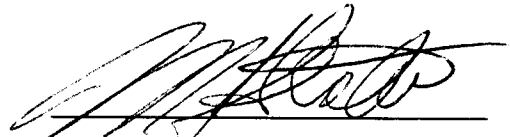


To the Graduate Council:

I am submitting herewith a dissertation written by Bruce Clemens entitled *On Environmental Interventions and Management Strategies*. I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Business Administration.

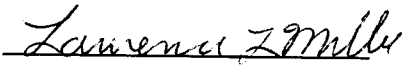


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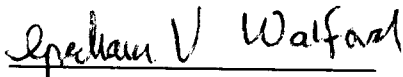
We have read this dissertation
and recommend its acceptance



Jack N. Barkenbus



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Accepted for the Council:



Associate Vice Chancellor and

Dean of the Graduate School

On Environmental Interventions and Management Strategies

A Dissertation Presented for the
Doctor of Philosophy Degree
The University of Tennessee, Knoxville

Bruce Clemens

May 1997

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I have learned that academic and research careers depend on substantial cooperation. I am thankful that my mentors and colleagues in this struggle for a Ph.D. have been so supportive and cooperative. I intend to use the skills that have been shared with me to improve my research and the research of my academic colleagues. I plan to offer other academic colleagues the generous time and advice that I have been provided.

ABSTRACT

Join us and investigate the relationship between environmental interventions and the strategies of a regulated firm. The remarkable growth of the "Organizations and the Natural Environment" interest group in the Academy of Management and the recent special issue of the Academy of Management Review (October, 1995) attest to the burgeoning interest in this area. As our globe shrinks, the issue will become even more important.

Perhaps our most interesting, and potentially noteworthy, finding was that the degree of cooperation between regulated firms was the *strongest* predictor of a firm's strategies to address environmental interventions. We had hypothesized that the type of environmental interventions would be the best predictor. Au contraire, the way the firm cooperated with its competitors was significantly more important than the type of environmental intervention, more important than the size of the firm and more important than the degree of regulatory intensity in the state. One possible implication for the government is to consider encouraging inter-firm cooperation to lead to more positive environmental performance.

In the process of supporting three of our six hypotheses, we developed a solid, and hopefully useful, measure for a typology of environmental interventions. Over the past decade, the "carrot" type of environmental interventions have become more popular than the traditional "stick" approach. Government officials have found that the best way to encourage the "right environmental thing" is to provide incentives so that the right environmental thing is *not* the "wrong economic thing". We believe we have performed the first analytic verification of a typology of environmental interventions that emphasizes the "carrot" type approaches.

We also tested an improved method of factor analysis. Many consider factor analysis, one of the most common statistical tools in the management literature, "voodoo statistics". The title of one critique, "Tom Swift and his magic factor analytic machine", sums up this voodoo view. We feel that our method, originally proposed by Harris (1967), will encourage and facilitate more objective factor analyses.

We conducted two surveys of over 400 steel firms over a three year period. We were able to test if the firms changed strategies over the three years. The four year study was

funded by the Environmental Protection Agency, the Department of Energy, the steel industry and the State of Tennessee.

We feel that our finding of the importance of collaboration and cooperation is noteworthy and could potentially contribute to sustainable development. In the words of Gladwin, Kennelly and Krause (1995:900) {1082} “transforming management theory and practice so that they positively contribute to sustainable development is, in our view, the greatest challenge facing the Academy of Management”.

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NOMENCLATURE, LIST OF ABBREVIATIONS

CEP	Council on Economic Priorities
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMA	Chemical Manufacturer's Association
DOE	Department of Energy
EPA	Environmental Protection Agency
FTE	Full Time Equivalent
ISRI	Institute of Scrap Recycling Industries
ISO	International Standards Organization
NORM	Naturally Occurring Radioactive Material
NRC	Nuclear Regulatory Commission
RCRA	Resource Conservation and Recovery Act
SMA	Steel Manufacturers Association
TRI	Toxic Release Inventory

CHAPTER I¹ - INTRODUCTION

This dissertation investigates the relationship between the form of environmental² initiatives and the response strategies of regulated organizations. The first chapter introduces the study and sets the stage for the balance of the proposal. The second chapter reviews the literature, develops the theoretical basis, and defines the hypotheses to be tested. The third chapter describes the methodology for testing the hypotheses. Data analysis is described in the fourth chapter; and the conclusions are in the fifth, and last, chapter.

The literature on the impact of regulations on organizations is growing, but few studies address the relationship between institutional pressures and the strategic choices of organizations. Indeed, Oliver (1991) states: "notably lacking from this literature ... is explicit attention to the strategic behaviors that organizations employ in direct response to the institutional processes that affect them." Practitioners and academics alike have advocated proactive strategies to address regulations. This research will include both reactive and proactive strategies dealing with the natural environment.

The Natural Environment

Environmental initiatives are an excellent choice for this research for several reasons. Environmental investments have become a significant strategic issue for many organizations. Costs for pollution control have grown significantly. The ratio of expenditures on pollution control to the GNP more than doubled between 1972 and 1990 (Greeno, 1994 {725}). In 1991, Mullins (1993) {940} estimates that more 100 billion dollars were spent on pollution control in the U.S. Indeed, the anticipated environmental expenditures for amendments to the Clean Air Act for facilities in the petroleum industry are greater than the book value of

¹This effort has been partially funded by the Environmental Protection Agency (EPA), the Department of Energy (DOE) and the State of Tennessee but does not constitute an endorsement.

² A potential source of confusion may exist for some readers between the *natural environment* and the *business environment*. In order to minimize the potential confusion, in the remainder of this effort, *environment* will mean the *natural environment*. The more general, business environment will be called the *business environment*.

facilities themselves (Walley & Whitehead, 1994 {499}). Pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended in 1986, public sector agencies should follow the same rules as a private firm. Indeed, environmental investments are strategic issues for the public sector as well. The estimated costs for environmental abatement for the public sector in the U.S. are 0.6% of the Gross Domestic Product, exceeding hundreds of billions of dollars (Caincross, 1991){46}. While the literature on the environment has grown quickly, a gap exists in research on the relationship between regulatory strategies in the government and political strategies in the regulated organization.

EPA celebrated its 25th anniversary in December of 1995 (Browner, 1995) {890}. Is the public still sensitive to the environment? Public opinion polls demonstrate that people are concerned about the environment, especially about threats to their health and to their children (Browner, Ruckelshaus, Costle and Reilly, 1995) {890}. Are the costs worth the benefits? Many scholars feel we will never know (Ashford, Hill, Mendez, Chisholm, Frenkel, Heaton and Priest, 1980) {956}. The problems in quantifying the benefits are beyond the scope of this study and arguably beyond the capabilities of current analytic tools. However, this study should help understand the decision making of regulated entities, an integral component of the equation. Academia is not responsible for, nor able to provide the ultimate comparison between environmental protection and economic impacts. In our stakeholder driven society, the public must decide.

Radioactive Scrap Metal

The Nuclear Regulatory Commission (NRC) has recognized the potential problem of radioactivity in scrap metal. We will apply the theory to the evolving regulations requiring installation of radiation-monitoring systems in the steel industry. In hundreds of instances, steel mills have received unmarked radioactively contaminated scrap metals that were not identified in time to prevent multi-million dollar clean-ups. Although there are no federal environmental regulations requiring steel mills to install radiation-detection equipment, many firms have already done so—an excellent example of innovative and voluntary compliance.

Recycling has been heralded by many environmentalists. Indeed, recycling has become

ingrained in our society. Recycling humor is becoming popular:

“Seattle baseball fans are so nice that after the New York Yankee fans threw garbage onto the field at a recent playoff game, the Seattle fans picked up the waste and sorted it for recycling.” (Rice, 1996) {1005}

Indeed, a large percentage of U.S. steel is recycled. But even recycling can raise concerns, such as radioactivity in metals.

Approximately 60% of the time, the source of the contamination in scrap steel processed by steel mills usually is Naturally Occurring Radioactive Material (NORM) (Yusko, 1996) {1008}. Petroleum deposits in the United States contain radium, a naturally occurring radioactive element. As the petroleum flows in pipelines, radium deposits onto the lining of the pipes. Over time, the radium forms a deposit, commonly referred to as “scale”, on the lining of the pipe. In certain situations, significant levels of radium can be detected in the scale. Steel mills can run into problems if they receive radium contaminated pipes as scrap.

Mills also receive unmarked radioactive gauges. Gauges containing radioactive materials are used in many industrial and household applications to measure thicknesses and other material properties. For example, gauges are used in many smoke detectors to measure opacity. If the steel mills do not immediately identify these contaminants, the smelting can cause contamination of the steel and radioactive releases into the environment. Remediation of these situations can require millions of dollars in clean-up costs. Figure 1 illustrates the potential flow of radioactive contamination in the steel industry.

State environmental agencies have documented several hundred cases of scrap metal contamination. New York, California, Alabama, Indiana, Louisiana, Pennsylvania, Utah, Kentucky, Texas, Illinois, and Tennessee have reported incidents. Undocumented cases, however, could number in the thousands. In February 1994, Nuclear Regulatory Commission (NRC) Chairman Ivan Selin emphasized the potential impact of the situation in a meeting with the Steel Manufacturers Association (SMA). Dr. Selin explained that the number of instances has increased rapidly over the past decade. Figure 2 displays the documented events since 1983.

To date, levels of radioactivity in recycled metals have not been high enough to raise

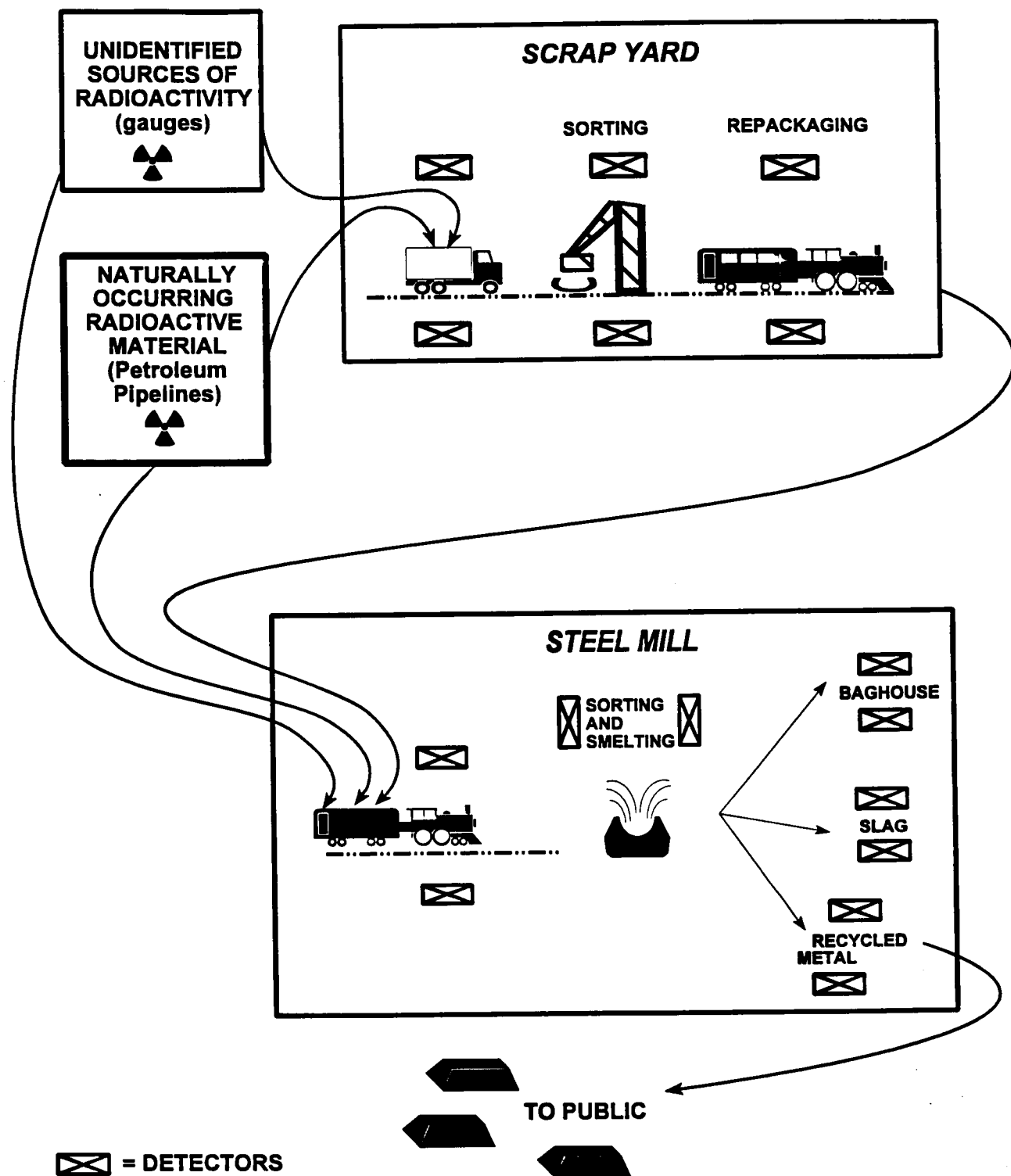


Figure 1 Potential flow of radioactive contamination in the steel industry

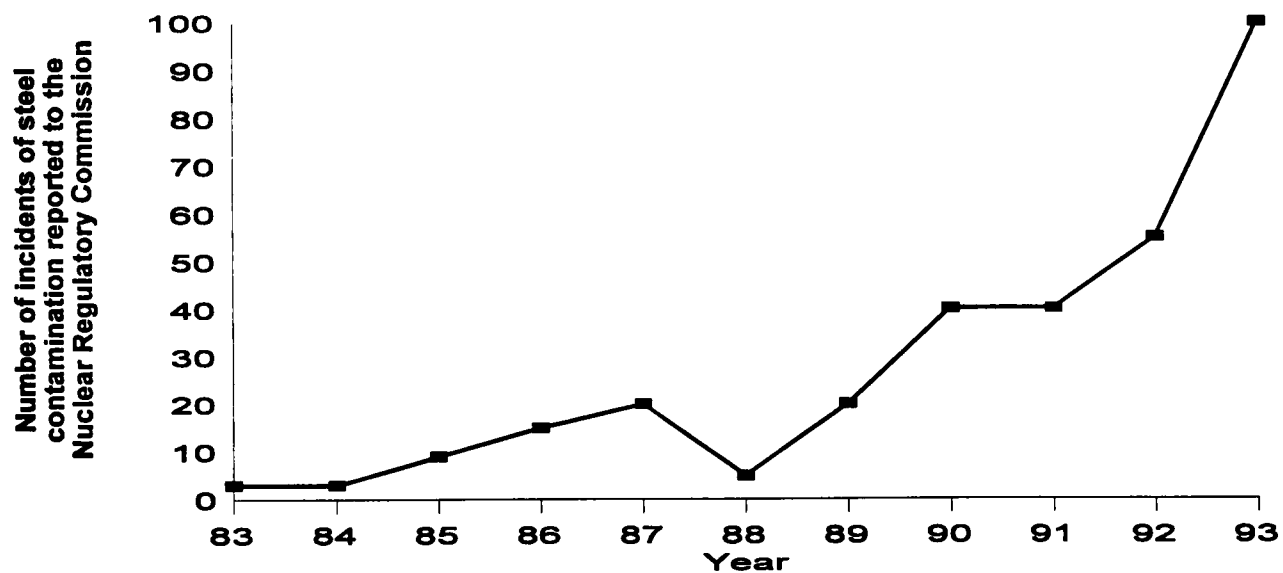


Figure 2 Radioactive material in scrap metal

Source: Lubenau, J.O. & Yusko. 1995

Radioactive materials in recycled metals. Health Physics. 68: 440

significant concerns about public health (Yusko & Lubeneau, 1995) {933}. However, the potential for such concerns exists because recycled metals are used in such consumer products as medical implants, frying pans, automobiles and infant high chairs. Workers in the steel industry face an even higher risk because radioactive contamination that is vaporized during processing can result in the inhalation of bone-seeking particles that pose a significant health threat. Indeed, the Steel Workers Union has placed potential radioactive contamination as their number one health priority (Epstein, 1994) {1004}. The fact that no comprehensive risk assessments have been performed is also a concern.

The steel industry is also very concerned with increased liabilities. Radioactivity can contaminate bag house dust, generated during the steel making process. The cleanup can reach tens of millions of dollars (NRC, 1996). This makes James Collins, the president of the Steel Manufacturer's Association (SMA) very nervous. The SMA is the largest trade association for firms with electric arc furnaces, referred to as mini-mills. "For some companies there is a crisis already", Collins says. "For others, it's still a crisis in the making." (Kuster, 1994:31) {724}.

Although the Department of Energy (DOE), the Nuclear Regulatory Commission (NRC), and the Environmental Protection Agency (EPA) are aware of the issue and have initiated studies, only minimal information now exists on the levels of radioactive contamination in metals. In the absence of federal standards, the Conference of Radiation Control Protection Directors has recently proposed guidelines to address the situation. The NRC and the EPA, at the request of the Steel Manufacturers Association, are currently developing a regulatory strategy to address this growing problem.

The steel industry in both the United States and Japan recognizes that radioactive contamination is a problem, affecting the manufacture of large-scale integrated circuits, photographic equipment, and radiation-detection equipment. In fact, although there are no federal environmental regulations requiring them to do so, many firms have already installed radiation protection equipment. One purpose of this study is to determine the most effective regulatory approach so that all recyclers would effectively deal with the growing problem of radioactive contamination in scrap metal.

CHAPTER II - REVIEW OF THE LITERATURE, THEORETICAL MODEL AND HYPOTHESES

Overview

This chapter will review the relevant literature, develop the hypotheses and conclude with the theoretical model. The overarching theoretical perspective is based on institutional theory. Institutional theory also provides the fundamental independent variable (the form of the environmental intervention), the dependent variable (response strategy of the regulated organization), and one moderating variable (level of institutionalization). The field of environmental economics provides a second moderating construct (regulatory intensity). The final moderating variable (level of collaboration) is from the literature on cooperation.

Institutional Theory

Classic management theories focused on owners, stockholders, suppliers and consumers as the most important actors for a firm to consider. Since Barnard (1938) {369}, management writers have recognized that organizations operate in a more complex business environment interacting with governments along with other significant stakeholders (Freeman, 1984) {77}. Institutional theorists (Hirsch, 1975) {860} point to the growth of the influence of the regulatory apparatus as proof that the regulated community must consider regulatory approaches of the public sector.

Institutionalized rules function as myths which organizations incorporate, gaining legitimacy, resources, stability, and enhanced survival prospects. Institutionalization involves the process by which social processes, obligations, or actualities come to take on a rule-like status in social thought and action (Meyer & Rowan, 1977). Indeed, regulations and structure are even vital to man's best friend:

“As long as dogs of low status know and keep their place, they need not fear attack from high-ranking dogs. Dogs like their society to be well ordered, and to this end rank themselves as if on the rungs of a ladder, the males on one side and the females on the other. In some dog societies the hierarchy system is so

willingly embraced that friction is rarely observed. And that is the point, really. Knowing who is who eliminates strife and fighting” (Thomas, 1993 page 70) {999}.

Scott (1987) describes four faces of Institutional theory:

1. Institutionalization as a process of instilling value:

-To institutionalize is to infuse with value beyond the technical requirements of the task at hand.

2. Institutionalization as a Process of Creating Reality:

-Humans, as biological creatures; have few constraints³, institutionalization produces constraints. Institutionalization is a social process by which individuals come to accept a shared definition of social reality.

3. Institutional theory as a Class of Elements

-Institutionalized belief systems constitute a distinctive class of elements that can account for the existence or the elaboration of organizational structure.

4. Institutions as Distinct Societal Spheres

-Institutionalization produces relatively enduring systems of social beliefs in religion, the family, and politics.

The institutional business environment is that part of the business environment that exists due to the political process. While management literature is rich in describing how institutional business environments constrain choice (Baum & Oliver, 1992 {872}; DiMaggio & Powell, 1983 {864}; Haveman, 1993{873}; Meyer & Rowan, 1977 {861}; Rowan, 1982 {862}; Tolbert & Zucker, 1983 {863}), little theory and empirical investigations have addressed an organization's strategic choices in an institutionalized business environment. Institutional theorists have studied how the business environment impacts the innovation of organizations (Damanpour, 1991) {447}, but have not extensively researched the impacts on strategy. Magat and Estomin (1981) {881} found that research on the regulatory process is

³While humans, as other animals “...are subject to disease and dismemberment and in constant need of food ...” (Janovy, 1984){1012}, our social constraints are even more complex than ‘man’s best friend.’”

sparse and has produced little general understanding of agency behavior. Oliver (1990, 1991) {571} also noted this lack of knowledge. One goal of this paper will attempt to fill this gap.

