the overall development of the project. "Organizational strategies" describes the general orientation of the suggested actions to be taken to achieve the objectives of the project, the dynamics of the development of the project, the ongoing interaction between the actors, and the methods utilized by the project designers in advocating the implementation of the sustainable development concept.

As the opening quotation suggests, Lélé (1991) captures the attitudinal shift that has taken place since the mid '80s' to early '90s' with the concept of sustainable development poised to become the mainstream development paradigm. When the development community recognized that environment and development objectives were no longer contradictory but were, in fact, *interdependent* on each other, an important conceptual shift had taken place. It was also clear, however, that sustainable development was quickly becoming a new cliché, a new catch phrase, a new rhetoric being coopted by development agencies without a clear definition, a conceptual underpinning, or a clear policy directive (Norgaard 1994; Reid 1995). Lélé (1991: 618) suggests the following for sustainable development practitioners:

> "If sustainable development is to be really 'sustained' as a development paradigm, two apparently divergent efforts are called for: making sustainable development more precise in its conceptual underpinnings, while allowing more flexibility and diversity of approaches in developing strategies that might lead to a society living in harmony with the environment and with itself."

How have sustainable development practitioners responded to the challenge? This chapter provides a case description of three sustainable development projects in three separate organizations: The International Institute for Energy Conservation, The Environmental Law Institute, and Sanders International. The corresponding sustainable development project in each organization is: "The Tai Partnership Project," "Blueprint for Sustainable Development in Virginia," and "A Strategic Framework for Promoting Sustainable Development in the Rio Grande Valley." The three sustainable development projects offer a good basis for exploring these concepts and relationships. Each project provides a unique contribution to the sustainable development field. First, they are diverse, ranging from an international context of energy efficiency to bioregional border issues to environmental policy within the context of a state. Second, they stem from different organizational contexts, two nonprofit organizations and one private organization. Third, the strategies are diverse and offer a window in the design for sustainability in the future.

5.2 The International Institute for Energy Conservation - The Tai Partnership Project

The International Institute for Energy Conservation (IIEC) is a nonprofit organization established in 1984 to accelerate the global adoption of energy efficiency policies, technologies, and practices towards sustainable development. Its

organizational mandate is to implement *energy efficiency* in developing countries. The IIEC has worked on two major fronts in the energy efficiency field: development of energy policy and demand-side management. It has participated in formulating and implementing energy efficiency policies in Thailand by working in conjunction with the government, utility companies, private companies, and environmental groups.

Demand-side management involves efficient use of current available energy resources. There are two basic methods for making more energy available - one is to increase energy supply by building more power plants and the other is to make existing energy consumption more efficient, hence the term demand-side management. Demand-side management shows consumers how to use energy more efficiently and hence allow more utility companies to free up existing available power for future use.

A private sector program that the IIEC has recently implemented in Thailand is known as *The Tai Partnership Project*. Unlike many other nonprofit environmental institutes in developing countries, the IIEC has pursued partnerships with private companies who provide high efficiency technologies and engineering services in order to implement energy efficiency policies and demand-side management programs. The IIEC (1994) defines this overall strategy as:

> "a multi-step process that streamlines trade assistance, providing companies with the information they need to commit to a new market; a matchmaking vehicle to bring U.S. companies together with well-matched partners; and an in-country support mechanism that ensures deal closure."

In developing countries, high efficiency technologies are difficult to obtain locally. The IIEC recognized that the emerging markets for environmentally superior products and services such as efficient motors, air conditioning systems, and lighting systems represented a potential growth for companies in developing countries. There was a potential market for American and European companies with expertise in high efficiency technology in a developing country context. The IIEC's strategy in Thailand identifies local companies who sell energy and who are interested in participating in the energy efficiency industry, and matches them up with companies from the U.S., Europe, and Japan. Since 1992, the IIEC has completed 12 actual deals between U.S. and Tai companies, ranging from joint manufacturing to licensing agreements to product distribution contracts (Opheim 1996).

5.2.1 Actors

Primary actors in the Tai Partnership projects include: the IIEC, international development agencies, government agencies in Thailand (responsible for the

country's energy policy and implementation such as the National Energy Policy Office and the Directorate for Energy Development Policy), private companies, and the National Utility company. Over the past eight years, the IIEC has worked with the Tai government to develop the Energy Conservation Promotion Act, which became a recent law in Thailand.

The IIEC's approach has been to *synergize* the various interests of the different actors and promote its organizational goals for implementing energy efficiency in developing countries. The IIEC views the implementation of energy efficiency programs as a critical tool for sustainable development. Synergy requires the understanding of the motivation of each actor so that relationships between various partners can be fostered.

Funding agencies such as the United States Agency for International Development (USAID) and the Department of Energy have goals beyond immediate aims of promoting U.S. exports and U.S. businesses. There is possibility for synergy between the IIEC and development agencies, since U.S. companies have experience to offer in energy efficiency. The U.S. has had a formal energy efficiency program for the past 20 years and has developed expertise and technical knowledge in this area. The IIEC's goal is not to promote U.S. exports, but through sharing of mutual interests, to accomplish the mission of *building indigenous capacities* of energy efficiency in developing countries.

The National Utility Company's interest, on the other hand, is to meet the demand of energy consumption in Thailand. The utilities see themselves as promoting energy efficiency because they have a social function. Responsible use of energy raises the reputation of the National Utility Company in the mind of the citizens. Finally, the private companies in Thailand have not only the goals of increasing business and the bottom line but also the desire to gain access to better technologies. This goal of gaining access to higher value technologies can be met though joint ventures with U.S. companies.

5.2.2 Context

Thailand is a unique Southeast Asian country which has formally adopted a national energy conservation act. This Energy Conservation Promotion Act promotes energy efficiency in the commercial and industrial sectors and is supported by the energy conservation promotion fund. The IIEC participated in the development of the Energy Conservation Promotion Act in the late '80s' with the government of Thailand. The fund supports two vital functions: it provides financial support for energy efficiency projects and puts a tax on nonrenewable energy through a tax on petroleum.

Energy Conservation Promotion Act. The Conservation Act emphasizes the efficient use of energy along with decreasing the use of petroleum-based energy resources. The Act promotes energy efficient technologies while providing incentives for reducing energy use though a tax-based system. The conservation promotion fund has generated about $80 million per year over the past five years with little or no expenditure. The fund currently stands at around $500 million and is allocated to be used to implement energy efficient programs in Thailand in the near future (Opheim 1996).

Unlike the environmental agenda in developed countries, it is the fast pace of economic development in countries such as Thailand that is driving energy conservation programs. The motivation for the Conservation Act was not environmental but economic in nature. During the '70s' and '80s' Thailand was growing economically at a staggering pace. Looking ahead, the government of Thailand realized that in order to keep pace with economic development, the supply of energy would have to match demand for energy. Economic policy makers in Thailand realized that one way to increase supply was through energy efficiency. With the economic growth at double digits, and with the demand for electricity growth at 15% to 17% a year, the government of Thailand saw that they could not match the demand (IIEC 1995). They also did not have the capital to pay for the additional power plants which were needed to meet the demand. The World Bank, for example, estimates that it will take $400 billion to finance new electric supply in the developing world in the next 25 years (Opheim 1996). The development banks thus will be able to fund only a small portion of the overall global energy needs. Economic development pressures are thus providing the incentive for conservation measures. Under the Energy Conservation Promotion Act about 900 industrial facilities and about 1400 commercial facilities are required to develop energy management plans which include energy audits and planning strategies for the efficient use of energy (Opheim 1996).

Demand-side Management. The second phase of the Conservation Promotion Act in Thailand includes working with the Electricity Generating Authority (which is the national generating utility), to develop demand-side management programs. The national utility has committed about $190 million to these programs (Opheim 1996).

The policy environment is very conducive for developing energy efficiency markets in Thailand such as efficient lighting systems, high efficiency fluorescent tubes, and air conditioning systems. Many of these technologies were not locally available in Thailand. By 1992, the IIEC had matched up five to six mid- size U.S. companies with local Tai partners to jointly manufacture, distribute, and market energy efficient technologies in Thailand.

Partnerships, the Energy Conservation Promotion Act Fund, and demand- side management programs have a reinforcing aspect on promoting energy efficiency. The private companies in Thailand have a role to fulfill due to the Conservation Promotion Act and legislation demanding energy efficiency and energy savings. The IIEC's private partnering programs are responding to the market opportunity that is created by the policy changes. The IIEC plays the role of a bridging organization (Brown 1991) between the private, public, and nonprofit sectors. In creating private sector ventures in energy efficient technologies, the IIEC is creating an alternative industry and creating a positive voice for energy efficient industry in current international discussion on global climate change. The established oil and coal industries have a coalition which provides a powerful voice against taking any action on global climate change. The IIEC plays a small but important role in giving the energy efficient industry an identity and voice that there is something to be gained economically from taking action on global climate change via demand-side management.

The IIEC is on the leading edge in its approach as a nonprofit institute in promoting energy-efficient industries in developing countries. How is the overall concept of sustainable development being defined at the IIEC? Simply in terms of providing access to energy efficient-technology for developing countries. The president at IIEC was pragmatic in his response when asked how the organization is operationalizing the concept of sustainable development.

> "It is a stretch of the term (sustainable development). Although we can say that the efficient refrigerator is a sustainable piece of technology, the fact is that it is still depleting resources, it is just doing it at slower rate. But that is the way we are defining it. We are not getting into the purity of the term, we are definitely slanting it."

5.2.3 Organizational Strategies

Long-Term Commitment. The IIEC has emphasized long-term relationships as the basis of their strategy for collaboration in the energy efficiency field in Thailand. The initial stage of the partnership project involves market research on energy efficient industries in developing countries. This research is initially funded by grants from federal agencies and international development banks. The market information is then brought to the U.S. companies while at the same time developing relationships with the overseas partners. The decision on how and when a visit to the host country is made is left to the companies. This way the companies have to make the commitment themselves through their own funding and make the statement that they are serious about participating in the market by taking the initiative.

For midsize U.S. companies who want to participate in growth, Southeast Asia represents an attractive alternative market. The U.S. market in air conditioning, refrigerators or lighting systems is a replacement market with little room for growth. However, for the mid-size to small companies who have small margins of cash flow, Asia also represents a big risk, due to the long term commitment of resources, time, human capital, and finances with little guarantee that they will succeed in gaining market share in these developing countries. They will have to visit the country, get to know the local partners and build long-term trust. As Kelly Opheim, the project director of the Tai partnership project states:

> "We have been working with the Tai government and Tai companies for a long time. How important is trust? They have to know the companies that they are going to work with face to face, not by faxes or on the phone. They have to meet with them many times to build up a level of trust that they are going to do business together. Business is done face to face, so it does take big commitment."

Cross Cultural Understanding. The IIEC has established its presence in Thailand since 1989, developing relationships with government agencies, utilities, and private companies. When U.S. companies arrive at their local office, they already have a liaison contact who has developed the relationship in an Asian cultural context, where trust and relationships play a significant role. For U.S. companies, having this liaison contact in the country, with relationships already developed with key players, is essential to successful partnerships.

As an Independent NGO, the IIEC carries the freedom to propose new policy directions and attract a variety of new sources of funding to try out new ideas. The new ideas come from the contacts in the regions where they work, within the organization and from contact with government utilities and private companies. Its primary importance is in understanding the local constraints and local motivations of government agencies, utilities, and private companies.

The IIEC is committed to building long-term relationships with local knowledge of the important players. Along with this local knowledge, an understanding of the regional and international trends is also needed to turn macro ideas into successful local projects. A trend in the energy world is toward greater provision of energy services as well as selling kilowatt hours of electricity. The IIEC has applied this concept in Thailand as part of the energy conservation plan and is planning to promote energy service companies who will sell lighting services or air conditioning services in its future private sector programs. The idea is floating in the energy world and the IIEC has made the point of applying it locally in the countries where they are currently working.

Changing Mindsets. The dominant approach to environmental planning in developing countries is supply-side management, the idea of meeting energy demands by producing more power plants. Supply-side management is also the dominant mindset of international aid agencies which fund big power development. There are advantages to power plants from the aid agencies' point of view in that they are well-known structures. The World bank and large commercial banks are used to financing such projects. There is the already established model, with both financial and infrastructure components, which has co-evolved to make big power plants. For the lending institutions it is easier to finance a power plant for many millions of dollars than to finance many small diverse projects, since management and transactions costs are much lower in the single big project. Thus, there is a disincentive for financial institutions to fund demand-side management programs.

Educating the lending institutions to understand that energy efficiency can play an important role in energy policy requires a shift in the dominant paradigm. The major aim of the IIEC has been to make energy efficiency a *major alternative* to the energy supply market rather than merely an add-on to alternative sources of energy. The IIEC's goal is to provide energy efficiency as a vital energy resource in combination with other sustainable energy technologies, such as renewable energy, cogeneration, and smaller power plants.

In order to accomplish this task, the IIEC has tried to aggregate projects and to consolidate them in financing. The overall system, particularly the institutional arrangements for financing demand-side management, is not yet established. Thus there are both micro and macro factors at work. The policy, financial, and economic infrastructures need to be developed along with local partnerships with the energy efficient companies to provide a product in a developing country market.

The intent of IIEC is not just to bring players together as an honest broker but also to act as a catalyst for change. The IIEC is participating in the creation of a new industry out of existing companies who are providing energy resources. This in turn creates a change in the attitudes of the people involved in the way that they are seeing themselves as forming a new industry rather than just a joint venture.

From a strictly biophysical perspective, energy efficiency is itself not sustainable in the long run because technological and institutional structures are depleting energy resources. Nonetheless, global environmental issues such as global warming can present a potential opportunity for the current government to rethink current energy policy. New funding opportunities and the countries' commitment to retool have the potential for changing the energy industry as it currently stands, dominated by the coal and oil industries. The IIEC's major contribution has been creating opportunities between private companies, governments and environmental organizations to create win/win situations among the various

players involved. Sustainable process rather than sustainable use of natural resources is emphasized by the IIEC. Sustainable process requires organizations, and individuals within organizations, to develop creative opportunities and not get locked into an ideology that predetermines a particular approach to sustainable development.

5.3 Environmental Law Institute - Blueprint for Sustainable Development of Virginia

The Environmental Law Institute (ELI), founded in 1969, is one of the more highly visible, well established nonprofit environmental institutes in the United States. The ELI is an independent research institute with the mandate of improving environmental law, public policy, and management principles for the advancement of environmental protection. The institute has an interdisciplinary research staff of attorneys, economists, and scientists to improve legal theory, and the process by which it is carried out, to advance environmental legislation.

A recent effort to implement the concept of sustainable development has been set out on a project entitled *Blueprint for Sustainable Development of Virginia.* The project involves the ELI's research of Virginia's businesses, government, community, and academic leaders to set out a framework of sustainability in Virginia. As the ELI's 1994 annual report promotes:

> "By examining the laws, policies, and institutions that influence local development patterns and resource uses, ELI has pointed a path to new opportunities that can promote economic and social progress while protecting both natural resources and productivity."