Fischer and Schott (1993) {969} theorize that changes in the features of organizations “(such as greening) are often introduced to make organizations more aligned with the changing norms and expectations of the institutional environment” (page 47). The authors also make the case that the institutional approach argues that “firms within the same organizational field (such as steel) come to resemble each other over time in structures and practice... Institutional theory may offer considerable guidance on the how, why and when of greening. It may explain why firms provide grants and donations to environmental causes, why they create industry codes of conduct” (page 48).

The Political Strategies Available to the Regulated Organization

The management field is rich in literature classifying *management* strategies (Eisenhardt & Zbaracki, 1992 {331}; Frederickson, 1984 {318}; George, 1972 {491} ; Hart, 1992 {332}; Huff & Reger, 1987 {330}; Lenway & Rehbein, 1991 {436}; Miles and Snow, 1978 {357}; Porter, 1980 {353}, 1985 {351}). While the literature on *political* strategies is not as developed as that of *management* strategies, it is growing quickly (Allison, 1971 {631}; Alpin & Hegarty, 1980; Birnbaum, 1984; Elsbach & Sutton, 1992 {555}; Pfeffer, 1981 {600}; Post, 1978 {580}; Schwenk, 1988 {362}; Sutton and Callahan, 1987 {594}). Mintzberg, building upon Barnard (1938) and Chandler (1962), defined strategy as a "pattern in a stream of decisions" (1978: 934). For the purposes of this study, *political strategy* is the pattern in the stream of decisions that firms adopt to address government policies. Both reactive and proactive strategies will be studied.

Birnbaum (1985) {375} studied how organizations address government initiatives. He revised a typology of eight political influence strategies, originally theorized by Alpin and Hegarty (1980) {368}. Through a factor analysis, Birnbaum consolidated the eight variables into two: pressure influence strategies (letter writing campaigns, enlisting third party organizations or individuals, and media campaigns) and information influence strategies (submitting reports, making personal visits, providing testimony, and contacting colleagues).

Birnbaum theorized that the four variables factored as an information strategy (submitting technical reports, making personal visits, giving testimony, and contacting colleagues) are more "direct" influence strategies. The four pressure variables (letter-writing campaigns, seeking third party organizations and third party individuals to exert influence, and media campaigns) are "indirect" strategies.

Oliver (1991) {557} developed an expanded typology of 15 tactics and five "political" strategies that organizations employ to address regulatory initiatives. Table 1 lists the 15 tactics and 5 strategies. The table provides two descriptions for each of the 15 tactic. Oliver argued that the five strategies lie on a continuum, ranging from passive to active approaches. The strategies, in rank order from most passive to most active, are: acquiescence, compromise, denial, defiance, and manipulation. We will use Oliver's strategies and tactics as the basis for the dependent variable, a firm's response to a regulatory approach. Oliver's theories lead us to the first hypothesis:

Hypothesis 1: Preferences for the fifteen tactics by regulated firms will group themselves into discrete strategies as predicted by Oliver.

Hypothesis 1A: Habit, imitate and comply will group as acquiesce.

Hypothesis 1B: Balance, pacify and bargain will load unto compromise.

Hypothesis 1C: Conceal buffer and escape will group as avoid.

Hypothesis 1D: Dismiss, confront and attack will load onto defy.

Hypothesis 1E: Co-opt, influence and control will group together as manipulate.

Historical Perspective: Three Phases of Environmental Responsibility

In order to understand a firm's options, the following section provides a brief perspective on the evolution of corporate environmental strategies. Based on a review of the literature, this section will develop an testable argument that the theory and practice of environmental management has developed in three interrelated phases. During the first phase, cost minimization, firms attempted to avoid or reduce compliance costs. Managers viewed investment in environmental protection as a direct drain on the bottom line. In the second phase, compliance, firms learned that environmental regulations would indeed be enforced.

Managers attempted to adopt environmental controls to avoid liabilities as cost-effectively as possible. In the third phase, beneficial environmental controls, certain firms found that investments in environmental protection could be a source of sustained competitive advantage.

The debate continues among scholars and practitioners regarding the second and third phase. Results are mixed concerning the circumstances under which environmental investments can be beneficial. A description of the three phases and today's realities follows:

Cost Minimization. Silent Spring, the seminal book by Rachel Carson (1962){765}, awoke the United States citizenry from a slumber of environmental neglect. Congress responded to public concerns quickly, passing far reaching environmental legislation and creating the Environmental Protection Agency (EPA). The 1960's marked the initiation of the first phase of managerial response, cost minimization. The prevailing economic view held that environmental expenditures had a negative effect on financial performance (Bragdon & Marlin, 1972). Many firms fought the Environmental Protection Agency, directly challenging the regulations and enforcement actions in court.

Soon after the first Earth Day in 1970, scholars became interested in the relationship between environmental responsiveness and corporate performance. Researchers called for an Environmental Bill of Rights based on a concept of social costs and benefits far wider than we have hitherto been willing to accept in American society (Wolozin, 1971; Murad, 1993) {37}. Early empirical studies focused on the pulp and paper industry (Bragdon & Marlin, 1972; Day, 1971) {39}. These studies were inconclusive, but they spawned several important, follow-up studies (Spicer, 1978 {36}; Aupperle, 1993{29}; Fogler, 1993{35}; McGuire, 1990{41}).

Cost Effective Compliance. The second phase of the debate began as firms discovered that consumers were willing to adjust their consumption habits to reflect their perceptions of a firm's environmental performance. Many firms heard the message and responded by developing corporate environmental strategies and forming environmental departments (Douglas & Judge, 1995){1003}. Some firms located their environmental departments at corporate headquarters, while other firms decentralized the environmental decision making to the plant level. Structure at times followed strategy (Chandler, 1962).

Table 1 - Strategies and Tactics - Oliver (1990, 1991)

Strategy	Tactic	Description (Asterisks indicate wording used in 1994)
Acquiesce	Habit	Follow the approach most commonly used in the past by our organization.* (Q57ACHAA ⁴) Speak with others in our firm and adopt the most effective approach used in the past. (Q61ACHAB)
	Imitate	Speak with other successful associates in our firm and adopt a similar position.* (Q54ACIMA) Follow the approach used by successful managers in other steel firms. (Q60ACIMB)
	Comply	Communicate with the relevant regulators to determine the best way to comply with the spirit and intent of the requirements. (Q65ACCMA) Make a conscious evaluation of the specific regulatory requirements and choose to comply with them.* (Q66ACCMB)
Compromise	Balance	Negotiate openly with the regulators to obtain a mutually agreeable solution.* (Q55CMPLA) Obtain a consensus between the regulators and our owners and customers. (Q62CMBLB)
	Bargain	Negotiate with the regulatory organizations to obtain an advantageous solution.* (Q56CMBRA) Bargain with the regulators to obtain a favorable position for our owner(s) and customers. (Q75CMBRB)
	Pacify	Partially conform with the required procedures that are the most important to the regulators. (Q53CMPCA) Determine the most important elements for the regulators and agree to comply. (Q74CMPCB)
Avoid	Conceal	Appear to comply but intentionally avoid certain aspects of the requirements.* (Q78AVCNA) Conceal certain aspects of our strategy from the regulators. (Q68AVCNB)

⁴ For our statistical analysis, we will name each item. The nomenclature for Q57ACHAA is Q57 = item (question) 57 on the questionnaire, AC = Acquiesce, HA = Habit A = the first of two items that refer to Habit.

Table 1 - Strategies and Tactics - Oliver (1990, 1991)

Strategy	Tactic	Description (Asterisks indicate wording used in 1994)
	Buffer	Reduce the sensitivity of our detectors to avoid identifying incoming radioactive contamination. (Q52AVBFA) Avoid participating in trade association activities that deal with radioactive scrap metal. (Q73AVBFB)
	Escape	Consider moving our operations out of state to avoid oversight. (Q79AVESA) Consider moving the operations overseas to minimize the potential for oversight. (Q71AVESB)
	Defy	Dismiss
		Ignore the requirements and continue doing business as usual.* (Q81DFDSA) Dismiss the requirements and attempt to avoid any discussion with the regulators. (Q67DFDSB)
	Confront	Attempt to sue the regulatory agency for the overly burdensome requirement. (Q64DFCNA) Challenge the requirements in court.* (Q80DFCNB)
	Attack	Challenge the requirements in the media.* (Q72DFATA) Mount a campaign with our suppliers and customers to attack the regulatory authority. (Q76DFATB)
Manipulate	Co-Opt	Attempt to form an alliance with the regulators.* (Q69MNCOB) Attempt to include a member of the regulators on an advisory board to oversee operations. (Q58MNCOA)
	Influence	Attempt to influence public perceptions on the need for cost effective requirements to avoid radioactive contamination.* (Q70MNINA) Organize our suppliers and customers to attempt to influence the requirements. (Q59MNINB)
	Control	Meet with elected legislatures to attempt to control the regulators.* (Q77MNCNA) Attempt to deal with federal regulators to control the state or local government. (Q63MNCNB)

During this phase, scholars recommended investigations of the relationship between environmental responsiveness and performance over time (Spicer, 1978 {36}). Spicer found that "... associations (between environmental responsibility and corporate performance) may be relatively short-lived phenomena under circumstances where public pressure results in legislative mandates with respect to pollution abatement."

Beneficial Environmental Controls. The late 1980's saw the dawn of the argument that environmental performance could provide a competitive advantage. Our nation's Vice President (Gore, 1992), certain chief executive officer's of major chemical companies (Reilly, 1990 {31}), and prominent scholars (Fawell, 1993 {17}; Bowers, 1993{764}; Porter, 1991{124}) argued that improved environmental responsiveness does not necessarily detract from a firm's financial performance. Others argued that environmental controls could even improve financial performance (Halvorsen, 1991{8}; Ilinitch, 1993; Marshall, 1993; Kolluru, 1994{298}).

Scholars have theorized that the process of thinking green can have a benefit to the firm in three ways. First, consumers are becoming more environmentally aware and could favor products from environmentally responsive firms (Groenewegen & Vergragt, 1991{301}; Reilly, 1990; Porter, 1991; Piasecki, 1992 {133}; Prince & Denison, 1993 {132}). Second, by thinking green, a firm will become more efficient at utilizing inputs and minimizing wastes (Kolluru, 1994; Barrett, 1993{129}). This philosophy could spill over into all production areas and improve financial performance. Third, a firm has several stakeholders, ranging from regulators to shareholders to customers, many of whom have environmental concerns. Companies now recognize that a firm must address stakeholder concerns to compete effectively (Jensen, 1976; Buchholz, 1993{126}). Others have hypothesized that the preferable alternative is to convert the threat (environmental liability) into an opportunity (Marcus, 1988{303}).

One recent example of a successful phase three strategy is the Ernest and Julio Gallo Company. Facing potentially stringent environmental regulations from the State, Gallo decided to adopt an environmentally sensitive approach. Before it was required by law, Gallo adopted an organic farming approach in the 1980's. According to Coleman Gallo, grandson of the founder, the approach has paid off for Gallo but has also resulted in benefits for the rest of the

wine industry. Today approximately 25% of the California wine industry has adopted organic farming. Even cotton farming, the showcase for the benefits of chemical biocides, is experimenting with organic farming. It seems to be paying off even in cotton. Recent information indicates that the 100% increase in prices for naturally grown cotton products swamp the 10 to 15% increase in costs of organic production (National Public Radio, All Things Considered, November 1-2, 1993).

The Present. The jury is still out. Although the evidence is growing that an environmentally sound approach can enhance financial performance, the results are still mixed. The debate continues well past the 20th anniversary of the first Earth Day. A recent article concludes: "Perhaps this issue, whether or not corporate social responsibility is related to profitability, will never be completely resolved (Aupperle & Carroll, 1985 {29}). In many ways the current state of the debate on corporate and environmental performance is similar to the early stages of the debate on strategic management. Both debates are fundamentally compilations of case studies. Representatives of firms and environmental organizations are accumulating excellent examples of approaches (Smart, 1993 {786}).

As was the case for strategic management in the early years, the debate on environmental and corporate performance must enter a new stage to mature. It is important to recognize the historical perspectives of a firm's attempts to address environmental initiatives. Theory on the interrelationship between the private and public sector needs to be based on an understanding of the past. This historical approach leads us to the next hypotheses:

Hypothesis 2: Over time, firms will modify environmental strategies

Hypothesis 2A: Over time, firms will be less likely to prefer acquiescence strategies, typical of the first phases of environmental management.

Hypothesis 2B: Over time, firms will be more likely to prefer manipulation strategies, more typical of the beneficial environmental controls phase.

Types of Environmental Interventions

Several authors have described the large box of tools available to the Environmental Protection Agency (EPA). In the beginning of the environmental movement, rules or

regulations, were the most typical form of government effort to protect the environment. When the federal government follows the Administrative Procedures Act, rules have the force of law. This research will look beyond rules and regulations.

Magat and Estomin (1981) {881} found that regulations could be classified in several ways including: the type or form of regulation (ranging from prescriptive to flexible), the number of firms addressed, the ease of compliance, the extent of congressional oversight, the role of the federal government versus the state, and the impact of stakeholders.

Milliman and Prince (1989) {931} looked at the effects of five different forms of regulation on technological change. The five forms included direct controls, emission subsidies, emission taxes, free marketable permits dispensed at frequent, regular intervals, and auctioned marketable permits sold at frequent, regular intervals. The authors found that emission taxes and auctioned permits provide the highest incentives for a firm to promote technological change.

Cropper and Oates (1992) {932} emphasized that the line between different forms of regulations is not as fine as some would like. In their words: "the dividing line between so-called command and control and incentive based policies is not always so clear (1992: 699)".

Wasserman (1992) {888} describes three ways to classify environmental regulations. *Clarity* reflects the degree to which the requirements are understandable. *Stringency* is a measure of the magnitude of the requirement or the degree to which emissions are controlled. In the 1970's EPA typically required 80% reductions. In the 1980's, the Agency has moved to requiring 95% to 99% reductions. The *Form of the Regulation* refers to whether the regulation is based on individual permits or general rules of applicability. General rules are easier to communicate to the regulated public. Wasserman argues that although more complicated to monitor, and more costly administratively, tailored permits can lead to high levels of voluntary compliance.

Wasserman differentiates between three *regulatory schemes*. First, "liability" oriented programs establish norms of behavior that are integrally linked to the legal system. Second, "command and control" requirements are specific and detailed. They were the norm in the early days of the Agency. Finally "market-based approaches" include fee systems, tradeable

permits and offset or bubble approaches.

Command and Control regulations are the most traditional and most common until recently. Command and control regulations can be divided into three types that vary in terms of “prescription”. By prescriptive we mean the level of specificity in the regulation. The most prescriptive, *technology forcing* command and control rules, require facilities to install specific hardware or adopt specified procedures. Second, EPA can set *effluent limitations* for facilities. Typical water regulations require that aqueous discharges be below specific limits for various pollutants. Air standards can require similar limitation for emissions. The least prescriptive of the command and control rules are *limits in the receiving media*. Such limits would establish limits in the stream or atmosphere.

EPA uses several types of Liability-Based regulations. Three options discussed by Wasserman are the provision for citizen suits, strict liability and joint and several liability. Certain statutes and rules allow citizens to intervene and file suits on behalf of the general public. The Resource Conservation and Recovery Act (RCRA) sets a standard of strict liability for the management of hazardous wastes. Strict liability means that litigants do not have to prove to the court that a hazardous waste is dangerous. RCRA mandates that hazardous waste, by its nature must be handled more carefully than other wastes.

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund) establishes joint and several liability. Under joint and several liability, a single contributor of a Superfund waste to a large landfill can be held liable for the cleanup of the entire landfill. Under joint and several liability, even though a partially responsible party did not cause the entire problem, the party can be held liable for the complete problem. As such, an individual responsible party could be liable for portions of the problem that he did not create.

Finally, Market Based Approaches have become popular in the past decade. Proponents feel that the additional economic efficiencies of Market Based Approaches outweigh the potential difficulties in enforcement. Market based approaches include fee systems and tradeable permits. Leiby, Jones, Stepheson, and Feldman (1989) {891} developed a comprehensive compendium of such market based approaches for climate change. Table 2 lists

Wasserman's (1992) regulatory schemes and options.

The Ninety's: Toward the Next Millennium

In 1994, the "Republican revolution" swept the party into majorities in both the U.S.

Table 2 - Regulatory Schemes - Summarized from Wasserman, 1992

Regulatory Schemes	Options
1. Command and Control	Technology forcing Limits in effluent Limits in receiving media
2. Liability-Based	Intervener capability - citizen suits Strict liability Joint and several liability
3. Market -Based	Fee systems Tradeable permits

House and Senate for the first time in decades. Many attribute the success of the Republicans and the presence of other anti federal government sentiments in the U.S. to an overuse of the federal regulatory mechanism. Even environmentalists view the Superfund regulations as overly cumbersome and prescriptive. The U.S. House is considering: "Legislation that would allow the Environmental Protection Agency to waive regulation for those that can provide a more efficient way to protect the environment". (Environmental Reporter, 1996, page 1581) {998}

The Washington Legal Foundation has filed petitions that allege that investigators for the EPA violate the rights of companies. The Foundation argues that the EPA should provide facilities with a written statement of rights before they enter premises. The Foundation feels that overzealous EPA investigators often violate the rights of individuals as well as organizations. The criminal penalties assessed pay tribute to the importance of EPA's regulatory tools. The Foundations petition alleges that "EPA is increasingly foregoing administrative and civil remedies for environmental infractions and is arbitrarily seeking *felony* (emphasis added) criminal indictment even for minor offenses" (Environmental Reporter, 1996, page 1580).

The most recent case cited in the petition was filed in 1994 against Benjamin Lacy, who owns a small business that bottles apple juice. "The Justice Department is seeking to incarcerate Mr. Lacy, a first offender, for a term of 27 to 33 months for a minor infraction that could have easily been addressed by administrative or civil penalties" (page 1582). Others argue that such a threat is the best tool to address non-compliance.

The Nuclear Regulatory Commission's Working Group

The Nuclear Regulatory Commission established a working group to deal with radioactivity in the scrap steel stream in 1995. The Steel Manufacturers Association, the largest trade group representing "mini-mills" is evaluating three regulatory approaches to address the problem of radioactive contamination in steel mills:

1. Requiring annual reports of the status of licensed devices by users, electronically if possible.
2. Charging a user fee to establish a capital fund that would finance the reporting system and support a bounty system to reward people who discover the lost sources.
3. Establish criminal penalties to be applied to users who improperly dispose of sources (but waived for demonstrable inadvertent loss). (Lubeneau, 1996 page 10) {1000}

The State approach

The state of Oregon established a program to monitor radiation sources in 1984. The program includes mail surveys and onsite inspections when funding is available. Oregon requires user fees for gauges that contain radioactive materials (however there are no fees for polonium 210 gauges). The Oregon program cost the state 1 Full Time Equivalent (FTE) employee to implement. The FTE was comprised of 500 hours to enter data, 500 hours to address statutes and rules, 500 hours to review rules and statutes, and 500 hours for programming. Reports of contamination requires 0.2 FTE annually in response time. Typically the state responds to 50 alarms per year. The most common source of alarm is from naturally occurring radioactive material (NORM). Oregon has a database of 1,800 records reflecting 99 general licenses. The records include 539 portable gauges and 1,294 sealed sources (Lubeneau,

1996 page 13).

Texas has a program that includes a \$200 filing fee. The program includes civil penalties and has imposed fines of up to \$16,000. The state requires quarterly reports from vendors and has the last 15 years of information in a database. Texas has issued 800 general license acknowledgments. Implementation took three and one-half years and "thousands" of staff hours (Nuclear Regulatory Commission, 1996). {1001}

The North Carolina program includes quarterly reporting and an annual fee of \$75. Inspections are scheduled every four years. The state has a goal of 400 general licenses to be registered. Iowa has proposed a rule to require written reports every three years and onsite inspections every six years. Illinois contacts general licensees by mail each year.

Industry is also developing internal programs that could be incorporated into an International Standards Organization (ISO) 14000 approach. The 3-M program controls 800-900 devices from the corporate office. 3-M's program includes inventory controls and inspection. Representatives from 3-M highlighted the need for uniform, national standards (Nuclear Regulatory Commission, 1996).

The Relationship between State and Federal Programs

The relationship between the federal government and the states is an important element for this study. Most environmental initiatives are conceived at the federal level. In general, the federal government issues general, broad-based regulations and attempts to encourage the states either to adopt the federal approach or develop a more specific approach. In certain cases, individual states take the lead and develop programs in anticipation of federal initiatives.

Enterprises involving radioactivity are overseen by the Nuclear Regulatory Commission (NRC) and the EPA at the federal level. The Atomic Energy Act enables the NRC to control the use of radioactive materials. The NRC has a process to delegate responsibility to the states. States that have the authority to act on behalf of the NRC are deemed "agreement states". Thus the issues of radioactivity in steel are overseen by agreement states and the NRC.

Relationship Between Regulatory Types and Political Strategies

Haveman (1993) {873} argued that most organizations generally follow the lead of other similar organizations. According to Haveman's "mimetic" phenomena, once one organization chooses a particular political strategy to respond to a given type of regulation, other organizations will choose the same strategy. Based on the mimetic philosophy, the first mover will define which political strategy to use for a particular type of regulation. Once a political strategy is chosen by the first mover, the strategy becomes the standard approach of the entire industry. Thus the mimetic paradigm would generate a strong and stable relationship between the type of regulation and the political strategy of the regulated organization.

Oliver argued that the higher the degree to which the regulatory agency used prescriptive approaches (command and control), the more likely a firm would choose passive strategies. She argued:

"When the force of law or government mandate buttresses cultural expectations, organizations are made more aware of public interests and will be less likely to respond defiantly because the consequences of noncompliance are more tangible and often more severe" (p: 168).

According to Oliver, passive political strategies include acquiescence and compromise. Active political strategies include defiance and manipulation. This leads to the next hypotheses.

Hypothesis 3: The type of regulatory initiatives is associated with the strategic choice of regulated organizations.

Hypothesis 3A: Command and Control regulations are associated with a preference for acquiescence and compromise.

Hypothesis 3B: Industry-monitored, flexible, non-prescriptive regulations are associated with defiance and manipulation.

Moderating Effects: Impact of Regulatory Intensity

Oliver (1990) theorized that the relative strength of the regulatory requirements will affect a firm's strategy. Environmental economists (Baumol & Oates, 1975 {4}; Bragdon & Marlin, 1972 {27}; Brown, 1993 {24}; Cebon, 1993 {311}; Ilinitich, 1993 {130}; Malawian & Brady, 1988 {313}; Marshall, 1993{136}), politicians (Gore, 1992 {45}), and public policy

scholars (Schelling, 1980 {361}) all suggest that the intensity of regulations affects the actions of a firm. The term of "regulatory intensity" was operationalized and is now being used in the environmental economics field to describe the level of potential impact of the regulatory agencies (Christainsen & Haveman, 1981{315}).

Ashford & Heaton (1983) {955} theorized that regulatory intensity moderates the relationship between the form of the regulation and the innovations adopted by the regulated organizations. The relationship could also hold for strategies other than innovation. The theory is that regulatory intensity will moderate the relationship between the regulatory strategy employed by an agency and the strategic response of a regulated organization. If a firm perceives its regulatory agencies as being strong and forceful (high regulatory intensity), the relationship between regulatory strategies and firm strategies will be stronger. Conversely, in a climate of low regulatory intensity, the relationship will not be as strong. This leads to:

Hypothesis 4: The level of regulatory intensity will moderate the relationship between the form of the regulations and the strategies of the regulated organization.

Hypothesis 4A: Higher levels of regulatory intensity will increase the relationship between the form of regulations and the strategies of regulated organization.

Moderating Effects: The Impacts of Institutionalization on Different Industries

Institutional theorists argue that highly regulated business environments encourage isomorphic behavior in organizations (Hirsch, 1975 {860}; Meyer & Rowan, 1977). Isomorphism in the biological sciences occurs when two organisms differ in ancestry, but have the same form or appearance. Management theorists have applied this biological concept to the organizational field. DiMaggio and Powell (1983) define isomorphism as the "constraining process that forces one unit in a population to resemble other units that face the same set of environmental conditions". The authors distinguished between competitive isomorphism and institutional isomorphism. This dissertation proposal will focus on the later. Rowan (1982) argues that the trend towards isomorphism progresses in three stages. First, professions, legislatures, and regulatory agencies build institutions. As the institution grows, the public becomes accustomed to the services provided. Finally, as adoptions become widespread the

rate of improvements slows; the services are routinized and formally institutionalized. In this final stage, rules and standards become fixed. Upon reaching the third stage, institutionalized organizations become isomorphic.

Birnbaum (1985) {375} hypothesized that differing levels of institutionalization will generate different strategies. Birnbaum studied manufacturing firms and public and private research institutions in the United States. Birnbaum reasoned that government agencies would be treated differently by regulators and thus their preferred strategies would be different. He reasoned that as dependence on government agencies increases, the perception of positive impacts of influence strategies will increase. However, Birnbaum found that decision makers from non-profit organizations did not perceive a greater positive impact of political strategies than decision makers from private firms. Additionally Birnbaum found that decision makers from privately owned organizations would not view passive strategies as having less positive impact than did organizational decision makers from publicly owned organizations.

The next hypothesis builds from Birnbaum's hypotheses and theory development. The following hypothesis is particularly important due to the dearth of empirical study on the effects of different regulatory instruments on different strategies (Harrison, 1981) {883}.

Hypothesis 5: The level of institutionalization will moderate the relationship between the type of regulatory initiative and organization's strategic response. Higher levels of institutionalization will produce stronger relationships between type of regulation and strategic response.

Moderating Effects: Collaboration

Trade associations have had a growing impact on the business environment. The Chemical Manufacturer's Association (CMA) and the Steel Manufacturer's Association are examples of trade associations that have exerted significant influence on issues relating to environmental protection (Wasserman, 1992). In addition to attempting to modify the approach of the regulatory apparatus, trade associations have encouraged members to participate in certain voluntary environmental initiatives (ISRI, 1992; Lubenau and Yusko, 1995).

The literature on cooperation also provides important information for the research

question of this effort. Collaborative responses are an integral aspect of strategic decisions (Gray, 1989) {782}. Wood (1986 {784}) argues that a firm will cooperate when and only when cooperation is in the firm's self-interest. Paine and Anderson (1983) {771} describe six cooperative strategies to effect the business environment. The first cooperative strategy, *alliance selection and negotiation* includes the identification of allies for each problem area. In many cases an ally that is useful in one problem will prove incompatible with another area. Second, *offensive and defensive strategies* occur after the alliance has been formed. The allies determine how to best impact the specific issue in the business environmental. Third, *implicit cooperation* is a covert form of cooperative strategy. Allies will engage in predictable patterns that will become known to other members of the alliance. The patterns will become self-sustaining and reduce levels of uncertainty. Fourth, *contracting* between allies is one of the most explicit form of cooperation. Fifth, strategies in which potentially hostile parties are absorbed into the leadership of an organizations is *coaptation*. The coaptation could occur between allies or between an organization and a potentially hostile representative of the external environment. Finally, allies can form *coalitions* and commit to joint decision making. Coalitions are the most severe form of cooperation because organizational autonomy is constrained. Trade associations are an example of coalitions (Davies, 1947 {766}; Jones, 1922 {768}; and Kirby, 1995 {776}). Aldrich and Pfeffer (1976) theorize that trade associations enhance the legitimacy of an industry and are a sign of industry maturation.

Galaskiewicz (1985) {887} and Van de Ven and Walker (1984) {897} reasoned that given the option, organizations would prefer not to establish interorganizational relations because such relationships can constrain their choice of subsequent actions. The theories predict an interesting paradox between an organization striving to maintain independence while knowing that it must engage in interorganizational relations (Jarillo, 1988) {886}.

Galaskiewicz (1985) classified types of interorganizational relations into three arenas: resource procurement and allocation, political advocacy, and organizational legitimization. He defined *multiplicity* as an action in one arena that depends upon the incorporation of strategies typically found in another arena.

Oliver (1990) theorized that the decision to initiate relations with another organization

is based on multiple contingencies. The “critical contingencies” include *necessity* (legal or regulatory requirements), *asymmetry* (potential to exercise power or control over others), *reciprocity* (potential for mutually beneficial cooperation), *efficiency* (improvement in *internal* input/output ratios), *stability* (predictability), and *legitimacy* (the institutional environment exerts pressure to justify activities or outputs). Oliver (1990) studied the relationships between the critical contingencies and six different forms of cooperative behavior including: trade associations, voluntary agency federations, joint ventures, joint programs, corporate-financial interlocks, and agency sponsor linkages. She reasoned that trade associations are more likely to form when the threat of government intervention is strong. One goal of the cooperative effort is to reduce the legislative or competitive uncertainty.

Indeed, cooperation can lead to a reduction of collective uncertainty. The higher the level of uncertainty, the more difficult to select the best strategy to address a regulatory initiative. In environments of low uncertainty, organizations can choose strategies that will effectively address a regulatory initiative. This leads us to the next hypothesis:

Hypothesis 6: The degree to which a firm participates in collaborative efforts will moderate the relationship between the form of an agency's regulatory initiatives and the political strategy of the regulated organization.

Summary

The overarching theoretical perspective is based on institutional theory. Institutional theory also provides the fundamental independent variable (the form of the regulation), the dependent variable (response strategy of the regulated organization), and one moderating variable (level of institutionalization). The field of environmental economics provides a second moderating construct (regulatory intensity). The final moderating variable (level of collaboration) is from the literature on cooperation. Figure 3 illustrates the constructs of the study.

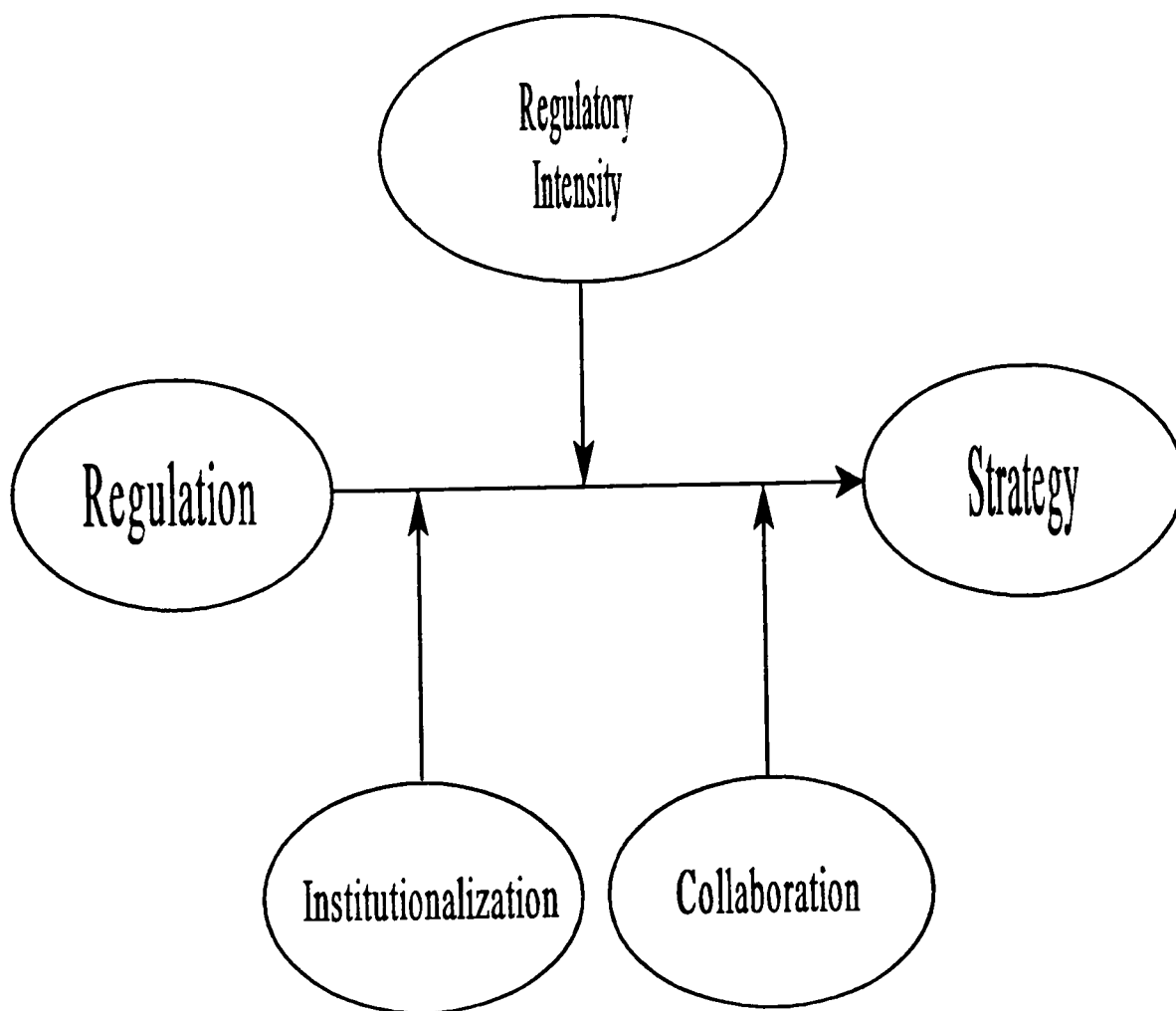


Figure 3 Theoretical constructs

CHAPTER III - METHODOLOGY

The structure of our methodology builds significantly on our 1994 survey and the subsequent analysis. The data collected in the 1994 survey were published in 1995 (Clemens, Douglas, and McGalliard). Many lessons were learned in the 1994 survey and resulting analysis. In particular, the operationalization of the dependent variables, the strategy of the regulated firms, was proposed and tested in the previous analysis. The 1996 survey was mailed to a similar population of managers in the steel industry that was surveyed in 1994. In summary, the 1994 survey and subsequent analysis should be viewed as a significant first phase of this dissertation.

Sampling Strategy - Production of the Data

The data collected in 1994 will be augmented with data that will be collected through a mail survey of the steel industry and a library search for data on regulatory intensity. The mail survey followed the Total Design Method (Dillman, 1978) {372}. Dillman designed a comprehensive methodology to produce effective mail surveys, which includes follow up postcards and follow-up letters to non-respondents.

This study is focused on one industrial category - metals. The metals industry was selected for its high burden of environmental regulation. Regulation of primary metal producers was one of the most intense (Pashigian, 1984) {123}. In addition, according to EPA's 1992 {1009} Toxic Release Inventory (TRI), the metals industry is a significant environmental discharger, more so than any other industry besides petroleum.

The steel industry affords three levels of institutionalization. Integrated mills are the most institutionalized, followed by the 100 mini-mills (members of the Steel Manufacturers Association). The least institutionalized are the more than 1,000 steel reprocessing facilities, member of the Institute of Scrap Recycling Industries. All of the more than 50 active members of the Steel Manufacturers Association (SMA), the trade association of mini-mills in America, will be surveyed. We also planned to send questionnaires to random members of the Institute of Scrap Recycling Industries (ISRI), the largest organization of steel reprocessing firms.

The 1994 Survey

To build the foundation for this dissertation proposal and to investigate and evaluate Oliver's typology, a survey was conducted in 1994. Oliver's (1991) typology of fifteen tactics and five political strategies were key to the 1994 survey and subsequent analysis (Clemens, Douglas, and McGalliard, 1996). Oliver's (1990, 1991) theorized tactics and strategies are those that are available to organizations to address a regulatory initiative. Oliver named the five strategies: acquiescence, compromise, denial, defiance, and manipulation.

Oliver's 1990 article received the best article award for the Academy of Management Review. The 1994 survey was the first attempt to empirically test Oliver's theories. Oliver's typology provides the foundation for the dependent variable, the strategy of the regulated organization, in this dissertation proposal.

Prior to the 1994 survey, each of the fifteen tactics was translated from Oliver's descriptions into tactics available to steel firms to address the problems of radioactivity in scrap metal. A pilot study was conducted through interviews at ISRI; SMA; Florida Steel, a mini-mill in Knoxville; Knox Metals, a steel reprocessing firm in Knoxville; the Environmental Protection Agency; and the Division of Radiological Protection of the Tennessee Department of Environment and Conservation. The major objective of the pilot study was to evaluate the wording of the description of each of the fifteen tactics in the questionnaire. The wording of the description for each tactic was significantly modified and improved based on the results of the pilot study.

In the 1994 survey, managers in the steel industry were asked to rank the effectiveness of each one of the fifteen tactics. The survey asked the managers to rank each of the fifteen tactics on a five-point Likert scale. A score of "one" indicated that the respondent felt that the tactic was not effective. A score of "five" indicated that the tactic was highly effective, in the mind of the respondent.

The combined response rate of the 1994 survey was 31%. While 31% is marginally acceptable, it was remarkable for the survey. Representatives of ISRI indicated that a 10% response rate is typical for their organization. Furthermore, in our litigious society, questions regarding potential environmental liabilities are very sensitive, adding to the difficulty.

Upon receiving the results of the 1994 survey, a factor analysis was conducted to confirm Oliver's theories and typology (Clemens, Douglas, and McGalliard, 1996). Oliver theorized that three tactics would combine to describe each of five strategies: *acquiesce*, *compromise*, *avoid*, *defy*, and *manipulate*. Oliver theorized that the tactics: habit, imitate, and comply would combine to form a strategy of *acquiesce*. Further, Oliver's theory proposed a *compromise* strategy made up of the tactics: balance, pacify, and bargain. Oliver proposed a third strategy, *avoid*, comprised of the tactics: conceal, buffer, and escape. Oliver's *defy* strategy was made up of the tactics: dismiss, confront, and attack. Finally, Oliver proposed that the tactics: co-opt, influence, and control would combine to describe a *manipulate* strategy.

A factor analysis was performed with the data from the 1994 survey to determine if the fifteen tactics loaded appropriately on the five theorized strategies. Each one of the fifteen tactic were converted to a variable for the factor analysis. The factor analysis was performed on all of the fifteen tactics simultaneously. Both principal axis factoring and a maximum likelihood analysis were performed. Both oblique and orthogonal rotations were applied. The results of the analysis were marginally consistent with Oliver's categorizations (Clemens, Douglas, and McGalliard, 1996). Three of the strategies (acquiescence, avoidance, and defiance) and their respective tactics loaded exactly as predicted by Oliver's theory. Chronbach's alphas ranged from .77 to .83.

Measures of Strategy - Dependent Variable

As in the 1994 survey, Oliver's (1991) typology of fifteen tactics and five political strategies will form the foundation for the dependent variable, the strategy of the regulated organization. In order to increase the reliability of the measures the questionnaire from 1994 was expanded for the proposed 1996 survey. In the 1994 survey only one description was provided for each tactic, for a total of fifteen descriptions. In the questionnaire for the proposed 1996 survey (see Appendix or Table 1) two descriptions are provided for each tactic, for a total of thirty descriptions. The thirty descriptions were sent to Christine Oliver at York University for her review and comment. Oliver (1996) found that the wording of the thirty descriptions adequately described the fifteen tactics.

Factor Analysis. Confirmatory factor analysis was performed to evaluate whether the tactics load on the appropriate strategies. The procedure detailed in Harris (1967) was used to factor analyze the data. Factor analysis is one of the most common techniques used in the management field, but the Harris procedure has not been extensively used. Typically, results of factor analyses are reported without a discussion of the process that the researchers used to choose the extraction and rotation techniques. Critics have argued that factor analysts choose the extraction that provides the best results. Use of the Harris (1967) technique addresses such criticism, and could be a positive contribution to the field. The Harris technique involves three steps as follows:

1. Compute communalities of each question and reject those less than 0.3.

Gorsuch (1974:185-6) {994} states: "...the minimum significant correlation coefficient ($p < 0.05$) with an n of 100 is about 0.2; therefore only elements of communalities greater than an absolute value of 0.4 would be interpreted if the analysis was based on 100 individuals. If it was expected that elements as low as 0.3 would be interpreted, then a minimum n of 175 would be needed. These figures are for problems with small to moderate size correlations, and may be too conservative for problems with many variables."

2. Perform factor analysis using various extractions, and
3. Interpret only those factors that are consistent over all extraction methods.

Based on the results of the Harris procedure, the resulting strategic factors were rotated orthogonally and treated as independent variables. If the factors are orthogonal, we can perform five independent regressions using each of the five factors as the dependent variables.

Scale. Each of the factors produced using the Harris procedure was treated as a separate dependent variable. The value of the variable was obtained by summing the results of the Likert scale scores. Thus the variable will range from a low of six (a score of one on each of the six questions) to a high of 42 (a score of seven on each of the six questions).

Measures of the Form of Regulatory Initiative - Independent Variable

The form of the regulatory initiative is the primary independent variable. The analysis

will assume that the regulatory initiative is a three-level categorical variable. The following categories are based on the previously described review of the literature (Wasserman, 1992; Leiby, Jones, Stephensen, and Feldman, 1989). The description of each of the categories is based on the notes of the working group of the Nuclear Regulatory Commission (Lubeneau, 1996) {1000}. The specific wording that follows (and used in the questionnaire) was reviewed and modified by representatives of the Nuclear Regulatory Commission and the Environmental Protection Agency. As a first attempt, we used the following the three levels of environmental interventions:

1. Economic incentives approaches: This option will use “market” forces to address the problem of radioactivity in scrap.