In June 1992, the United Nations' Conference on Environment and Development was held in Rio De Janeiro and produced Agenda 21, which called forth a global partnership for sustainability to be implemented at the local level. The ELI, having participated in the planning of the conference as one of the members of the nongovernmental sector, made the effort to implement Agenda 21 at the state level. ELI (1994) states agenda 21 as providing a set of:

> "Detailed recommendations for managing natural resources and changing economic behaviors so that national, state, and local governments, industry, non-governmental organizations and the general public can all promote economic growth while protecting the environment."

The ELI's focus since the '80's has primarily been at the state level. So the mandate of Agenda 21, which was to implement the lower levels of government, was an ideal fit for the ELI, which already had extensive experience working at the state level. The ELI saw it as an area that could effectively be addressed while other

environmental organizations were often focusing environmental concerns at the national level. During the early '90's, the Virginia Environmental Endowment (VEE) had funded other environmental projects in Virginia and began some work on the negotiation of water disputes in the coal mining areas of Southwestern Virginia. The VEE also wanted to apply the construct of Agenda 21 in Virginia. The executive director of the endowment had been particularly interested in applying the issues of sustainable development in Virginia. Also during this time, the Virginia General Assembly (1993) passed a joint House Resolution no. 653, stating that:

> "The United States of America has voluntarily accepted the goal of achieving sustainable development, and the need to prepare a U.S. National Strategy for Sustainable Development, by joining in the international consensus to ratify Agenda 21, the primary, long-term action plan stemming from the United Nations Conference on Environment and Development, held in Rio de Janeiro in June 1992..... That the governor, state and local officials, and the leaders of educational institutions and civic organizations be encouraged to work together to prepare a Virginia strategy for sustainable development, to serve as a national model for widespread emulation."

The Blueprint was the next logical step in the process of implementing Agenda 21 in Virginia. The project aims to provide: "practical recommendations for ways to achieve economic and social progress while protecting Virginia's environment, conserving its valuable natural resources, and ensuring its long term productivity and quality of life" (Keiner 1996).

The goal of the Blueprint was to produce some legislative recommendation for the general assembly that could remove barriers and provide incentives for sustainable growth in Virginia industry. One of the unique features of this report was the emphasis on community building as part of sustainability.
The report was completed in December of 1993.

5.3.1 Actors

Primary actors involved in the Blueprint are the Environmental Law Institute, the Virginia Environmental Endowment, the Virginia Task Force on Sustainable Development, and community-based organizations in Virginia. The role of each participant in the project is discussed below.

Environmental Law Institute. The ELI brings an academic approach to environmental issues by holding seminars and training programs and bridging disparate points of view to diffuse some of the antagonism found in current environmental disputes. The Institute envisions itself as a meeting place for groups

with different concerns about the environment to come together to develop a common action. The communication approach adopted by the ELI enables the participants to put aside their rhetoric to allow the participants in the environmental debate to dialogue in the areas of common interest. The ELI does not litigate nor lobby in the Congress. As a result, the Institute is often seen as a moderate voice in environmental issues. The Institute's goal is to improve environmental conditions, but the method is through conflict resolution and consensus building.

Historically, the ELI began by publishing law reports so that it gave a more research-oriented outlook on environmental issues. As the institute evolved and began to do more research, it took on a multidisciplinary orientation with lawyers, economists, and scientists participating. U.S. environmental laws have traditionally been approached via a single medium. For example, air law is separate and distinct from water law though ecologically one can be affected by the other. This approach is clearly different from other environmental law advocacy groups who have evolved over the years with particular expertise and experience in one single medium such as air law or water law.

The multidisciplinary focus is helpful since the trend in environmental issues is to be able to perceive the problem in a wholistic way. Another unique approach that the ELI has adopted is the utilization of a cooperative grass roots approach and it has made a point of taking this approach to developing countries. The ELI has made a point of developing local partners. These local partners set the agenda and ask the ELI what their needs are. The multidisciplinary approach gives them a level of flexibility in that they can draw people from whatever areas in which they need help. If the problem is water pollution, for example, they can draw on staff or recruit government and industry personnel to volunteer to conduct seminars and training on that issue.

Virginia Task Force on Sustainable Development. An important political player in the project was the Virginia Task Force on Sustainable Development, a political committee appointed by the Governor of Virginia. However, the task force, rather than supporting sustainable development initiatives, was primarily interested in economic development. The task force provided a political barrier at the state level and forced the ELI to turn attention to the community level.

The first report of the Blueprint for Sustainable Development of Virginia was completed in December 1993 and a new governor had been elected at that time. Unlike the previous governor, who had been interested in environmental issues, it became apparent that legislative recommendation adopted in 1993 would not go very far in Governor Allen's tenure, even though the 1994 general assembly did pass the resolution for the creation of a task force for sustainable development.

> "The task force shall assess current sustainable development initiatives in the Commonwealth and other areas, develop a statewide strategic plan for sustainable development, and recommend appropriate actions which state and local governments, citizens groups, and nonprofit organizations, especially in rural areas of the Commonwealth, might consider for implementation." (General Assembly of Virginia 1994)

Governor Allen appointed the members of the taskforce but due to lack of interest, the task force did not begin the work until a year later. The ELI was asked to help with a briefing and background report for the task force and was invited to testify and make recommendations, based on the earlier report, on what Virginia would need to do to pursue sustainability. However, it became clear that the task force was not interested in following the recommendations made earlier in the Blueprint (Keiner 1996). The task force dissolved in the Fall of 1995 with the recommendation that no further work be done. At this point, the ELI turned to the local level, realizing that state level action was going to be minimal given the outlook of the current administration. The ELI realized that it was not necessary to turn to the state level for action. It discovered that community-based groups were already launching local sustainable development initiatives despite the political environment at the state level.

Community Groups. The political barriers which prevented the state from adopting sustainable development initiatives provided a common basis for various community groups to come together. Community-level organizations such as the Northampton Economic Forum on Virginia's Eastern Shore, the Clinch-Powell Sustainable Development Forum in Southwestern Virginia and the Thomas Jefferson Planning District Sustainability Council in the Piedmont district were already engaged in adopting sustainable development principles at the local level. The organization's activities on the theme of sustainable development are reported by the ELI in the document called, *Building On the Blueprint: How Virginia's Communities are Implementing Sustainable Development*. The document reviews 29 community efforts in the Commonwealth to protect natural resources along with economic growth. It provides models for Virginia towns, cities, counties, and communities to pursue the goal of sustainability. I report some of the activities below:

The Northampton County sustainable development initiative focuses on the need to reduce the shore county's poverty and the need to coordinate environmental protection with community development. The Northampton County Board of Supervisors has adopted the objectives and strategies of developing eco-industry as the basis of its economic development policies. The effort paid off with the eco-industrial park demonstration project, which was selected by the President's Council on Sustainable Development at the Port of Cape Charles in Northampton County. The sustainable technology industrial park will feature a fifty five acre facility for

assembling solar cells into photovoltaic panels, an environmental education facility, a tertiary sewage treatment system, restored wetlands, remediation of a hazardous waste system, and a nature trail.

The Clinch-Powell sustainable development initiative includes communities in southwestern Virginia within the watershed of the Clinch and Powell Rivers. The initiative is designed to respond to the region's weak economic and declining job market along with declining environmental quality. The intent of the initiative is to create jobs, build worker skills, and support ecologically sound business. The strategies include sustainable wood projects, sustainable agriculture, nature tourism, sustainable home construction, a regional information bank, land resources, and recycled materials and energy-efficient products. Part of the task is to develop environmentally sustainable markets such as markets for sustainably harvested wood products that come from horse logging and solar kiln processing. Marketing efforts are also featured in the sustainable agricultural project by developing networks for local growers to sell products to local restaurants and the *Fresh Fields* grocery chain. They also plan to research ways to link farmers with food banks and health departments as a way to supply food to low and moderate income families.

The Thomas Jefferson Sustainability Council provides an assessment of regional capacity to accommodate environmentally sound development. They are looking at ways in which their master and comprehensive plans may be changed. Through various studies the council is providing a vehicle for defining sustainability in the Piedmont region. The research ranges from identifying risks to sustainability as well as agreements among regional stakeholders with inputs from hundreds of citizens involved in fourteen different working groups. The technical advisory panel of the Thomas Jefferson Council developed the *Thomas Jefferson Study to Preserve and Assess the Regional Environment* which consists of ten components: risk assessment, regional build-out, economic development, urban assessment, transportation, housing, energy, education, environmental assessment, and carrying capacity analysis. The data will be developed to assist future planning and policy formulations. A technical blueprint for sustainability in the region came out as a result of this study in 1994. The council has been developing indicators and benchmarks which provide guidelines of the region's vision on sustainability. The intent is to combine indicator data with the benchmark to identify sector problems for community action. The regional planning initiatives for sustainable development emphasizes long term planning with community involvement, and the development of environmental data on key sectors.

5.3.2 Context

As stated above, the adversarial position to environmental protection taken by the Governor Allen's administration and the Secretary of Natural Resources helped communities to bond together in a common effort. Various local and regional

community groups had been pursuing a plan for environmentally sound economic growth despite the lack of state level support. Independently, each community had reached a common understanding that the concept of sustainability would be useful for their communities. The second report, *Building on the Blueprint*, was published to show that results were indeed taking place despite the state level ambivalence toward environmental protection. Not only did the major groups with strong funding and local support show results, but other groups in the state were also making changes at the community level. This report not only provided various models for initiating sustainable development objectives but also showed that a political coalition could be formed to influence state environmental policy. The next potential project which the ELI identified was to present a workshop with the Virginia Association of Counties and municipal leagues to further engage other local leaders. The ELI has played an integral role in providing a structure for people to come together and to disseminating that information to the public. The ELI see themselves as not only doing research but as the disseminator of the results to encourage replication.

Barriers. There are three major perceived barriers to sustainable development in Virginia. The first is the lack of political and social commitment to sustainable development. This is due to the traditionally short time frame under which political decisions are made. The solution to this problem would be to develop a political commitment to long-term objectives and short-term incremental steps towards the objectives. The Blueprint recognized that the usual political pressure of short-term interest will need to change to meet the interest for long-term sustainability.

The second impediment is the lack of information and access to existing information. The actions to overcome this impediment will require citizen participation at all levels. The plan requires accurate and comprehensive economic, demographic, scientific, and technical information establishing a geographic information network for Virginia.

The third impediment is the nature of Virginia's environmental decision-making institutions which are fragmented and tend to be reactive rather than proactive. The lack of planning capability and the lack of regional cooperation often place the state in a reactive position. The institutional fragmentation is further enhanced by the frequent lack of coordination between state and local agencies where resource boundaries do not coincide with institutional boundaries. It also requires that the creation of state, local, and voluntary institutions be capable of implementing long-run policies.

Indicators of sustainable development, (including economic development, resource use, community vitality, environmental quality, and development of environmental quality to test against the bench marks), will determine how well

the progress is achieving sustainability. Furthermore, business and government agencies will need to apply these indicators to evaluate their own status.

5.3.3 Organizational Strategies

Two major strategies dominated ELI's approach to the project. These were the utilization of a retreat to share information, and a multidisciplinary approach to implementing the objectives of sustainable development at the state level.

Retreat. The ELI put together a two and a half day retreat which included some of the major community initiatives under way in Virginia: the Clinch Powell Sustainability Initiative, the Thomas Jefferson Planning Commission, and the North Hampton County Sustainability Initiative, among others. The retreat was utilized as a gathering place to exchange information and for each group to learn from the other participating group's knowledge and experiences. The first day was spent on informing each other of how they got started, where the funding came from, how they drew the various community members into their efforts, what the goals were, current status reports, and what they hoped to accomplish. The second day was spent discussing common problems and issues which each community group faced in implementing the goals of the project. A follow-up seminar was proposed at the retreat but this did not take place. The principal intention of the retreat was to develop commonalties and models for action that were already under way so that each group did not duplicate others efforts.

Multi-Disciplinary Approach. A vision for sustainability articulated in the Blueprint consists of the interdependence of three elements; economy, community development, and environment. Community development has a particularly important role. The integration of the three major elements is articulated in the following:

> "Decisions affecting the economy always affect the environment and the power of citizens to shape their communities; decisions affecting citizens' ability to work together for the future affect the economy and the environment; decisions affecting the environment have powerful effects on communities and on the structure of the economy." (ELI 1994)

The vision of sustainability for Virginia promoted by the ELI takes on a bioregional planning outlook. Bioregionalism implies a network of small-scale communities that are self-reliant, committed to social equity, engaged in participatory-decision making, and utilize local environmental resources. The vision includes compact urban communities, environmentally sound and energy-efficient industrial bases, undeveloped open spaces, clean energy, air, and water. The method of implementation requires a coordinated regional growth management plan, an efficient transportation network, the reduction of long commutes to work places,

and dense development. The plan also calls for each region of the Commonwealth to develop hub markets for diverse agricultural and renewable resource products, replacing food and fiber growth from the outside with locally produced sustainable agricultural products with a close tie between the urban and rural areas.

Development of new housing, commercial centers, and industry requires re-development rather than the conversion of rural farmland to suburban sprawl. The vision also includes incentives to foster energy-efficient industries, pollution prevention, recycling, and the sustainable use of renewable resources such as the forest, fisheries, and agricultural land. The planning is informed through broad-based citizen participation, local entrepreneurship and community involvement. It is predicted that without such a vision, the current patterns of economic development will lead to suburban sprawl, urban decay, joblessness, overcrowded schools, air pollution, increased crime, loss of farmland, traffic gridlock, water shortages, water pollution, and higher taxes to pay for infrastructure and overloaded public services.

5.4 Sanders International - A Strategic Framework for Promoting Sustainable Development in the Rio Grand Valley

Sanders International is a private consulting firm which promotes sustainable development through business ventures in the area of environment and development. It is a business facilitation firm. As the principle director of the organization frankly states,

> "When we talk to public policy people, we try to put it in terms of technology transfer, because it is a kind of public policy focus, if we talk to the business people it is simply helping them put a venture together, whether it is selling a product or licensing a technology, or finding a partner for a joint venture, or making a direct investment. The bottom line is that we are very transaction oriented." (Sanders 1996)

The case study focuses on the promotion of sustainable development in the Rio Grande Valley. The purpose of the project was to develop a broad framework for federal initiatives to support sustainable development on the U.S. - Mexican border between El Paso and Brownville in Texas on the U.S. border, and between Juarez and Metamoros on the Mexican border. The steps taken are to identify major environmental issues found in the watershed, to identify solutions for the region, to address current efforts, and to suggest both short term and long term initiatives.

5.4.1 Actors

The two primary actors involved in the case study are the U.S. Department of Commerce and Sanders International. The Commerce Department has both a direct and indirect interest in sustainable development. From an ecological point of view it has direct interest due to the fact that the National Oceanic and Atmospheric Administration, which has interest in marine and global warming, is under the control of the Commerce Department. The Commerce Department also has interest in technology development. One of the major drives in the Commerce Department is economic development. The federal department promotes the development of infrastructure support, international trade, and export promotion. Thus, from an economic development point of view, it is a major player in implementing sustainable development programs.