- A) Producers and users of gauges will be assessed licensee fees. The fees would be deposited in a fund to defray costs of regulatory oversight.
- B) The fees will be collected and used for bounties to identify individuals and organizations that do not follow prescribed procedures.
- C) The insurance industry would reduce premiums for those firms that install effective detection system. The insurance industry could also write riders to existing policies to defray the costs of disposing of sources found in the scrap.

2. Command and control: A regulatory agency would specify a minimum program to identify and prevent potential problems. The agency would also establish minimum criteria to remedy problems when they occur. The regulators would perform periodic audits including on-site inspections and mail surveys. The regulators could require improved labeling of gauges and other generally licensed devices. The enforcement agency would establish civil and criminal penalties for actions leading to contamination of steel. The implementing agency would be:

- A) local government,
- B) the state,
- C) the Environmental Protection Agency,
- D) the Nuclear Regulatory Commission, or
- E) an International Body.

3. Industry-based programs: This option will rely on industry monitoring. The system will be based on the International Standards Organization (ISO) 14000 approach. ISO 14000 will establish criteria for environmental controls. The International Standards Organization (ISO) was formed in 1947 in Amsterdam, Holland, and sets standards for a wide range of products and management operations. ISO 14000 is a management system designed to help a firm continuously improve upon its environmental performance. ISO 14000 enables a company to integrate quality environmental management systems with their business operations without relying on external regulation.

ISO 14000 will be finalized this year and thus offers an excellent example of an innovative and emerging approach (Kinsella, 1994) {1005}. A recent survey of corporations by Arthur D. Little showed that 68% of the respondents thought that ISO 14000 certification would be important or very important to their future business (Dean & Sawhney, 1996). {1011} An independent registering agency would certify that firms meet the ISO 14000 standards for radiation controls. The ISO 14000 requirements may include:

- A) monitors,
- B) training to enable employees to more easily identify un-licensed sources.
- C) audits,
- D) contributions to a fund to promote industry research into improvements in detection systems, and
- E) Procedures to work with the suppliers of scrap to minimize incidents.

Scale. The form of the environmental intervention was treated as three variables. Respondents to the questionnaire will be asked their preferences for each of the sub-options of the three classes of environmental interventions. Preferences were recorded on a seven point Likert scale. The scores for each of the sub-options were summed to generate a variable for each of the three forms of regulatory initiatives. Thus the variable for economic incentives could range from a low of three (a score of one for each of the three sub-options) to a high of 21 (a score of seven for each of the three sub-options). The variable for command and control could

range from five to 35. The variable for industry-based programs could also range from five to 35.

Measures of Regulatory Intensity - Moderating Variable

The analysis considered the intensity of the regulatory environment as a moderating variable. We operationalized regulatory intensity in two ways. First, the per-capita budget of the state regulatory agency (Maloney and Brady, 1988) {313} provided one measure. For each state, the budget of the state environmental regulatory agency will be divided by the total population of the state to obtain a ratio of regulatory intensity. High values of the ratio will indicate a state with high levels of regulatory intensity. Low values of the ratio indicate lower levels of regulatory intensity. The Green Index (Hall & Kerr, 1992) {363} provided data on the budget of the regulatory agency of each state. A second, perceptual measure of regulatory intensity was based on a questions in the survey requesting the respondents estimates of the regulatory intensity of the state.

Scale. Depending on the correlations and reliabilities of the items, we planned to normalize and sum the two measures for regulatory intensity.

Measure of the Levels of Institutionalization - Moderating Variable

Two different industries were surveyed, scrap yards and mini-mills. Mini-mills were considered institutionalized (and scored 2), scrap yards were scored as non-institutionalized (scored 1). The variable was be treated as a two level categorical variable.

Measures of Collaboration - Moderating Variable

In our proposal, we intended to us participation in trade associations as a measure of cooperation. This was to serve as one of our moderating variables. We had intended to use experts from the SMA and ISRI. We planned to ask the experts to rate the level of collaboration that they have received from each of their member companies. Our plan was to ask the experts to grade each firm from a low of one to a high of seven.

The SMA declined our invitation to rate their members. After conferring with the SMA

and ISRI representatives, we drafted two items on the questionnaire to measure collaboration.

Measure of Organizational size - Control Variable

The size of the organization was a control variable. The size of the organization is an important characteristic in regulatory actions (Yeager, 1987) {929}. In pretesting the survey, experts in the steel industry provided for the best measure of organizational size. Our experts recommended the annual production output in tons of steel over several years.

Recent research has used a variety of definitions of size. Singh looked at three measures the natural logarithms (Robinson and Pearce, 1988 {375}) of sales volume (in thousands of dollars), net assets (in thousands of dollars), and the number of employees in an organization. Singh (1986{118}) compared all three and found that they were all correlated (.85 and above for each).

Scale. The questionnaire asked respondents to estimate the tons of metal processed in each of the past two years. The questionnaire also asked the number of full time employees employed in the firm. If the number of full time employees is significantly correlated to the number of employees, a composite measure of the sum of the standardized results of both measures was envisioned. The variable was reviewed for normality, and transformed log-normally.

Descriptive Statistics

We planned to run “inter-ocular trauma”⁵ tests on the data. Normality and multicollinearity were reviewed. We planned to search for outliers using DF Betas (Neter, Wasserman & Kutner, 1990) {367}.

Factor Analysis - Hypotheses 1, 1A, 1B, 1C, 1D, and 1E

As described earlier, we planned to use confirmatory factor analysis according to the

⁵Attributed Dr. James L. Schmidhammer, inter-ocular trauma tests determine if any of the data unquestionably raise concerns.

Harris (1967) procedure on the thirty variables describing the fifteen tactics. We intended to convert the thirty descriptions into variables and combine them in one factor analysis.

Hypothesis 1A will be accepted if the six descriptions of habit, imitate, and comply load together (as acquiesce) with a Chronbach's alpha of greater than 0.60. If the six descriptions for balance, pacify and bargain load as one (compromise) with Chronbach's alpha in excess of 0.60, Hypothesis 1B will be confirmed. Hypothesis 1C will be accepted if the six descriptions of conceal, buffer and escape combine with an acceptable Chronbach's alpha. If the six descriptions of dismiss,, confront and attack group; Hypothesis 1D will be accepted. Finally, Hypothesis 1E will be accepted if the six descriptions of co-opt, influence and control load together.

Hypothesis 2 - Paired T-Tests

In 1994, Clemens, Douglas, and McGalliard (1996) surveyed the same firms that we surveyed in this study. Respondents were asked to indicate their preferences for each of Oliver's fifteen tactics on a one to five Likert scale. The survey for this study asked similar questions. For Hypothesis 2, the standardized composite preference for each strategy from the 1993 survey was to be compared to the similar results of the proposed 1996 survey.

We planned to perform T-tests to determine if the respondents in 1996 have a higher regard for certain strategies. To test Hypothesis 2, the change in respondents preferences for acquiesce strategies and for manipulation strategies was used. Hypothesis 2A predicts that there would be a significant decrease in the respondents preferences' for acquiesce strategies. Hypothesis 2B predicts that there will be significant increase in the respondents' preferences for manipulation strategies. We planned to compare the mean response for each tactic and strategy in the 1993 survey to the mean response for each tactic and strategy in the 1996 survey.

Hypotheses 3-6 - Moderated Regressions

For hypotheses 3-6, our plan was to run four levels of analyses. *First*, correlations between the political strategies and the form of regulatory initiatives were planned. *Second*, depending on the results of the correlations, we considered running a MANOVA including all

five strategies as dependent variables. We felt the MANOVA could provide an overall test statistic using the following equation:

(1)

$$Y_i = \beta_0 + \beta_1 (X_1) + \beta_2 (X_2) + \beta_3 (X_3) + \beta_4 (X_4) + \beta_5 (X_1) (X_2) + \beta_6 (X_1) (X_3) + \beta_7 (X_1) (X_4) + \epsilon$$

where:

- Y_i = political strategy:
 - Y_1 = Acquiesce,
 - Y_2 = Compromise,
 - Y_3 = Avoid,
 - Y_4 = Defy,
 - Y_5 = Manipulate,
- X_i = Form of Regulatory Approach:
 - $X_{(1)1}$ = Economic incentives,
 - $X_{(1)2}$ = Command and Control,
 - $X_{(1)3}$ = Industry-based programs,
- X_2 = Level of Regulatory Intensity,
- X_3 = Level of Institutionalization (coded 1 or 2),
- and
- X_4 = Level of Collaboration.

Third, depending on the results of the correlations and the MANOVA, we planned to run up to 15 independent, moderated regressions relating each of the five strategies (factors) and each of the three environmental interventions. Based on recent studies of Oliver's typologies (Goodstein, 1994; Oliver, 1990; Tabak & Barr, 1994; and Ingram & Simons, 1995) Oliver's strategies could be treated as a continuous, or even an ordinal categorical variables. We planned to treat each strategy as an independent variable.

Fourth, Main and interaction effects were to be analyzed. Cohen (1968) developed the following test statistic to determine if an interaction effect was significant:

$$F_{(b, n-a-b-1)} = \left| \frac{(R_{ab}^2 - R_a^2) / b}{(1 - R_{ab}^2) / (n - a - b - 1)} \right| \quad (2)$$

where

R^2_{ab} = coefficient of determination of the saturated model,

R^2_a = coefficient of determination of the model including only the main effects,

a = the number of variables with a main effect,

b = the number of interaction terms,

and

n = sample size.

Hypothesis 3 - Main Effects of Form of Regulation. For Hypothesis 3, we planned to calculate the main effects for each of the types of strategies (factors) and each type of regulatory initiative. All regressions were to control for firm size. We tested for significance of the main effects. To test Hypothesis 3, we evaluated the significance of the t-tests of the Beta weights for the form of regulation (X_i).

Hypothesis 3A - Association between “Command - Control” and Acquiesce - Compromise. We planned to perform T-test of the Pearson correlations between command and control approach and the acquiesce and compromise strategies.

Hypothesis 3B: Association Between Industry-monitored, flexible, non-prescriptive regulations and defiance - manipulation. We planned to compare T-test statistics of the Pearson correlations between industry-based approaches and the defiance and manipulation.

Hypothesis 4 - Moderated Effect of Regulatory Intensity. Cohen’s test was to be run comparing the R^2_a of the regression equation of the main effects only (equation (3)) with the R^2_{ab} of the regression equation of the main effects and Regulatory Intensity (equation (4)). To test Hypothesis 4, Cohen’s F was evaluated for significance.

(3)

$$Y_i = \beta_0 + \beta_1 (X_i) + \beta_2 (X_2) + e$$

(4)

$$Y_i = \beta_0 + \beta_1 (X_i) + \beta_2 (X_2) + \beta_5 (X_i) (X_2) + e$$

Hypothesis 5 - Moderated Effect of Level of Institutionalization. Cohen’s test was to be run again, this time comparing the R^2_a of the regression equation of the main effects only (3) with the R^2_{ab} of the regression equation of the main effects and Level of Institutionalization (5). To test Hypothesis 5, Cohen’s F was to be evaluated for significance.

(5)

$$Y_i = \beta_0 + \beta_1 (X_i) + \beta_3 (X_3) + \beta_6 (X_i) (X_3) + \epsilon$$

Hypothesis 6 - Moderated Effect of Collaboration. For the third time, we planned to run Cohen's test to compare the R^2_a of the regression equation of the main effects only (3) with the R^2_{ab} of the regression equation of the main effects and Regulatory Intensity (6). Once again, to test Hypothesis 6, Cohen's F was evaluated for significance.

(6)

$$Y_i = \beta_0 + \beta_1 (X_i) + \beta_3 (X_3) + \beta_6 (X_i) (X_3) + \epsilon$$

Conclusion of Chapter on Methodology

This chapter described the methodology that was used to test the hypotheses. The next chapter will discuss the data analysis.

CHAPTER IV - DATA ANALYSIS

The objective of this chapter is to describe the analysis to test hypotheses that were developed in Chapter II using the methods described in Chapter III. The first section of this chapter describes three pilot studies that we performed to improve the psychometrics of the measures of the survey instrument.

Pilot Studies to Refine the Questionnaire

The majority of the data for this effort was collected by surveying managers in the steel industry. A questionnaire was developed and used in our 1994 survey of the same industry. The major independent variable in this effort was not included in the 1994 survey. In order to develop reliable measures for this new independent variable and to improve the 1994 survey, "we" (sic) decided to perform pilot tests.

Through a search of the literature (Clemens & Feldman, 1996) {1087}, conversations with experts and two pilot tests performed in the summer of 1996, we developed a list of 41 possible items to describe this fundamental independent variable - interventions to address the problems associated with radioactive scrap metal. We hope the measures could also apply to a much wider range of environmental issues.

We based our hypotheses developed in the previous chapters on a categorization of three types of interventions - command and control, economic incentives and industry-based programs. One of the objectives of the pilot studies was to test the categorization.

In order to test our hypotheses, we needed to develop scales or measures that were described in the last chapter. In order to generate valuable results, our measures had to be *reliable* and *valid*. Two aspects of reliability are consistency over time and consistency across experts. A reliable test administered to several experts will produce consistent results.

Valid tests are those that measure what the test is intended to measure. A test can be reliable, but not valid. For instance, tests that have students memorize chemical terms may be highly reliable, but may not be good measures of a students understanding of chemistry. Our pilot tests focus on reliability.

One of the most common measures of reliability is Chronbach's alpha. Chronbach's

alpha is based on the average covariance of items within a test. Chronbach's alpha can be computed using the following formula (SPSS, 1996 {1060}):

$$\alpha = (k (\overline{cov}) / (\overline{var})) / ((1 + (k-1) (\overline{cov}) / (\overline{var})) \quad (7)$$

where:

α = Chronbach's alpha, a measure of reliability

k = the number of items in the scale

cov = covariance between items and

var = variance between items

Reliabilities of 0.6 to 0.8 are acceptable for exploratory research. Researchers should expect reliabilities of greater than 0.8 for confirmatory analyses (Nunnally, 1978) {1058}.

First Pilot Study

Soon after the defense of this dissertation, in late May, 1996, we began our first pilot test. We mailed a booklet survey, based on our 1994 questionnaire, to experts who had participated in conferences and workshops that dealt with environmental interventions to address the potential problem of radioactivity in metal. We asked respondents to rate the effectiveness of 14 items that exemplified command and control, economic incentives and industry-based programs. The 14 items were drawn from comments provided by the steel industry to the Nuclear Regulatory Commission (1996) {1001}. Five items comprised the first category, command and control. The second category, economic incentives, included four items. The third category, industry based controls, included five items.

Results of the First Pilot Study

We received 20 valid responses to the first pilot study. The reliabilities were marginally acceptable for economic incentives, The reliabilities of the industry-based programs and command and control category were not adequate (Table 3). The experts rated the economic incentive approaches similarly, but did not agree on the effectiveness of industry-based approaches and command and control approaches.

Table 3 - Results of the First Pilot Study

Category of environmental intervention	Number of items	Inter-item correlation (r)	Reliability (Chronbach's alpha)
Command and control	5	.0035	.05
Economic Incentives	4	.2937	.63
Industry-based approaches	5	.1451	.46

The low reliability of the command and control category is one of the more interesting findings of our research. We believe that the low reliability was due to the fact that the five items that we used to categorize command and control approaches differed in the type of regulatory authority. Indeed, the only difference in the five items was the regulatory authority. The five regulatory authorities were local, state, two different federal agencies (EPA and NRC) and international agencies. Our respondents rated the effectiveness of command and control items very differently based on whether the implementing agency was a local, state, federal, or international organization. The variability of the type of implementing authority seems to be much greater than the variability between our three categories of initiatives. Future studies could investigate this interesting area.

Another major benefit of the first pilot study is that the respondents provided excellent examples of additional options of each of the types of interventions.

Second Pilot Study - National Academy of Sciences Panel

We were invited to the National Academy of Sciences to discuss our research on June 17-18, 1996. The Academy had assembled an expert panel to discuss the problems of radioactivity in scrap metal. We requested and received Academy approval to test our survey on the workshop participants. Based on recommendations received in the first pilot study, we reworded several of the items to address the concerns of the respondents of the first pilot study. We also increased the number of items for each category.

One criticism of the first survey was that we categorized our theorized types of regulatory approaches in the survey instrument. The survey began with a grouping of all the

command and control approaches. The next items in the survey were examples of economic incentive options. The last group of items were industry based approaches. In essence, we “coerced” the respondents to categorize the items into the three types of regulatory approaches. In order to obtain a more objective result, we eliminated the categorizations on the second pilot survey. Furthermore, we randomly ordered all the items.

Results of the second pilot test

We received nine useable responses from the Academy of Sciences working group. Table 4 displays the results. The Chronbach alphas as measures of reliability were within acceptable levels.

Table 4 - Results of the Second Pilot Study

Category of environmental intervention	Number of items	Inter-item correlation (r)	Reliability (Chronbach's alpha)
Command and control	10	.21	.72
Economic Incentives	7	.22	.73
Industry-based approaches	14	.20	.81

Third Pilot Test

Our first two pilot studies queried experts that were not necessarily responsible for negotiating with the government. We now felt comfortable enough with the survey instrument to test it on the population that we had planned to survey - managers in the steel industry.

The respondents from the National Academy of Sciences working group offered additional wording improvements to the survey. We sent the revised survey to a random sample of 150 members of the steel industry. We received seventeen useable responses. We asked respondents to rate the effectiveness of possible interventions. We tested if experts rated the 30 items used to explain the three categories of environmental interventions consistently. The results of the third pilot test are provided in Table 5.

Summary Results of the Three Pilot Studies

The reliabilities of our categorizations increased substantially through the pilot studies. The reliabilities of .85 to .92 provide confidence that our questionnaire will reliably measure the categorization. Our next step was to decide on the sample size required to test our hypotheses.

Table 5 - Results of the Third Pilot Study

Environmental intervention	Number of items	Inter-item correlation (r)	Reliability (Chronbach's alpha)
Command and control	9	.38	.85
Economic Incentives	8	.61	.92
Industry-based approaches	13	.31	.85

Calculation of Necessary Sample Size

A comprehensive analysis to determine the optimum sample size is included in the Appendix. For Hypotheses 2, 2A and 2B we need a sample size ranging from 13 to 135. For Hypothesis 3 we need a sample size from 135 to 138. For Hypotheses 4-6 we need a sample size of 32 to 138. Our analysis contained in the Appendix concludes that 139 valid responses should be sufficient to test all of our hypotheses.

The Full Survey

We followed the Total Design Method (Dillman, 1978 {372} and Salant & Dillman, 1995 {1075}) to maximize our response rate. We mailed surveys to all of the 393 respondents from our 1994 survey that were not part of our pilot study. In addition we sent the questionnaire to a random sample of 79 additional firms, 11 local firms and the remaining nine members of the Steel Manufacturers Association for a total of 492 firms.

One week later we sent postcards to the 492. In three weeks we sent letters and replacement surveys to those firms that had not responded. We included a test of radioactivity

in 200 of the packages, hoping to increase the response rate. We sent a third follow-up survey to those that had not responded to our pilot study.

Results of the Full Survey

To date we have received 190 valid responses. Based on our power calculations, our goal was 139 completed surveys. In total we sent out 150 surveys in the pilot study and an additional 492 for a total of 642. Of the 642, the post office was not able to deliver 37 due to incorrect addresses or expirations of forwarding orders. In addition, 49 firms indicated that they were not qualified to respond in that they did not process metal, but rather paper or plastics. Thus our sample surveyed was 556 (642-37-49) and our response rate was higher than 34% (190/556). 51% of our respondents were owners, 17% were operations managers, 14% were environmental managers. The remainder included technical managers and other representatives.

In addition to the numerical responses to the questionnaire, many respondents provided helpful and at times colorful opinions. Ten respondents emphasized the industry's frustrations with the current situation. Sixteen respondents provided comments on the options and offered opinions on effective approaches. Two responders provided specific advice for improvements for future questionnaires. Finally, three criticized our study. The specific comments are included in the Appendix. We feel the depth and extent of the comments are noteworthy. Indeed, many of our respondents took significant time in responding. Table 6 summarizes information on the number of words of the responses in each category.

Table 6 - Analysis of the Number of Words in Comments from the Survey

Category of comments	Num- ber	Range in words	Total Words	Standard deviation	Mean
Comments on Situation	10	19-237	918	74.4	91.8
Options proposed	16	6-170	679	43.6	42.4
Methodology of study	2	38-160	198	86.3	99
Criticisms	3	44-115	240	35.5	80
Total	31	6-237	2035	59.6	66.6

We feel the table demonstrates the importance that our respondents placed on the issue of radioactivity in steel. We can be more comfortable with the results knowing that 31 of our respondents ($31/190 = 16\%$) felt strongly enough to add additional comments. As we suspected, we have chosen a "real world" problem to investigate.

Exploring our Data

We entered the data directly into the Statistical Package for the Social Sciences (SPSS) Version 6.1. Our next step was a detailed exploration of the data. We explored the data to identify data coding errors and to evaluate the assumptions necessary for our hypotheses tests. First we ran box plots to identify outliers for each variable. We found and corrected less than ten mistaken entries.

We calculated skewness and kurtosis (either more or less peaked than a normal distribution). Values for kurtosis over 10 are suspect (Ladd, 1996){1076}. We tested for normality using the Lilliefors and Shapiro-Wilks tests.

As expected, those items that used Likert scores were distributed normally. Our only difficulty occurred in our estimate of regulatory intensity and size. In regulatory intensity, Question 9 on the survey, Q9VISIT, asked respondents the number of times they were visited by state regulatory representatives over the past year. The large share of respondents were visited very infrequently, but a number of respondents were visited 10 or more times. The histogram indicates a significant leftward skewing as is typical for such variables. After discussing the issue with Professor John Philpot, professor of statistics at the University of Tennessee, we decided not to perform transformations.

Measures for organizational size included Q43TON1994 (tons of metal produced in 1994), Q43TON1995 (tons of metal produced in 1995) and Q44FTE (number of employees). The items demonstrated leftward skewing typical of measures of size of organizations. While log normal transformations normalized all three variables considerably, we again decided not to preform the transformations.

Reliabilities

Our next step was to check on the reliabilities of the variables. A more thorough discussion of the importance of reliabilities was provided in an earlier section. The next sections will address the variables individually.

Regulatory Interventions. As described earlier, eight items were examples of economic incentives, nine were command and control approaches and 13 exemplified industry-led approaches. Table 7 provides the reliabilities.

Thanks to the improvements in the first two pilot studies, the reliabilities of these variables are adequate. Nunnally (1994) {1058} considers Chronbach's alphas of 0.6 typical for exploratory research and 0.8 typical for confirmatory studies. In order to maximize the number of observations

Table 7 - Reliabilities of the Regulatory Interventions in the Full Survey

Variable	Number of items	Observations	Reliability (Chronbach's alpha)
Command and control	9	178	.79
Economic Incentives	8	182	.82
Industry-based approaches	13	175	.81

for our tests, we will use the mean of the respondent's preferences for the appropriate items to measure each of the three regulatory initiatives.

Regulatory Intensity. We have four measures for regulatory intensity. The per capita budget of the state environmental agency (RIPERCAP) and the percentage of the total state budget allocated for the environment (PRCNSB) were obtained from Hall & Kerr (1992). Two questions to estimate regulatory intensity were included in the survey. Q48REGIN was a self-reported estimate of regulatory intensity. Q49VISITS⁶ was the number of visits from state

⁶ In general, the first three digits of a variable name refer to the item number in the questionnaire. Thus in Q49VISITS, Q49 indicates that Q49VISITS is the 49th item (question) on the questionnaire. The remaining digits in the variable refer to the item measured. VISITS in Q49VISITS indicates that the item measures the number of visits by the regulators in the last five years.

regulators in past five years.

The Chronbach alpha of the four items was marginally acceptable (.61). However, correlation coefficients and a factor analysis indicated that the two archival measures (RIPERCAP and PRCNSB) and the two survey measures (Q48REGIN and Q49VISITS) loaded independently. Thus we will consider regulatory intensity as two separate variables. The first we will call Regulatory Intensity Potential (REGINPOT). It will be calculated as the mean of RIPERCAP and PRCNSB. We will name the second, Regulatory Intensity Perception (REGINPER), calculated as the mean of Q48REGIN and Q49VISIT. Table 8 displays the correlations of the four items.

Collaboration. The survey included two questions that measured the level of collaboration. Q50COOP measured the degree to which survey respondents had worked with other firms on the issue of radioactivity in metal. Q51COLAB asked respondents to indicate the types of collaboration practiced. Pearson's correlation coefficient between the two was 0.39 significant at the .001 level.

Table 8 - Correlation Coefficients for Regulatory Intensity

	Q49VISIT	Q48REGIN	RIPERCP	PRCNSB
Q49VISIT	1.0000 (179) P= .	.4471 (178) P= .000	.0309 (177) P= .683	.0792 (177) P= .295
Q48REGIN	.4471 (178) P= .000	1.0000 (186) P= .	-.0115 (184) P= .877	.0020 (184) P= .978
RIPERCP	.0309 (177) P= .683	-.0115 (184) P= .877	1.0000 (190) P= .	.9550 (190) P= .000
PRCNSB	.0792 (177) P= .295	.0020 (184) P= .978	.9550 (190) P= .000	1.0000 (190) P= .
(Coefficient / (Cases) / 2-tailed Significance)				

Although the correlation is significant, the less than perfect correlation may be due to the wording and scoring of question 51 (Q51COLAB). Question 51 allows the respondent to circle one of 6 possible tactics that range from low collaboration to high collaboration. If the respondent circled more than one, it was scored as the mean. Based on the acceptable degree of correlation, we used the simple mean of these two variables to measure the degree of collaboration.

Organizational Size. We used three measures for organizational size: the tons of metal produced in 1994 (Q43TON94) and 1995 (Q43TON95), and the number of full time employees (Q44FTE). Chronbach's alpha for the three measures was .91. We used the mean of the three measures to indicate organizational size (ORGSIZE).

Data Analysis for Hypothesis 1

To test Hypotheses 1, 1A, 1B, 1C, 1D and 1E; we followed the Harris (1967) procedure as described in the previous chapter. We used both Principal Component Analysis and Principal Axis Factoring extractions. We used varimax, equimax, quartimax, and oblimin rotations. We used scale⁷ scores to develop the factors. Our first attempt was to replicate Oliver's theories and extract exactly five factors.

In our desire to improve reliability of Oliver's construct we doubled the number of items that were used in the 1996 survey as compared to the 1994 survey. Oliver had theorized 15 tactics, three for each of five strategies. In the pilot stages of the 1994 survey, we met with members of the steel industry and developed 15 items that reflected each of Oliver's tactics. During the pilot testing of the 1996 survey, we added one item to each tactic. Thus the 1996 survey includes 30 items that represent the 15 tactics.

Theoretically, the two items that were intended to describe each tactic should be correlated. For 13 of the 15 tactics, the correlations between the relevant items are significant

⁷ Scale scores are NOT factor loadings. The factor was computed as the simple mean of the results of the appropriate items from the questionnaire. The scores were NOT modified based on factor loadings.

at the 0.003 level or less. The two items that measure “buffer” (Q52AVBFA⁸ and Q73AVBFB) are not correlated at the 10% level. The two that measure “pacify” (Q53CMCPA and Q74CMPCB) are correlated at the 0.066% level. Six of the fifteen tactics registered a Chronbach’s alpha of greater than 0.60.

Our next step following the Harris (1967) procedure, was to perform various extractions and rotations. Our first set of analyses extracted five factors, following Oliver’s (1990 and 1991) theories on five strategies.

Five Factors. Oliver’s theories support a five factor extraction with each set of three tactics loading separately on one factor. Information on the eigenvalues and communalities are displayed in Table 9. The first two factors provide 35.2% of the variation.

Table 9 - Five Factor Extraction - Principal Components

Factor	Eigenvalue	Percentage of Variance	Cumulative Percent
1	6.25706	20.9	20.9
2	4.31249	14.4	35.2
3	1.81650	6.1	41.3
4	1.47341	4.9	46.2
5	1.38917	4.6	50.8

Table 10 summarizes the results of one of the five factor extractions. The factor loadings in bold are those recommended by the Harris (1967) procedure, described in Chapter 3. In addition to Principal Components with a varimax rotation, we ran principal components with equimax, quartimax and oblimin rotations. We also used principal axis factoring with varimax and oblimin rotations. These results are included in the Appendix.

⁸ For this and in subsequent tables we will use the following conventions for variable names. The first three digits refer to the item number on the questionnaire. For example in Q57ACHAA, Q57 refers to item (question) number 57 on the questionnaire. The next two letters indicate the strategy AC = acquiesce, CM = compromise, AV = avoid, DF = defy and MN = manipulate. The next two letters indicate the tactic. HA = habit, IM = imitate, CM = comply, BL = balance, PC = pacify, BR = bargain, CN = conceal, BF = buffer, ES = escape, DS = dismiss, CN = confront, AT = attack, CO = Co-opt, IN = influence and CN = control. WE used two items for each tactic. If the last letter is A the item is the first example of the tactics. B indicates the second item describing the tactic.

Table 10 - Five-Factor Extraction - Principal Components with a Varimax Rotation

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Q57ACHAA	-.11532	-.06069	.56800	-.19053	.24810
Q61ACHAB	.04495	.12973	.82363	-.10586	.12963
Q54ACIMA	-.12577	.41591	.37736	.24869	.09186
Q60ACIMB	-.10488	.16043	.66716	.27848	-.09082
Q65ACCMA	-.04321	.75436	.08583	.11797	-.17712
Q66ACCMB	-.26577	.56616	.32116	-.08967	.01715
Q55CMBLA	-.08689	.82441	-.02988	.07651	.16276
Q62CMBLB	-.09650	.61837	.26571	-.08927	.11055
Q53CMPCA	.44458	-.06298	.23982	.14119	.26683
Q74CMPCB	-.13647	.21976	.53979	.43144	-.13918
Q56CMBRA	-.06815	.53135	-.17422	.29009	.47123
Q75CMBRB	.09302	.09421	.04462	.77608	.10569
Q68AVCNB	.79943	-.06182	.02362	.08811	-.02534
Q78AVCNA	.71760	-.10899	-.04553	-.13463	.12618
Q52AVBFA	.32401	-.23211	.07632	.02817	.56928
Q73AVBFB	.43482	-.27826	-.06076	-.15099	-.02034
Q71AVESB	.71545	.02468	-.03809	-.11784	.12026
Q79AVESA	.78705	.05286	-.02982	-.10253	.02014
Q67DFDSB	.76369	-.13308	-.04230	-.01230	-.11120
Q81DFDSA	.75951	-.15029	-.03814	.16783	-.29522
Q64DFCNA	.55608	-.06480	.02960	.23691	.34853
Q80DFCNB	.47915	-.04593	-.12139	.05164	.06280
Q72DFATA	.55373	-.07974	-.06834	.18093	.08725
Q76DFATB	.64138	-.08663	-.09703	.22867	.19494
Q58MNCDA	-.11801	.26022	.26836	-.00532	.38158
Q69MNCOB	-.07712	.38704	.02402	.44875	.14765
Q59MNINB	-.00740	.09511	.42089	.21222	.45164
Q70MNINA	.09409	.14750	.30269	.29124	.25994
Q63MNCNB	.18597	.21782	.06085	.12549	.64699
Q77MNCNA	.42787	-.17638	.04577	.58396	.15485

Even considering the deficiencies in our measures for buffer and pacify, none of the attempts replicated Oliver's theories.

Four Factors. Clemens and Douglas (1996) found that Oliver's strategies could be interpreted as four factors. Only the three defy tactics loaded consistently. The four factor results show an improvement over the five factor extraction, but still do not dovetail with theory. In addition to Principal Components with a varimax rotation, we ran principal components with equimax, quartimax and oblimin rotations. We also used principal axis factoring with varimax and oblimin rotations. These results are included in an Appendix.

Two Factors. The fact that the first two factors accounted for more than 35.2% of the

variance, leads one to attempt a two-factor solution. Also, the scree plots of most of the extractions, including those after eliminating pacify and buffer, indicate that the first two eigenvalues absorb the preponderance of the variance. Tables 11 and 12 summarize the results of one of the two factor extractions. In addition to Principal Components with a varimax rotation, we ran principal components with equimax, quartimax and oblimin rotations. We also used principal axis factoring with varimax and oblimin rotations. The results of the other rotations are provided in the Appendix.

Summary of Harris Techniques for Factor Analysis. The items in the survey do not cleanly factor into the five strategies as theorized by Oliver (1990) nor into four as proposed by Clemens and Douglas (1996). Based on the Harris procedure and after attempting extractions of two, three, four, five and nine factors; we feel the two factor extraction provides the best factoring. According to Harris, the first item (Q57ACHAA) had a insufficient communality (.09) and was discarded from the analysis.

The most stable factor based on the Harris procedure shown in Table 12 and confirmed in Tables C-1 through C-9 in Appendix C, is the combination of the six 'avoid' items and the six 'defy' items. The 12 items have a Chronbach's alpha of .8253. Item number 77 on the questionnaire (Q77MNCNA) also consistently loaded with the 12 avoid and defy items.

Q77MNCNA was worded "Attempt to deal with federal regulators to control the state or local government." In hindsight, we feel this option is more of a "defy" tactic rather than a "manipulate" tactic. Therefore, we felt that the item could indeed load with the first factor. If the inter-item correlations remain constant, adding items to a factor should increase the Chronbach's alpha. The relationship between Chronbach's alpha, the number of items and the inter-item correlation is provided in the Appendix. Adding item Q77MNCNA increased the Chronbach's alpha from .8253 to .8319, but the mean of the inter-item correlations decreased from .3655 to .3510.

Contrary to theory Q53CMPCA also loaded with the avoid and defy items. Q53CMPCA was worded: "Partially conform with the required procedures that are the most important to the regulators." Again in hindsight, we feel that this item is more similar to an

Table 11 - Two-factor Extraction - Principal Components

Factor	Eigenvalue	Percentage of Variance	Cumulative Percent
1	6.25706	20.9	20.9
2	4.31249	14.4	35.2

Table 12 - Two-factor Extraction - Principal Components - Varimax Rotation

Item	Factor 1	Factor 2
Q57ACHAA*	-.07528	.29506
Q61ACHAB	.04342	.52391
Q54ACIMA*	-.09328	.61126
Q60ACIMB	-.07130	.54084
Q65ACCMA	-.15742	.51112
Q66ACCMB	-.33697	.53165
Q55CMBLA	-.13887	.61312
Q62CMBLB	-.16416	.55444
Q53CMPCA	.52204	.19888
Q74CMPCB	-.08874	.55547
Q56CMBRA	.03528	.54819
Q75CMBRB	.26901	.41695
Q68AVCNB	.77146	-.08364
Q78AVCNA	.68713	-.17084
Q52AVBFA	.47591	.08795
Q73AVBFB	.40686	-.32112
Q71AVESB	.66937	-.07680
Q79AVESA	.71266	-.09402
Q67DFDSB	.70468	-.23259
Q81DFDSA	.69928	-.24139
Q64DFCNA	.66388	.14341
Q80DFCNB	.47971	-.09830
Q72DFATA	.58888	-.03973
Q76DFATB	.70723	-.00844
Q58MNCDA	-.05388	.46511
Q69MNCOB	.00797	.49960
Q59MNINB	.13820	.54050
Q70MNINA	.19687	.45836
Q63MNCNB	.32468	.44957
Q77MNCNA	.58930	.15435

“avoid” tactic than a “compromise” tactic. Adding Q53CMPCA in the first factor increased Chronbach’s alpha to .8377, but the mean of the inter-item correlation again decreased to .3397. For the balance of this analysis, our factor number one will include all 14 items. We will call this factor “adversarial” or ADVERSER.

The remaining five of the six items for acquiesce, five of the six compromise items and five of the six manipulate items loaded as a second factor. These 15 items produce a Chronbach’s alpha of .80. We will refer to this factor as “work the system” or WORKINSY.

Data Analysis for Hypotheses 2, 2A and 2B

To test hypotheses 2A and 2B we reviewed the data from our 1994 survey. Hypothesis 2A predicts that the mean of the preference for acquiesce strategies would decrease from 1994 to 1996. The measure for acquiesce in the 1994 survey was the mean of the respondent’s preferences for the three tactics as predicted by Oliver (1991) and confirmed in Clemens and Douglas (1996). The three tactics were habit, imitate and comply. As proposed in the last chapter, we performed a paired t-test. Thus we only used those cases (144-146) that responded both in 1994 and in 1996.

The Chronbach’s alpha for habit, imitate and comply in 1994 was .78 (Clemens and Douglas, 1996). In the 1996 survey the Chronbach’s alpha for the six items corresponding to the similar tactics was .69

Hypothesis 2B addressed the preference for manipulation strategies. Oliver theorized that the tactics co-opt, influence and control combined to describe a manipulate strategy. The Chronbach’s alpha for these three manipulation tactics from 1994 data was .89. However, the results of the factor analysis in 1996 survey, as described above, did not produce a clean manipulation strategy. Chronbach’s alpha for the six items that comprise these tactics was .62 in 1996.

Arguably, the results of our tests of Hypothesis 1 render Hypothesis 2 more difficult to test. We decided to test the Oliver theory rather than modify our hypotheses to address the findings of Hypothesis 1.

In Table 13, ACQUIESC is the mean of the tactics habit, imitate and comply in the

Table 13 T-tests for Paired Samples - Hypothesis 2A

Variable	Number of pairs	Paired Differences:	
		Mean significance	Mean 1-tailed
ACQUIESCE 1996	146	5.2212	1.0140
ACQUIESCE 1994		3.4064	
Hypothesis 2B			
MANIPULATE 1996	144	4.1852	.9415
MANIPULATE 1994		3.2437	

1996 survey. ACQUIS94 is the mean of the corresponding tactics from our 1994 survey. In the table, MANIPULA is the mean of the respondents preferences for the co-opt, influence and control tactics in the 1996 survey. MANIPU94 is the mean of the preference for the corresponding tactics in the 1994 survey.

These results indicate a significant relationship between preferences for manipulation and acquiescence. As hypothesized, we found our respondents preferred manipulation strategies to a greater degree in 1996 than in 1994. Our T-test was significant at the .0001 level.

We found a similarly strong relationship between preferences for acquiescence strategies in 1994 and 1996. We had hypothesized that our respondents would find acquiescence less attractive. Surprisingly, our respondents viewed acquiescence more favorable in 1996! The next chapter will address this interesting result.

Data Analysis for Hypotheses 3-6

Correlations. To test Hypotheses 3, we first investigated bi-variate correlations between the relevant variables. Table 14 provides the correlations. Based on simple correlations, it seems a relationship exists between WORKINSY and each of the three regulatory initiatives at the .0001 level. In addition ADVERSER and command and control

Table 14 - Correlations between main independent and dependent variables

	WORKINSY	ADVERSER	COMMANDC	ECONOMIC	INDUSTRY
WORKINSY	1.0000 (182) P= .	.0025 (180) P= .974	.2946 (181) P= .000	.2807 (181) P= .000	.3889 (181) P= .000
ADVERSER	.0025 (180) P= .974	1.0000 (180) P= .	-.1729 (180) P= .020	-.0014 (180) P= .985	-.0527 (180) P= .482
COMMANDC	.2946 (181) P= .000	-.1729 (180) P= .020	1.0000 (190) P= .	.2281 (190) P= .002	.2802 (190) P= .000
ECONOMIC	.2807 (181) P= .000	-.0014 (180) P= .985	.2281 (190) P= .002	1.0000 (191) P= .	.5959 (191) P= .000
INDUSTRY	.3889 (181) P= .000	-.0527 (180) P= .482	.2802 (190) P= .000	.5959 (191) P= .000	1.0000 (191) P= .

interventions are correlated at the 2% level of significance. The following sections will investigate the hypothesized relationship further.

Multiple Analysis of Variance (MANOVA). In the previous chapter, we discussed the possibility of performing a MANOVA analysis to shed additional light on the relationship between regulatory interventions and strategies. After extensive communications with Professor John Philpot, professor of statistics; Dr. James Schmidhammer, lecturer in statistics and Mr. Robert Muenchen, head of the statistical consulting group at the University of Tennessee, we now believe that in order to use MANOVA effectively with our data we would have to blend repeated measures analysis with MANOVA. Furthermore, hierarchical multi variate regression will garner information from investigating the moderating effects of regulatory intensity, collaboration and institutionalization than would not be possible with a MANOVA. Therefore we now believe that multi variate hierarchical regressions provides more useful information than the proposed MANOVA.⁹

⁹ Even though the MANOVA is not the most powerful analysis, we have included a MANOVA in the Appendix. We proposed performing a MANOVA in Chapter 3. We felt we should perform the analysis to complete our commitment of the last chapter.

Regressions including all three independent variables simultaneously. Next we performed two regressions including all three independent variables simultaneously. Both models include all three types of regulatory interventions and their interactions. The first had ADVERSER as the dependent variable. The second had WORKINSY as the dependent variable. While the adjusted r-squares were a remarkably high 0.29 for WORKINSY and 0.22 for ADVERSER, multicollinearity raised its ugly head. Several Variance Inflation Factors were over 50, significantly greater than recommend level of 10 (Neter, Wasserman, and Kutner, 1990).