The principal investigator in the project was Ed Sanders, executive director of Sanders International. An earlier part of his career was spent in the Office of Management and Budget on the international side, looking at foreign assistance, trade finance, and state department operations. It was clear to him that when border issues arose the bureaucratic system broke down. The primary reason was that the State Department, which is responsible for the conduct of U.S. foreign policy, takes a very protective stance against border issues. Border issues are also difficult to deal with regionally from a legal stand point because there is a federal prohibition in the U.S. where localities and states cannot negotiate border issues with their counterparts.

Border issues are fundamentally problematic due to the interface of political boundary and environmental problems which transcend current institutional capacities to deal with these complex issues. From a public administration focus the government institutions on both sides are faced with enormous obstacles. The Mexican federal government is highly centralized and the state department is insular. The problem, ideally, is suited to be dealt between municipalities rather than foreign ministries.

Sustainability. In this project, two dimensions of sustainability are emphasized. The first emphasizes the goal of balancing economic growth with short-term environmental protection. The second is long-term and emphasizes the goal of protecting the interests of future generations.

The short-term dimension acknowledges that "end-of-pipe" measures can be avoided by investments to prevent environmental waste in the first place. It is a conceptual shift from environmental protection to environmental prevention. The pollution prevention measures can yield increased efficiencies and cost savings as by-products. Thus, there is a potential economic advantage to pollution prevention measures. The framework emphasizes the promotion of source reduction and pollution prevention, which minimizes waste and pollution from economic production. It also emphasizes developing products and technologies which build

on each other and are integrated with pollution prevention through multiple use cycles -the idea that product and waste from one cycle can to be used as inputs in the next cycle. This is commonly known as industrial ecology. The thinking is that economic growth and technological change become the prerequisites for protecting environmental quality.

The emphasis on the long-term dimension comes from the fact that current ground water consumption in the Rio Grande Valley is depleting the resource at an unsustainable level. This problem, however, has received little attention from either the environmental or the economic development communities since current environmental issues focus only on short-term issues. In the case of air pollution, for example, the main objective is to improve the condition of the ambient air by reducing the level of particulate matter, ground-level ozone, and carbon monoxide. Ambient air, however, dissipates within hours and days after its initial release so current approaches to environmental issues are short-term and have little influence over how future generations will address environmental issues.

An important dimension of sustainable development emphasizes the local level. An important aspect of sustainable development is the inclusion of local communities. If the project is not supported by the local communities, it is unlikely that programs and policies themselves will be adopted in the long term. Poverty and lack of economic opportunities in the border areas provide little room for environmental considerations. Thus, local communities who require sustainable development policies by necessity require both economic development and environmental protection.

5.4.2 Context

The Bicultural Region. The border along the Rio Grande Valley stretches for over 1200 miles and has unique cross border relationships. Each of the major cities like Elpaso / Juarez, Laredo / Nuevo Laredo, Brownsville / Matamoros have more social and economic interactions with each other than with other cities inside the border. The area has very unique bicultural dimensions, the U.S. side having a population which is 80%-90% Hispanic. Many residents have families on both sides of the border. Social and economic relationships are developed largely through cross-border trade opportunities. The border is also characterized by extreme poverty. On the U.S. side, four of the poorest counties in the country are on the border and more than half the population live below the poverty line. In some parts, the Mexican side of the border has significantly poorer environmental and economic conditions than the U.S. side. Unplanned settlements are wide spread on both side of the border. These areas often lack public infrastructure with poor drinking water and sanitation conditions. The manufacturing facilities (Maquiladora industries) along the border have attracted a large mobile work-force. The mobile population adds pressure to the urban services but does not contribute to the tax base in the region.

The growth of the manufacturing facilities on the Mexican border which serve the U.S. market will continue to draw more people to the area and the North American Free Trade Agreement (NAFTA) will continue to accelerate this trend. These trends will further add pressure to the already fragile environmental conditions. The Mexican government has not made the border area a priority, expecting that U.S. or Texas state agencies will eventually do something about the environmental issues, since they affect Americans. These institutional conditions make collaborative programs to deal with common pollution problems a great challenge.

Lack of Cross Border Institutions. Currently, the government institutions lack mechanisms to deal with cross border environmental issues. All of the environmental problems span the border and they cannot be solved by taking steps only on one side or the other. For example, all the twin cities in the region share a common airshed. In addition, El Peso and Juarez share common aquifers which are projected to be totally depleted within 30 years. Also, all of the Rio Grande Valley region shares the surface water. The environmental issues relating to aquifers, surface water, or airshed cut across political boundaries. The approach in dealing with environmental conditions in the region consist of utilizing economic incentives to maximize environmental benefits.

> "A rational approach to addressing the various problems would attack the worst sources of pollution first, regardless of which side of the border they originate, where the benefits of reduction will yield the greatest returns versus cost. A good example of the need for this approach is air pollution along the El Paso/Juarez border where the major problems are on the Mexican side, but the resources to deal with them are relatively limited. The major emissions of air pollutants (particulate matter, carbon monoxide, sulfur and nitrogen oxides) come from very old cars, small scale brick factories, uncontrolled burning, and unpaved roads in Juarez. In most cases, substantial reductions in emissions of air pollutants from Mexican sources could be achieved at a relatively small cost in comparison to the cost of equal reductions on the U.S. side, where tighter controls have already forced most of the relatively easy reductions." (Sanders International 1996)

There are disparities in the relative costs of reducing emissions. Currently, the Environmental Defense Fund is promoting a "systems" approach to solving environmental problems and developing plans for an international air quality management district for the El Peso/Juarez area. The air quality district would allow emissions trade-offs, encouraging investments where the benefits are high and the relative cost of reducing emissions would be low.

Poverty. Standard of living issues and the focus on short-term impacts often make environmental conditions low in the priorities of the citizens. Poverty conditions on both sides of the border and the lack of institutions to finance pollution control

make environmental protection problematic. Local populations' primary concerns are jobs, education, housing, transportation, crime, and life-related issues where environmental considerations often rank last. Access to drinking water is a concern but long-term depletion of resources, wastewater treatment and waste disposal are not priorities in most citizens' minds. The conclusion is:

> "Programs to promote economic development and to support environmental protection are inextricably inter-related. Unfortunately, in practice, programs to advance these two goals are all too frequently treated as entirely separable, if not actually in conflict. Accordingly, the Commerce Department, as the lead economic development agency, and EPA, as the lead environmental protection agency, need to undertake a coordinated effort to encourage joint consideration of these two elements of sustainable development." (p.10)

5.4.3 Organizational Strategies

Cross-Border Institutions. Major institutional building requires the creation of special purpose districts to deal with cross border environmental issues ranging from air, water, wastewater, solid and hazardous waste management, and habitat preservation. The financing constraint makes it a factor so that innovative strategies at the municipal and local levels are needed.

One of the recommendations is to form an inter-agency group to examine and develop programs to deal with groundwater depletion. The goal would be to create incentives to use water in its highest value uses and then treat and reuse it for industrial and agricultural purposes. The demand-side management also encourages residential and commercial conservation of electric power.

Low Cost, Innovative Technologies. The relative low-income base in the region lacks the ability to support higher-cost conventional approaches to environmental problem solving. For example, large wastewater treatment plants can cost up to $200 million. Potential projects can be funded in the United States via tax-exempt issues with federal support. Municipal governments which finance the projects can repay the loans through user fees, but such finance markets may not exist in Mexico. Thus, they will require either federal revenue or international finance. User fees, if collected, are based on pesos while the project fees may be borrowed in U.S. dollars. The low income levels of the residents makes it difficult to service debt through user fees.

The promotion of innovative low-cost technologies becomes attractive, especially in the case of wastewater treatment. These technologies include constructed wetlands, use of aquatic plants, and agricultural re-use systems but they face strong opposition from traditional engineers who are often paid fees based on a percentage of project costs. Thus, there is a natural bias towards larger, more costly projects. Banks and municipalities are reluctant to fund these smaller projects due to the perceived risk, even though they represent perhaps the only affordable solution.

Part of the task for the federal government would be to remove barriers to the transfer of low-cost and innovative technologies and to create programs to "certify" the performance of these technologies in ways which would enhance confidence in the cost and effectiveness predictions.

Incentives for the Longer Term. As the director of the project articulates:

> "The short-term focus on the financial return for most investment is driven by the practice of discounting future benefits to their net present value through the use of a market interest rate. This approach is correct from a financial perspective because it accurately reflects the time value of money which could be invested today to generate greater revenues in the future. The use of discount rates, however, is not fully satisfactory when considering the needs of future generations because we may not invest in ways that advance their interest."

What is recommended by Ed Sanders is an Assistant Secretary-level task force between commerce and the EPA to integrate economic development and environmental protection planning activities along the border. Neither the EPA's environmental protection program nor the Commerce's economic development program are going to be successful unless they are linked with each other.

The task force would allow a framework for implementing environmental side agreements in NAFTA with current programs underway. This would allow the integration of economic development needs in close coordination with environmental projects for an integrated approach. What is emphasized is innovation within current structures to deal with an integrated approach.

Eco-Industrial Parks. Considerable appeal is given to the development of eco-industrial parks as a catalyst for sustainable development activities. The benefits are that they provide better environmental infrastructure by using common effluent treatment plants or co-generation facilities and a location for cross-linked recycling and resource recovery firms. This follows the EPA and the President's Council on Sustainable Development, as they have sponsored the planning for eco-industrial parks to be located in Brownsville. The eco-industrial park idea would be attractive in any area where there is a lack of common effluent treatment capability and there

exists a need for on-site power generation and associated co-generation opportunities. This in turn leads to investment in these schemes.

For the U.S. Department of Commerce, the concept of eco-industrial parks should be very well known since it already has substantial experience in funding infrastructure investment for industrial parks, as well as an ability to undertake research on synergies among industries in terms of input and waste stream treatment requirements. Also, taking the idea of the Maquiladora concept further, the border region would provide an opportunity for labor-intensive product disassembly operations, activities that are attractive for cross-border collaboration with lower cost and lower skill activities on the Mexican side and higher cost activities on the U.S. side.

5.5 Conclusion

This chapter provides a case description of the selected sustainable development strategies in leading environmental organizations. Table 5.1 provides summary of the findings. The chapter address three major questions, who, what, and how, each corresponding to three major system characteristics of the project, *actors, context, and organizational strategies*. Who were the major actors? What was the circumstance surrounding each project? How are sustainable development strategies being implemented in each project? In the next chapter, I will elaborate on the contextual analysis of the selected case studies utilizing a general evolutionary methodology.

Table 5.1 Overview of the Project Analyses

Organizations / Categories	International Institute for Energy Conservation	Environmental Law Institute	Sanders International
Concept of Sustainability	**Cross sectoral partnerships for energy efficiency**	**Linking economic and environmental objectives**	**Pollution Prevention; Renewable Resource Use**
Level of Activity	**International**	**State and Local**	**Regional, Bi-national**
Organizational Mandate	**Energy Efficiency Implementation**	**Advance Environmental Legislation**	**Private Sector Partnerships; Business Facilitation.**
Actors	**IIEC, International Development Agencies, Private Companies**	**ELI; Virginia Task Force on Sustainable Development; Community Organizations**	**Sanders International; U.S. Department of Commerce**
Context	**Energy Conservation Act; Demand-side management**	**Lack of Political Commitment; Lack of Information; Hierarchical Institutions**	**Lack of cross-border institutions; Poverty**
Strategies	**Private partnerships; Cultural understanding; Changing Mindsets**	**Development of Networks; Multi-Disciplinary Approach**	**Cross-border Institutions; Low Cost, Innovative Technologies Eco-Industrial Parks**

CHAPTER 6

Application of the General Evolutionary Methodology for Contextual Analysis of the Selected Case Studies

Achieving more participatory paths for development requires an evolution in our formal and informal thinking.

Norman Uphoff 1996:410

6.1 Introduction

Having synthesized the methodological elements derived from the general evolutionary perspective in chapter 3, I will now turn to the empirical exploration of these elements in current sustainable development strategies in the context of sustainable development.

The purpose of this chapter is threefold: First, I will identify the nonlinear interdependent elements that are affecting the configuration of sustainable development strategies at the project level - the micro attractors; Second, I will

describe the macro attractors - the sustainable development fields[28], and the dynamic relationship between micro and macro attractors; Third, I will describe qualitative evolutionary changes taking place in current sustainable development strategies. What I am attempting to describe in this chapter is an abstract model of the co-evolutionary relationship between sustainable development strategies and the overall environmental management field and the pathways of efficiencies within current environmental organizations that are setting forth the conditions for the next phase in sustainable development approaches.

Current literature on sustainable development, in response to the continual degradation of natural resource systems, concentrates on a number of wide ranging factors that constitute nothing short of a renaissance. Policy prescriptions for sustainable development have moved beyond notions of economic restructuring, grassroots development, family planning, elimination of state subsidies, poverty reduction, and population control. Advocates are now calling for the transformation of the culture of consumerism (Milbrath 1994; Goodland, Daly and Kellenberg 1994), for restructuring the economy according to ecological principles (Colby 1989), creating sustainable communities (Beatley 1995), and evolving levels of consciousness (Ornstein and Ehrlich 1989: Elgin 1994). Few advocates of sustainable development, however, have taken a critical perspective to address the factors that induce the evolution of the sustainable development field other than to invoke a new vision of society that gives values to social equity, human worth and ecological health (Reid 1995).

The evidence from the contextual analysis of sustainable development projects being initiated by the International Institute for Energy Conservation, the Environmental Law Institute, and Sanders International reveals that micro-project attractors are shaped by three nonlinear interdependent variables: values, technology, and organizational structure. Current sustainable development initiatives emphasize the well-being of future generations, integration of resource management policy initiatives, and collaborative decision making processes. Evidence from the selected case studies also indicates that micro project attractors are shaped by the larger macro fields (i.e., paradigms of environmental management in development). I will argue that environmental management strategies co-evolve with the overall field. There is evidence from the corporate sector that corporate environmental strategy also co-evolves with the larger institutional field

[28] I am using the term "sustainable development field" to broadly describe cultural ideas, network of institutions, collective meaning, and values that inform how we should integrate social, environmental and development issues. The term "field" is borrowed from "self-organization" literature where emergence of new order is accompanied by the emergence of a new field. Currently there are various sets of sustainable development fields, what Colby (1989) calls paradigms of environmental management in development. The argument that I will make in the dissertation is that sustainable development fields drive the development of organizational strategies for sustainability and sustainable development strategies in turn can bring forth new fields.

(Hoffman 1995) My own evidence from the three case studies suggests that the emerging sustainable development field is currently driven through three pathways of efficiency: market driven technologies, partnerships, and the formation of new environmental industries.

6.2 Nonlinear Interdependence: Structural Components

The concept of nonlinear interdependence represents the structural dimension of the general evolutionary methodology. The primary structural characteristic that needs to be described is the micro-project attractor. The micro-project attractor describes interdependent dynamics at the project level. Variables of analysis include interdependence and the source of instability.

Interdependence describes a condition in which the complex adaptive system in question cannot be broken down into separate elements or its component parts. Nonlinear interactive systems are said to be non-reducible and non-decomposable (Goerner 1994). Interdependence produces a picture of complex, interactive causality. The variables mutually affect one another in the process of creating a form.