Univariate Regressions. In order to address multicollinearity we ran six independent regressions using the three types of regulatory interventions (command and control, economic incentives and industry-based) as independent variables and the two factored strategies (WORKINSY and ADVERSER) as the dependent variables. We ran "post-hoc" Cohen (1968) tests to investigate potential interaction effects as described in Hypotheses 4-6. "*Interaction* is the working together of two or more independent variables in their influence on a dependent variable" (Kerlinger, 1986: 230).

We confirmed normality, calculated DF Betas, and checked for multicollinearity. All diagnostics were within tolerances (Neter, Wasserman & Kutner, 1990). DF Betas were less than 1. The variance inflations factors (VIF) were all below 10. The highest VIFs occurred in the interaction terms. Govindarajan and Fisher (1990:274) {321} suggest that multicollinearity caused by the correlations between the interaction terms and the main effects is not a cause for concern.

Tables 15 and 16 provide the results. All the models use organizational size as a control variable. Model 1 is the results of the regression of main effects of each of the three types of regulation. No moderating effects are included in Model 1. Models 2, 3, 4 and 5 only include one moderating variable, the relevant independent variable (Command and Control, Economic Incentives or Industry-based) and the control variable. Model 2 includes the main effects and the moderated effect of perceived regulatory intensity, no other moderators are included. Model 3 includes the main effects and the sole moderated effect

Table 15 - Regression Results - Dependent Variable Y_1 = "Work in the System"			
Model #	Type of Regulatory Initiative		
	Command & Control	Economic Incentives	Industry-based
Model 1: Main Effects	Sig (T) = .0905	Sig (T) = .0923	Sig (T) = .1499
R ² /(Adjusted)	.1686/.1545	.1609/.1466	.1880/.1741
Significance of F	.0000	.0000	.0000
Model 2: Perceived Regulatory Intensity	Sig (T) = .0360	Sig (T) = .0701	Sig (T) = .2098
R ² /Adjusted	.1730/.1538	.1600/.1406	.1863/.1675
Significance of F	.0000	.0000	.0000
Significance of F-Cohen	.35	.1.00	.0068
Model 3: Potential Regulatory Intensity	Sig (T) = .1426	Sig (T) = .1279	Sig (T) = .1506
R ² /Adjusted	.1716/.1525	.1662/.1470	.1942/.1756
Significance of F	.0000	.0000	.0000
Significance of F-Cohen	.44	.30	.0028
Model 4: Level of Institutionalization	Sig (T) = .1116	Sig (T) = .1802	Sig (T) = .1016
R ² /Adjusted	.1608/.1414	.1573/.1378	.1835/.1646
Significance of F	.0000	.0000	.0000
Significance of F-Cohen	1.00	1.00	.0022
Model 5: Cooperation	Sig (T) = .0125	Sig (T) = .0293	Sig (T) = .8503
R ² /Adjusted	.1807/.1619	.1702/.1511	.1960/.1775
Significance of F	.0000	.0000	.0000
Significance of F-Cohen	.12	.17	.0001
Model 6: Saturated Model	Sig (T) = .0138	Sig(T) = .0794	Sig(T) = .5225
R ² /Adjusted	.1968/.1633	.1946/.1610	.2189/.1864
Significance of F	.0000	.0000	.0000

Table 16 - Regression Results - Dependent Variable Y_2 = "Adversarial"			
Model #	Type of Regulatory Initiative		
	Command & Control	Economic Incentives	Industry-based
Model 1: Main Effects	Sig (T) = .2405	Sig (T) = .3395	Sig (T) = .9384
R^2 /(Adjusted)	.0376/.0212	.0216/.0049	.0315/.0150
Significance of F	.0799	.2779	.1301
Model 2: Perceived Regulatory Intensity	Sig (T) = .5339	Sig (T) = .2021	Sig (T) = .8281
R^2 /Adjusted	.044/.021	.0316/.0092	.0389/.0167
Significance of F	.1014	.2324	.1409
Significance of F-Cohen	.29	.049	.26
Model 3: Potential Regulatory Intensity	Sig (T) = .3804	Sig (T) = .3109	Sig (T) = .7883
R^2 /Adjusted	.0421/.0201	.0238/.0013	.0366/.0144
Significance of F	.1103	.3785	.1634
Significance of F-Cohen	.38	.060	.35
Model 4: Level of Institutionalization	Sig (T) = .2853	Sig (T) = .3383	Sig (T) = .9243
R^2 /Adjusted	.0495/.0275	.0372/.0149	.0436/.0215
Significance of F	.0645	.1588	.1009
Significance of F-Cohen	.15	.028	.15
Model 5: Cooperation	Sig (T) = .1863	Sig(T) = .0328	Sig(T) = .0259
R^2 /Adjusted	.1250/.1048	.0859/.0649	.1113/.0909
Significance of F	.0001	.0034	.0004
Significance of F-Cohen	.000065	.000015	.00015
Model 6: Saturated Model	Sig (T) = .2629	Sig(T) = .0541	Sig(T) = .0535
R^2 /Adjusted	.1288/.0926	.0893/.0513	.1162/.0794
Significance of F	.0014	.0256	.0037

of potential regulatory intensity. Model 4 includes the main effects and the moderated effect of the level of institutionalization. Model 5 includes the main effects and the moderated effect of level of cooperation. Model 6 is the saturated model.

Tables 15 and 16 confirm one of the results discovered in the correlations MANOVA and fully combined and saturated regressions; namely the main effects on WORKINSY are stronger than the effects on ADVERSER¹⁰. Tables 15 and 16 also provide the results of Hypotheses 4-6. The results of F-Cohen refute Hypothesis 4 in that the effects of Regulatory Intensity (both perceived and potential) are not significant. Likewise the F-Cohen results deny the effects of the level of institutionalization (Hypothesis 5). Finally, the F-Cohen results support Hypothesis 6 strongly. It seems the level of cooperation is significant in four of the six cases at the .0001 level!

Table 17 summarizes the results of Tables 15 and 16. The Table highlights the results that three of the six main effects (Hypothesis 3) are significant at the .0000 level and one is significant at the .08 level. Further, four of the six interaction effects of cooperation (Hypothesis 6) are significant.

Hypothesis 4 Regulatory Intensity

Our results did not support the hypothesized moderating effect of regulatory intensity. We found only one of six possible significant interactions of perceived regulatory intensity (with industry-based controls on "work the system"). Likewise, we found only one of six possible significant interaction effects of potential regulatory intensity (with industry-based approaches on "work the system"). Perhaps our problem was our measures for regulatory

¹⁰ Interestingly, while all the three overall F-tests are highly significant for "work the system" only a few of the individual T-tests are significant. In the saturated model for "work the system" and command and control, only the main effect, the collaboration interaction and the interaction between command and control and industry-based approaches are significant. In the saturated model for work the system and economic incentives, only the main effect, the interaction between economic incentives and command and control and the interaction between economic incentives and industry-based programs are significant. In the saturated model for work in the system and industry based programs, only the interaction between industry-based approaches and command and control was significant.

Table 17 - Summary of Significance of F-tests on Regressions (Models 2, 3 4 and 5 are F-tests from Cohen, 1968)						
Model #	Dependent variable = WORKINSY			Dependent variable = ADVERSER		
	Command & Control	Economic Incentives	Industry- based	Command & Control	Economic Incentives	Industry- based
Model 1: Main Effects	.0000	.0000	.0000	.080	.28	.1301
Model 2: Perceived Regulatory Intensity	.34	1.00	.0068	.29	.049	.26
Model 3: Potential Regulatory Intensity	.44	.30	.0028	.38	.060	.35
Model 4: Institutionalization	1.00	1.00	.0093	.15	.028	.15
Model 5: Cooperation	.12	.17	.0022	.000065	.000015	.00015
Model 6: Saturated Model	.0000	.0000	.0000	.0014	.0256	.0037

intensity. Future research should investigate the paradox between perceived and potential regulatory intensity.

Hypothesis 5 Institutionalization

Again our results did not support the hypothesized effect. We hypothesized that the degree of institutionalization would moderate the relationship between environmental interventions and a firm's strategies. We found only two of six significant interaction effects (with industry-based controls on "work in the system" and with economic incentives on adversarial strategies).

We measured the level of institutionalization by whether our respondents were a mini-mill or a scrap reprocessing facility. Mini-mills are significantly more capitalized than scrap reprocessing firms. We theorized that size would also be an important variable as has been shown in other environmental policy analyses (Barkenbus and Barkenbus, 1989){1043}.

Our theory assumed that the greater the capitalization, the greater the level of institutionalization. This may have been our error. Another measure of institutionalization is the age of the firm. The mini-mill industry is only two decades old. Scrap reprocessing firms have been in existence much longer. Table 18 compares the age of our respondents.

Table 18 - Comparison of Age of Mini-mills and Scrap Yards

Type	Mean year of founding	n	Significance of difference ¹
Mini-mills	1963	14	.023
Scrap Yards	1913	131	
1. Significance for two-tailed test.			

Thus while mini-mills are more capitalized, they are younger. Perhaps the differences in age confounded the comparison. Another explanation is the mini-mills and scrap yards hold very similar views on radioactive metal. Even assuming that mini-mills are more institutionalized than scrap yards, this agreement between mini-mills and scrap yards and the differences in ages are more robust than the differences in institutionalization.

Hypothesis 6 Collaboration

We obtained strong support for hypothesis 6. All relationships were significant at the .001 level or better. Arguably, some of the strength of the relationships could be caused by mono-method bias, but the strength is undeniable. Future studies could shed light on this interesting topic.

In order to further investigate the relationship, we ran regressions using collaboration as an independent variable (Table 19). When we included the interaction terms (COLLAB_CC, EI and IB), the Variance Inflation Factors increased to a range of 27 to 72.

This analysis supports the bi-variate correlations, the MANOVAs and the regressions indicating that the relationship between a firm's strategies and collaboration is as significant as the degree the firm rates economic incentives or industry-based interventions.

Table 19 - Summary results of Post-hoc Regressions Investigating Collaboration

	Dependent Variable	
	Work in the System	Adversarial
R²	.21	.13
Adjusted R²	.19	.11
F-test Significance	.0000	.0001
Independent Variable:	T-test Significance: p ($\beta > 0$)	T-test Significance: p ($\beta > 0$)
Collaboration	.0510	.0000
Command & Control	.0038	.0133
Economic Incentives	.2823	.9666
Industry-based	.0029	.8804

The signs of the Beta coefficients make sense as well. The Beta for collaboration using “Work in the System” is positive while regressing against “Adversarial” produces a negative Beta. Thus high degrees of inter-industry collaboration are related to greater preferences for positive strategies (Work the System). Lower levels of inter-firm collaboration are related to higher preference for negative (adversarial) strategies. This is consistent with the MANOVA analysis.

Table 19 is the culmination of the analysis of this study. We feel it represents the strongest regression that is supported by theory. Including our theorized control variable, organizational size, did not improve our results substantially¹¹.

Conclusion of Chapter on Data Analysis

Our analysis supports Hypotheses 2, 2B, 3 and 6. We did not find support for Hypothesis 1, 2A, 4 and 5. The next and final chapter provides further discussion of the results and proposes future studies.

¹¹The R-squared improved, but the adjusted R-square decreased marginally.

CHAPTER V - CONCLUSIONS and FURTHER STUDIES

Conclusions

Either the glass is half full or the glass is too tall. In the last chapter, we found support for Hypotheses 2, 2B, 3 and 6. Our analysis did **not** support Hypotheses 1, 2A, 4 and 5. In the process, we developed a solid measure for a typology of environmental interventions. Perhaps our most noteworthy finding was the level of collaboration between firms was at least as strong of a predictor of strategies as was the type of environmental intervention.

The results in the last chapter and the summary provided in this chapter indicate that we have explained no more than 29%¹² of the variance in the way that steel managers prefer environmental strategies. We had hoped for significantly higher R-squared, but 29% is high for similar social science research. The obvious question is what causes the remaining 71% of the variation. Some possible examples are psychological variables, political preferences and education¹³ of the respondents. Other factors in the business environment include the financial strength and slack of the firms, and the sub-culture of the business environment. We hope that future research will demonstrate that the majority of the 71% is identifiable and not attributable to measurement error. The last section in this chapter on Future Research discusses some of the additional questions that could lead to a more clear understanding of the 71%.

Measurement Improvements. We were pleased at our results to develop a typology of environmental interventions. We believe we have performed the first analytic verification of a typology of environmental interventions. The typology includes command and control, economic incentives and industry-based programs.

Our pilot test uncovered another interesting finding. We found that the regulated community draws a significant distinction between command and control regulations based on the authority that imposes the control. Our respondents took a significantly different view of command and control approaches that were administered by the international, federal, state or local authorities.

¹²Adjusted r-squared ranged from as low as 8% to a high of 29%

¹³Our 1994 study found only a minimal relationship with education.

Another potentially useful finding dealt with the operationalization of regulatory intensity. We found a significant difference between our respondent's perceptions of regulatory intensity and the relative budget of the relevant regulatory agencies. The difference was hidden behind an acceptable measure of reliability between perceptions and state budgets. Fortuitously, we decided to confirm our successful tests of reliability with a factor analyses and correlations. Correlations and factor analyses uncovered the differences.

It seems that the budget of state environmental agencies is not clearly associated with perceptions of regulatory intensity. One possible answer, offered by a former federal regulator¹⁴, is that well funded state agencies do not need to impose regulatory intensity. The threat of a gorilla in the closet can be sufficient.

Hypotheses 1, 1A, 1B, 1C, 1D and 1E: It's more simple than we thought.. We found that Oliver's 15 tactics did not partition as theorized. Our data demonstrate that the tactics divide into two, rather than five, strategies. We can describe our two strategies as positive and negative. The negative strategy includes avoidance and denial. The positive strategy includes acquiescence, compromise and manipulation.

One could argue that our findings support neo-institutional theorists (DiMaggio & Powell, 1983; Haveman, 1993; and Meyer & Rowan, 1977) who argue that an organization's options are constrained considerably by the business environment. Our results support a more parsimonious model of firm strategy.

As a budding management strategist, the author views this finding with some trepidation. Perhaps industry doesn't need scientific management experts. Perhaps it's only the environment that determines what a firm will do. Perhaps the large business department in Books-a-Million, the growing number of best-selling management texts and the fees requested by management consultants (Barkenbus, 1994 {1078}) will pass. Micklewait and Wooldridge (1996) {1079} also argue that many management theories could be overly complicated.

Hypotheses 2: Life improves. Perhaps the strongest aspect of our effort was the

¹⁴ A conversation with Richard Landon Stanford, former EPA official, December, 1996

time series data collection comparing our surveys in 1994 and 1996. Our paired sample t-tests found a significant relationship between preferences for manipulation and acquiescence. As hypothesized, we found our respondents preferred manipulation strategies to a greater degree in 1996 than in 1994. Our T-test was significant at the .0001 level.

We found a similarly strong relationship between preferences for acquiescence strategies in 1994 and 1996. We had hypothesized that our respondents would find acquiescence less attractive. Surprisingly, our respondents viewed acquiescence more favorably in 1996! One possible explanation is steel firms are even more confused than ever.

The impact of uncertainty on decision making is a well studied phenomenon. For more than a half of a century, management theorists have argued that external conditions such as uncertainty are highly related to an organization's strategies (Andrew, 1987; Barnard, 1938; Unsafe, 1990; and Chandler, 1962). Indeed, Oliver (1991) theorized that in highly uncertain environment, managers will favor passive strategies.

The debate surrounding standards for radioactive metal has escalated since 1994 (NRC, 1996). According to one environmental consultant¹⁵, this higher degree of uncertainty may be the cause of an increased preference for acquiescence.

Arguably this is good news for the industry and the regulators. Firms are more likely to "work within the system" in 1996 than in 1994. They are also less likely to adopt confrontational strategies.

Hypotheses 3: The unifying theory is alive and well. Our correlations demonstrate a significant relationship (at the .001 level) between the positive strategies (WORKINSY) and all three environmental interventions. Also the relationship between negative strategy (ADVERSER) and command and control approaches was significant at the 2% level.

Our MANOVA confirmed two of the relationships discovered in the correlation table. There seems to be no relationship between economic incentives and our dependent variables. The relationship between Command and Control and Industry-based approaches is stronger. The strongest relationship was the univariate between Industry-based approaches and

¹⁵Conversation with Laura Adler, former EPA representative, December, 1996

WORKINSY, significant at the 2% level. The univariate relationship between Command and control and ADVERSER was significant at the 5.8% level. The correlations indicate a relationship between WORKINSY and Command and Control and Economic incentives. These two relationships were not confirmed in the MANOVA.

Our fully saturated regressions on the negative strategy were significant at the .0087 level. The regression on the positive strategy was significant at the .0001. While these results are heartening, multicollinearity raised its head.

Our correlations, regressions and, to some degree, MANOVAs provide support for hypothesis 3. Our data support a relationship between environmental interventions and a firm's strategies.

Hypotheses 4 Regulatory Intensity. Our results did not support the hypothesized moderating effect of regulatory intensity. We found no effect of perceived regulatory intensity and a very minor effect of potential regulatory intensity. Perhaps our problem was methodological. Future research should investigate the paradox between perceived and potential regulatory intensity.

Hypotheses 5 Institutionalization. Again our results did not support the hypothesized effect. We hypothesized that the degree of institutionalization would moderate the relationship between environmental interventions and a firm's strategies. We measured the level of institutionalization by whether our respondents were a mini-mill or a scrap reprocessing facility. Mini-mills are significantly more capitalized than scrap reprocessing firms. We theorized that size would also be an important variable as has been shown in other environmental policy analyses (Barkenbus and Barkenbus, 1989){1043}.

Thus while mini-mills are more capitalized, they are younger. Perhaps the differences in age confounded the comparison. One other explanation is that the mini-mills and scrap yards hold very similar views on the issue of radioactive metal. Even assuming that mini-mills are more institutionalized than scrap yards, this agreement and similarities between mini-mills and scrap yards may be greater than the differences in institutionalization.

Hypotheses 6 - Collaboration. This was a surprisingly strong finding. All relationships were significant at the .001 level or better. This analysis indicates that the

relationship between a firm's strategies and collaboration is more significant than the degree the firm rates economic incentives or industry-based interventions. The signs of the Beta coefficients make sense as well. Thus high degrees of inter-industry collaboration are related to greater preferences for positive strategies (Work in the System). High levels of inter-firm collaboration are related with lower preference for negative strategies.

This could be interpreted to mean that firms that cooperate with each other will favor "positive" (Work in the System) strategies. Firms that do not cooperate with each other are more likely to prefer "negative" (adversarial) strategies. Extending the argument, EPA might find it easier to work with industries that have strong inter-firm cooperation.

Indeed, EPA may find it beneficial to support industry cooperation. The type of support would be important. Non-industry stakeholders could view such an effort as an "un-holy" alliance between big government and big industry. Perhaps incentives to encourage cooperation at the local levels may be the most effective tack. One example could be grants or awards to state or local governments to support trade associations.

Future Studies

The Causality Issue: Can Strategic Choice Affect the Business Environment?

Three approaches dominate the literature on the relationship between strategy and the business environment. Pennings (1992) {856} argued that the strategic fit paradigm is the longest lasting literature stream in the management literature. Strategic fit proponents argue that effective strategies should be derived from the existing business environment (Child, 1972 {854}; Doty, Glick & Huber, 1993 {859}; Ginsberg & Venkatraman, 1985 {857}; and Lawless & Finch, 1989{858}) . Secondly, the determinism school argues that the business environment defines a pre-ordained (isomorphic) path that firms must follow (DiMaggio & Powell, 1983). Lastly, the stakeholder (Freeman, 1984{77}), institutional (Oliver, 1990{557}), industrial organizational economics (Porter, 1991 {817}); and marketing literature (Hoch & Deighton, 1989 {816}) argue that an organization can shape its business environment by working with customers and other relevant stakeholders.

The first school argues that the *business environment shapes strategies*, the second

school argues that *business environment defines strategies*, the third school theorizes that *strategies shape the business environment*. The third school seems the most compelling based on the following discussion.

Pfeffer and Salancik (1978) {876} theorized that firms first attempt to control the business environment. The authors postulate that if the first attempt fails, the firm will adapt to the business environment in the most strategically beneficial manner. Young (1988) {900} is more direct: "In both human ecology and population ecology, it is clear that the actors can change their business environments and can alter their resources, sometimes in dramatic ways."

Organizations have used regulations and other political activities to attempt to change the business environment. Scott (1987) {867} documented how states and professional bodies shape institutional business environment. Yoffie (1988 {778}) provides an excellent example of how Silicon Valley went to capital hill to affect their business environment. Antitrust policy implicitly recognizes that organizations make efforts to limit or otherwise manage the competitiveness of their business environments (Pfeffer & Salancik, 1978).