Interactive dynamics also create a pattern of flow. The concept of an "attractor" stems from "chaos" literature and describes a state towards which a system tends to flow (Goerner 1994). A system can move through multiple states through a series of bifurcation points or transformation points in the system (Clayton and Radcliffe 1996). Interactive dynamics create a flow and in turn create a dynamic form.

An attractor exhibits order - a self-stabilizing form. An attractor is an ongoing state maintained by the interdependent dynamics of its variables. An attractor can exhibit a relatively stable state - a self generated order that is resistant to change. Attractors in essence are at the edge of order and chaos, in a state of nonlinear equilibrium. Sources of instability (key forces which affect the patterns of interactive dynamics) become an important area of research. Sources of instability lead to an understanding of whether or not the micro attractor will maintain its form, dissolve, or change its form. An understanding of bifurcation points shows how the same interactive dynamics can lead to changes in the project attractor.

Given this framework, attention turns to the following question: How has the strategy of the environmental organization responded to sustainable development, and what are the dynamics by which this transformation has taken place? The subset questions are as follows: What are the interdependent variables in the three case studies? What are the forces acting on the micro- project attractor? Does the micro-project attractor exhibit stability? What are the sources of instability in the micro-project attractor?

The critical assessment of the case studies reveals three major interacting variables in sustainable development strategies that pull the project to its particular micro-project attractor. Figure 6.1 describes the interacting process. These co-affecting variables were found in all three case studies. Although the dynamics vary in each of the cases for the purpose of developing an abstract model, the nonlinear interdependent variables describe broad structural components that shape the development patterns of the sustainable development strategies at the project level. The abstract model that is developed is a description of the project from a complex adaptive system point of view. It focuses on the "geometry of behavior", focusing on patterns and transformation between patterns (Goerner 1994).

Environmental management technologies have a direct impact on how the goal of sustainable development will be implemented. Environmental management technologies, however, do not evolve in response to environmental problems directly, but rather co-evolve in response to organizational values, organizational structure, and the larger sustainable

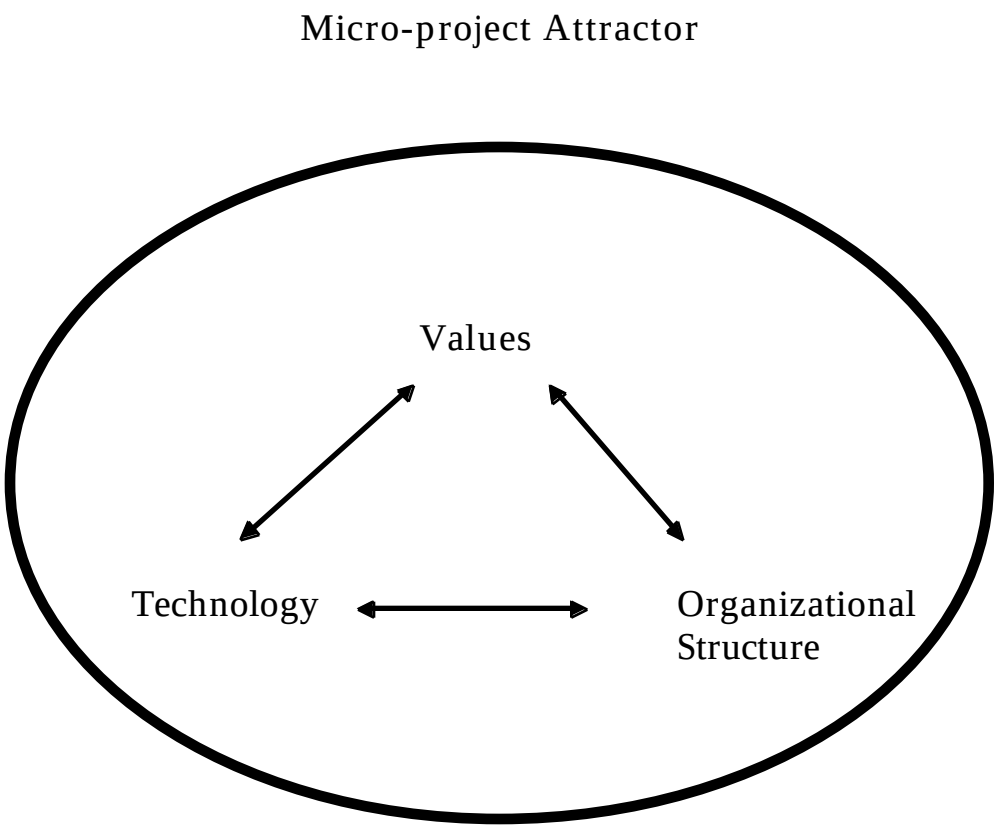


Figure 6.1 Nonlinear Interdependent Dynamics

development field. Values, particularly in the context of sustainability, are shaped by larger fields such as changing world views and changing paradigms of environmental management in development.

Values affect sustainable development strategies and are affected by the development of the types of strategy through their interaction with this field. Values and personal experiences, however, set the conditions for the types of sustainable development technologies chosen and affect the organizational structures that project directors initiate. Each case study portrays the role of values in a different way; some were explicit, while others portrayed the roles of values implicitly. For each selected case, personal, organizational, and institutional values vary; they differ in the contextual paradigm from which they emerged. The following sections describe micro-project attractors and interdependent systems for each selected case study.

6.2.1 The Tai Partnership Project

Micro-Project Attractor. The Tai Partnership's distinctive environmental management strategy is the development of an energy efficient industry as a major alternative to the energy supply market. The project aims to provide a vital energy resource in combination with other sustainable energy technologies such as co-generation and renewable energy. It extends the economic paradigm of considering pollution as not just an external condition of the market system but as a negative resource. It extends the economic concerns of efficiency with the efficient use of natural resources which are becoming scarce, especially in the light of high rates of economic growth and high rates of population growth in developing countries. Market forces are utilized to create opportunities for profit-based demand-side management projects with sensitivity to cultural and social factors for energy conservation. The technology reflects the strong desire to couple economic gain with environmental conservation, because in Thailand it is the economic necessity that is pushing concerns for sustainability rather than the environmental problems. The outcome of this venture is the development of a new energy-efficient industry. According to Opheim (1996), the project director at IIEC:

> "We recognize that in order to implement energy efficiency you need high efficiency technologies, you need engineering services to make it all happen and for that you need private companies. So the perspective which permeates all of our work is the attention to the private sector, and the importance and actual implementation of energy efficiency."

Sustainable development is defined in terms of resource conservation, reinforcing the connection between economic growth and the environment. Efforts involve market research in energy efficiency, collaboration between private and public

sectors, technology transfers through joint ventures, and participation in the development of Thailand's energy conservation policy.

Interdependent System. At IIEC personal values have a direct impact on the strategies chosen. For Russell Stern, the president at IIEC, his personal values directly set forth the type of environmental projects he wanted to initiate. As he states:

> "I came to this field of energy efficiency and energy conservation, theologically. It was a personal soul searching when I was in college. The times reflected an event which shaped my personal outlook on the world. It was a time of the second oil shock and I recognized that we were going to be making some decisions as a global economy and as a domestic economy, and that we were going to have impacts for a long time on future generations. This was in the late 70s before the term sustainable development became popular" (Stern 1996).

The personal values along with insights as to what motivated individuals had a direct bearing on the types of project that were being initiated at IIEC. Again, Russell Stern:

> "I realized that in order for people to care about how energy-efficient things are and therefore the environmental impacts of energy use, you have to define it in economic terms to show who would profit personally from this, and so that started my thinking on how you create business opportunities out of energy efficiency. So, a lot of our creative thinking in this organization is oriented towards how you motivate behavior. The win-win situations are there, so we don't have to create them; what we have to do is articulate them and create systems that they can just drop into that do not require too much entrepreneurial creativity on their part . Our role is to see where these imperfections are and how to fix them. Our role is to think creatively about how you paint an obvious picture from a cultural/societal perspective and how to paint it as a profit opportunity for individuals. Why would governments do it? It depends on who you are dealing with. If you are dealing with a government agency, you see to it that they get credit for something good. The question one has to ask is what is their reward system, what rewards them?"

In Thailand the focus is on high efficiency lighting. So, high efficiency fluorescent tubes with electronic ballasts were the first products that the IIEC emphasized. The electronic ballast was a product that was needed for the energy conservation program but which was not locally available in Thailand. In 1992 the IIEC matched up five or six US companies with local Tai partners to jointly manufacture,

distribute and market energy efficient ballasts in Thailand. This started the trend for a new market which did not exist before and impacted on the overall level of resource consumption. The type of technology chosen affects the type of market that will be created for resource conservation. The particular technology and the market co-evolve.

The nonlinear interdependent relationship between values and technology can also set the context for the development of a new identity for the organization itself. It provides a shift in the way nonprofit organizations are perceived and their methods for sustainable development. Working with private companies sets the IIEC apart from other NGO's in developing countries, and provides new identities within the NGO community. As the current President of the organization states:

> "What too many of our developing country NGO's are in a pattern of doing is saying what is bad and not presenting an alternative. There is a very strong ideological bent in the NGO community that comes out of the desire to remain pure, that working in the private sector is a bad thing and that you get tainted by working with the private companies for the industry that presents products you are trying to get out there as a solution. As long as they play that game, they are limiting themselves and won't be effective. So, one way that we distinguish ourselves is we explicitly work to make the sustainable energy industry successful. And we state that and we reach out to them and work with them" (Stern 1996).

How has the micro-project attractor maintained its stability? What forces are acting on the micro-project attractor? One of the dominant sources of project instability for a nonprofit organization such as the IIEC is the constantly changing funding environment.

At the IIEC, the organizational learning system was adopted to stress individual creativity and organizational innovations. The President instituted an open communication process through a series of e-mail and round-table discussion groups and changed organizational structures to help create an environment where the staff, along with the administrators, could contribute to the sustainability of the organization. The strategies included decentralized authority, low formalization, lateral connections, teamwork and an integrated knowledge base.

The IIEC was facing a situation where federal funding, which represented 70% of the total funding sources was going to be cut in 1997. They were faced with the condition of either diversifying the funding resources or cutting their staff. Russell Stern realized that the nature of communication between program directors and administration influences the range of choices that the organization can exercise. The ability of members of the organization to extract information, provide feedback, and develop creative solutions depends on mutual respect and trust. The staff

members and directors, who were his peers and friends, were afraid to assert their creative thoughts in a hierarchical environment for fear of being judged. As a result, open communication channels utilizing e-mail discussion groups to talk about creative approaches to funding, organizational sustainability, and individual ownership were instituted.

With shrinking funding and changing business environments, finding new funding sources became a priority. A unique solution to the funding question came forth as part of the round-table discussion. The idea was to develop a working relationship with the copper industry to open up new avenues of cross sectoral partnerships. Environmental organizations have traditionally avoided working with the copper industry for ideological reasons. Production of copper in the past involved strip mining and caused serious land degradation. However, copper is a component part of many of the energy efficient products which the IIEC was promoting and the energy efficiency of many technologies is directly proportional to the amount of copper in them. For example, a motor that has heavier copper windings is more energy efficient than one that has less copper. Copper performs at a higher level of efficiency but its main competitor, aluminum, is cheaper. The copper industry is constantly looking for ways to compete with aluminum to create a market for copper in ways that the value of the copper is greater than the price margin of aluminum. An aluminum motor is lower in its initial cost, but the copper motor would save five times the cost due to its energy efficiency.

The IIEC produced market research on the potential use of copper for energy efficient technologies in developing countries. The copper industry bought the idea and provided a significant new funding resource of over half a million dollars to the IIEC to identify the benefits of the energy efficient markets for the copper industry. An unlikely partnership between the copper industry and an environmental organization was developed. As Russell Stern relates:

> "I never thought about copper before, and so it is looking sideways at who else benefits from our work. The competitive advantage is that other organizations are not yet thinking in terms of partnership with the copper industry" (Stern 1996).

Organizational structures can aid in the development of creative approaches, and provide alternative responses to the current sustainable development field. Carley and Christie (1993) describe the process of innovation as learning to learn, or action learning. The action learning process at the IIEC led to the development of lateral connections which provided a means to deal with complex changes in the organizational environment. The primary task of managers is to develop an environment of learning within the organization to sustain the organization itself. Organizational innovation, therefore, is pivotal in the management of complexity.

It requires a continual process of innovation through collaboration and consensus for the sustainability of the micro-project attractor.

6.2.2 Blueprint for Sustainable Development of Virginia

Micro-Project Attractor. The Blueprint for Sustainable Development emphasizes a holistic approach to sustainability. The recommendations to the General Assembly of Virginia cover eight different sectors including managing economic growth, building sustainable industry, preventing pollution, sustainable use of energy resources, protection of air quality, preserving historic and natural resources, and developing sustainable communities. The dominant approach is utilizing environmentally friendly incentives to harness market forces for efficient environmental management. This approach pulls the rest of the project along. The essence of the approach is ecologizing the economy (Colby 1989). The proposal takes economic growth, community development, and the environment and seeks to find reinforcing linkages between the three. The plan argues for the protection of ecological resources and the integration of environmental and economic policies to assure future economic growth in Virginia. For example, the recommendation of a sustainable industry includes the use of private activity bonds to attract the expanding energy industry, reinstating Virginia's expired renewable energy income tax credit, and enacting a new investment tax credit of 10% of the one-time cost of converting from present manufacturing processes to more environmentally sound, pollution preventing processes. In all of these categories, environmental data collection, incentive-based strategies, and restructuring state institutions for achieving sustainable objectives are strongly emphasized. Special emphasis is placed on community development.

Interdependent System. The environmental management strategies at ELI are shaped by the interdependent relationship between organizational structure and organizational value. The holistic approach to sustainability stems from the multidisciplinary organizational structure. The choice of utilizing the retreat for gathering information, developing contacts, and disseminating information to the public, stems from the organizational value of coalescing divergent view points on environmental issues and educating the public. The organizational value that is placed on choice and cooperation comes from the multidisciplinary nature of the organization. The project attractor with its holistic influences is affected by the organizational structure and organizational values. As the project director articulates:

> "One of the things that distinguishes ELI from other environmental adversary groups is that we envision ourselves as a sort of meeting place for groups with different concerns about the environment. We frequently hold seminars and training programs and try to bring together disparate points of view and defuse some issues, because the environmental field, has always

been an antagonistic area..... Our staff is multi-disciplinary, a number of us are lawyers, but we have economists, scientists, and some engineers. That is different from other advocacy groups, who have evolved over the years, because they have to have particular expertise, and experience in particular law to bring in litigation, they have become more and more specialized. One thing that has helped us in that approach is that, although US environmental laws are single dimension, air law, water law, etc., we have worked very hard to look at problems in a multi-dimensional fashion. We hope that our multi-dimensional focus will enable us to be well positioned as things evolve, because the trend is clearly to think in a multi-disciplinary way."

The switch from the legislative approach at the state level to local action was a fairly easy shift for ELI due to its organizational emphasis on a multi-disciplinary approach and community action. The project director puts the idea in the following way:

> "It has reaffirmed for us that our model of working in the U.S. and other countries, working with grassroots groups and working bottom up is an approach that can produce results. Because we have the commitment, we could see that changes were taking place. Numbers of us have worked with community groups with the idea of community involvement; individual citizens, if they have a say, will become more engaged, and will exhibit more concern and will for win/win solutions that will produce much more effective change in the community" (Keiner 1996).

In the case of ELI, the technological focus is secondary. The organizational values remain the development and implementation of environmental protection laws and policies, and developing citizen participation in environmental protection. The ELI's project goals include the development and implementation of effective environmental protection laws and policies, and the forging of a constructive, meaningful role for citizens in the creation and implementation of environmental protection regimes.

6.2.3 A Strategic Framework for Promoting Sustainable Development in the Rio Grande Valley

Project Attractor. The environmental management strategy in the Rio Grande Valley focuses on three primary dimensions of sustainability: One, reconciling

economic growth and near-term environmental protection. Two, protecting the interest of future generations. Three, grassroots development. As the project director states, "it is almost axiomatic that polices which are not supported by the local population will not be sustainable in the longer run" (Sanders 1996). Conceptually, environmental protection, poverty, and economic development are linked and given equal weight. Similar to the IIEC's approach, the proposal extends the economic paradigm of considering pollution as not just an external condition of the market but as a negative resource. As the strategic framework advocates:

> "There is growing awareness that "end-of-pipe" measures, which are a dead weight cost to the economy, can usually be avoided by investments to prevent the waste in the first place. These "pollution prevention" measures often yield increased efficiencies and cost savings as a by-product" (Sanders International 1996).

Recommendations include the formation of an Assistant Secretary - level Department of Commerce and EPA task force to collect economic and environmental information on the border and to set up certification program for low-cost innovative environmental technologies. It also includes systemic effort to promote eco-industrial parks in the region, technological development for water conservation and reuse, and promoting eco-tourism in the region.

Interdependence. The proposed sustainable development strategy in the Rio Grande Valley is derived from two major factors: personal experience and technology. The sustainable development problematique in the Rio Grande Valley illustrates a common mis-match between the nature of environmental problems and problem-solving structures in government. Such differences between ecological boundaries and political systems often leads to an inadequate response to ecological problems (Carley and Christie 1993). The project director of the Rio Grande Valley project had recognized the problem in a different context. The early part of his career was spent in the office of management and budget on the international side looking at foreign assistance and trade finance and state department operations. As he states:

> "There are lot of organizational issues when you are operating at an international context. Whenever Mexican border issues or Canadian border issues came up, the system just broke down, because the state department is responsible for the conduct of US foreign policy and took a very protective stance to anything that the government did, and it had to come through the state department" (Sanders 1996).

In a cross border issue, governments are not only caught in a single linear approach to complex ecological problems due to the vertically integrated, single sector system, but they also lack bi-national regional structures to effectively address the sources of

pollution and resource depletion on both sides of the border. In a bi-national context, the nature of environmental problems not only requires multi-sector responses but also a multi-national response at the local and regional level.

The recommendations to promote collaborative institutional structures for facilitating cross-border initiatives through bi-national wastewater treatment projects, and the development of the El Paso/Juarez international air quality management district as a model for cross-border regulatory initiatives, directly stems from the personal experience of the project director in the public sector.

The technological emphasis comes from the need to improve the standard of living for the local population as an integral component in environmental protection. The integrated orientation leads to an environmentally friendly industrial- based approach to sustainability. The strategic framework states:

> "A significant amount of discretionary income is needed before the local population will be willing to support and pay for environmental protection activities. As a result, the programs to promote economic development and to support environmental protection are inextricably inter-related" (Sanders International 1996).

The promotion of low-cost innovative technologies for U.S. companies is linked to jobs and income for the workers in the region. Currently, U.S. companies do not have a comparative advantage in large scale environmental technologies. In wastewater treatment, for example, European companies are ahead of U.S. companies in putting large scale technologies together because the U.S. environmental industry has been characterized by municipal monopolies which have prevented technological initiatives, what the project directors calls "systemic biases" in the system. In the U.S., waste water treatment has been run by local water companies which are municipally owned, compared to the British and the French who have privatized their water and waste water facilities. As Ed Sanders states:

> "We don't have much of a water industry in the US, because of the monopoly structure, or you had superfund driven hazardous waste remediation kinds of issues where you have had the lawyers spreading all kinds of fears, where staying out of the headlines has been the issue rather than cleaning up the site. Therefore, no real pressure for cost effective innovative technologies was developed" (Sanders 1996).

How do you take advantage of systemic biases and promote U.S. industry? The U.S. has a comparative advantage in low-cost treatment technologies such as constructed wetlands and the use of aquatic plant treatment technologies. From the commerce department point of view, promotion of low-cost technologies would give a boost to U.S. industries and also benefit the environment. There is an opportunity to

promote an industry where the U.S. is stronger, linking low cost environmentally sound technologies with regional economic development.

6.2.4 Summary

I have argued so far that internal configurations of projects are driven by three major variables; values, technology and organizational structure. This constitutes the internal dynamics of micro-project attractors. Internal factors such as personal experiences of the project directors, organizational values and structure, and technology are all intertwined in co-effecting relationships which influence sustainable development strategies. As the evidence suggests, sustainable development strategies at the project level do not reflect a pure values concern for the environment nor pure economic efficiency criteria.

However, the internal configuration of the project is only one level of organizational action. There is also the macro level to consider. Chaos theory suggests that the macro attractors affect micro attractors and in turn, micro attractors can shape macro attractors. Evidence suggests that environmental organizations not only find themselves in the complexity of internal environments but also derive their ideas from three major paradigms of environmental management - environmental protection, resource management, and ecodevelopment. I will examine these ideas further by first identifying the various macro level sustainable development field.

6.3 Self-Organization: Process Components

The concept of self organization represents the process dimension of general evolutionary methodology. Having described the interdependent variables and the micro-project attractors, I will now describe the macro attractors and the relationship between the micro and macro. In a self-organization process, causality stems from both the top and the bottom. Global order arises from local activity and feeds back into the local activity. Reductionism studies bottom-up causality, and holism approaches top down causality, but self-organization theory suggest causation stemming from both. A system description requires the linkage between the micro and macro. Variables of analysis includes how the macro field affects micro-project attractors and how the macro field may arise from micro attractors. “Macro attractor” in this study refers to the sustainable development field. The following questions are addressed in this section. What are the axes of the sustainable development fields? What are the dynamic processes which link micro project attractors

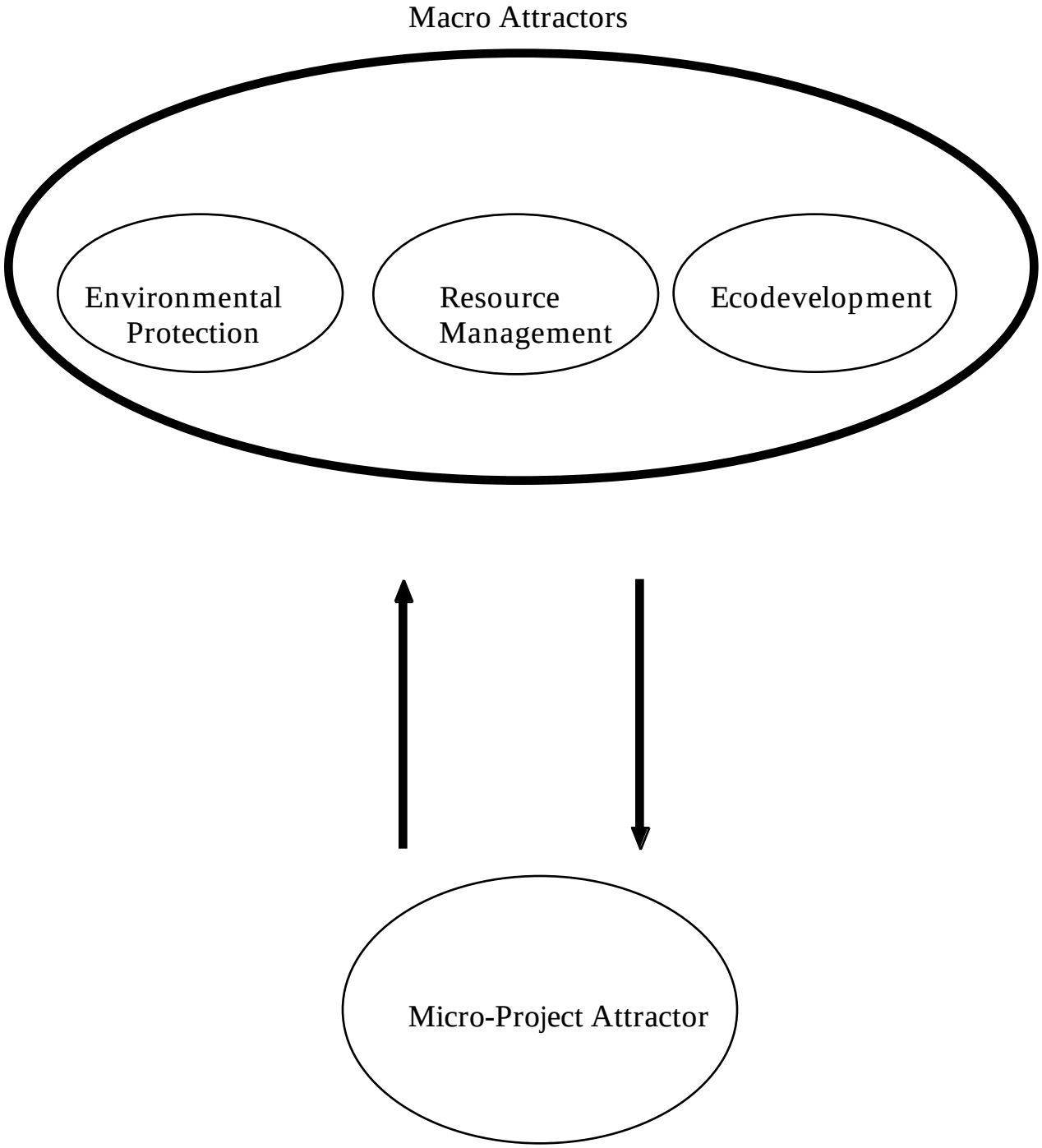


Figure 6.2 Schematic of Sustainable Development Fields

and macro fields? Evidence from the case studies reveals that competing notions of sustainable fields, environmental protection and resource management lie at the politicization of implementing sustainable development strategies. Figure 6.2 describes the dynamic relationship between the micro-project attractors and sustainable development fields.

6.3.1 Sustainable Development Fields

This dissertation argues that the sustainable development strategies are limited by larger paradigms of environmental management in development. Colby (1989) [29] suggests five major paradigms of environmental management in development. I will argue that the current concept of sustainable development is clustered around three of the five major paradigms - environmental protection, resource management, and eco-development.

Environmental Protection. The dominant view within the economic growth establishment, shared by government agencies and international development agencies, reduces poverty, equity and environmental considerations to economic development with restraint (Silva 1997). [30] Conceptually, this paradigm focuses on cleaning up after the limits are exceeded but does not create development activities which are integrated within ecological limits. In this paradigm of thought, the consequence of pollution and resource degradation is dealt with after the fact rather than with an emphasis on pollution prevention. The environmental protection paradigm is dominant in both developed and developing countries. Due to the heavy pressure for rapid economic growth, ecological considerations are often treated as an add-on to development issues. The dominant approach in this

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[29] Colby, Michael E. 1989. *The Evolution of Paradigms of Environmental Management in Development* Discussion Paper No. 80. Washington, DC: World Bank. Following an evolutionary perspective, Michael Colby focused on the relationship between nature and human activity, solutions and management strategies to develop various paradigms of environmental management in development. He argued that evolution of environmental management in development can be categorized in five broad paradigms. He refers to these paradigms as "frontier economics," "deep ecology," "environmental protection," "resource management," and "eco-development." Underlying each paradigm is a different set of assumptions about human nature and activity, about nature itself and the interaction between nature and human activity. Each asks different questions about how society should develop, each also perceives different criteria of success and consequently differing solutions and management strategies. Colby argues that the human activities, economic and socio-cultural development all take place in relationship with the biophysical world, and that the notion of "development" is the transformation of this relationship.

[30] Silva, Eduardo. 1997. Conservation, Sustainable Development, and the Politics of Native Forest Policy in Chile. *In Latin American Environmental Policy in International Perspective,* MacDonald, Gordon J., Nielson, Daniel L., and Stern, Marc A., eds. Boulder Colorado: Westview Press.

paradigm is to incorporate clean-up technologies to current industrial modes of production to mitigate environmental impacts.[31]

From this perspective it is obvious to see that governments are often reluctant to integrate environmental policy in development planning because of the perception of added cost and slowing down economic growth. In an international context, developing countries have argued that the new global environmental agenda is a new form of neo-colonial coercion designed to repress economic growth in these countries. In the environmental protection paradigm, the impacts of pollution on health and quality of the environment are the primary concerns. Limits to growth are not considered as a serious problem due to faith in technology and the ability of market systems to develop man-made substitutes for natural resources.

Resource Management. [32] This alternative view seeks to link economic growth, social equity, and ecological viability. The policy approach in this paradigm is infused with an ecologically centered world view[33] including efforts at decentralization, democracy, multiple use of natural resources, smaller scale enterprise, grass roots development, environmentally sound technologies, and equitable distribution of wealth.

The most recognizable document that exemplifies this paradigm is the Brundtland Commission's report, *Our Common Future*. The commission was asked by the UN General Assembly to formulate a global agenda for change and long term environmental strategies for achieving sustainable development. One of the primary conclusions that came out of this report was that the current development path leaves many people in a state of poverty and degrades the environment at the same time. The report integrated the environment and development issues for the

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[31] This type of thinking dominated national as well as international agreements. For example the 1972 UN conference on the Human Environment known commonly as the Stockholm conference which took the step of recognizing the specific need to manage the environment, the practical emphasis was on the remedial nature or 'end of the pipe' solution. The Stockholm conference also involved the first major attempt to involve the international community to construct a positive response to environmental problems. (Reid 1995).

[32] This paradigm is called the "*Global Efficiency*" path (Sachs 1993) where the "*ecology is being economized*." (Colby 1989). The Neoclassical model of the closed economic system is replaced with the ecological economic model of thermodynamically open economic system embedded in the larger context of the ecosystem.

[33] One of the important shifts in perception that takes place in this paradigm is the recognition of the "nature's economy," such as ecosystem services to the economic system, the stock and flow of nutrient cycle, ecosystem services, and throughput processing abilities of different ecosystems. Current economic analysis takes the ecological function as given and do not recognize its benefits to the human economy. Again, a conceptual fallacy which the ecological economists are trying to remedy.

first time from a global community perspective. It explicitly linked development with environmental degradation and poverty as a mutually interdependent system.

They argued that efficient use of resources, integrated economic and ecological principles, and environmentally sound technologies can charter a new globally efficient path for development. Economic growth is linked with care and concern for ecological integrity and resilience. Proponents of resource management argue for the total reduction of the scale of human activity to control the effects of population and consumption per capita. Emphasis on energy efficiency and resource conservation takes on a meaningful role rather than just being an afterthought. Pollution prevention rather than "clean up" is also emphasized.