Classic marketing literature assumes that firms can influence the business environment. Farris and Albion's (1980) {961} meta-analysis attempts to reconcile marketing's questions regarding if advertising affects prices and the business environment. The authors conclude that existing empirical studies indeed verify that marketing affects prices. The direction of the affect is in question however. Several empirical studies found that marketing increases prices and several others found that marketing decreases prices.

Hoch and Deighton (1989) {816} go one step beyond classic marketing approach and theorize how a firm can affect the learning process of consumers. The authors theorize that consumers learn in a four step process: hypothesizing, exposure, encoding, and integration.

Community ecology (Astley, 1985) {794} builds on traditional population ecology. Population ecologists argued that while populations change over time, they persist as organizational species. "Organizational species can be distinguished in terms of their dominant competencies or comps. Comps play the same role as the genes in population gene pools" (p: 226). This "compool" transmits know-how from one generation to the next and acts as a

barrier to change. Community ecology departs from the isomorphic results of population ecology and describes the rise and fall of populations of organizations. The development of new organizations can change the business environment. An example is the impact of the M-form organization on the business environment (Chandler, 1977) {360}.

Therefore, it could be argued that an organization can indeed effect its business environment. In particular, a regulated organization will attempt to influence the form and substance of the environmental laws, regulations, and procedures. A subsequent study could test a hypothesis that the choice of strategy of the regulated community will affect the level of proscription in regulatory initiatives.

Perform empirical studies. Scholars should examine additional explanatory independent variables that have not been sufficiently researched. One example is to look at the firm's investment in research and development. Another is to study at the focal length of a firm's strategy. Firms that invest in research and development and firms with a longer term view could behave differently than firms that are not research intensive or have a shorter-term strategy. Many other explanatory variables are possible.

One possible explanatory variable is the strategy of the corporation. One proposition is that if a firm invests in research and development, it will be more likely to reap positive benefits from environmental responsiveness. Another proposition is that firm's with longer-term strategies will eventually receive the benefits from environmental investments (Gore, 1992).

Several recent empirical studies have focused on environmental controls and financial performance. One recent normative study advocates the use of "Total Environmental Quality" (Sharfman, 1993). One very interesting empirical study "appears to confirm general suspicions that chemical facilities owned by more broadly diversified parents are on the average "dirtier" than facilities owned by companies that are more focused (Dooley, 1993). Another study adds aspects to established corporate social responsibility framework to facilitate research (Aupperle, 1993).

Improve Environmental Performance Measures. The question addressing environmental performance is part of a larger debate regarding the relationship between

corporate social responsibility and financial performance (Aupperle, 1993; Fogler, 1993; McGuire, 1990). Appropriate measures of financial performance are much more established than frameworks for environmental responsiveness. The accounting discipline has investigated measures for environmental responsiveness. As early as 1971, one article called for the "published financial reports disclose information on the responsibility for pollution whether imposed by law or assumed voluntarily by firms (Beams, 1971)."

Ongoing research by the Energy, Environment, and Resources Center at the University of Tennessee identified 150 systems used to rank chemicals (Swanson, 1996). The authors of the effort found that EPA's Toxics Release Inventory was the most comprehensive (The United States Environmental Protection Agency, 1992). The Environmental Protection Agency (EPA) initiated the Toxics Release Inventory (TRI) in 1986. The TRI focuses on releases of specific chemicals into the air, water, and land. The data base also includes estimates for releases "transferred" into Publicly Owned Treatment Works, treatment or disposal facilities, recycling efforts, and energy recovery plants. In 1991, more than 23,000 facilities reported data.

Many problems exist with the TRI data base. The TRI data are compiled on the basis of individual releases from specific facilities. In order to compare this data to financial performance data, researchers will have to consolidate the TRI information to the corporate level. In order to control for differences in industries, we recommend measuring *changes* in environmental releases from all sources as the independent variable.

One alternative to the TRI is a system established by the Council on Economic Priorities (CEP). The CEP established the Corporate Environmental Data Clearinghouse to prepare reports on the environmental impacts of corporations. The Clearinghouse has completed reports on 100 corporations in industries including Aerospace, Automobile, Beverages, Chemicals, Household Consumer Products, Electric Utilities, Electric Equipment, Food, Footwear, Forest Products, Oil, and Tobacco. Another logical measure is the system established by Fortune magazine. Future research may be able to evaluate the debate using the Fortune measurements.

Evaluate strategy as a moderating variable. Researchers could investigate

Michael Porter's characterization of firms as either cost leaders or differentiators. Porter (Schnake, 1993; Mitchell, 1989) hypothesized that in general, a firm follows a cost leadership or a differentiation strategy. Further research could investigate if the degree of cost leadership can help explain the relationship between environmental responsiveness and corporate performance.

Conclusions

We found support for Hypotheses 2, 2B, 3 and 6. Our analysis did not support Hypotheses 1, 2A, 4 and 5. In the process, we developed a solid measure for a typology of environmental interventions. We believe we have performed the first analytic verification of a typology of environmental interventions.

Perhaps our most noteworthy finding was the importance of the level of collaboration between firms as a predictor of strategies. This was a surprisingly strong finding. This analysis indicates that the relationship between a firm's strategies and collaboration is more significant than the degree the firm rates economic incentives or industry-based interventions. We found high levels of inter-firm collaboration are related with higher preference for "work the system" strategies. This makes intuitive sense. Those firms that are more willing to collaborate with each other are more willing to collaborate (work within the system) with the regulatory authorities. Those firms that are less willing to work with each other are more prone to "defy or avoid" regulatory authorities.

We argued that this could mean that firms that cooperate with each other will favor "positive" (Work the System) strategies. Firms that do not cooperate with each other are more likely to prefer "negative" (Adversarial) strategies. Extending the argument, EPA might find it easier to work with industries that have strong inter-firm cooperation.

Indeed, EPA may find it beneficial to support industry cooperation. The type of support would be important. Non-industry stakeholders could view such an effort as an "unholy alliance" between big government and big industry. Perhaps incentives to encourage cooperation at the local level may be the most effective tack. One example could be contracts or awards to state or local governments to support trade associations.

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APPENDICES

APPENDIX A - CALCULATION OF RECOMMENDED SAMPLE SIZE

Calculation of Recommended Sample Size - Background

The more reliable the data are that we collect, the more we can understand about the underlying phenomenon. In this era of shrinking resources for research, effective researchers must trade off between significance, power and the cost of acquiring the necessary data. Our study is no exception.

Our selected industry constrains our choice of sample size somewhat. The majority of mini-mills in the United States (approximately 53) belong to the Steel Manufacturers Association (SMA). In our 1994 survey we sent questionnaires to two individuals in each of the 53 firms: representatives of the environmental committee and members of the Board of Directors. We could afford to re-sample each firm in the SMA.

Our choice of sample size for scrap processors was more difficult. No four or six digit Standard Industrial Classification (SIC) code adequately defines scrap processors. More than 2,000 firms belong to the Institute of Scrap Recycling Industries (ISRI). We could not reasonably survey every member of ISRI. Thus we needed to use statistical techniques to decide on the appropriate sample size. The following sections describe how to choose a sample size based on statistical power considerations. We will determine required sample size for Hypotheses 2, 3, 4, 5 and 6.

Sample size determination for Hypotheses 2, 2A and 2B

We planned to perform Analyses of Variance (ANOVA) for Hypotheses 2, 2A and 2B. For Hypothesis 2, we intended to compare the differences of the means of preferences for acquiescence and manipulation strategies between 1993 and 1996. The preferences for strategies were to be measured on a Likert scale of from one to seven. The scale was developed by Oliver (1990, 1991) and refined in our 1994 survey.

One component in determining sample size is defining the "effect" size. Effect size is the "the degree to which the phenomenon is present in the population to the degree to which the null hypothesis is false" (Cohen, 1988: 10) {1062}. Cohen (1988) operationalized a relationship between effect size and sample sizes for ANOVA tests. Cohen defined the effect size index, d as follows:

$$d = (m_A - m_B) / \sigma \quad (1)$$

Where:

m_A = the mean of the first population

m_B = the mean of the second population and

σ = the standard deviation.

The test assumes that the standard deviation is the same in both populations, which is a solid assumption for Likert measures. Thus, in order to determine the effect size, we need an estimate of the standard deviation of the population. Our 1994 survey of the same industry will help. For the purposes of this power analysis, we will assume that the variance of the responses in our 1994 survey is similar to the variance that we will obtain in our proposed survey.

If we assume that a significant change in means (the effect size) is one point of the seven point Likert scale, we have a d of .32 (1/3.1) for Acquiesce and .30 (1/3.3) for Manipulate. These fall in the range that Cohen recommends for social science research. Cohen considers 0.5 a "medium" range and 0.2 acceptable for new areas of research inquiry.

If we assume an acceptable Type I (alpha) error of 5% and Type II error of 80%, we can now enter Cohen's table 2.4.1 to determine sample size. For a d of 0.29, N can be interpolated as 135. For a d of 0.32, N can be interpolated as 126. Table A-1 summarizes these results.

Table A-1 Descriptive statistics from the 1994 survey

Strategy	Standard Deviation	Standardized Mean	effect size index (d)	N required
Acquiesce	3.1	1.94	0.32	126
Manipulate	3.3	1.86	0.30	135

The sample size from the 1994 test was 417.

If we use the estimate for the standard deviation from our pilot study, a different N will result. Table A-2 provides these data. The mean and standard deviation have been standardized. Plugging the new values into the previous formula provides a d's of (1/1.13) for acquiesce, (1/1.04) for Comply, (1/.85) for avoid, (1/.76) for defy and (1/1.28) for manipulate. Using Table 2.4.1. in Cohen, the N's range from 9 to 20. These results are surprisingly significantly less than the previous results. It seems that Cohen's calculations are extremely sensitive to the variance estimates of the underlying population.

Table A-2 Descriptive statistics from the pilot survey

Variable	Mean	Standard Deviation	N	d	N Required
Acquiesce	4.87	1.13	20	.88	20
Comply	4.22	1.04	20	.96	13
Avoid	1.93	.85	20	1.18	10
Defy	1.69	.76	19	1.32	9
Manipulate	3.76	1.28	19	0.78	20

Sample size determination for Hypotheses 3 - The MANOVA

We had planned to perform a MANOVA to understand the underlying relationship between regulatory initiatives and strategies. Cohen (1988) describes a process to determine the sample size required for some desired amount of power (given the other parameters) for MANOVAs. The relationship between the correlation of the dependent and independent variables (R), the power, alpha, and the effect size is complex. Cohen describes two ways to define the effect size. One way is to use operational definitions of the effect size. A second method is based on the correlation of the independent and dependent variables. A third method uses specific software developed by Cohen.

A problem arises in the first two methods in that the relationship between λ and power depends on v , which is in turn a function of N, which is what we're trying to determine. Cohen solves the conundrum through iteration, selecting a trial value for v listed in a Cohen table, use its λ value for the desired power and compute N with one of the formulas provided. Then, if the computed N implies v substantially different from our trial value, one repeats the computation using the new value for v .

Use an estimated correlation of 0.20 between the independent and dependent variables. Here Cohen describes the following steps:

1. Enter Table 9.4.2 with the desired power, u , and a trial value for v , usually $v = 120$ and determine the value for λ .

For our data using a Type I error of .05, a power of .80 and a trial value of v of 120, $u = (3)(5) = 15$, $\lambda = 20.7$, for trial value of an infinite v , $\lambda = 18.8$

2. Estimate a value for f^2 using:

$$f^2 = L^{-1/s} - 1 \quad (2)$$

Where:

L = Wilks Lambda,

s = a function of the number of independent (k_x) and dependent (k_y) variables, for our test $k_y = 5$ and $k_x = 3$. Using table 10.2.2 (Cohen, 1988:475), $s = 2.76$.

f^2 = the effect size index for regressions and MANOVAS

We will assume that $R^2_{x,y} = .20$. From Example 10.16 (page 516) if the Wilks Lambda for the whole association, L is $R(2)$ complementary, $L = (1 - R^2_{x,y})$.

Therefore $f^2 = (1 - .80)^{-1/2.76} - 1 = 0.785$

3. Imply a value for v as follows (Equation 10.4.1):

$$v = (\lambda / f^2) u - 1 \quad (3)$$

Plugging in our values:

$$v = (20.7/0.785)(15) - 1 = 395$$

4. To find the value of λ for the implied v , interpolate in Tables 9.4.1-2 (page 450-54). Interpolation is linear in the reciprocals of the v 's. For the lower and upper tabled v values between which the implied v lies, (v_L, v_U) (120, ∞) and their respective values (λ_L, λ_U) , (20.7, 18.8) the interpolated value is as follows (equation 10.4.2):

$$\lambda = \lambda_L - ((1/v_L) - (1/v)) / ((1/v_L) - (1/v_U)) (\lambda_L - \lambda_U) \quad (4)$$

Plugging in our values:

$$\begin{aligned} \lambda &= 20.7 - ((1/120 - .00833) - (1/395 - .00252)) / (.00833 - 0) (20.7 - 18.8) \\ &= 20.7 - .00581 / .00833 (1.9) = 19.37 \end{aligned}$$

5. Substitute this λ into (10) to obtain the iterated value of v .

$$v = (19.37/0.785)(15) - 1 = 369$$

Then to find N , substitute in

$$N = (1/s) (v + u/2 - 1) + (k_y + k_x + 3) / 2 + \max(k_c, k_a + k_g) \quad (5)$$

where: u = the numerator degrees of freedom = $k_x k_y$ = number of measures = $(3)(5) = 15$
 k_c = the number of variables that have been partialled
 k_a = used in categorical analyses
 k_g = used in hierarchical analyses

Plugging in our values yields:

$$\begin{aligned} N &= 1/2.76 (369 + 15/2 - 1) + (5 + 3 + 3)/2 + \max(0, 0 + 0) \\ &= (0.362)(369 + 5.5 - 1) + 5 = 135 \end{aligned}$$

Using a Range of Three Operational Definitions. Cohen also describes process for an estimate of sample size based on three levels of effect size index (f^2), .02, .15, and .35.

1. This is identical as before, using Table 9.4.2, a Type I error of .05, a power of .80 and a trial value of v of 120, $u = (3)(5) = 15$, $\lambda = 20.7$, for trial value of an infinite v , $\lambda = 18.8$
2. This time we will use the three levels of effect size.
3. As before, we will imply a value for v using (Equation 10.4.1) but we will set values of f^2 using small (.02), medium (.15), and large (.35) effect sizes.:

$$v = (\lambda / f^2) u - 1 \quad (6)$$

Plugging in our values: For small value f^2 (.02), $v = (20.7/.02)(15) - 1 = 15,524$

For medium values (.15), $v = (20.7/.15)(15) - 1 = 2,069$

For large values (.35), $v = (20.7/.35)(15) - 1 = 886$

4. As before, to find the value of λ for the implied v , interpolate in Tables 9.4.1-2 (page 450-54). Interpolation is linear in the reciprocals of the v 's. For the lower and upper tabled v values between which the implied v lies, (v_L, v_U) and their respective values (λ_L, λ_U) , the interpolated value is as follows:

$$\lambda = \lambda_L - \left(\left(\frac{1}{v_L} \right) - \left(\frac{1}{v} \right) \right) / \left(\left(\frac{1}{v_L} \right) - \left(\frac{1}{v_U} \right) \right) (\lambda_L - \lambda_U) \quad (7)$$

Plugging in

our values:

$$\begin{aligned} \lambda \text{ (small)} &= 20.7 - ((1/120 = .00833) - (1/15,524 = .0000644)) / (.00833 - 0)(20.7 - 18.8) \\ &= 20.7 - .008267 / .00833 (1.9) = 18.81 \\ \lambda \text{ (medium)} &= 20.7 - ((1/120 = .00833) - (1/2,069 = .000483)) / (.00833 - 0)(20.7 - 18.8) \\ &= 20.7 - (.007847 / .00833 = .9420) (1.9) = 18.91 \\ \lambda \text{ (large)} &= 20.7 - ((1/120 = .00833) - (1/886 = .00113)) / (.00833 - 0) (20.7 - 18.8) \\ &= 20.7 - (.0072 / .00833 = 0.864) (1.9) = 19.06 \end{aligned}$$

5. As before, we substitute these three values for λ into (10) to obtain the iterated value of v .

$$v = (18.81, 18.91, \text{ and } 19.06) / 0.785 (15) - 1 = 358, 360 \text{ and } 363$$

Then to find N , substitute as before into:

Plugging in our values yields:

$$N = (1/s) (v + u/2 - 1) + (k_y + k_x + 3) / 2 + \max(k_c, k_a + k_g) \quad (8)$$

$$\begin{aligned} N &= 1/2.76 ((358, 360 \text{ and } 362) + 15/2 - 1) + (5 + 3 + 3)/2 + \max(0, 0 + 0) \\ &= (0.362)((358, 360 \text{ and } 362)) + 5.5 - 1 + 5 = 136, 137 \text{ and } 138 \end{aligned}$$

Sample Size for Hypotheses 4 - 6

To test Hypotheses 4-6 we planned to run moderated regressions, sometimes referred to as hierarchical regression. We will run the regressions using the factored strategies as the dependent variables. Thus if five factors resulted, five regressions were to be performed separately on each of the five management strategies, the dependent variables.

Assume that the independent variables account for 15% of the variance. Cohen provides an alternative to the sample size calculation avoiding an assumption of effect sizes. This method is based on the estimated percentage of variance of the dependent variable that is caused by the independent variables. If we assume that the independent variables will account for 15% of the variance of the dependent variable ($R^2_{Y \cdot B} = 0.15$). From equation 9.2.2:

$$f^2 = (R^2_{Y \cdot B}) / (1 - R^2_{Y \cdot B}) = .15 / .85 = .18$$

From Table 9.4.2 (page 452), for an α of 0.05, power of 0.80, $u = (6)(5) = 30$, for trial v of 120, $\lambda = 29.0$; for a v of ∞ , $\lambda = 24.5$. Equation 9.4.9 provides:

$$N = (\lambda / f^2) + w + z \quad (9)$$

Plugging in our values:

$$N \text{ (for a trial } v \text{ of } 120) = (29/0.18) + 2 + 1 = 164$$

Equation 9.4.2 (page 445) provides:

$$\lambda = \lambda_L - \left(\left(\frac{1}{v_L} \right) - \left(\frac{1}{v} \right) \right) / \left(\left(\frac{1}{v_L} \right) - \left(\frac{1}{v_U} \right) \right) (\lambda_L - \lambda_U) \quad (10)$$

Plugging in our values:

$$\begin{aligned} \lambda &= 29.0 - ((1/120 = 0.00833) - (1/.00252)) / (.00833 - 0)(29.0 - 24.5) \\ &= 23.7 - .00581 / .00833 (2.7) = 21.8 \end{aligned}$$

Equation 9.4.8 is:

$$N = \lambda(1 - R^2_{Y \cdot B}) / (R^2_{Y \cdot B}) + w = 23.7(.85) / .15 + 4 = 139 \quad (11)$$

Conclusion on Calculation of Sample Size

For Hypotheses 2, 2A and 2B we need a sample size ranging from 13 to 135. For Hypothesis 3 we need a sample size from 135 to 138. For Hypotheses 4-6 we need a sample size of 32 to 138. However, a sample size of 74 is acceptable. Our analysis indicates that 139 valid responses should be sufficient to test all of our hypotheses. Table A-3 summarizes the information on sample size.

Table A-3 Summary of Sample Size Analysis

Hypotheses:	N based on Type I error of .05, Type II error of .80 and:				
	Typical effect size indices	Variance in 1994 survey	Variance in pilot study	Assumed Correlation	Assumed portion of variance
2, 2A & 2B		126-135	13 - 20		
3, 3A & 3B	136-138			135	
4-6					139

APPENDIX B - ADDITIONAL RESPONSES TO THE QUESTIONNAIRE

Comments on the existing situation

One respondent focused on the economic impacts:

... We are only able to handle 75% of the material that we used to recycle due to fears of regulations. ... Our employee base is 45% of what it was.. Let's work with reputable scrap dealers to solve our problems.. (45 words).

An owner of a small scrap yard (2,000 tons per year) stated:

Having had Naturally Occurring Radioactive Material (NORM) pipe (from an oil field) in a load of scrap and from manufacturing businesses, a solution for this problem would be to check, clean or dispose at the time it is pulled from the ground if it is contaminated. Now it is loaded on trucks and sent to whoever wants a load of this pipe to do whatever they want to do with it (67 words).