Ecodevelopment. The ecodevelopment approach to sustainability makes an explicit linkage between social, ecological, and economic criteria in a positive sense. In the ecodevelopment path, the very notion of polluters paying is restructured so that economy functions are based on ecological principles. Advocates of the ecodevelopment paradigm promote the use of renewable energy, sustainable agriculture, agroforestry, ecologically sound common property regimes, use of indigenous knowledge, and community participation.

Proponents of ecodevelopment conclude that the ecodevelopment path is not solely about pollution prevention, efficient use of resources, or getting the prices right on resource consumption, but that it represents fundamental transformation of the material economic attitude. They argue that concepts of adaptability, ecosystem resilience, and uncertainty are required in the long- term management of the environment. Research activity includes incorporating ecological uncertainty in economic modeling and systemic planning rather than just risk management (Funtowicz and Ravetz 1994; Shackley, Wynne and Waterton 1996). This view recognizes that ecosystems are emergent complex systems based on the interplay between human activity and the biosphere (Norgaard 1994). Sustainable development planning would include concerns for future generations, non-human species, and ecologically centered values.

Having described the three distinct conceptual views of environmental management, I will now examine the relationship between micro-project attractors and sustainable development fields. The findings suggest that the primary driver in the current development of sustainable development strategies is the resource management paradigm.

6.3.2 Linking Micro-Project Attractors and Sustainable Development Fields

Evidence from the case studies clearly indicates that the macro attractor of the sustainable development field has shifted from environmental protection to

resource management. In all three case studies, project design centered on resource management themes such as long-term sustainability of resource use and paths of development based on interdependent linkages between economic growth, environmental conservation, and social equity. The resource management paradigm acts as a filter to ensure that project directors have defined their problems and proposed actions to solve the perceived problems. The overall field provides a set of possibilities which environmental organizations interpret to define factors of environmental management. The overall sustainable development field influences the conception of sustainable development that is chosen and implemented (Hoffman 1995).

However, although the selected sustainable design strategies emphasize long-term resource use and movement away from "end-of-pipe" measures, current strategies have yet to reinforce a positive construct of the relationship between human economic activity and ecological principles. It has yet to manifest the ecodevelopment paradigm. The IIEC's program on energy efficiency is a shift away from emphasis on clean-up technologies, yet natural resources still will be depleted, albeit at a slower rate. The promotion of eco-industrial parks by the ELI in Virginia, and Sander's International in the Rio Grande Valley, provide environmental infrastructure through pollution prevention technologies, yet we have yet to see a strong push towards the integration of industries with renewable resources.

The dominant theme in all three cases at national and international levels is to expand traditional economic concerns of efficiency with efficient use of biophysical resources, pollution prevention, and ecosystem monitoring. The emergence of the resource management paradigm as the dominant cultural template for organizational action signals the evolution of an organizational response to sustainable development. However, the long-run evolution of the project attractors involves the politicization of sustainable development strategies. The changes in the macro attractors impacts the ability of micro attractors to maintain their identity and effectiveness. Responses of the micro attractors can also initiate new changes in the overall field.

Two major competing views of sustainable development - environmental protection versus resource management, lie at the basis of politicization of sustainable development strategies. Evidence from the selected case studies

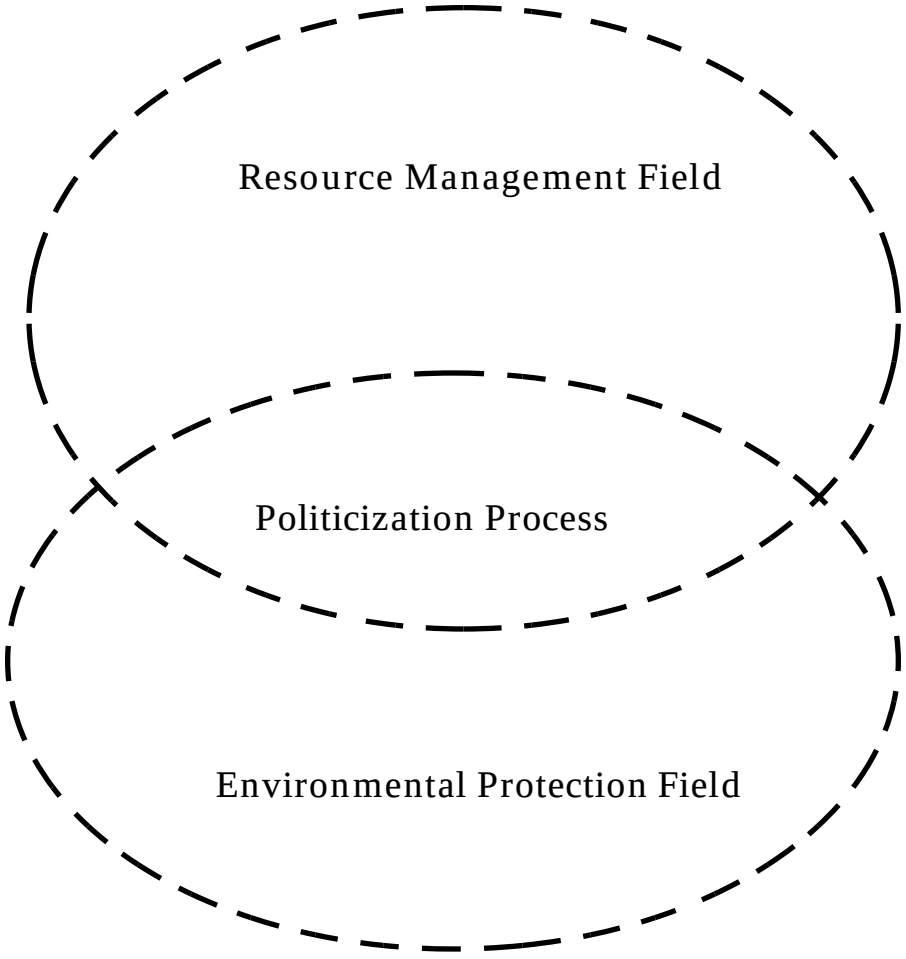

Figure 6.3 Schematic of the Politicization Process

suggests that the politicization of sustainable development strategies involves competing dynamics between the proponents of environmental protection and those of resource management paradigms. Figure 6.3 provides a schematic of the politicization process.

Politicization Process. Evidence for the "Blueprint" project suggests that the major source of instability originated from an external source. In the implementation of the project, the ELI found itself in a direct struggle with a group with a differing position on sustainable development -- the Virginia Task Force on Sustainable Development. Supporters of the environmental protection paradigm dominated the agenda-setting stage of the policy-making in Virginia under Governor Allen's administration. The market-friendly group reduced the principles of equity and environmental considerations to market-friendly economic growth (Silva 1997). Environmental degradation was considered to be an unfortunate consequence of economic development which needed to be ameliorated. The solutions were limited to developing technological approaches to mitigating the environmental impacts of industrial production. The Virginia Task Force on Sustainable Development strongly supported the market-friendly approach and resisted all recommendations made in the "Blueprint." This approach was shared by networks of experts in government agencies and supporters of the economic growth paradigm who were bound together by similar values, knowledge, and policy outlook. They formed an epistemic community[34] and shaped the State's attitude towards sustainable development.

This opposition was a major source of politicization in the evolution of the project and confirmed that environmental issues in the context of sustainable development are not just a technical matter. The Virginia Task Force on Sustainable Development reflected an uncompromising posture on key issues relating to the policy recommendation by ELI. The presence of powerful market-friendly groups at the state level forced ELI to turn to the local level to form an alternative epistemic community. Community level organizations such as the Northampton Economic Forum on Virginia's Eastern Shore, the Clinch-Powell Sustainable Development Forum in Southwestern Virginia, and the Thomas Jefferson Planning District Sustainability Council (in the Piedmont district) shared ELI's conception of sustainable development where environmental concerns, social equity and economic development were given equal weight conceptually. This approach promotes restoration ecology and pollution prevention rather than clean-up technologies, energy efficiency, and resource conservation, local self-reliance, and grass roots development for a more equitable distribution of wealth. As a result of this collaboration, ELI produced another report following up on the "Blueprint"

[34] An epistemic community is a term coined by Haas (1991) that describes a group of actors who shared similar values, knowledge base, and policy outlook who bond together to shape the overall direction of policy-making in a political context.

documenting community groups in Virginia that were launching sustainable development initiatives. Their alliance with like-minded community groups quickly raised a challenge to the market-friendly epistemic community at the State level. This was also the intention of ELI in producing the follow-up report.

Shortly after the ELI initiative, the Virginia assembly took a significant step to improve the law which affects Virginia citizens' ability to participate in environmental planning. Citizens in Virginia have the right to challenge environmental permits being issued by the state through lawsuits if they feel that environmental permits contribute to further degradation of the environment. This new law is a testimonial to ELI and the alternative epistemic community. Although the general context of policy-making favors the market-friendly approach at the State level, changes are taking place, albeit from a weaker position than the alternative epistemic community would like.

Similar to the ELI's project which faced opposition from a group with a differing position on sustainable development, proposals for sustainable development in the Rio Grande Valley also faced resistance from the EPA. One of the recommended institutional provisions of the proposal was to create an Assistant Secretary-level Task force between the Commerce department and the Environmental Protection Agency at the federal level because "neither EPA's environmental protection programs nor Commerce's economic development programs are likely to be fully effective unless they are better linked with each other" (Sanders 1996). The recommendation was not implemented. The proposal was in direct opposition to the EPA's approach to environmental protection. The EPA's approach towards environmental pollution is focused on setting limits and repairing ecosystems damaged by industrial activity, rather than ways of improving both ecological resilience and economic development (Colby 1989). The project director stated:

> "EPA is a regulatory agency, and despite all its statements about being proactive and caring about sustainable development, it's essentially, 'thou shall not pollute.' They have a hard time looking beyond that fairly narrow regulatory mandate" (Sanders 1996).

6.3.3 Summary

This examination of sustainable development policy confirms two expectations. First, in the case of ELI, the structural stability of the project is strong due to its emphasis on multi-disciplinary perspectives and grassroots development. These factors provide the flexibility needed to adapt to outside forces (Carley and Christie 1993). Second, the politicization of sustainable development issues means that the outcome of the project depends on the context of the sustainable development field. Again in the ELI's case study, the State institutions in the form of a market-friendly

epistemic community, along with social forces, clearly has a stronghold on the policy formulation in Virginia at this time. They limit the extent to which alternative epistemic communities can impact their view of sustainable development at the State level. However, the politicization process also dictates that an alliance between nonprofit organizations and local community groups can form a strong alternative epistemic community and generate new policy directions. The formation of alternative epistemic communities is a necessary criterion for sustainable development. Examination of the case studies confirms that adoption of sustainable development policies requires not only a technical and holistic environmental policy but also a strong epistemic community. This means alliances, collaboration, and partnerships.

The evidence from this project confirms again that the adoption of sustainable development strategies is a political process with debate centering on different conceptions of sustainable development. Differing conceptual views of sustainable development stand at the center of the environmental political discourse at both the State and Federal level, within a national and bi-national context. Each epistemic community utilizes its conception of sustainable development to legitimize its environmental credentials and impact project strategies and seeks to influence their outcome. As Silva (1997:65) states, "all are 'green' but there are clearly different shades with significant political consequences."

6.4 Qualitative Evolution: Transformational Components

To understand the process by which new attractors emerge, one has to study the selection process utilized by the project designers. Within the context of micro-project attractors, the selection process emerges internally. In environmental management systems, selection is influenced by new efficiencies where the conditions in the attractor allow it. In self-organizing systems, the more efficient the path is, the more energy it pulls, amplifying the field via a nonlinear process. The selection process accelerates the ordered complexity and provides the means for new structural relations in the internal variables. The nonlinear dynamic in the selection process can produce new levels of complexity via order through fluctuation. Important questions to address are: what are the pathways of efficiencies in the local attractors? What are the new field that may be emerging as a result of this process? What are the configurations of the new system? What are its patterns? The assessment of the case studies reveals three pathways of efficiencies in sustainable development strategies - market driven approach, partnerships, and the formation of new industries. Figure 6.4 provide a schematic of the pathways of efficiencies.

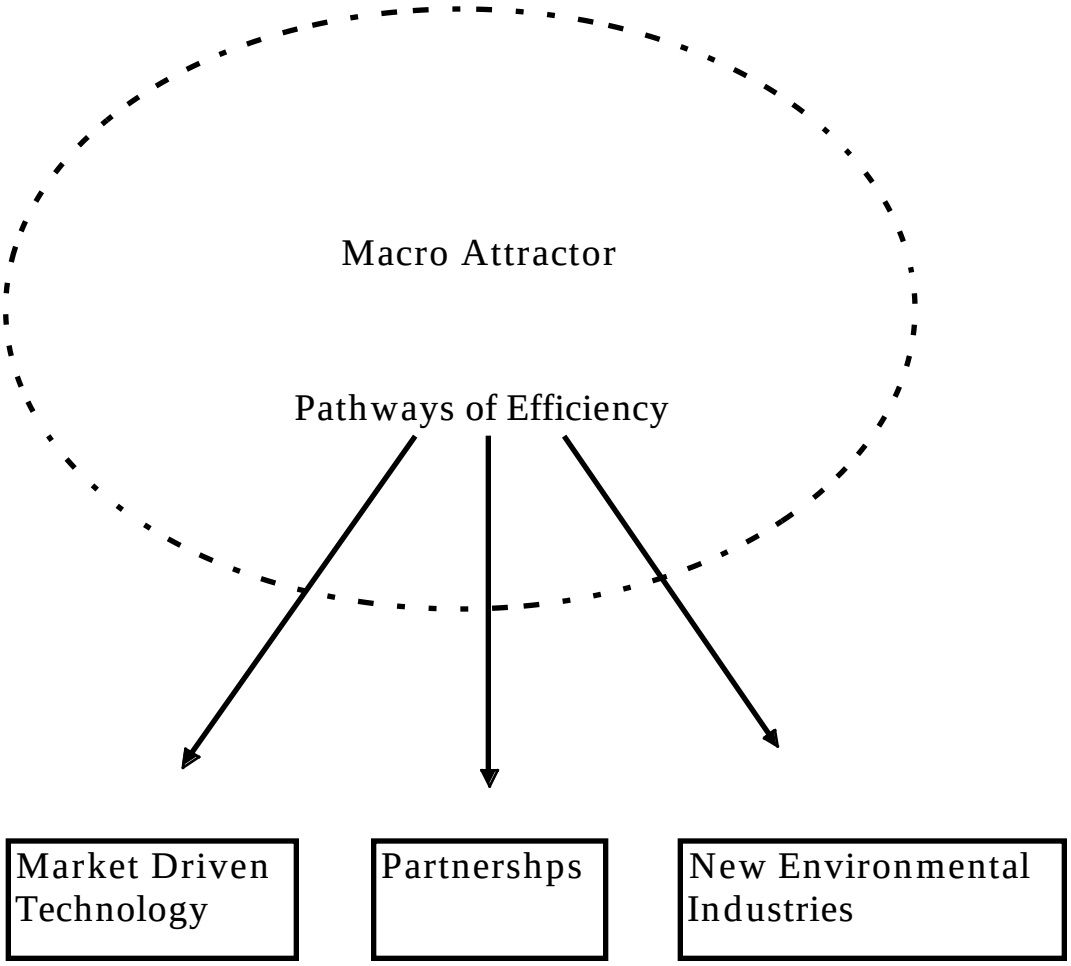

Figure 6.4 Schematic of the Pathways of Efficiency

6.4.1 Market Driven Technology

As mentioned in chapter 2, many definitions of sustainable development currently exist. One principle, however, that is common to all advocates of sustainable development is the need to couple economic activity with environmental concerns (Turner, Pearce and Bateman 1993). The concept of sustainable development challenges the traditional paradigm of inherent conflict between industrial growth and environmental protection. The definition cited by the World Commission on Environment and Development specifies two criteria of sustainability, *intergenerational* equity and *intragenerational* equity. The way to decouple the negative relationship between economic and environmental impacts is to minimize resource consumption and the waste assimilative capacity of ecosystems when economic activities impose costs on future generations (intergenerational equity) along with increasing the standards of living for the world's poor (intragenerational equity). How are the sustainability criteria currently being implemented? Evidence from the current case studies under analysis suggest that the answer lies in using the market mechanism via technological shifts for resource conservation.

The promotion of eco-industrial parks is a key recommendation in both the ELI's plan for sustainability in Virginia and the Sanders International plan for sustainable development policy in the Rio Grande Valley. Eco-parks promote source reduction and pollution prevention by minimizing waste and pollution from productive activities -- product and waste from one cycle being used as an input for the next cycle -- industrial ecology. The project director cites three reasons for using eco-industrial parks as a catalyst for sustainable development: 1) better environmental infrastructure with common effluent treatment plants and co-generation facilities, for traditional industrial parks; 2) location for cross-linked recycling and resource recovery firms; 3) recruitment of a diversified family of vertically integrated firms whose waste streams serve as inputs to other tenants in the park. Traditional waste management policy utilizes a "command and control" regulatory approach in which the regulatory authority sets an environmental standard and the polluting source is required by law to comply. The promotion of eco-industrial development is a significant shift in a situation where current conditions lack a common effluent treatment capability and there are evident needs for an on-site power generation.

From the federal government's point of view, management efficiency is gained. The Commerce department and the Economic Development Administration (EDA) already have substantial experience in funding infrastructure investments for industrial parks. It would be a mere conceptual shift to link ecological dimensions with the financing of industrial parks.

The objective of export expansion would be achieved as well by promoting a segment of the US industry, such as constructed wetlands and the use of aquatic plant treatment technologies. Another example of utilizing the market for environmentally sound development is technology validation (i.e., certification programs). There are significant costs involved in technological validation for ecologically friendly, low-cost, affordable technologies. One of the specific agendas would be to set up a certification program for low-cost, innovative, environmental technologies for use along the U.S.-Mexico border.

It is a win/win recommendation for the government to become actively involved in low-cost, environmentally sound technological systems for the region by getting rid of market imperfections and promoting pollution prevention measures. These point toward economic growth and technological change as a prerequisite for environmental quality.

The IIEC's effort is evidence of a shift from developing field efficiencies through correcting market imperfections, to creating new markets for environmentally sound development. The IIEC's entire mission is to promote energy efficiency as a fundamental tool for economic development. Its strategies are carried out in several ways, requiring banks to provide loans for efficiency projects, affecting the government policies to create a level playing field for energy efficiency, etc. The current goal is to change the mindset of government to considering interest in energy efficiency on a par with investment in new power plants through working directly with the private sector on joint ventures. The mandate is to build markets for energy efficient products and services for developing countries. What starts out as technology transfer in joint ventures, develops into strengthening indigenous capacity in the developing countries to provide energy efficient technologies and services to the development of a new industry.

The evidence from the three projects indicates that project designs are based on the drive towards efficiency and creativity. The criteria of sustainability is not based so much on resource conservation as on preserving the gains of economic efficiency and incorporating the values of environmental services in the market systems.

6.4.2 Partnerships

Environmental organizations constantly face complexity and uncertainty and their own dilemma of how to operationalize their objectives in the context of sustainable development. This situation is compounded by the fact that traditional rational planning models, which assume an equilibrium world of stable prediction and control, cannot be operationalized in an emergent world view. Evidence from the case studies suggests new institutional arrangements are being created that provide

horizontal linkages across sectors, vertical linkages among various organizations that influence environmental policy and creation of local networks.[35]

Bridging organizations serve as catalysts in the formation of networks as evidenced by ELI's project. Networks are defined as "organizational forms that link many autonomous individuals and organizations that share a common perspective without being subject to the authority of any common hierarchy" (Brown 1991). ELI's role was to allow exchanges of resources and information among the local community groups who were engaged in sustainable development activities. ELI functioned as the center of communication and co-ordination as well as a catalyst for pushing forward a sustainability agenda in Virginia. Its primary function was to serve as a communication channel between various community groups, funding organizations, and the State Government. Although its recommendation includes diverse tasks[36] for the state of Virginia, ELI's own function was to provide service links to other parties, provide a catalyst to galvanize diverse community groups for sustainable development projects in its own region and possibly secure some resources for the community groups.
The process generated enthusiasm and interest and empowered the local community groups to push sustainable development agendas in a difficult political context. The document proved to be politically important in that it showed the politicians who operated on short time frames that sustainable development initiatives with positive results were talking place at the local level.

Bridging organizations have also played a critical role in the formation of intra-organizational partnerships that enable differing government agencies to cooperate on the problems of cross-border environmental and economic development problems. The specific near-term recommendation by Sanders International was to form an Assistant Secretary-level Department of Commerce and EPA task force to focus specifically on sustainable development actions for the U.S.-Mexico border. The purpose of this joint task force would be to develop and sponsor a program to collect relevant information on current economic and environmental programs on both sides of the border. It would also prepare a sustainable development plan which would be integrated with the Border 200 plan and explicitly incorporate economic development along with environmental protection considerations. Furthermore, it would evaluate the potential for setting up a "certification"

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[35] This process has been described by Brown (1991) as "bridging organizations." Bridging organizations devote their own resources to linkages with other sectors, organizations and community groups through mutual sharing of information and human resources.

[36] The tasks included diverse efforts such as a coordinated regional growth management plan with the emphasis on clean and reliable drinking water supplies, sewage services, and development of an efficient transportation network, developing hub markets for the agricultural and renewable resource products from the region, promotion of dense, mixed-use development, local policies and incentives for energy-efficient industries, commercial establishments, and pollution prevention.

program for low-cost, innovative, environmental technologies for use along the border.

By promoting a collaborative institutional structure, Sanders International was acting as a catalyst for a new institutional arrangement that could facilitate cross-border initiatives. The Department of Commerce has the potential of promoting sustainable development through its core economic, technology, and trade development programs. It makes an ideal partner with the Environmental Protection Agency (EPA) in integrating environmental and economic development objectives along the border. The joint resources and creativity between the government agencies are needed to move beyond compliance actions, and facilitate the adoption of innovative and affordable environmental technologies for the region.

The next example concerns the activities of the IIEC in the context of a developing country to form cross-organizational partnerships. Cross- organizational partnerships can cooperate on development problems to create new joint ventures and reform institutional structures for resource conservation. Nongovernmental bridging organizations are especially suited to act as catalysts for development of public-private partnerships to deal with intractable environment problems. As Brown (1991:817) states:

> "The joint resources and creativity of voluntary organizations, government agencies, and private firms can build sustainable development systems where none of them could prevail alone."

The cross-sectoral partnerships have brought together companies that provide energy efficient motors, air conditioners, lighting, building controls, and engineering services, to coalesce themselves as providers of energy resources. Creating partnerships allows these companies to see themselves in a way that that they have not seen themselves before, as a new industry. The IIEC demonstrates the importance of cross-sectoral partnerships that link government institutions, private companies, and nonprofit organizations in the promotion of energy conservation. It creates a new institutional arrangement for energy efficiency to become a serious contributor to meeting energy capacity. It creates a shift in mindset of the energy planners that building power plants is not the only way to meet increasing energy demands. Energy efficiency can be an integral part of supplying energy to the world. Cross-sectoral partnerships therefore can play an important role in changing the overall picture of how energy efficiency is perceived and provide a significant option for energy planners.

6.4.3 Creating A New Industrial Base for Energy Efficiency

The previous section described how bridging organizations can be catalysts for the formation of partnerships and networks for new institutional arrangements. In the case of the IIEC, this organization provides not only a bridge in bringing key actors together, but the horizontal linkage that allows intersectoral cooperation to give rise to vertical linkages that enable the networks between the private sector partners to change energy policy. Sustaining linkages depends on enabling horizontal partnerships to influence the overall environmental policy to provide long term development incentives to these firms (Goulet 1989)

The paradigm of energy efficiency opposes the mindset of major international development agencies which have traditionally been in favor of power development to supply energy. Shifting this paradigm requires educating major financiers of power projects. As the director of the project Kelley Opheim articulates,

> "The major issue is shifting the supply-side paradigm. It requires seeing energy efficiency in a different light. One of the things that we are looking overall at IIEC which is changing our perspective from sort of working around the edges of energy supply world to pushing energy efficiency as an integral part of the market. One of the biggest barriers to overcome is that energy planning is typically done by the people that build power plants, so it is always about expansion and not about making efficient what you already have. So it is a completely new paradigm to put into the planning process at the high level of government there " (Opheim, 1996).

The partnerships developed by IIEC are helping to shift energy policy in developing countries. The cross-sectoral partnerships are providing a working model to endorse energy efficiency with both financing and economic feasibility. International development banks prefer financing big power projects because there are smaller transaction costs involved in financing one big project than in financing many small energy efficiency projects. Therefore, there are systemic financial biases which require alternative successful models to convince major development banks that energy efficiency can be a real alternative in energy planning. Energy efficiency technologies such as renewable energy, cogeneration, smaller power-plants, combine recycle power-plants, and clean energy resources will be integral to a sustainable energy policy in developing countries for the future.

The IIEC's role has been strategic in this change. The IIEC has played the role of an honest broker in helping different private firms to work together. More importantly, the private sector companies form new networks and help to create a market for energy efficiency. As the IIEC's case demonstrates, cross- sectoral partnerships between government, nonprofit organizations, and private companies can strengthen the institutional base for sustainable development. The Energy Conservation Promotion Act and demand-side management programs create opportunities for private companies to create environmentally sound markets.

Bridging organizations can build vertical linkages that encourage alternative industry's influence on global environmental policy-making. In the IIEC's case, they can mobilize private partners and the new energy-efficiency industry to achieve political influence on the current discussion on global climate change. The coal and oil industries are the major opponents to taking action on global climate change. They are supported by a coalition of companies who have lobbied against taking action on global climate change. The major argument of these companies is that compliance on global climate change policies will slow global economic growth. If the energy efficiency industry can develop a coalition of companies, it can be given a voice to say that there is economic growth potential in taking action on global climate change. It gives the energy efficiency industry an identity and a voice in global environmental negotiation. Again as the project director states:

> "IIEC is really trying to be on the cutting edge of getting energy efficiency and sustainable energy technologies into this mix. How do we make sure that we are part of policy debate and part of the market for energy? How do we mainstream these technologies? So we have lot of work to do." (Opheim 1996)

The model that is being utilized at IIEC is one of refined thinking in managing to shift the overall paradigm of development. It provides a paradigm of alternative development that draws on economic productivity and market efficiency, as well as environmentally sound polices combined with participation by the nonprofit sector for creative efforts in sustainable development. The creation of new sustainable industries via multi-sectoral partnerships provides an alternative pathway for development. Bridging organizations such as the IIEC play a critical role as institution builders for sustainable development.

6.4.4 Summary

As the evidence indicates, through the promotion of market driven technologies, partnerships, and environmental industries, organizations can provide new pathways for implementing the goals of sustainable development. The partnerships described in the case studies take several forms, ranging from loose networks and intra-organizational partnerships to cross-organizational partnerships. Bridging organizations play an important role in providing values and vision that determine how power and resources are distributed to impact outcomes. Networks and partnerships provide critical leverage for meeting sustainable development objectives which go beyond what each organization can accomplish alone. Bridging organizations not only provide a catalytic role in large scale social change and sustainable development activities, but also, and perhaps more importantly, create ecological linkages that can respond to complex and intractable problems. Ecological

linkages between organizations are important institutional arrangements that can support and sustain development initiatives.

In the context of sustainable development, there is a continual pressure for technological innovations, organizational learning and decision-making. The emergence of environmentally sound market-driven technologies, partnerships and new environmental industries are new forms of efficiency being developed in the macro attractor - field of sustainable development.

CHAPTER 7

Summary and Conclusions

The revolution, as always, will come from the within and be embedded in the without.

Ken Wilber 1995: 197

7.1 Summary

I have argued in chapter 2 that two distinct philosophical paradigms dominate current approaches to environmental management: the material paradigm and the ecological paradigm. The material paradigm, with emphasis on technology and information, assumes that substitution between natural and man-made capital is always possible. It is, therefore, believed that only *relative scarcity* exists between resources whose primary value is the productive input into the economic process. Primary policy implications of this paradigm are to internalize external costs associated with environmental degradation through a competitive market system and to correct policies that artificially cause natural resource degradation in the first place. On the other hand, the ecological paradigm assumes that there is *absolute scarcity* in the natural environment, as evidenced in the limited capacity of the environment to absorb pollution from economic activities, e.g., global warming. The policy implications of this paradigm are to impose limits on the scale of global economic process, induce technological shifts toward energy efficiency and renewable energy resources, and to reduce current levels of global population.

I do not dispute the important policy contributions that both of these paradigms can make with regard to environment and development issues. However, both of these

paradigms are highly linear and deterministic in their outlook, with fixed assumptions about the nature of the problem and provisions for ultimate solutions.

This dissertation starts from a fundamentally different place. The question of sustainability, which calls for enlightened self-interest based on a responsibility to the natural environment as well as future generations, requires that we perceive the ecological-development dynamic from a co-evolutionary, or complex adaptive systems perspective. This argument is not only based on the fact that human beings have co-evolved with the natural environment, but that the core dynamic between ecological, economic, political, cultural, and spiritual systems are emergent, intentional and creative. Complex adaptive systems exhibit dynamic emergent behavior which are nonreductionistic, unpredictable and uncontrollable. Traditional scientific approaches which focus on reductionism, control, and prediction, are unable to comprehend emergent dynamics.

The post-modern general evolutionary sciences create a radical change of perspective (Goerner 1994). They show how simple relations can be hidden in a complex system bounded by a network of complex causality. The general evolutionary sciences produce an image of a dynamic, emergent, and order-producing universe evident from atoms, ecosystems, and civilizations. What are some key findings from the general evolutionary literature? How can we utilize this knowledge base for understanding and managing complex adaptive systems? Can we articulate a methodology for the study of complex adaptive systems? These were the major questions which drove the research.