An interesting idea from an environmental manager from Illinois was as follows:

The problem "shows up" at the gate - it is not ours; however, the regulators want us to devote the manpower, machinery and time to find the source. We do not see the value of alerting them any longer - it is a shipper/supplier concern so we give them the phone number and they can decide whether to notify the regulators or not. The fact that we put up monitors should not make us enforcement agents of the state. If the state would actually help, i.e. pay for the costs and handle the matter, it would be worth cooperating. Instead, the attitude of the state is to put blinders on and focus on a "non-compliance"/"enforcement" mentality. One notable exception is James Yusko of Pennsylvania. We will continue to notify him because he helps. We only regret that he can't dispose of the problem once they are isolated. We would like to see the government hit the manufacturers and users of radioactive materials with fees large enough to maintain a facility/organization to deal with the downstream mishaps which only occur if they fail to do their part and act responsibly in the first place. Additionally, we would like to see an expansion of the effort to handle NORM contaminated scrap in a beneficial way (213 words).

An owner of a scrap yard added a "family-values" plea:

Our scrap business has been in business since 1941. We are a small retail scrap business, father and son, light industry. I hope the management of radioactive scrap metals can be resolved through your research. I hope we don't get any radioactive scrap (43 words).

An owner of a scrap yard stated:

I don't think most firms want to deceive regulators. We want fair standards that are born from consensus negotiations with industry leaders and or trade associations. This should create procedures that are not overly burdensome and too costly. If the cost is too high people will have few options: either conceal their improper actions or move to a place that does not have these regulations. In either of these scenarios the public loses because radioactive contamination will increase due to a lack of scrap collection sites around the country.

People will have little choice on how to dispose of outlawed items such as a radioactive source or metals that have been contaminated or are considered hazardous. The parties involved must realize the negative effect of policies that are too restrictive and or costly or are too lax. The bottom line is that we want to operate our business in the safest way possible to our employees, the public and have a positive impact on the environment. After all, we are recyclers, not dealers of waste.

One other principle should be noted. We are a commodity business. Increased costs associated with any regulations will be passed on the consumer. This forces us to be as efficient as possible. When new regulations go into effect the firm which can comply with the lowest direct cost wins. This is why compromises must exist for the good of the general public loses (237 words).

An operation of a scrap yard added:

We are a small yard. We buy about half of our steel from industry and half from individual peddlers. We do not have any detection (detection) device or knowledge of radioactivity. All our steel is sold to dealers that have detectors or to steel mills with detectors (47 words).

An environmental manager of a consortium of secondary aluminum producers added:

Historically the problem has been less in our industry than in the steel industry. We have detected several radioactive shipments and the regulatory authorities have been very helpful. I feel the key is to keep track of the radioactive sources so they don't make it to the scrap stream ... Publication of "guidance documents" is useful (55 words).

Another "confidential" respondent added:

In my market, all contaminated materials come from the oil fields. I have a problem with the fact that when I check EVERY load coming into my yard for radiation and a piece of pipe for example measuring 2"

diameter and 6" long is missed... Why don't they (the people) pay for this problem by providing disposal at my yard or at the mills. ... I have turned away many loads of scrap where it ends up.. who knows?? There is NO doubt the severity of this problem, however the costs for control to my very small business is high (102 words).

Another metals buyer of a scrap yard added:

I understand the need to detect radioactive material. Our facility does not have radiation detectors. We have looked at a system, but to date, we have not (installed one). I feel that with EPA tightening the noose on various hazards that one day it will be mandatory to have the proposer equipment to detect radiation. As a rule we do not accept any type of metal from the medical field or lead. This survey surprised me, because radioactivity in our industry is not a talked about item. Have a good day.... (91 words)

Another owner of a scrap yard:

... we must have a cheap way of disposing of (NORM), or we are forced to cheat (19 words).

Comments on the options proposed

Another group of respondents discussed our proposed options and many offered modifications. The environmental engineer of a large (one millions ton a year) mini-mill offered a more effective option for the government:

Development and implementation of standards which address source (radioactive) users; and effective tracking methods for use and proper disposal of these devices (22 words).

One respondent struck at the political 'jugular':

Keep the government out of it totally (7 words).

A marketing manager from a scrap yard recommended to

Require all scrap processors to have radiation detection equipment (as a) condition to sell scrap to foundries and steel mills (18 words).

An owner of a small (3000 ton per year) scrap yard added:

Government regulations and fines are required to get companies to make progress (12 words).

An operations manager of a scrap yard proposed this alternative:

Education of workers in the industry on detection problems and sources (common materials to look for, etc.). More government is NOT the answer. If workers in this field know the problems, they will make corrections (35 words).

One owner and operator of a member firm of ISRI stated:

I believe that the atomic commission should have a record of all the sources of radioactivity and should be able to control the disposal of these properly when they become obsolete

The respondent continued and added:

We have installed scale monitors... We also have hand held equipment. We double check each shipment before it leaves the yard. The steel mills are continually changing their requirements and they give this information as they change it. ... We understand (their problems) and are very cooperative with their people to help them (avoid contamination). We educate our customers. We feel we are better able (than the state or municipal government) to control the problem. We believe that when you organize another bureaucracy.. We "do not" and "want not" any government subsidies. We as Americans are loosing our freedom. We need to wake up and do for ourselves. We are becoming a (legal) suit happy society. .. We need less government and more productive people... Thank you (170 words).

Another owner of a scrap yard provided:

I agree on getting state and federal authorities to agree on limits and their effect on residual or low level radiation would be a big step in the right direction. After that is accomplished, compliance can be achieved by (adopting) on of the many methods mentioned in the survey (49 words).

A scrap broker added:

I believe that all yards should have gate monitors for the safety of themselves and their employees and their neighbors. I do not believe that the government should not get involved (31 words).

Another owner of a scrap yard added that we:

Need a "clearing house" non-government agency to help with programs, inspections, regulations, disposal, etc, NATIONWIDE (16 words).

An environmental manager of a mini-mill offered two other options:

Producers would be liable for sources from "cradle to grave".

Local and State agency would actually know (what) they are doing and have standards to follow 26 words).

Another added:

Education and communication solve all problems (6 words).

An owner of a scrap yard stated:

We have found that dealing with the NRC to be time consuming and to little avail. Their site inspectors are on their terms only. Their site inspectors are NAZI like (32 words).

The health and safety supervisor of an integrated mill described potential problems of an industry managed insurance program. The respondent predicted that only those mills with inadequate detectors would participate (30 words).

Another added:

We must penalize firms that produce radioactive sources when they are lost, a fund must be established by these manufacturers for each unit produced in order to help pay for clean and disposal when these sources find their way to a scrap facility. Every scrap facility must have proper equipment and training .. Before they contaminate property and until they are moved to a steel mill which creates a whole new problem (71 words).

An owner of a 75,000 ton scrap yard added:

What is needed is factual information on the effects of radiation contamination from The types of radioactive materials we are likely to encounter. With that information we need to develop practical regulations and cost-effective methods of disposal (38 words).

A late respondent, the environmental manager of a steel foundry added:

Industry is best served by minimizing government involvement. Radiation detection equipment is readily available and affordable. Scrap consumers should take steps to monitor their incoming materials. Scrap suppliers will be forced by competitive market forces to install and use detectors. Buyers should soon be able to insist that their suppliers certify the scrap as radiation free. Prudent scrap dealers should buy liability insurance for accidental distribution of radioactive contamination. Insurance premiums should provide incentives for installation of radiations detectors by dealers and users. Government involvement should be limited to penalties for improper disposal of radiation sources, and perhaps requiring scrap dealers to carry insurance which would cover cleanup costs of distribution of radioactive materials (116 words).

Methodology issues

Two respondents commented on our study and methodology. A vice-president of a scrap yard felt that item 54 could be misinterpreted. The respondent felt that speaking with successful associate in other firms was very effective, but that the adopting a similar position was not effective (38 words).

A vice-president of a mini-mill provided comments on two of our items.

The respondent felt that item six need clarification. He rated the item a seven (very positive effect) but felt that the survey should have stated that the license fees should be paid by the source producer. He also felt that item number 20 could be better broken into two questions. He felt that the regulators oversight of scrap yards would be considerable more effective (a five) than audits of his own mini-mill. He also thought that radiation detectors were already at the "state of the art" and could not be effectively. He added: Go after the NRC for not doing (its) job. (Assess) huge fines for loosing a source. The regulators are not doing anything.

The same respondent continued:

We are more concerned with detection than regulating scrap processors. The wrong people are paying the price for the negligence of others. Almost all mills that have melted a source have had good detection equipment (160 words).

Criticisms of our study

Finally, a group of respondents criticized our efforts. In the word of one survey respondent:

... We have invested in detectors, which I consider a waste of money that could have been used in buying more productive equipment. It appears to me that you want bigger government - more inspectors and regulations. That is why the 21st century will belong to Asia (44 words).

.Another criticized the survey:

The majority of questions are irrelevant to solving the problem. Nucor Utah plant discovered a radioactive source in their incoming scrap that was traced to a major chemical company. After complaints by Nucor, the NRC fined the chemical company \$2,5000 for losing the source. This fine is ridiculous when compared to the costs (due to) melting a source at a steel company. The latest estimate of Cesium 137 in an electric arc furnace is ... eight to ten million dollars. Many of the smaller companies would be driven into bankruptcy by this charge. The only solution is increased licensee fees and stiff penalties to companies and government agencies that lose or misplace a sources (possibly even criminal charges) (115 words).

A respondent who had significant problems with the survey was from a rolling mill, not a mini-mill nor a scrap yard. The engineer wrote:

I hope you got good state grant, because this seems to be a waste of my federal tax dollars.

The individual continued

I worked for four years (1991 to 1995) as a project manager and regulatory consultant in the field of radioactive and mixed waste remediation both for private and federal agency clients. This survey is a repetition of recent work in the literature, and appears to be designed solely to provide publication credit. I suggest you find a more original (and potentially fruitful) study target (81 words).

APPENDIX C - RESULTS FROM HARRIS PROCEDURE

Harris (1967) theorized that researchers should perform various extractions with various rotations to understand the underlying associations between items. Tables C-1 to C-9 summarize the findings from the Harris procedure. Our chosen two factor result appears in Table C-9.

Table C-1 - Five Factors - Principal Components Analysis with Varimax Rotation

	1	2	3	4	5
Acquiesce		65,66	57	(60)	60,61
Compromise	53,	55,56		74,75	(53)
Avoid	68,71,72		52	78	
Defy	64,67,72, 76,74,69		(64)		
Manipulate	77	58,69	59,63,70	(69) (77)	62

Numbers in the cells correspond to items on the questionnaire that loaded on respective factors.
Numbers in parentheses indicates secondary loadings.

Table C-2 - Five Factors - Principal Components Analysis with Quartimax Rotation

	1	2	3	4	5
Acquiesce		65,66	57,	60,61	(60)
Compromise	(53),	55,56,(74),75		53,62	74
Avoid	68,71,(78),7 9		52		78
Defy	64,67,72,76, 80,81		(64)		
Manipulate	77,	58,69,	59,63,70		

Table C-3 - Five Factors - Principal Components Analysis with Equimax Rotation

	1	2	3	4	5
Acquiesce		65,66	(60)	57	60, 61
Compromise	53,	55,56	74, 75		62
Avoid	68,71,79		(71) 78	52	
Defy	(64) 67, 72, 76, 80, 81			64	
Manipulate	77	58,(69)	69	59,63,70	

Table C-4 - Five Factors - Principal Axis Factoring with Varimax Rotation

	1	2	3	4	5
Acquiesce		65,66		57,	60,61
Compromise		55,56	74,75		62
Avoid	68,71,79			52	
Defy	64,67,72,65, 80,81				
Manipulate	77		69	59,63	

Table C-5 - Four Factors - Principal Components Analysis with Varimax Rotation

	1	2	3	4
Acquiesce		60,65,66	57	(60) 61
Compromise	53 (74)	55(56)62,74		(55) 56
Avoid	68, 71,78,79		52	
Defy	64,67,72,76,80,81			
Manipulate		69	59,63,(69)70,77	58

Table C-6 - Four Factors - Principal Components Analysis with Quartimax Rotation

	1	2	3	4
Acquiesce		60,65,66	57	60,61
Compromise	53	(55)56,62,74		(56)
Avoid	68,71,78,79		52	
Defy	64,67,72,76,80,81			
Manipulate		69	59,63,(69)70,77	

Table C-7 - Four Factors - Principal Components Analysis with Equimax Rotation

	1	2	3	4
Acquiesce		60, 61, 65, 66	57	
Compromise	53,	(55) 62,74		55, 56
Avoid	68,71,78,79		52	
Defy	64, 67, 72, 76, 80, 81			
Manipulate		69	59, 63, 70, 77	58

Table C-8 - Four Factors - Principal Axis Factoring with Varimax Rotation

	1	2	3	4
Acquiesce		60, 61, 65, 66	(65)	57
Compromise	53 (74)	(55) 74	55, 56	
Avoid	68,71,78,79, 80, 81			52
Defy	64,67,72,76			
Manipulate		(69)		59, 63 (69)70

Table C-9 Two Factors - Principal Component Analysis with Varimax, Equimax, Oblimin rotations and Principal Axis Factoring with Varimax and Oblimin rotations

	1	2
Acquiesce		60,65,66
Compromise	53 (74)	55,56,74,75
Avoid	52, 68,71,78,79,	
Defy	64,67,72,76,80,81	
Manipulate	77	59,63,69

The tables demonstrate that the two factor extraction is significantly more stable than the five or four factor extraction. We performed four extractions forcing to five factors. We also performed four extractions forcing to four factors. Both the four and five factor extractions yielded four different loading patterns.

We performed five different extraction forcing two factors. Each of the five extractions of the two factor attempt yielded the identical factor loading.

We can learn more from the Harris procedure. In almost every case, avoid and defy load on the same factor. Similarly, in almost all cases acquiesce and compromise load on the same factor. The case is not as clear for manipulation.

Thus our respondents could not differentiate between the items portraying avoid and defy. Similarly, our respondents were not able to distinguish between acquiesce and compromise.

Indeed, strategies of avoidance and defiance are very similar. Both are adversarial and confrontational. Likewise, acquiescence and compromise are similar. Both indicate working within the system. Manipulation strategies could arguably be viewed as either adversarial or working within the system.

In conclusion, our methods support a two factor strategic typology. The first, we could call adversarial includes defiance and avoidance. The second, called "working the system" includes acquiescence, compromise, and to some degree manipulation.

APPENDIX D - RELATIONSHIP BETWEEN CHRONBACH'S ALPHA, INTER-ITEM CORRELATION AND THE NUMBER OF ITEMS

Increasing the number of items from 12 to 13 should increase the reliability. Assuming that the inter-item correlation is constant, increasing the number of items from 12 to 13 should increase the reliabilities by the following formula (Nunnally, 1978 page 243 {1058} and SPSS, 1996) {1060}:

$$\alpha = (k (\bar{r})) / (1 + (k-1) (\bar{r}))$$

Where:

α = Chronbach's alpha, a measure of reliability.

k = the number of items and

r = the inter-item correlation.

Assuming that we would obtain the same inter-item correlations, the reliability should increase.

APPENDIX E - ADDITIONAL ANALYSIS INVESTIGATING HYPOTHESIS 2

A look at all five strategies may be illuminating. Table D-1 displays the results for all five strategies as hypothesized by Oliver

Table E-1 Comparison for Preferences for Oliver's (1991) Strategies in 1994 and 1996

Strategy	Preference in 1994	Preference in 1996	n	Significance in difference in means
Acquiesce	3.38	5.22	136	.000
Compromise ¹	3.29	4.73	136	.000
Avoid	2.73	1.98	135	.000
Defy	2.25	2.29	135	.724
Manipulate	3.23	4.25	135	.000

1) In 1994, the compromise tactics did not load independently, but rather in combination with the manipulation strategies.

From our factor analysis, acquiesce, compromise and manipulate were combined as a "work within the system" strategy. Avoid and defy combined as a combative strategy. It is interesting that the results of the paired t-tests broke into two results that correspond to the results of our factor analysis. Respondents in 1996 favored each of the three "work within the system" strategies to a greater degree than in 1994. Respondents found avoidance less favorable and denial about the same.

Arguably this is good news for the industry and the regulators. Firms are more likely to "work within the system" in 1996 than in 1994. They are also less likely to adopt confrontational strategies.

APPENDIX F - MULTIPLE ANALYSIS OF VARIANCE (MANOVA)

Even though the MANOVA is not the most powerful analysis, I have included this MANOVA. I felt I needed to do so to complete my commitment of the last chapter. Table 1 explains the basis of the MANOVA.

Table F-1 Basis for MANOVA

Interventions	Median Score	Score	Use the system (WORKINSY)	Adversarial (ADVERSER)
Command & control (CATCOM2)	4.111	High	P_{ACi} to P_{ACu}	P_{ACj} to P_{ACv}
		Low	P_{ACk} to P_{ACw}	P_{ACl} to P_{ACx}
Economic incentives (CATECO2)	4.500	High	P_{ACm} to P_{Ay}	P_{ACn} to P_{ACz}
		Low	P_{ACo} to P_{ACuu}	P_{ACp} to P_{ACvv}
Industry-based (CATIND2)	4.692	High	P_{ACq} to P_{ACww}	P_{ACr} to P_{ACxx}
		Low	P_{ACs} to P_{ACyy}	P_{ACt} to P_{ACzz}

Note: P_{ACi} to P_{ACu} = Preference for WORKINSY of the i th to u th firm that exhibited a high preference for Command & control interventions

None of the tests that SPSS provides (PILLAIS, HOTELLINGS, and WILKS) for the interactions were significant. Table 2 provides the SPSS results of the MANOVA for the direct effects.

TABLE F-2 MANOVA RESULTS

EFFECT .. CATIND2						
Multi variate Tests of Significance (S = 1, M = 0, N = 83 ½)						
Test Name	Value	Exact F	Hypoth. DF	Error DF	Sig. of F	
Hotellings	.04271	3.60925	2.00	169.00	.029	
Wilks	.95904	3.60925	2.00	169.00	.029	
Note.. F statistics are exact.						

EFFECT .. CATIND2 (Cont.)						
Univariate F-tests with (1,170) D. F.						
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
WORKINSY	3.81547	91.74942	3.81547	.53970	7.06958	.009
ADVERSER	.22479	165.70655	.22479	.97474	.23061	.632

EFFECT .. CATECO2						
Multi variate Tests of Significance (S = 1, M = 0, N = 83 ½)						
Test Name	Value	Exact F	Hypoth. DF	Error DF	Sig. of F	
Hotellings	.01399	1.18195	2.00	169.00	.309	
Wilks	.98621	1.18195	2.00	169.00	.309	
Note.. F statistics are exact.						

EFFECT .. CATECO2 (Cont.)						
Univariate F-tests with (1,170) D. F.						
Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
WORKINSY	1.02623	91.74942	1.02623	.53970	1.90147	.170
ADVERSER	.43508	165.70655	.43508	.97474	.44636	.505

EFFECT .. CATCOM2

Multi variate Tests of Significance (S = 1, M = 0, N = 83 ½)

Test Name	Value	Exact F	Hypoth. DF	Error DF	Sig. of F
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Hotellings	.02682	2.26633	2.00	169.00	.107
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Wilks	.97388	2.26633	2.00	169.00	.107
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Note.. F statistics are exact.

EFFECT .. CATCOM2 (Cont.)

Univariate F-tests with (1,170) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
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WORKINSY	.80151	91.74942	.80151	.53970	1.48510	.225
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ADVERSER	3.06293	165.70655	3.06293	.97474	3.14229	.078
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Table F-2 confirms two of the relationships discovered in the correlation table. There seems to be no relationship between economic incentives and our dependent variables (CATECO2). The relationship including Command and Control and Industry-based approaches (CATIND2) are stronger. The strongest relationship was the univariate between Industry-based approaches and WORKINSY, significant at the 0.009 level. The univariate relationship between Command and control (CATCOM2) and ADVERSER was significant at the 7.8% level.

The correlations indicated a relationship between WORKINSY and Command and Control and Economic incentives. These two relationships were not confirmed in the MANOVA.

VITA

Bruce Clemens was born in Syracuse New York on March 24, 1949. He attended public and private schools in St. Louis Mo where he graduated from Chaminade in June, 1967. He entered Cornell University during the summer of 1967 where he graduated in 1972 with a B.S. in civil and environmental engineering. He worked in Central America for eight years establishing "Agua del Pueblo", a non-profit technical assistance institution providing training and environmental sanitation projects. He entered the Master's program at the Kennedy School at Harvard University where he graduated with a M.P.A. in 1979. He subsequently worked at the Environmental Protection Agency in Washington D.C. He married Mary (Libby) Scopino. He moved with Libby and their son, Benjamin Samuel Clemens, to Oak Ridge Tennessee to work with Bechtel Environmental, Inc. Bruce's daughter, Louise Alexandra Clemens, hails from Oak Ridge. He entered the University of Tennessee to pursue a doctorate in strategic management. He received his doctoral degree in 1997. He is presently working with Lockwood Greene Technologies, Inc. in Oak Ridge TN.