The major contribution this dissertation provides is predominately theoretical. In particular, it provides a general evolutionary methodology for sustainable development. General evolutionary sciences cover very broad terrain ranging from chaos theory and complexity science to nonlinear thermodynamics. My effort in this dissertation has been to translate an emerging world view to a nonreductionist methodology that focuses on understanding patterns of relationships and emergence for sustainable development strategies. This was done by identifying three major conceptual elements: nonlinear interdependence, self-organization, and qualitative evolution. Our conceptual understanding of an order-producing universe provides a basis for *ecological systems thinking* that emphasizes three major components: 1)interdependent relationships; 2) patterns which emerge and evolve, and 3) new pathways by which this change takes place. Ecological systems thinking allows us, then, to develop a methodology for analyzing complex adaptive systems that focus on structural, process, and transformational components (chapter 3).

7.2 Findings

Analysis of sustainable development strategies used by three separate environmental organizations, utilizing the general evolutionary methodology, provides three major findings, as follows: micro-project attractor, sustainable development field, and pathways of efficiency.

7.2.1 Micro-Project Attractor

Evidence from the three case studies suggests that a project attractor comes from three nonlinear interdependent variables: values, technology, and organizational structure. "Attractor" refers to a state towards which the system tends to flow. This pattern is created by the internal dynamics between these three variables. These co-affecting variables were dominant in all three case studies. Sustainable development strategies do not emerge autonomously, they co-evolve in response to the type of environmental management technologies chosen or emphasized by the organization, in the context of its organizational values and structure. Personal values which affect sustainable development strategies were also found to be shaped by macro fields, such as changing world views and changing paradigms of environmental management in development. Values and personal experiences often set the conditions for the type of sustainable development technologies chosen and affect the organizational structure that project directors initiate. Thus, sustainable development strategies reflect an institutionalization process based on an organization's leadership, the people in the organization, the organizational mandate, and the organization's internal culture.

At IIEC, the emphasis on developing markets for high efficiency fluorescent tubes in Thailand stems from personal as well as the organizational value of promoting energy efficiency in developing countries. The holistic approach to sustainable development of Virginia promoted by ELI, with the emphasis on choice and cooperation, is strongly influenced by the multidisciplinary nature of the organization. In the case of Sanders International, the recommendations to promote collaborative institutions structure for facilitating cross-border initiatives arise from the director's personal experiences in understanding the limitation of federal structures. Although the type of technology chosen to implement the concept of sustainability differ in these organizations, in all three cases, the project attractor emerges from the nonlinear interdependence between technology, values, and organizational structure.

7.2.2 Sustainable Development Fields[37]

[37] Sustainable development fields represent larger paradigms of environmental management in development. Sustainable development strategies are not developed from an isolated context; they are developed in relation to environmental management strategies being formed by other organizations. From a general evolutionary perspective, project attractors are embedded in sustainable development fields and both "affect," and are "affected" by, each other in a dynamic interrelationship.

Evidence from the three case studies reveals that politicization of sustainable development strategies is generally rooted in two rival conceptualizations of sustainable development: environmental protection and resource management. However, evidence from the three case studies indicates that the sustainable development field has shifted from environmental protection to resource management. All the case studies reveal resource management themes, such as the long-term sustainability of resource use, integration of economic and environmental concerns, and social equity.

The sustainable development field provides a context for an organization to focus its vision and provide a set of possible actions. It directly influences the type of greening process that is employed to reach the goals of 'sustainability.' It provides a macro template for structuring new actions and organizational change (Hoffman 1995).

The implication of the politicization of sustainable development issues is that the outcome of the project depends on the context of the sustainable development field. In the case of the ELI, for example, state institutions, in the form of a market-friendly epistemic community, limited the extent to which sustainable development could be implemented at the state level. This led to an alliance between nonprofit organizations and local communities to form an alternative epistemic community to generate new policy directions. It signaled the importance of forming alternative epistemic communities through a process of alliances, collaboration, and partnerships for adapting sustainable development policies.

Differing conceptual views of sustainable development stand at the center of environmental political discourse. Each epistemic community utilizes its concept of sustainable development to legitimize its environmental credentials, develop project strategies, and influence their outcome. Movement towards sustainability is not solely a technical or economic issue; it is also a political process involving differing perception of the sustainable development field.

Evidence indicates that the choice of sustainable development field helps to form a sense of institutional identity by providing a cultural template for new action. In turn, local action can shape the outcome of new sustainable development fields through the formation of alternative epistemic communities. The abstract description that is portrayed is a model of complex causality. The macro field arises from local activity and feeds back onto the local level. Causality thus comes from both directions, and has both top-down and bottom-up dimensions. The relationship is ecological in the sense that it is nonreductionistic; causation does not stem from the top or bottom, it comes from both directions.

7.2.3 Pathways of Efficiency

Application of the general evolutionary methodology also reveals that new selection processes are emerging internally. In current sustainable development strategies, the selection processes are influenced by new efficiency in the micro-project attractors. The major pathways of efficiency are market driven approaches, partnerships, and the formation of new industries.

In all three cases, the dominant approach to implementing the sustainability criteria was to promote a technological shift for resource conservation via the market system. For example, the promotion of eco-industrial parks is a key recommendation in both the ELI's plans for sustainability in Virginia and the Sanders International plan for a sustainable development policy in the Rio Grande Valley. Eco-parks are designed to promote prevention of pollution by minimizing waste. The promotion of eco-industrial development is a good example of utilizing current infrastructure and availability of resources for environmental protection. Eco-industrial development not only provides a movement away from the "command and control" approach to waste management, but also provides a model of linking ecological dimensions with financing of traditional industrial parks that can be duplicated in other areas. This approach also allows the government to become actively involved in low-cost environmentally sound technological systems for improving environmental quality, and promoting industries which have a comparative advantage in the area of ecologically friendly, low-cost, affordable technologies.

The evidence from the three projects indicates that the objectives of sustainability are not being defined solely in terms of resource conservation. They are being defined in terms of preserving the gains of economic efficiency and incorporating the values of environmental services in the market system. They *include* the value of market efficiency and *transcend* the traditional approach by incorporating ecological values.

Another gain in efficiency is in the management infrastructure for sustainable development. New institutional arrangements are being created to provide horizontal linkages across sectors, vertical linkages among organizations, and creation of local networks. Current environmental organizations are acting as "bridging" organizations (Brown 1991). They are devoting significant amounts of their own resources to form linkages with other sectors, organizations, and community groups. Evidence from the case studies indicates that "bridging" organizations can facilitate formation of networks to function as centers of communication and coordination as well as catalysts for engaging political dialogue on the subject of sustainability.

"Bridging" organizations also play a role in the formation of inter-organizational partnerships on cross-border environmental issues. They provide catalysts for new institutional arrangements that can facilitate cross-border initiatives which are currently lacking. Finally, "bridging" organizations can form cross-organizational partnerships promoting new joint-ventures and reforming current institutional structures for resource conservation. In the case of IIEC, for example, cross-sector partnerships linking government institutions, private companies, and nonprofit organizations created new institutional arrangements for energy efficiency. These examples demonstrate that, more than ever, environmental organizations are engaged in the development and sustaining of new institutional arrangements that can induce a new movement to conserve resources, changing the overall picture of evolving environmental policies from the environmental protection paradigm to the resource management paradigm.

New institutional arrangements can also lead to shifts in the paradigm of resource use. In the case of IIEC, cross sectoral partnerships are changing how energy efficiency is perceived by the energy planners, and thus provide an alternative to the traditional approach to energy policy. The mindset of major international development agencies has traditionally favored the development of power plants to supply energy. The partnership model provides a working example for energy efficient technologies, such as renewable energy and cogeneration, and shows them to be economically and financially feasible. In doing so, the partnerships between government, nonprofit organizations, and private companies are creating a market for energy efficiency.

The vertical linkage between the various sectors is strengthening the institutional basis for sustainable development. Overall, the model that is being developed by the environmental organizations is one of inducing a shift in the overall approach to sustainable development. Emphasis on resource use is being integrated with institutional development through partnerships and environmentally sound technologies. Evidence from the case studies indicates that the creation of sustainable industries, with emphasis on economic productivity through market efficiency, is providing a new pathway for implementing the overall concept of sustainable development.

7.3 Theoretical and Practical Implications

The general evolutionary methodology proposed in this dissertation is derived from a shift in the scientific frame of reference, from linear independence to nonlinear interdependence, simple causality to complex causality, mechanistic thinking to ecological thinking, stasis to constant change. It is derived not only from the epistemological notion of "both/and" but also the expansion of the

methodology as "reframing and renewal." The emphasis on nonlinear interdependence, self-organization, and qualitative evolution *reframes* the way the sustainable development problematique is perceived and is brought forth in a *renewed* way, moving away from the illusions of total control and prediction to understanding patterns of interaction, emergence, and transformation.

Traditionally, once a new concept is introduced, it is followed by a formal modeling process to give the model the ability to simulate and predict. However, with a complex dynamic issue, such as the sustainable development problematique, it is not possible to equate precise models or equations with predictability. The renewed understanding of the physical basis for how order emerges, which redefines our understanding of development, has profound implications for how we apply a conceptual framework in practice. We can no longer think solely in terms of linear cause and effect. The assumption that if we can measure either quantitatively or qualitatively the relative importance of each causal factor, and if we can change those factors the desired objective will be reached, is no longer valid.

The account of sustainable development strategies derived from the general evolutionary methodology finds a middle way between the holistic outlook and the atomistic account of sustainable development. The common approach to sustainable development has been predominately reductionistic in nature, focusing on techno-economic solutions such as designing for efficiency, proper resource pricing, and managing common resources. On the other side, those who emphasize needed changes for deeper socio-political reform call forth an holistic approach to sustainable development, invoking ideals of social justice, equity, local participation and decentralization.

What we are witnessing within environmental organizations is the interdependence, or co-evolution, of sustainable development fields outside the organizational context, together with strategies inside the organization, that go beyond a reductionistic or holistic account of sustainable development. This calls to attention not only the importance of internal dynamics, but also the relationship between micro-project attractors and the macro field, and the interactive relationship between local and global factors. Sustainable development strategies are a result of an organization's internal dynamic of complex factors, such as technology, values, and organizational structure, and the external field of paradigms of environmental management in development. The implementation of sustainable development strategies is not static or linear. There is a *nonreductionistic* relationship between sustainable development fields and micro-project attractors involving the formation of epistemic communities, partnerships, and new institutional arrangements that emerge based on a complex set of factors.

From a theoretical context, the account of sustainable development strategies portrayed in this study gives greater attention to complex causality, understanding

local behavior in terms of the relationship to the larger global context, and also how the global context is affected by the local behavior. The general evolutionary methodology accounts for factors that induce the evolution of the sustainable development field.

This account also has some practical implications for policy makers and environmental advocates. The current approach to environmental policy is centered on incorporating clean-up technologies in current industrial modes of production to mitigate environmental impacts, utilizing the market mechanism. This account ignores the interdependent factors mentioned above that induce the shift in the evolution of environmental management in development. Technological and economic factors represent only some of the factors which influence change. Policy makers should focus on broader sustainable development fields and develop complementary institutional mechanisms such as partnerships, promoting bridging organizations, and organizations which induce new fields, along with marginal, incremental market mechanisms.

For the environmental advocates, sustainable development requires a new perspective and identity. It requires a new conception of progress and development based on a coevolutionary view of change in social and ecological systems (Norgaard 1994). The politicization of sustainable development issues can occur between environmental advocates who have two distinct conceptions of sustainable development. If the environmental advocates become trapped in the modernist tendencies of linearity, determinism and either/or thinking, they will become ineffective and even hinder changes required for the evolution of environmental management in development. For environmental advocates to be effective, they will need to be encouraged in multiple ways of knowing, develop strong synthetic (design) as well as analytic skills at the local level, and be encouraged to understand values systems which inform the ways we learn, what we learn, and how we use what we learn (Dyck 1988). As Dyck (1998) argues,

> "Professionals should learn to be wary of simplistic deterministic approaches to such (people-environment) relationships, whether they are cultural, social or scientific. Professionals who plan to work in cultures different from their own have a special responsibility to develop an in-depth understanding of those other cultures. It is not reasonable to assume either the superiority of any given culture or its immutability, remembering that culture itself is a dynamic variable in the coevolutionary context."

7. 5 Opportunities for Future Research

Beyond the more scientific understanding of the emergent factors, the general evolutionary perspective provides a deeper understanding of our place in the world. I am part of the order producing universe that I am trying to describe. The implication of the postmodern epistemology, where the observer is not separated from the observed, and where we co-create the macro field which impacts our micro-level choices through the co-evolutionary process, give my responsibility to this process a new meaning.

> "This inseparability of all aspects takes ecology to a deeper level. It is not just that living things are curiously interconnected; our interconnection and our existence, each and all, are part of an unfolding process which created us, directs us and to which we contribute." (Goerner 1994:152)

This general evolutionary perspective brings to the foreground the notion of evolution of consciousness. In chapter 2, I identified the epistemological challenges associated with sustainable development. The evolution of consciousness is central to overcoming tenants of modernism which affect our current institutions, policies, and our world view. This evolution will require that we perceive phenomena from a process orientation looking at flows of events as well as stationary patterns, allowing meaning to emerge and unfold by examining cultural motivations and hidden prejudices through a process of collective dialogue.

The essence of postmodern epistemology seeks a balance between structure and process, determinism and possibility, and intention and action. I have, in this dissertation, developed a general evolutionary methodology which emphasizes ecological thinking as one approach to implementing postmodern epistemology in practice.

However, this dissertation is only the beginning of applying a general evolutionary perspective to practice. The application of a general evolutionary methodology to the field of sustainable development creates opportunities for further important research. As an expansion of the analysis, further study should consider how an environmental organization's response to sustainable development interfaces with emerging world platforms which have transnational and planetary impacts such as the internet, international finance, and other new international regimes.

In this study, I have utilized the general evolutionary methodology to focus predominately on external structures of emergence and transformation. I have not looked at the internal factors such as values, ethics, and stages of consciousness that can induce emergence of social institutional structures for sustainable development. Not considering the internal factors in future research would further exacerbate the schism between humanities and sciences.

The solution to the current environmental crisis and the road towards sustainability will require a shift in worldview, a shift in human consciousness (Wilber 1995). Further studies need to consider the stages of individual, interpersonal, and cultural transformation that can result in a truly global society. Various methods and approaches have been utilized by different cultural traditions, particularly wisdom centered or contemplative traditions, to invoke the evolution of consciousness. The means by which contemplative methods, traditions, and teaching can be applied to the current time, participants, places, and circumstances represent important practical areas for research.

The essence of a general evolutionary perspective emphasizes a constant process of learning. Sustainable development is a struggle to transcend and dive deeper within oneself and extend oneself out to others as the opening quote to this chapter suggests, a process of envelopment, a process of finding balance between the outer and inner, developing new modes of comprehension, new ways of becoming. The current inability to resolve the environmental crisis can be viewed as a crisis in consciousness.

Sustainable development, in short, will require the evolution of consciousness, being able to transcend the limitations of cultural patterns through a transcultural view (Rash 1986) . The transformation to a sustainable future, if there is to be one, will lie with those individuals who have grasped this intent, who struggle to evolve themselves within a context of a world that is ever unfolding and who participate in the co-evolution of mainstream social institutions that set the stage for new refinement, a wider embrace, wider freedom, and a meaningfulness of life that can be shared by the collective community of humans, ecological beings, and physical systems.

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